

On a new systematic character in genus *Rhaphigaster* Laporte, 1833 and an unnamed groove in Pentatomoidea

О новом таксономическом признаке рода *Rhaphigaster* Laporte, 1833 и строении брюшного ободка у Pentatomoidea

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КЛЮЧЕВЫЕ СЛОВА. *Rhaphigaster*, Pentatomidae, Heteroptera, брюшной ободок, европейско-средиземноморская фауна, латеротергиты, определительные таблицы.

ABSTRACT. The three Euromediterranean species of the genus *Rhaphigaster*, *brevispina* Horváth, 1889, *haraldi* Lindberg, 1932, and *nebulosa* (Poda, 1761), have been comparatively studied. Some interesting dorsoabdominal structures are discussed. An overlooked and previously unnamed groove, which is now referred to as “connexival groove”, clearly delimits the dorsal laterotergites. On the other hand, the shape of VIII and IX laterotergites has shown to be a useful systematic character for separating species. An identification key is given on the basis of those laterotergites and other external characters.

РЕЗЮМЕ. В работе изучены три европейско-средиземноморских вида рода *Rhaphigaster*: *R. brevispina* Horváth, 1889, *R. haraldi* Lindberg, 1932 и *R. nebulosa* (Poda, 1761). Рассмотрено строение брюшного ободка. Структура, впервые обозначенная здесь как “желобок брюшного ободка”, чётко отграничивает спинные латеротергиты. Показано, что форма VIII и IX латеротергитов является хорошим таксономическим признаком для разграничения видов. Приведены определительные таблицы видов, основанные на признаках латеротергитов и других внешних признаках.

Introduction

The Palaearctic genus *Rhaphigaster* Laporte, 1833 (Pentatomidae: Pentatominae) comprises four species: *brevispina* Horváth, 1889, with a wide Asian distribution; *genitalia* Yang, 1934, recorded only from China;

haraldi Lindberg, 1932, which is a strict Maghreb element; and *nebulosa* (Poda, 1761), extending widely along the Euromediterranean and Middle Asian regions. They are all relatively large species, generally associated to several deciduous trees [Vidal, 1949; Linnavuori, 1965; Carapezza, 1997].

Concerning the Euromediterranean fauna, a number of characters have been used in the separation of the three native species. *R. brevispina* may be easily distinguished from the other two species by its shorter ventral spinelike process, which does not surpass the mesocoxae (but see misidentification of Israeli specimens of *R. nebulosa* by Linnavuori [1960, 1993]). On the contrary, the separation of *R. haraldi* from *R. nebulosa* could hardly be based on a single character but usually involves both external characters, such as the coloration pattern of certain parts (antennal articles, punctuation of the connexivum, pronotum and scutellum) [Vidal, 1949; Stichel, 1961], and characters of the male genitalia, such as the shape, size and coloration of the pygophore and the shape of the parameres [Vidal, 1949; Carapezza, 1997] as well as the female external genitalia in ventral view [Putshkov, 1965].

The actual reliability of all those characters for separating *R. haraldi* and *R. nebulosa* is diverse. The mentioned external features are particularly weak, as may be verified when studying large series of *R. nebulosa*. In fact, we have identified as true external differences no more than the third tarsomere, which may be black (*R. nebulosa*) or concolor (*R. haraldi*), and the femora, which may bear a black spot on the apical half (*R. nebulosa*) or lack it (*R. haraldi*), then showing a

dense black punctuation (some specimens of *R. nebulosa* may exhibit some isolated blackish punctuation).

The variability of *R. nebulosa* was previously discussed by Linnavuori [1960, 1993], who stated that specimens from the Pontomediterranean area differ from Central and West European ones in the more elongate body and head, the somewhat paler colouring and the slightly longer antennae, both forms being connected by intermediates. We believe that the subject is more complex, since, in addition to geographically distant populations, ecological separations also occur within them. Even more, all those units may overlap, as is frequent in species with such a large distribution. It is not possible, accordingly, to provide any synthesis of that which remains to be studied.

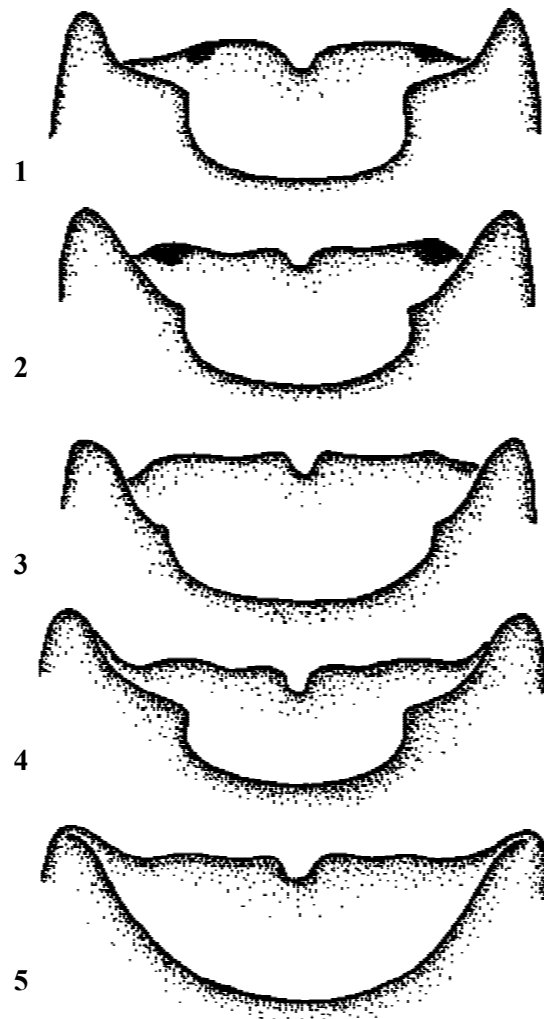
With regard to the male genitalia, Carapezza [1997] provides useful illustrations of the parameres and the pygophore in ventral view. In *R. nebulosa* the basal half of the pygophore is darkened, totally in ventral view (although sometimes interrupted in the middle) and to a great extent in dorsal view, as corroborated for nearly all populations studied. The exceptions are some specimens from Corsica and Greece, in which the pygophore is wholly pale and the pair of black spots of the diaphragm, a feature also shared by most populations, is lacking. Another male studied from Corsica, however, exhibits the standard coloration pattern, i. e. blackish including the spots of the diaphragm; moreover, the ventral indentation is like in the specimen from Catalonia (Fig. 2). In addition, in one male from Sicily the dorsal side of the pygophore is entirely black, ventrally bearing a pair of basal spots whereas the black spots of the diaphragm are lacking. On the other hand, the difference given by Vidal [1949] for the dorsal margin of the pygophore is not valid, since its shape is highly variable in *R. nebulosa*, as shown in Figs 1–5 by means of specimens from several localities.

In these circumstances, it seems desirable to establish the valid characters and even to find new ones, in order to provide an identification key which includes both males and females.

An overlooked abdominal structure in Pentatomoidea

During the preparation of the “Faune de France” volume devoted, among others, to Pentatomini, the senior author (J.R.) found an abdominal structure in *Rhaphigaster*, which could not be recognized among the descriptive characters used for Pentatomoidea; the search for previous records of it in the literature has become unsuccessful. After having discussed the subject with some colleagues (see Acknowledgements), we come to the conclusion that it actually is an overlooked feature exhibited not only by *Rhaphigaster* but also by other genera in a variable degree.

The observed structure is located on the connexivum or lateral margin of the abdomen. The connexivum is made up of dorsal and ventral laterotergites (strictly, laterotergites and laterosternites or ventrites), even



Figs 1–5. Pygophore (dorsal view) of *Rhaphigaster nebulosa* (Poda, 1761) from several localities: 1 — El Montseny, Catalonia, Spain (coll. J. Ribes, Barcelona); 2 — Oliana, Catalonia, Spain (coll. J. Ribes, Barcelona); 3 — Corsica, France (coll. MNHN, Paris) / Lacony, Greece (coll. Matocq, Paris); 4 — Germany (redrawn from Linnavuori, 1960); 5 — Morocco (redrawn from Vidal, 1949).

Рис. 1–5. Пигофор (орсально) *Rhaphigaster nebulosa* (Poda, 1761) из разных точек: 1 — Эдб Монсени, Каталония, Испания (колл. Ж. Рибес, Барселона); 2 — Ольяна, Каталония, Испания (колл. Ж. Рибес, Барселона); 3 — Корсика, Франция (колл. MNHN, Париж) / Лаконь, Греция (колл. А. Маток, Париж); 4 — Германия (из Линнавуори, 1960 с изменениями); 5 — Марокко (из Vidal, 1949 с изменениями).

though in Pentatomoidea the latter are not as distinct as the former [Derjanschi & Péricart, 2005]. As a rule, any pair of ventral and dorsal plates is joined in a line or border extending along the lateral margin of its respective segment. As for the abdomen, it is to be expected that such joining line is located on the lateral margin of the connexivum [see, for example, Derjanschi & Péricart, 2005: p. 27: Fig. 5a]. However, such an arrangement is observed in many, but not all, genera of pentatomids, as verified in *Rhaphigaster*.

Particularly, in the VII–VIII abdominal segments of *Rhaphigaster* (Figs 6–8: females: also the IX segment is

shown) that joining line is substantially moved away from the visually dorso-ventral margin, consequently becoming part of the dorsal surface of the connexivum and giving rise to what may be called a "connexival groove" (CG). In fact, in some other taxa, the ventral laterotergal region may, jointly with spiracles, become part of the dorsum, as advised by Štys (pers. comm. to S. P.-C.). Thus, an additional, small, platelike area can be observed together with the dorsal laterotergite, which will be referred to as "dorsal edge of ventral laterotergite" (DEVL).

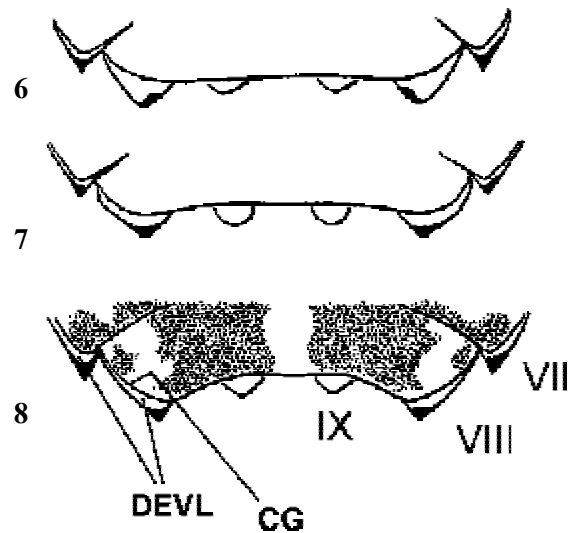
As a result, a new and complementary character or set of characters may be cautiously added to the previously used for the connexivum in Pentatomoidea (namely, whole proportions, punctuation or coloration patterns, and posterolateral projections), derived from the position of the CG itself as well as from the shape and size of the associated DEVL in each segment. Having verified the presence of the connexival groove in a number of pentatomoid genera besides *Rhaphigaster*, we suggest that it could be useful as a systematic character in some of them. As far as the genus *Rhaphigaster* is concerned, while not directly due to high variability in position, it is indirectly useful because it clearly delimits the laterotergites, otherwise coarsely defined plates. Hence, the shape of the VIII and IX laterotergites are included in the identification key proposed below, since the former is distinctly defined and the latter indirectly outlined by that groove.

Usefulness of the various characters in *Rhaphigaster*, with emphasis on external ones

As commented in the Introduction, some characters of the external morphology have proved to be of limited value as systematic characters for the Euromediterranean *Rhaphigaster* species. Instead of antennae and dorsal punctuation, the femora and tarsi have revealed to be useful characters, even when several Italian, French and Iberian specimens of *R. nebulosa* have been observed with the apices of I and II tarsomeres varying from black to brown pale. Concerning the male and female genitalia, Figs 9–20 show some previously used and valid characters, such as the shape of the pygophore (but only in ventral view, as stated above) and the shape of the parameres [see also Carapezza, 1997], as well as the spermatheca, previously illustrated [Servadei, 1964] only for *R. nebulosa*.

Differences are subtle but rather constant between the parameres of *R. haraldi* (Fig. 15) and *R. nebulosa* (Fig. 19): in the former, the sensory lobe is almost parallel to the apical portion of the hypophysis, whereas it is at a wider angle (nearly approaching 90°) in the latter. However, as in many other Pentatomidae, the parameres are twisted around more than one axis, not allowing for straightforward identification of closely related species. The spermatheca is practically identical in the three taxa (Figs. 12, 16 and 20), with only small differences in the reservoir and in the length of the proximal spermathecal duct.

It is commonly accepted that, when possible, external characters are preferable to genitalia (which involve laborious and time-consuming techniques) for constructing identification keys. It is also desirable that both males



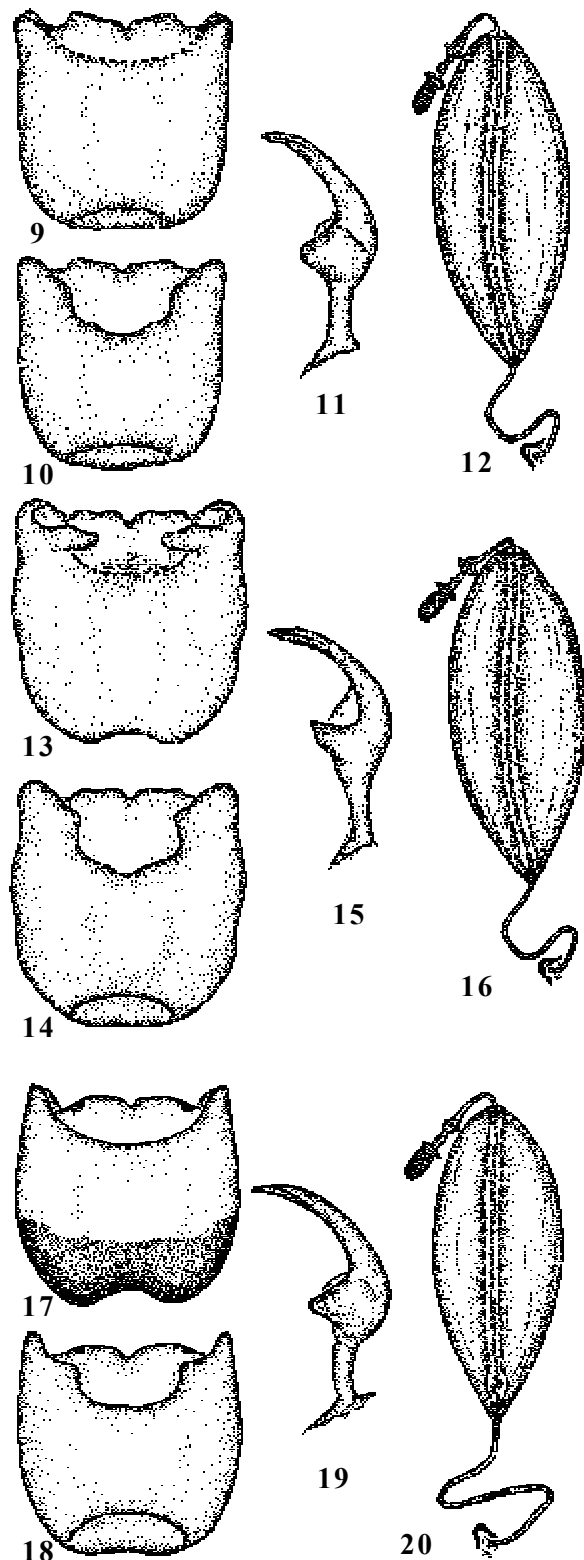
Figs 6–8. Female VII–IX abdominal segments (dorsal view) in the Euromediterranean species of *Rhaphigaster*: 6 — *R. brevispina* Horváth, 1889, from Samarkand, Uzbekistan (coll. MNHN, Paris); 7 — *R. haraldi* Lindberg, 1932, from Col des Chacals, Algeria (coll. Matocq, Paris); 8 — *R. nebulosa* (Poda, 1761), from Genoa, Italy (coll. J. Ribes, Barcelona). Abbreviations: VII, VIII and IX — VII, VIII and IX laterotergites, respectively; CG — connexival groove; DEVL — dorsal edge of ventral laterotergite. On Figs 6–7 darkened areas have not been reproduced.

Рис. 6–8. Абдоминальные сегменты VII–IX самки (вид с дорсальной стороны) евро-средиземноморских видов *Rhaphigaster*: 6 — *R. brevispina* Horváth, 1889, из Самарканда, Узбекистан (колл. MNHN, Париж); 7 — *R. haraldi* Lindberg, 1932, из Коль де Чакалс, Алжир (колл. А. Маток, Париж); 8 — *R. nebulosa* (Пода, 1761), из Генуи, Италия (колл. Ж. Рибес, Барселона). Сокращения: VII, VIII и IX — VII, VIII и IX латеротергиты, соответственно; CG — углубление брюшного ободка; DEVL — дорсальный край вентрального латеротергита. На Рис. 6–7 области затемнения не воспроизведены.

and females could be independently identified. Concerning the Euromediterranean species of *Rhaphigaster*, such a dichotomic key is provided below; in addition to traditional characters, attention has been paid to the discussed features of the laterotergites.

Female VII–IX dorsal segments of the three species are illustrated in Figs 6–8, showing the posterior margin of the dorsal laterotergites as well as the connexival areas called DEVL. In spite of the noticeable differences among them relative to the position of the CG, a high degree of variability has been observed within species: depending on the specimen studied, that groove may be more or less moved away from the visually dorso-ventral margin. Nevertheless, the females of *R. brevispina* may be separated by the posterior margin of their VIII DEVL, which is rounded apically, and by the dorsally visible portion of their IX laterotergite, which is triangular. In contrast, in the females of *R. haraldi* and *R. nebulosa* the VIII DEVL is sharp posteriorly. In addition, the dorsally visible portion of the IX laterotergite is semicircular in *R. haraldi* and triangular in *R. nebulosa*.

Methodologically, the only care that has to be taken is to use a wet paintbrush to fold the membrane forwards when observing the abdominal structures, particularly with dry specimens.



Figs 9–20. *Rhaphigaster* spp: 9–12 — *R. brevispina* Horváth, 1889, from Uzbekistan (coll. MNHN, Paris, and coll. J. Ribes, Barcelona); 13–16 — *R. haraldi* Lindberg, 1932, from Algeria (coll. Matocq, Paris); 17–20 — *R. nebulosa* (Poda, 1761), from Catalonia (coll. J. Ribes, Barcelona): 9–10, 13–14, 17–18 — pygophore (9, 13, 17 — ventral view; 10, 14, 18 — dorsal view); 11, 15, 19 — paramere; 12, 16, 20 — spermatheca.

Рис. 9–20. *Rhaphigaster* spp: 9–12 — *R. brevispina* Horváth, 1889, из Узбекистана (колл. MNHN, Париж и колл. Ж.Рибес, Барселона); 13–16 — *R. haraldi* Lindberg, 1932, из Алжира (колл. А. Маток, Париж); 17–20 — *R. nebulosa* (Poda, 1761), из Каталонии (колл. Ж.Рибес, Барселона): 9–10, 13–14, 17–18 — пифофор (9, 13, 17 — вид с вентральной стороны; 10, 14, 18 — вид с дорсальной стороны); 11, 15, 19 — парамер; 12, 16, 20 — сперматека.

KEY TO THE EUROMEDITERRANEAN *RHAPHIGASTER* SPECIES

- 1 (2) III abdominal sternite with the median spinelike process short, not or slightly exceeding the anterior margin of mesocoxae. Female: dorsal edge of VIII ventral laterotergite (DEVL) in dorsal view (Fig. 6) slightly rounded posteriorly *R. brevispina* Horváth, 1889
- 2 (1) III abdominal sternite with the median spinelike process long, reaching at least the anterior margin of procoxae. Female: dorsal edge of VIII ventral laterotergite (DEVL) in dorsal view (Figs 7–8) sharp posteriorly 3
- 3 (4) Femora (mainly hind femora) bearing an isolated, evident, black spot on the anteroventral apical half, elsewhere not punctuated or with blackish points, especially around the apex. Last tarsomere largely blackish; sometimes first and second tarsomeres with the apices brown to black. Male: pygophore in ventral view, (Fig. 17) with the basal half darkened, sometimes interrupted in the middle (and unicolor in some specimens from Corsica and Greece). Female: IX laterotergite in dorsal view (Fig. 8) triangular *R. nebulosa* (Poda, 1761)
- 4 (3) Femora lacking any isolated, evident, black spot on the apical half, but provided with blackish points almost throughout. Tarsi pale, unicolor. Male: pygophore in ventral view (Fig. 13) unicolor. Female: IX laterotergite in dorsal view (Fig. 7) semicircular *R. haraldi* Lindberg, 1932

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