

The female genitalia of *Gonioctena*, subgenus *Spartoxena* (Coleoptera: Chrysomelidae)

ANDRÉS BASELGA

Departamento de Biodiversidad y Biología Evolutiva, Museo Nacional de Ciencias Naturales—CSIC, Madrid, Spain

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Abstract

The taxonomy of the eight species of *Gonioctena* Chevrolat belonging to the subgenus *Spartoxena* Motschulsky is mostly based on male genitalia due to the unsuitability of external characters (i.e. coloration patterns) for identification. In order to provide similar diagnostic characters for both genders, the female genitalia of the eight species are described and illustrated. Considering the lack of spermathecae within the genus, the shapes of tergite 8, and sternites 8 and 9 have been explored as possible diagnostic characters. These structures present marked differences between taxa and simultaneously stability among individuals of each species, and thus they are very useful for taxonomic purposes. A key to the females of the subgenus *Spartoxena* is provided, and figures of tergite 9, and sternites 8 and 9 of each species are included.

Keywords: Chrysomelidae, female genitalia, *Gonioctena*, identification key, *Spartoxena*

Introduction

The genus *Gonioctena* Chevrolat (Coleoptera: Chrysomelidae: Chrysomelinae) is widely distributed in the Holarctic region and contains more than 70 species classified into nine monophyletic subgenera (Mardulyn et al. 1997). Among them, *Spartoxena* Motschulsky is comprised of eight species restricted to southwest Europe and north Africa, with its maximum diversity in the Iberian Peninsula (four species). The intraspecific variability and the external interspecific similarity in morphology and coloration have produced a high number of synonyms and the need of several taxonomic works clarifying the true status of several taxa from the Iberian Peninsula (Bechyné 1957) or North Africa (Bourdonné and Doguet 1979). More recent taxonomic works on this subgenus are a review dealing with the *G. variabilis* group and stating the subgeneric taxonomy followed in this paper (Kippenberg 2001), and finally a contribution describing two larvae for the first time and providing an identification key to the known larvae (Baselga and Novoa 2004). In Kippenberg's review a comprehensive identification key to the adults of the subgenus is provided. It deals with some external characters but it is almost completely based on the structure of the aedeagus,

Correspondence: Andrés Baselga, Departamento de Biodiversidad y Biología Evolutiva, Museo Nacional de Ciencias Naturales—CSIC, c/ José Gutiérrez Abascal 2, 28006 Madrid, Spain. Email: baselga@mncn.csic.es

so the identification of females is not always possible when no males are captured from the same sample.

Traditionally, the use of the female genitalia of Chrysomelidae as diagnostic characters was not taken into account with the same attention as the male genitalia. However, many papers have shown the usefulness of diverse structures of the female genital armature for the identification of specimens (see e.g. Brivio 1958, 1977; Leonardi 1970, 1972; Bordy and Doguet 1987; Kangas and Rutanen 1993; Doguet 1994; Konstantinov 1998; Bordy 2000; Lingafelter and Konstantinov 2000; Biondi and D'Alessandro 2003; Baselga and Novoa 2005; Baselga 2006). Among female genitalia, spermatheca is the most studied structure, due to its interspecific variability and thus diagnostic value in determining taxa. However, this structure is lacking in *Gonioctena* species (Bontems 1988). I therefore explored the sclerites of segments 8 and 9, considering the interesting results found by Brivio (1958) for another chrysomeline genus, *Phratora* Chevrolat, 1837. The aim of this paper is to describe the female genitalia of the eight species belonging to the subgenus *Spartoxena*, providing tools for the identification of females with accuracy comparable to that of males.

Material and methods

This study is mainly based on the collection of Museo Nacional de Ciencias Naturales, Madrid, Spain (MNCN). Also, the personal collection of A. Baselga (BASC) was reviewed and several specimens of *G. procax* and *G. secsaouia* were kindly provided by S. Doguet (Fontenay-sous-Bois, France), which are currently deposited in the MNCN collection. The following species were studied (the nomenclature and classification follows that of Kippenberg 2001), and the respective localities are only those corresponding to the females dissected to extract the genitalia:

Gonioctena (Spartoxena) aegrota (Fabricius, 1798)—Spain: Córdoba, Lucena; Cuenca, Cañizares; Granada, Puebla de Don Fadrique; Guadalajara; Madrid, Chapinería; Madrid, Cercedilla; Ourense, Pobra de Trives, Mendoia; Teruel, Albarracín; Vizcaya.

G. (Spartoxena) gobanzi (Reitter, 1902)—Italy: Trento, Lavarone.

G. (Spartoxena) irrorata (Weise, 1891)—Morocco: Agadir, Sus; Essaouira [Mogador]; Taroudannt [Tarudant].

G. (Spartoxena) leprieuri (Pic, 1911)—Spain: León, Torrestío; Lugo, Pedrafita do Cebreiro [Piedrafita del Cebrero]; Ourense, Vilariño de Conso.

G. (Spartoxena) procax (Normand, 1947)—Algeria: Annaba, Djebel Edough.

G. (Spartoxena) pseudogobanzi Kippenberg, 2001—Spain: Almería; Almería, Tabernas (paratype); Granada, Motril; Murcia; Murcia, Cartagena.

G. (Spartoxena) secsaouia (Kocher, 1953)—Morocco: Marrakech, Oukaimeden, Djebel Tizerag; Tanger.

G. (Spartoxena) variabilis (Olivier, 1790)—Spain: Álava, Vitoria; Cuenca, Embalse de Alarcón; Cuenca, Olivares del Júcar; Guadalajara, Embalse de Pálmaces; Huesca, Ansó-Roncal; Huesca, Embún; Huesca, Villanúa-Castiello; Soria, Montenegro de Cameros; Teruel.

Terminal segments of the abdomen of females were extracted and cleared with warm 10% KOH. Thereafter, genital segments (tergite 8, sternites 8 and 9) were dissected and cleared again with warm 10% KOH. The two KOH washes are necessary in order to properly separate and observe each sclerite. Female genitalia were mounted along with specimens

using dimethyl hydantoin formaldehyde resin (DMHF). Drawings were traced using CorelDraw 11 software, from images captured with a Nikon Coolpix 4500 digital camera attached to a Zeiss 475057 stereomicroscope.

Results

Tergite 8 and sternites 8 and 9 were dissected from specimens of each species of *Spartoxena*. These structures, despite small variation among individuals, are constant within species. Sclerotized structures are described below.

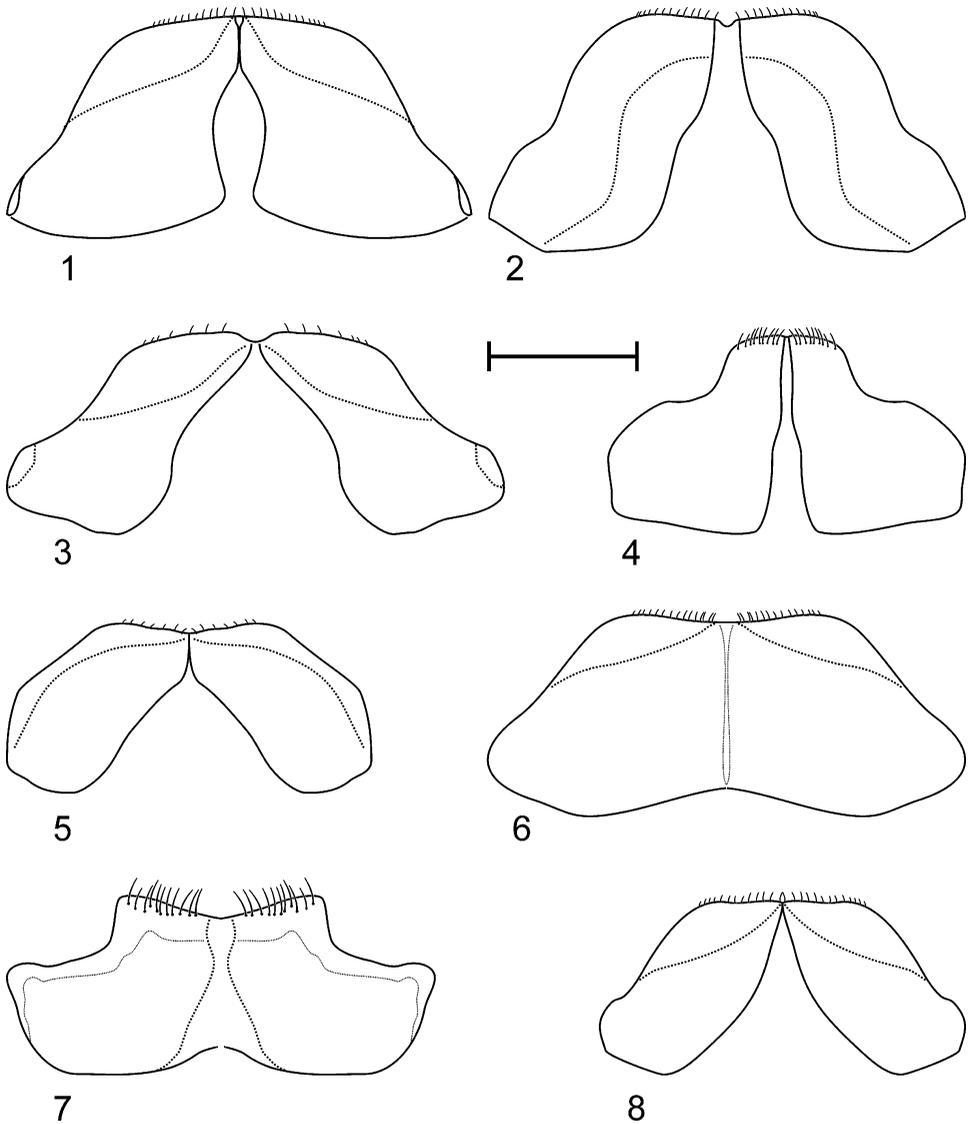
Tergite 8 (Figures 1–8) is composed of two trapezoidal sclerites more or less fused in the middle, but in most species joined by a membranous strip. Sclerites bear numerous setae apically, setae especially long in *G. leprieuri* and *G. secsaouia*. In these two taxa tergite 8 is very different from all the others in having an anteapical constriction, which is narrow in *G. leprieuri* (Figure 4) and wide in *G. secsaouia* (Figure 7). The shape of the other species is more similar, but extension of the sclerotized part of sclerites (and thus the different distances between them) provides reliable information about the identity of the specimens: in *G. irrorata* (Figure 3), *G. procax* (Figure 5), and *G. variabilis* (Figure 8) sclerites are widely separated at the base, whereas in *G. aegrota* (Figure 1) and *G. pseudogobanzi* (Figure 6) sclerites are joined all along the middle longitudinal line or very narrowly separated.

Sternite 8 (Figures 9–16) consists of a transverse sclerite with a median apical notch enclosed by two expansions bearing setae. Two membranous loops are attached to the sternite. The outline of sternite 8 is highly diagnostic, mainly due to the size and shape of the median notch, from the large and wide horseshoe-shaped one of *G. pseudogobanzi* (Figure 14) to the small and narrow one of *G. irrorata* (Figure 11), or from the V-shaped notch of *G. variabilis* (Figure 16) to the wide U-shaped one of *G. aegrota* (Figure 9). Most different species are *G. secsaouia* (Figure 15) with a slightly sclerotized sternite which has a poorly delineated median notch (strongly widened and not enclosed by two lateral expansions) and minute setae, and especially *G. leprieuri* (Figure 12) and *G. procax* (Figure 13) with a small sternite 8 in which median notch and lateral branches are poorly developed.

Sternite 9 (Figures 17–24) is comprised of two finger-shaped sclerites (homologous to vaginal palpi of flea beetles), bearing numerous setae and a conical membranous sensillum at the apex. These structures are quite similar among species, providing little diagnostic information. *G. secsaouia* (Figure 23) and *G. variabilis* (Figure 24) have small vaginal palpi, articulated to basal sclerotizations that are not present in the remaining taxa. *G. leprieuri* (Figure 20) and *G. pseudogobanzi* (Figure 22) have short and broad vaginal palpi, compared to *G. aegrota* (Figure 17), *G. gobanzi* (Figure 18), *G. irrorata* (Figure 19), and *G. procax* (Figure 21).

Discussion

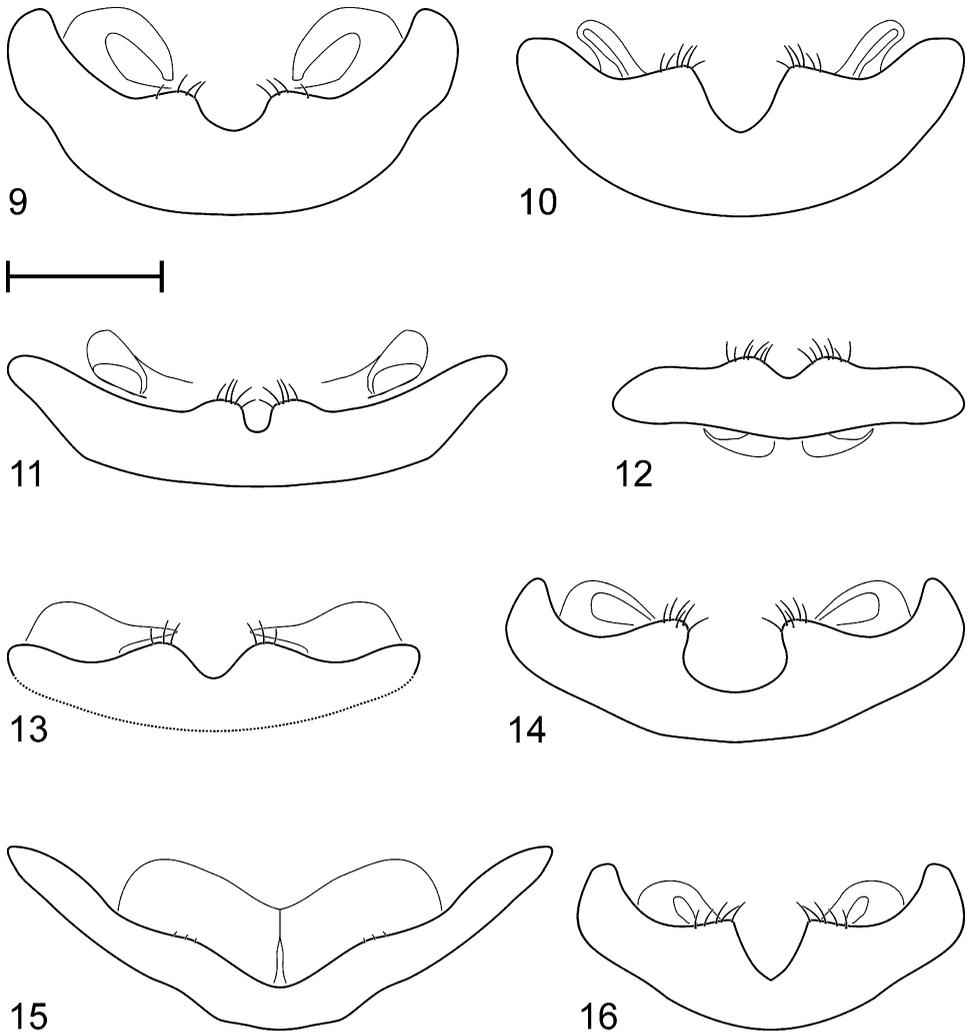
The study of the female genitalia of *Spartoxena* suggests the homology of the sclerites among Chrysomelinae and Galerucinae (including flea beetles). The absence of any sclerotization of the 9th tergite in *Spartoxena* or in the chrysomeline genus *Phratora* (Brivio 1958), is observed in flea beetles as well (Konstantinov 2002). Other Chrysomelinae were found by Brivio (1958) to have two reduced lateral sclerotizations in tergite 9. This feature contrasts with the Cryptocephalinae, in which a well-developed 9th tergite is present



Figures 1–8. Tergite 8 of *Goniocтена (Spartoxena)* spp. (1) *G. aegrota*. (2) *G. gobanzi*. (3) *G. irrorata*. (4) *G. leprieuri*. (5) *G. procax*. (6) *G. pseudogobanzi*. (7) *G. secsaouia*. (8) *G. variabilis*. Scale bar: 0.5 mm.

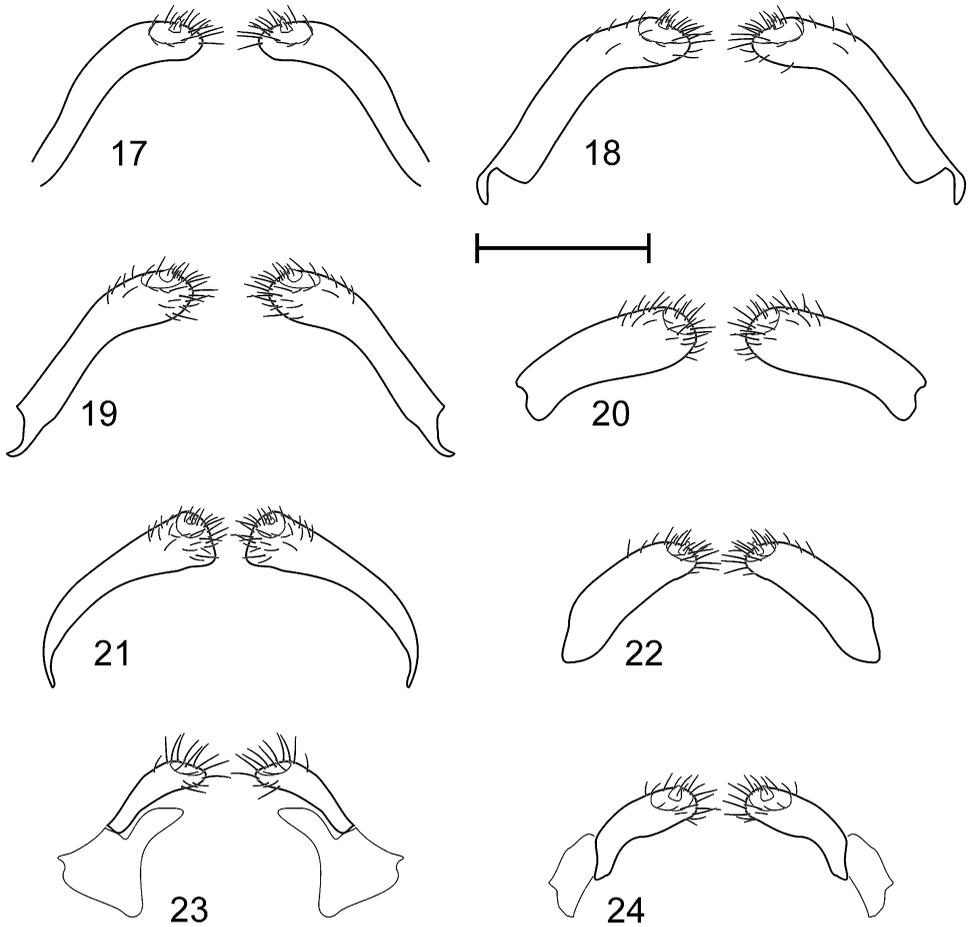
(Chamorro-Lacayo et al. 2006). On the other hand, the homology of the paired 9th sternite of *Cryptocephalinae* with the vaginal palpi (gonocoxites of Doguet 1994) of *Galerucinae* was pointed out by Chamorro-Lacayo et al. (2006) and the same conclusion is suggested for the paired 9th sternite of *Chrysomelinae*, considering the present results.

In terms of taxonomic purposes, the usefulness of female genitalia of *Spartoxena* is confirmed by the present results. The shape of tergite 8 and especially sternite 8 reveals visible differences between taxa and is constant among individuals of each species. Therefore, females of *Spartoxena* can be identified without ambiguity independently of the



Figures 9–16. Sternite 8 of *Gonioctena* (*Spartoxena*) spp. (9) *G. aegrota*. (10) *G. gobanzi*. (11) *G. irrorata*. (12) *G. leprieuri*. (13) *G. procax*. (14) *G. pseudogobanzi*. (15) *G. secsaouia*. (16) *G. variabilis*. Scale bar: 0.5 mm.

presence of males in the same sample. This is important in isolated specimens preserved in collections or in individuals of species with overlapping distributions as *G. variabilis*/*G. aegrota* or *G. pseudogobanzi*/*G. aegrota*. The latter pair of species coexists in southern Spain but the shape of tergite 8 and especially the form of the median notch of sternite 8, which is shallow U-shaped in *G. aegrota* (Figure 9) instead of deep horseshoe-shaped in *G. pseudogobanzi* (Figure 14), allows an accurate identification of the specimens. In the case of *G. variabilis* and *G. aegrota*, that are sympatric in central-eastern Spain, sclerites of tergite 8 are broadly separated basally in *G. variabilis* (Figure 8) whereas they are almost contiguous in *G. aegrota* (Figure 1), and the median notch of sternite 8 is clearly V-shaped in *G. variabilis* (Figure 16) instead of U-shaped in *G. aegrota* (Figure 9), as mentioned above.



Figures 17–24. Sternite 9 of *Gonioctena* (*Spartoxena*) spp. (17) *G. aegrota*. (18) *G. gobanzi*. (19) *G. irrorata*. (20) *G. leprieuri*. (21) *G. procax*. (22) *G. pseudogobanzi*. (23) *G. secsaouia*. (24) *G. variabilis*. Scale bar: 0.5 mm.

Key to the females of the subgenus *Spartoxena*

- 1. Tergite 8 sharply constricted anteapically (Figures 4, 7) 2
- Tergite 8 progressively narrowed towards apex (Figures 1–3, 5, 6, 8) 3
- 2.(1) Apical expansion of tergite 8 narrow (Figure 4). Sternite 8 well sclerotized (Figure 12). Vaginal palpi large and broad (Figure 20). NW Spain *G. leprieuri* (Pic)
- Apical expansion of tergite 8 wide (Figure 7). Sternite 8 almost completely membranous (Figure 15). Vaginal palpi small (Figure 23). Morocco, Algeria. *G. secsaouia* (Kocher)
- 3.(1) Sclerites of tergite 8 joining all along the middle longitudinal line or very narrowly separated (Figures 1, 6) 4
- Sclerites of tergite 8 widely separated at base (Figures 3, 5, 8) 5

- 4.(3) Median notch of sternite 8 relatively shallow, wide U-shaped (Figure 9). Vaginal palpi long, finger-shaped (Figure 17). Iberian peninsula, excepting the NE quarter *G. aegrota* (Fabricius)
- Median notch of sternite 8 deep, horseshoe-shaped (Figure 14). Vaginal palpi short and broad (Figure 22). SE Spain. *G. pseudogobanzi* Kippenberg
- 5.(3) Median notch of sternite 8 shallow (Figures 11, 13) 6
- Median notch of sternite 8 deep (Figures 10, 16) 7
- 6.(5) Median notch of sternite 8 narrow (Figure 11). N Africa, from Morocco to Libya *G. irrorata* (Weise)
- Median notch of sternite 8 wide (Figure 13). Algeria *G. procox* (Normand)
- 7.(5) Vaginal palpi large and long (more than four times longer than wide) (Figure 18). Alps *G. gobanzi* (Reitter)
- Vaginal palpi small and relatively short (less than four times longer than wide) (Figure 24). NE quarter of Spain *G. variabilis* (Olivier)

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