

# Contribution to the knowledge of Mediterranean Leuctra (Plecoptera : Leuctridae)

Autor(en): **Pardo, Isabel / Zwick, Peter**

Objektyp: **Article**

Zeitschrift: **Mitteilungen der Schweizerischen Entomologischen Gesellschaft =  
Bulletin de la Société Entomologique Suisse = Journal of the  
Swiss Entomological Society**

Band (Jahr): **66 (1993)**

Heft 3-4: **@**

PDF erstellt am: **26.09.2024**

Persistenter Link: <https://doi.org/10.5169/seals-402536>

## **Nutzungsbedingungen**

Die ETH-Bibliothek ist Anbieterin der digitalisierten Zeitschriften. Sie besitzt keine Urheberrechte an den Inhalten der Zeitschriften. Die Rechte liegen in der Regel bei den Herausgebern. Die auf der Plattform e-periodica veröffentlichten Dokumente stehen für nicht-kommerzielle Zwecke in Lehre und Forschung sowie für die private Nutzung frei zur Verfügung. Einzelne Dateien oder Ausdrucke aus diesem Angebot können zusammen mit diesen Nutzungsbedingungen und den korrekten Herkunftsbezeichnungen weitergegeben werden. Das Veröffentlichen von Bildern in Print- und Online-Publikationen ist nur mit vorheriger Genehmigung der Rechteinhaber erlaubt. Die systematische Speicherung von Teilen des elektronischen Angebots auf anderen Servern bedarf ebenfalls des schriftlichen Einverständnisses der Rechteinhaber.

## **Haftungsausschluss**

Alle Angaben erfolgen ohne Gewähr für Vollständigkeit oder Richtigkeit. Es wird keine Haftung übernommen für Schäden durch die Verwendung von Informationen aus diesem Online-Angebot oder durch das Fehlen von Informationen. Dies gilt auch für Inhalte Dritter, die über dieses Angebot zugänglich sind.

## Contribution to the Knowledge of Mediterranean *Leuctra* (Plecoptera: Leuctridae)

ISABEL PARDO<sup>1</sup> & PETER ZWICK<sup>2</sup>

<sup>1</sup>Departamento de Biología Animal, Universidad de Santiago de Compostela, E-15706 Santiago, Spain

<sup>2</sup>Limnologische Flußstation des Max-Planck-Instituts für Limnologie, Postfach 260, D-36105 Schlitz, Germany

*Contribution to the Knowledge of Mediterranean Leuctra (Plecoptera: Leuctridae).* - Several new species of the genus *Leuctra* (Plecoptera: Leuctridae) are named. They are: *L. tunisica* (Tunisia), *L. balearica* (Majorca), *L. aegaeica* (Andros, Euboea, Naxos), *L. rhodoica* (Rhodes), *L. kykladica* (Naxos), and *L. minoica* (Kreta); their distinctive genital characters are illustrated. New collections and range extensions of some known Mediterranean *Leuctra* are also presented.

Keywords: Stoneflies, Plecoptera, *Leuctra*, Mediterranean area, systematics, new species

### INTRODUCTION

Among the Plecoptera: Nemouroidea, the family Leuctridae is distinguished by the male intromittent organs. Sperm transfer is through the specialized inner lobes of the paraprocts, each of which contains a narrow canal opening near the tip and originating from a common base to which the actual penis is permanently fused. Other parts of the paraprocts may also be modified and assist in mating. At the generic level, the family has its greatest diversity in North America and Northeast Asia, with a number of genera that have at some time crossed the Bering Strait and are shared between the continents.

The European fauna (including the Palaearctic part of North Africa) is poor at the generic level, with two of the three genera, *Pachyleuctra* DESPAX and *Tyrrhenoleuctra* CONSIGLIO, restricted to the Southwest of the Mediterranean region. The third European genus is *Leuctra* STEPHENS, which is one of the few very large genera in the order including more than one hundred (of the altogether over 2000) species of Plecoptera. *Leuctra* has a disjunct distribution, with some 25 species in (essentially, Eastern) North America (STEWART *et al.*, 1988), and more than 100 species in Europe. Most species have a characteristic spermathecal sclerite suggesting monophyly of the genus. At least in Europe those few species that lack this sclerite seem to do so secondarily, because other characters permit their assignment to subordinate species groups in *Leuctra*. Whether the North American species form a monophyletic group that may be the sister group of all European species needs to be ascertained.

In Europe, diversity of *Leuctra* exhibits a pronounced gradient from few species in the North (e.g., 4 in Scandinavia, 6 in the British Isles; HYNES, 1977, LILLEHAMMER, 1988), a moderate number in Central Europe (e.g., over 30 in Switzerland, AUBERT, 1959), to very many in the Mediterranean region (e.g., nearly 60 in Italy; RAVIZZA, in prep.). The northern species are widespread taxa that also occur in southern Europe. This pattern agrees with the assumption that the central and

northern European Plecoptera fauna is largely (if not entirely) composed of post-glacial immigrants from the Mediterranean region (ZWICK, 1982), but the existence of indigeneous central European elements belonging to the Dinodal, a faunal realm recognized by MALICKY (1988) is not excluded. Among the widespread northern *Leuctra* is the type-species, *L. fusca* (LINNAEUS, 1758); it is the only European *Leuctra* extending far beyond the Ural Mountains, in fact as far as the Amur region in the Russian Far East (LEVANIDOVA & ZHILTZOVA, 1979).

In contrast, many of the Mediterranean *Leuctra* are endemic of relatively small areas, reflecting both the continuous development of the fauna without Pleistocene extinctions, and the geographic discontinuity of the Mediterranean region which is composed of several major peninsulas, and many smaller islands and archipelagos. The habitats of the largely cool-adapted mountain stream Plecoptera are subject to still greater subdivision and isolation.

By necessity, this situation implies that many of the related Mediterranean taxa are allopatric, especially the many endemics on particular islands or archipelagos. Therefore, common occurrence with related forms, which is generally accepted as convenient indication of effective hybridization barriers, and hence specific rank, is excluded. One could argue that some of the morphologically different taxa are in fact allopatric subspecies. Sometimes, authors use importance of morphological differences in their reasoning for specific rank, which we regard as invalid. We are aware that our ranking of taxa is, strictly speaking, arbitrary.

Presently we see no way to solve this problem; hybridization experiments are out of question, and sophisticated methods like enzyme gel electrophoresis have so far only sparingly been applied to Mediterranean Plecoptera (FOCHETTI, in print), unfortunately not yet to *Leuctra*. However, even such data would provide no immediate evidence of species limits, although they would add valuable evidence of a non-morphological nature, for evaluation and discussion.

The rich collections by Dr. H. MALICKY on the study which is reported here contain many species of *Leuctra*; it would be impractical to list the entire material. We restrict ourselves to the description of several new species in these collections, and to an arbitrary selection of records of poorly known species, or faunistically remarkable collections; we make no mention of collections of species from areas from which they had previously been reported, or even of which they are local or regional endemics.

#### MATERIAL AND METHODS

The Mediterranean Plecoptera fauna is very interesting taxonomically and biogeographically, but was studied much later than the comparatively de-pauperate central and north European fauna. Knowledge of Mediterranean Plecoptera is still incomplete, although there has been much progress lately; we refer to relevant literature in the taxonomic section, where appropriate. During the last decades, the collections by Hans MALICKY have added most conspicuously to our knowledge, and the results presented in this paper are also based on his successful collecting; publications on additional Plecoptera genera from the same collections are in preparation.

For the identification of the material, we have conducted a comprehensive literature survey, relying on papers listed in the stonefly catalogues (ILLIES, 1966, ZWICK, 1972) and on the comprehensive collection of more recent literature as well as the comparative material in coll. P. ZWICK at Schlitz. Our list of references is restricted to immediately relevant studies quoted in the text.

The material is preserved in alcohol; we have used Wild M5 and Wild M3Z dissecting microscopes equipped with a camera lucida in our study. Occasionally, parts were dissected, mounted, and studied under high magnification of compound microscopes.

Holotypes and most paratypes of the new taxa are presently kept in coll. P. ZWICK, at the Limnologische Flußstation des Max-Planck-Instituts für Limnologie at Schlitz; some paratypes and additional material are deposited in the personal collection of I. PARDO, at Santiago de Compostela.

#### DESCRIPTIONS AND RECORDS

##### *Leuctra tunisica* PARDO et ZWICK, sp. n.

#### *Material*

TUNISIA: 4 km S Ain Draham, (36°43'N/8°40'W), 660 m, 16.-18.5.1982, holotype male; paratypes: 64 males, 71 females; same locality, 530 m, 17.-18.5.1982, 1 male, 2 females. Additional material: TUNISIA: 4 km S Ain Draham, 650 m, 16.-18.5.1982, 2 females; near Hammam Bourgiba (36°41'N/8°30'E), 15.5.-7.6.1982: 3 km S, 460 m, 8 males, 2 females; 6 km E, 350 m, 1 male, 2 females; 7 km E, 510 m, 19 males, 23 females; 8 km E Hammam Bourgiba, 520 m, 11 males, 6 females; Oued Sardouk (36°43'N/8°43'E), 600 m, 15.5.-7.6.1982, 1 male, 1 female.

Small species belonging to the *fusca*-group. Forewing, male: 3-4 mm; female: 4-4.8 mm; wings reaching or little surpassing the abdominal tip. Head dark brown with two yellow areas to inside of eyes. Generally brownish; basal third and distal quarter of the femur and first tarsal segment contrastingly yellow.

#### *Male (Fig. 1a-c)*

I-V tergites simple, except tergite V membraneous in its central part. Tergites VI-X modified, VI and VII with processes. Processes on segment VI are two rounded lobes separated by approximately 3.5 times their width; they are very close to the anterior segment margin. Behind them, an essentially bell-shaped central area of tergite VI membraneous, pale, with fine pilosity, only the anterior half of its sides well defined. Tergite VII similar, its processes smaller, as widely separated as the anterior processes.

Antecosta of tergite VIII divided for about one fourth the segment width, a triangularly widened central area pale, soft, finely pilose. Lateral sclerotization ends in pronounced acute angles on the antecosta. Antecosta of tergite IX deeply re-entrant, sclerotization consisting of two lateral arms curving back and meeting medially to form a transverse sclerotized central bar. Tergite X with four-lobed anterior margin; its hind margin with two lateral long sclerotized projections extending over the bases of the cerci. Extensions tapering, less sclerotized apically; in lateral view they project as acute triangles above the cerci. Epiproct consisting of a dark oval area around a long sclerotized stalk rising from tergite X.

Sternites simple, no vesicle on segment IX. Sternite IX forming a subgenital plate, its posterior margin covering paraproct bases. Sclerotization of plate not uniform, with paramedian subdistal pale areas. Lateral paraproct lobes with a blunt triangular lobe near middle, and a minute point pressed against inner paraproct lobes, but no proper style; the inner lobes (specilla) well developed, relatively straight, tips curved up in side view, apex simple.



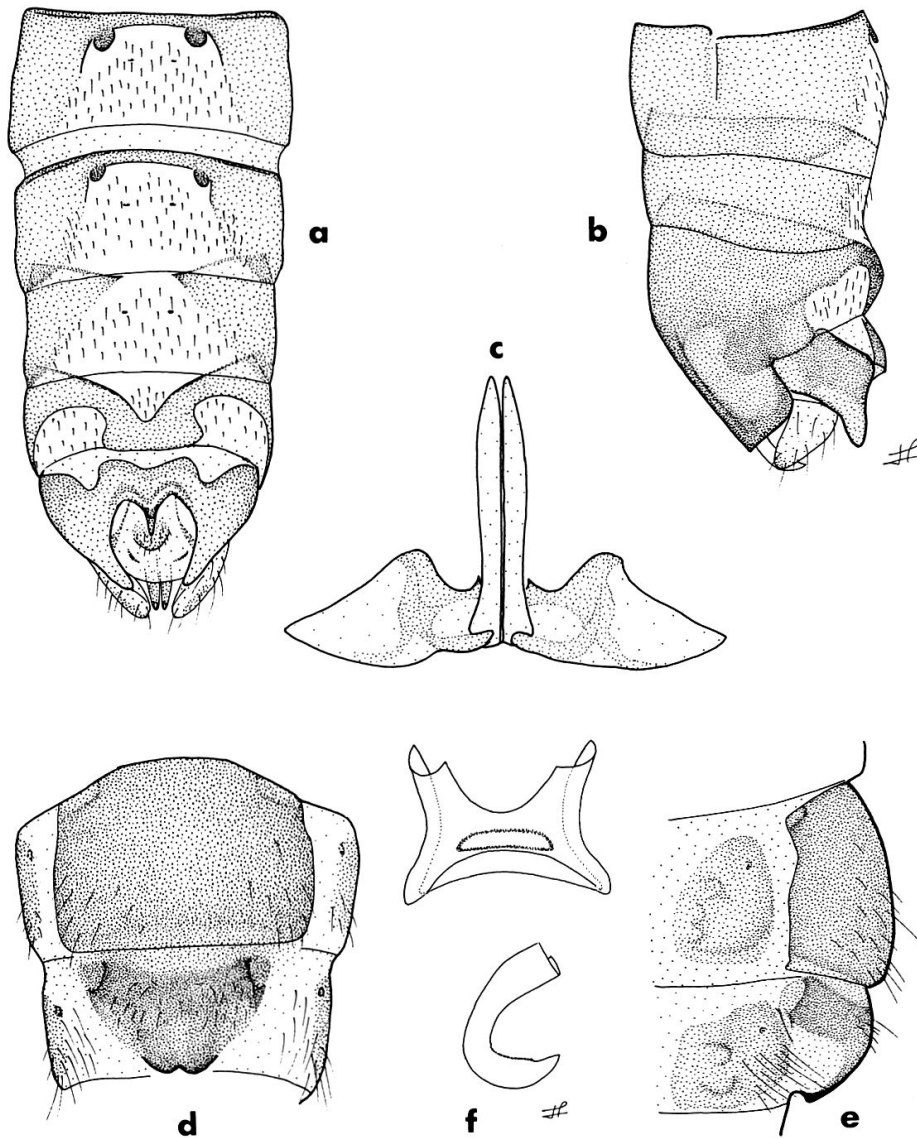


Fig. 1. *Leuctra tunisica* sp. n.: male abdominal tip in dorsal (a) and lateral (b) views, posterior view of paraprocts (c); segments VII + VIII of the female ventrally (d), laterally (e), and spermathecal sclerite in lateral and dorsal views (f).

#### Female (Fig. 1d-f)

Tergites I-VIII membranous, with transverse row of 4 pigmented spots; a fifth small sclerite in the middle, near the posterior margin. Sternite VII large, bulging ventrally, posterior edge less pigmented than rest; thin long hairs occur mainly postero-laterally. Sternite VIII large, hemispherical, fully sclerotized at the base, with lateral impressions for muscle insertion. Beyond the basal third, sclerotization narrows and forms two vague paramedian bands; it ends in a bilobed sclerotized plate. In side view, the entire segment is regularly curved in a semi-circle, the posterior sclerotized edge directed obliquely upward. Posterior sides of segment VIII with long straight hairs. Sternite IX with anteromedian pale area and scattered long hairs, otherwise simple. Paraprocts normal.

Sclerite at the entrance into spermatheca very small, essentially a little plate with large central perforation, margins of latter strongly sclerotized; this perforated plate is bent to take the shape of a wide funnel.

### *Affinities*

*L. tunisica* is easily recognized and unique in the genus for the long extensions of tergite X, and the peculiarly shaped sclerite on tergite IX. The outer genitalia of female are distinctive, there are no similar species. The spermathecal sclerite is very exceptional and has no parallel among species known to us. *L. tunisica* may be an isolated species. At the same time, tergite structure resembles species in the *fusca*-group s.l., because of the lack of convergent sclerites on tergite IX it particularly resembles the *fusca*-group s.str. (ZWICK, 1978: 221). It also agrees with other members of this group by the reduced vesicle. Reduced styles on male paraprocts occur also in some other species of the same group, but also in less similar species, like *L. albida* KEMPNY.

### *Leuctra balearica* PARDO et ZWICK, sp. n.

### *Material*

SPAIN, Majorca: North Soller, (39°47'N/2°46'E), 750 m, 1.- 6.10.1981, holotype male, one male paratype, both teneral.

Small species belonging to the *fusca*-group. Forewing 5.5-5.7 mm long. Generally light chestnut brown; epimerites and two basal thirds of femora very pale; head, thorax and distal third of femora darker.

### *Male (Fig. 2)*

Tergites I-V simple, posterior part of V membranous. Tergites VI-X modified. Tergite VI sclerotized only in anterior third, posteriorly with large, soft membranous rectangular area covered by thin hairs; hairs also extend some distance onto anterior lateral sclerites. Two plate-shaped appendages at the end of anterior sclerite are separated by about their own width; in lateral view, lobes directed backwards at 45°.

Antecosta VII entire, a bell-shaped membranous area with thin hairs immediately behind it. Lateral sclerites meeting antecosta at an acute angle; at the anterior third of their medial edge are two small rounded sclerotized processes pointing slightly outwards; the lobes tend backwards at 45°; behind them, some small thin hairs on sclerites. Antecosta VIII interrupted for about one third of its width, tips pointed; tergite VIII mostly membranous, with fine pilosity. Medial edges of lateral sclerites diffuse.

Antecosta IX divided for about half the segment width, pointed, gradually widening and merging with lateral sclerites. Tergite covered with fine pilosity, membranous except for an isolated posteromedian area consisting of two medially connected triangles. Tergite X laterally with thin long hairs, bilobed anteriorly but not well delimited. Epiproct consisting of a rounded soft area just beyond posterior margin of tergite X, no distinct stalk.

Cerci normal, paraprocts distinctive: the long and slender inner lobes (specilla) obtusely angled at about midlength; outer paraproct lobes short, bilobed, lobe corresponding to styles of other species wide, blunt, half as long the very narrow slender styles.

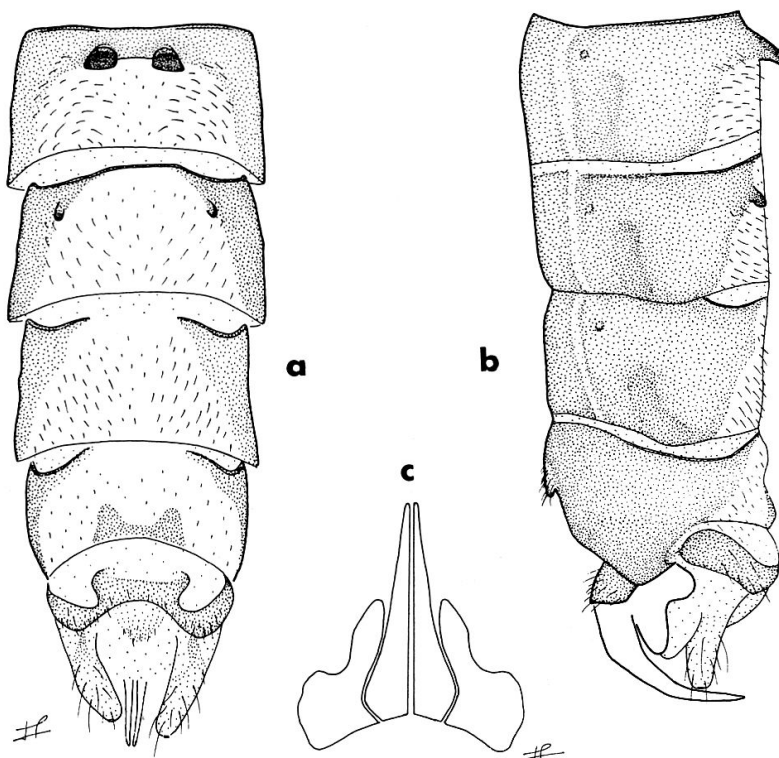


Fig. 2. *Leuctra balearica* sp. n.: male abdominal tip in dorsal (a) and lateral (b) views, and posterior view of paraprocts (c).

Sternites normal, IX with a small rounded sessile vesicle. Sternite IX not uniformly convex as is usual but with a subterminal median impression; the distal edge again curved outward, overlying the base of the paraprocts.

#### *Female*

Unknown.

#### *Affinities*

AUBERT (1954) distinguished several groups of species in *Leuctra*; the present species belongs to the *fusca*-group. Within that, AUBERT identified subgroups, separating subgroups a and b by the absence or presence, respectively, of processes on tergite VIII. However, we feel that this sometimes conflicts with other resemblances, e.g., reduction of processes on tergite VII. We can propose no definite limits between the various subsets of species and simply compare *L. balearica* to the most similar ones in the *fusca*-group s.l., regardless of presently accepted subgroup assignment.

*L. balearica* is very similar to *L. hiberiaca* AUBERT, *L. aurita* NAVAS, *L. lusitanica* AUBERT, and *L. lamellosa* DESPAX (AUBERT, 1956, 1962). However, it differs in details of tergite structure from every single one, and very clearly differs from all its relatives by the reduced paraproct styles. Species with similarly reduced styles, e.g. *L. tunisica*, or *L. albida*, are very different in tergite structure.

Remarks: we are uncertain if the shape of sternite IX is typical of this taxon, or simply results from muscle contraction and subsequent distortion of the very ten-eral males during conservation.

*Leuctra aegaieica* PARDO et ZWICK, sp. n.

*Material*

GREECE, Andros: S Varidion, (37°57'N/24°46'E), 70 m, 10.3.1982, holotype, brachypterous male; paratypes, brachypterous: 5 males, 5 females. Paratypes, macropterous: Apikia (37°51'N/24°54'E), 300 m, 24.10.1980, 2 females, 3 nymphs; below Vurkoti (37°52'N/24°55'E), 150 m, 23.10.1980, 3 males, 5 females; S Varidion (37°57'N/24°46'E), 170 m, 20.10.1980, 3 males (of which one brachypterous), 1 female. Additional material: GREECE: Andros, 20.-24.10.1980: Varidion (37°58'N/24°47'E), 130 m, 1 male; W Agios Nikolaos (37°52'N/24°55'E), 280 m, 1 male, 3 females; above Apikia (37°51'N/24°54'E), 350 m, 1 male. Euboea: S Komiton (38°04'N/24°32'E), 540 m, 10.-12.10.1980, 4 males, 3 females. Naxos: above Koronis (25°32'N/37°08'E), 660 m, 3 males, 1 female; 640 m, 2 males, 4 females; below Koronis, 410 m, 2 males, 1 nymph; Moni Faneromeni (25°28'N/37°08'E), 20 m, 2 males.

Small species belonging to the *fusca*-group; brachypterous and macropterous specimens exist, sometimes both occur together. Length of forewings:

	Male	Female
brachypterous	4-5.2 mm;	4.5-5.5 mm.
macropterous	5-6.5 mm;	6.2-7.5 mm.

Generally light brown; head, prothorax and distal third of femora darker.

*Male (Fig. 3a-d)*

Tergites I-V simple, V membraneous in its posterior half. Tergites VI-X modified, VI and VII with processes. Posterior half of tergite VI largely membraneous with small thin hairs. Anterior fourth of segment sclerotized, carrying two short and wide transverse processes separated for a distance a little greater than their own width; in side view, the plate-like processes are almost erect.

Antecosta of tergite VII divided for about one third of segment width, medial edges of sclerites truncate. Central area of tergite largely membraneous. Two long processes with rounded ends arising about midlength on the sides are curved medially and project over the membraneous field; behind the processes, the lateral sclerite border becomes diffuse and the soft area is covered by long thin hairs. In side view, the processes are thin, inclined at about 45°.

Antecosta VIII interrupted for one third of tergite width, free ends sharp. Tergite largely membraneous medially. Lateral sclerotized areas extended into two dark arms meeting medially in a transverse posteromedian bar from which a central triangular pigmented area extends anteriorly.

Tergite IX mostly membraneous, antecosta divided for a small distance, with long slender ends. An isolated dark, triangular area is placed posteromedially; sometimes, its tip is indistinct, or at least much paler than the rest, and then the sclerite resembles the usual two connected triangles.

Anterior margin of tergite X deeply bilobed. Epiproct unusual in that the pigmented long stalk is very prominent and continuous with the posterior edge of tergite from which it rises. The rounded end of stalk rests in a soft, somewhat raised and hairy membraneous oval area.

Sternites simple, IX without vesicle. Paraproct styles very narrow in posterior view and a little shorter than specilla; in side view, the styles are broad basally, narrowed in a curved line to a very thin point in the distal half. Cerci mostly pigmented, long and slender.

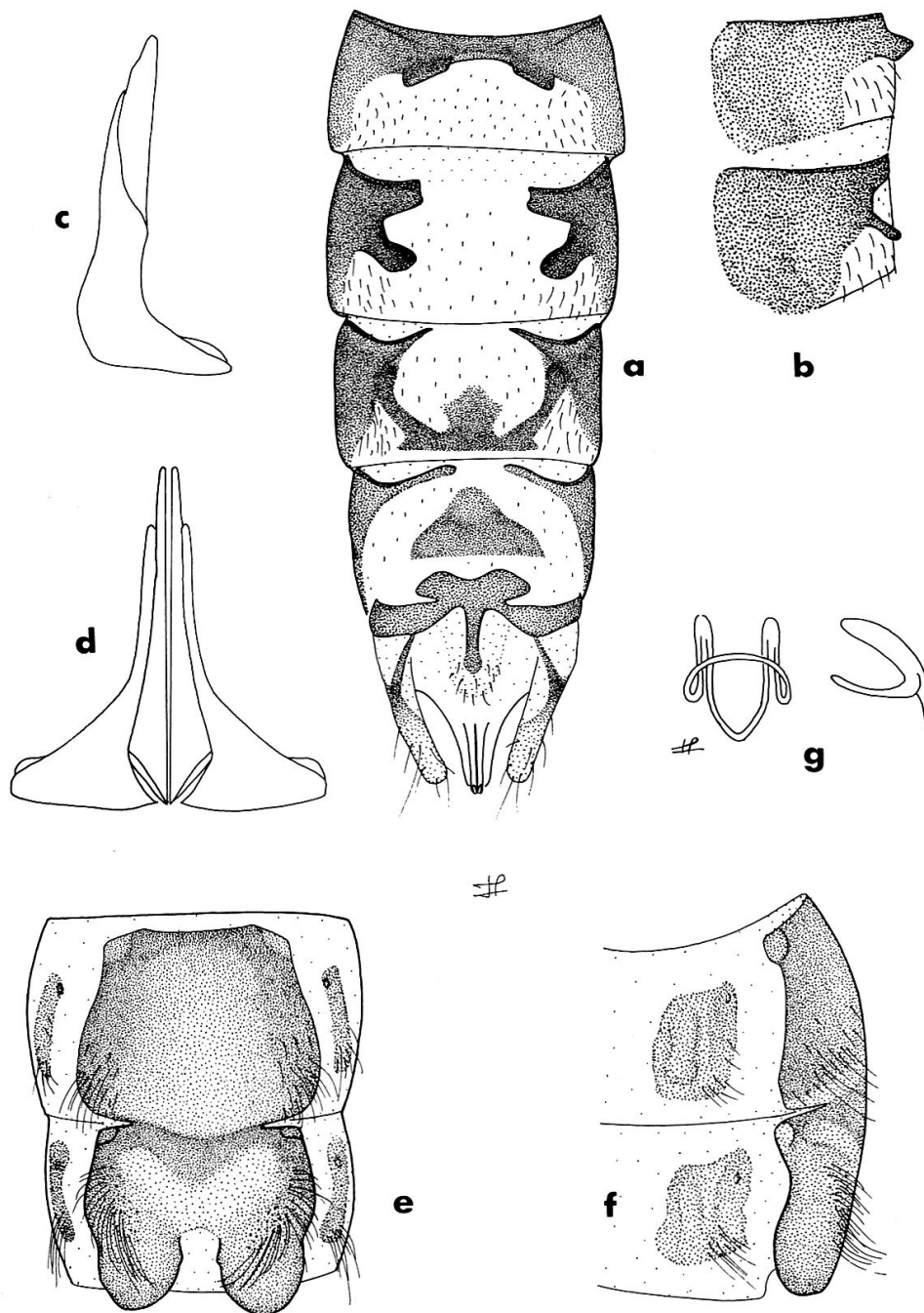


Fig. 3. *Leuctra aegaeica* sp. n.: male abdominal tip in dorsal view (a), lateral view of tergites VI + VII (b), posterior (c) and lateral (d) view of paraprocts; segments VII + VIII of the female ventrally (e), laterally (f), and spermathecal sclerite in lateral and ventral views (g).

*Female (Fig. 3e-g)*

Anterior sternites simple. Sternite VII less pigmented and wider posteriorly than in front, laterally with long thin hairs, distally connected to sternite VIII. Sternite VIII large, divided posteriorly for almost half its length by a well delimited central notch. Notch rounded anteriorly, first with almost parallel sides, divergent distally. The notch separates two long lateral sclerotized lobes with nearly circular distal edges. Sternite in front of notch with a less sclerotized heart-shaped pale area surrounded by long hairs extending over the bare lobes. In lateral view, sternites VII and VIII together are regularly curved over their entire length. Paraprocts normal. Pigmented cerci long and slender.

Spermatheca of normal shape, slender, not very sclerotized.

*Affinities*

Male *L. aegaeica* resemble other Greek species of the *fusca*-group (ZWICK, 1978), mainly *L. candiae* ZWICK. *L. candiae* differs mainly by more closely set processes on tergite VI, by the pointed ends of antecosta VII, the more distally placed processes of tergite VII, and the simple anterior margin of the transverse posteromedian band on tergite VIII. *L. candiae* also has paraproct styles distinctly shorter than the specilla. The female bears some resemblance with *L. rhodoica* sp.n., which, however has a much wider notch. *L. aegaeica* also reminds one of *L. moreae* ZWICK, but there the notch is much shorter and the sides of the subgenital plate are inflated, almost globular. *L. cypria* ZWICK is distantly similar, with a bare subgenital plate.

*Leuctra rhodoica* PARDO et ZWICK, sp.n.

*Material*

GREECE, Rhodes: Epta Piges, (36°15'N/28°07'E), 60 m, 4-6.11.1980, holotype male, paratypes: 2 males, 8 females, same data.

Slender medium-sized species belonging to the *fusca*-group. Forewing, male: 7-7.5 mm; female: 7.5-9.5 mm. Generally light brown; head, thorax and distal third of femora darker, brown.

*Male (Fig. 4a-c)*

Tergites I-V simple, except tergite V membranous posterolaterally. Tergites VI-X modified, tergites VI and VII with processes. Posterior half of tergite VI with wide membranous trapezoid area slightly triangularly extended anteromedially between processes; membrane finely pilose on its sides. The broad anterior sclerite carries two rounded convergent lobes separated by two times their width; in lateral view, lobes resembling a beak.

Tergite VII medially largely membranous, antecosta divided for nearly one fifth of the segment width, ends of antecosta acute. Lateral sclerites with two plate-shaped lobes just behind midlength; in front of these, the medial sclerite edges are curved but two straight dark lines on them leading to the processes are subparallel. Processes strongly sclerotized at rounded apex, curved inwards, their axes perpendicular to body axis, an erect little cone in side view. Central membrane bare, except some pilosity behind the processes.



Tergite VIII mostly membranous, antecosta narrowly divided, ends acute. Median borders of lateral sclerites not well delimited and not distinctly connected to two pigmented bands that meet medially, constituting a transverse posteromedian bar. Center of tergite bare, sides covered by long thin hairs beginning approximately at origin of oblique bars.

Antecosta IX interrupted for a small distance, free ends finger-shaped. Tergite mostly membranous with a pigmented posteromedial trapezoidal area. Anterior margin of tergite X bilobed. Club shaped stalk of epiproct rising from posterior edge of tergite X surrounded by slightly darker and more distinctly pilose integument; in side view, it is raised as little soft cone. Cerci normal.

Sternites normal, IX without vesicle. Paraprocts with two small rounded lobes on the outside. Styles shorter than specilla, obtuse, with two subterminal hairs. Specilla normal.

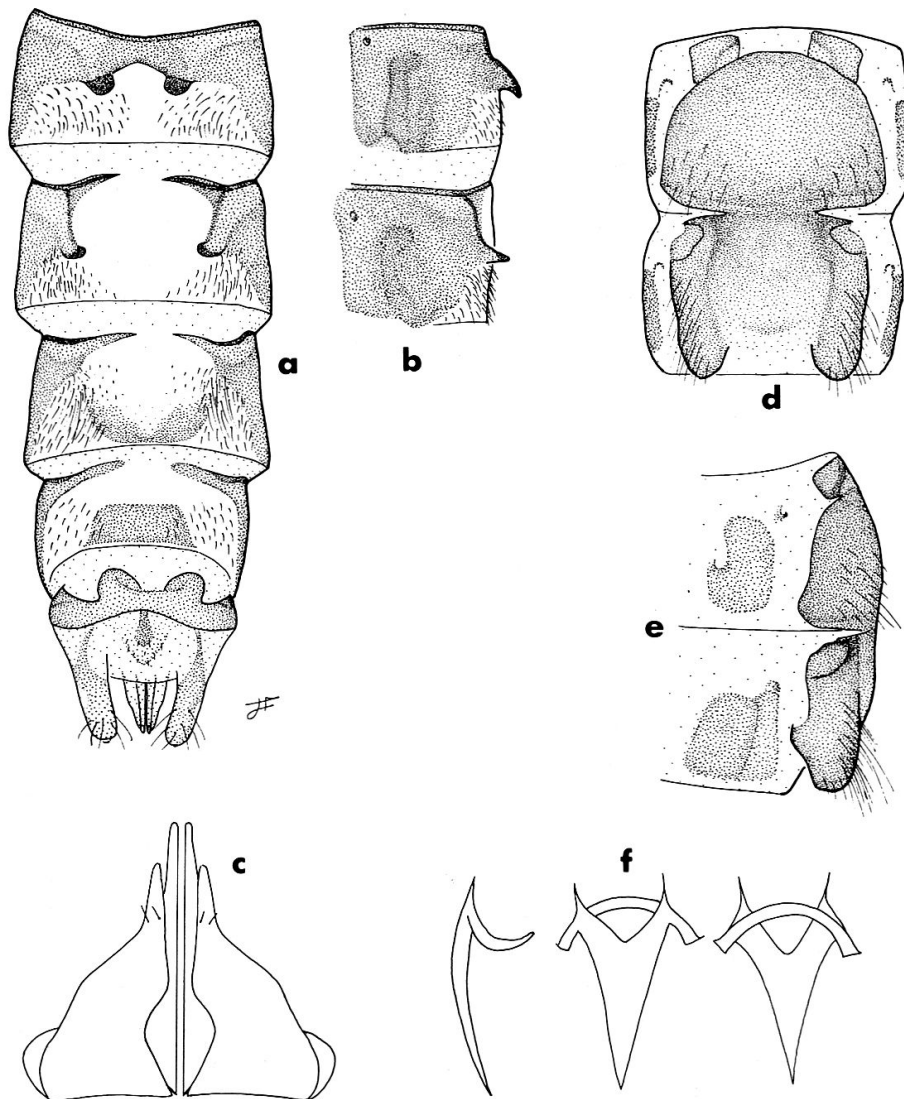


Fig. 4. *Leuctra rhodoica* sp.n.: male abdominal tip in dorsal view (a), lateral view of tergites VI + VII (b), posterior view of paraprocts (c); segments VII + VIII of the female ventrally (d), laterally (e), and spermathecal sclerite in lateral, dorsal and ventral views (f).

*Female (Fig. 4d-f)*

Tergites I-VIII membranous, with a row of four spots. Tergites VII to IX with increasing posteromedial pigmentation, tergite X completely pigmented. Anterior sternites normal, sternite VII widened posteriorly, semicircular, medially fused to sternite VIII. Anterior impressions marking muscle attachment sites strongly marked.

Sternite VIII is a wide subgenital plate with a wide, medially poorly delimited posterior notch occupying about one fourth of the length and half the width of the sternite. The notch separates two lateral sclerotized lobes with rounded well delimited edges. Lateral sclerotization in front of these lobes prominent and covered with long thin hairs; two lateral sclerotized bands thereby become very prominent. The median part of the subgenital plate decreasingly sclerotized towards posterior linear edge, except a small pigmented centrodiscal area. In side view both sternites have a common continuous profile line, distally hidden by the more raised lateral lobes. Paraprocts and cerci simple.

Spermathecal sclerite resembling a broad V supporting a delicate ring.

*Affinities*

*L. rhodoica* males are very close to other Eastern Mediterranean species of the *fusca*-group (ZWICK, 1978). *L. graeca* ZWICK and *L. cypria* have the processes on tergite VII at the end of the segment, and the sclerite edges in front of them are parallel; the antecosta VII is entire, or at best indistinctly divided in some *L. graeca*. *L. candiae* is most similar to *L. rhodoica*, but processes on tergite VII are also further back, much stronger, and those on tergite VI are also differently placed and shaped. The related species have at best traces of the outer lobes on the paraprocts, while in *L. rhodoica* they are very apparent. Females of the related species are very different externally, only *L. cypria* and *L. moreae* have distant resemblances with *L. rhodoica*. However, the spermathecal sclerite of *L. cypria* is very similar.

*Leuctra kykladica* PARDO et ZWICK, sp. n.

*Material*

GREECE: Naxos: above Koronis, (37°08'N/25°32'E), 660 m, 26-28.10.1980, holotype male, paratypes: 2 females.

Medium-sized species belonging to the *fusca*-group. Forewing, male: 6.2 mm; female: 7-7.5 mm. Sclerotized parts of the body brown; two basal thirds of femora light brown. There is a darker area on the prescuta of both meso- and metathorax.

*Male (Fig. 5a-c)*

Tergites I-V simple, except V membranous posteriorly. Tergites VI-X modified, VI and VII with processes. Tergite VI with two wide, plate-shaped lobes, separated for a distance nearly one and a half times their width; the lobes are very close to the antecosta. A semicircular central area behind them membranous, with fine pilosity. In lateral view, the contour line rises at about 45° to a small slightly declivous plateau.

Antecosta of tergite VII divided for one third of the tergite width, anterior limits of the wide central membranous area rounded, leading to two lateral dark processes just behind midlength; processes are obliquely positioned transverse semi-

erect plates; in profile, they are quite massive and plump. Beyond them, long thin hairs on the diffusely limited sclerite. Antecosta VIII widely interrupted, tergite medially largely membranous. Lateral sclerotized areas with long thin hairs, and connected to two dark bands meeting medially in a transverse posteromedian bar; membrane behind bar slightly pigmented.

Tergite IX largely membranous. Antecosta narrowly interrupted, with finger-shaped ends. Two square pigmented areas near posterior segment border widely separate. Anterior margin of tergite X deeply bilobed. The epiproct is formed by a dark rounded area connected with a long sclerotized stalk rising from tergite X.

Sternites simple, no vesicle on segment IX. Paraprocts simple, styles with sparse fine pilosity, nearly of the same length as the specilla. A few long thin hairs on styles.

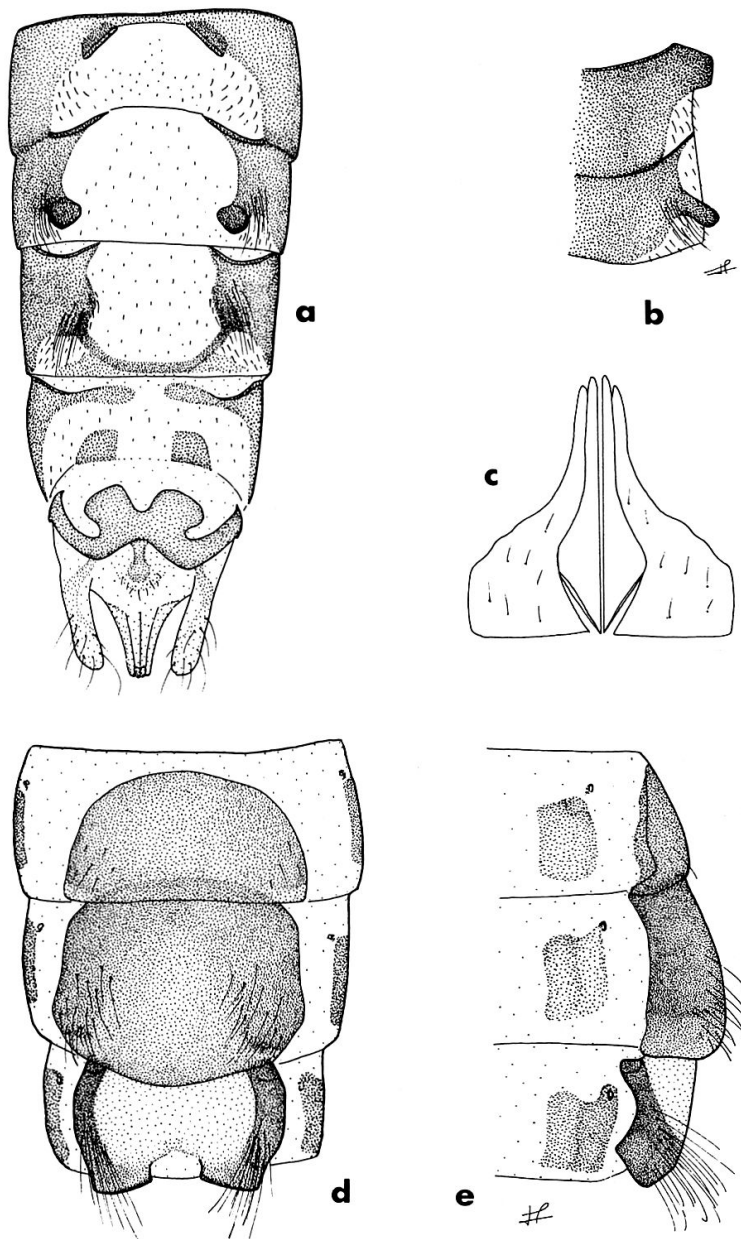


Fig. 5. *Leuctra kykladica* sp. n.: male abdominal tip in dorsal view (a), lateral view of tergites VI + VII (b), posterior view of paraprocts (c); segments VI-VIII of the female ventrally (d) and laterally (e).

*Female (Fig. 5d, e)*

Anterior sternites simple. Sclerotized posterior border of sternite VI overlapping anterior margin of sternite VII, the latter fully sclerotized but paler medially and on its posterior half than anteriorly; being large and wide, posterolaterally with long hairs. Sternite VIII a large, medially pale subgenital plate ending in two lateral truncate lobes with slightly converging distal edges; lobes separated by an anteriorly pointed notch slightly less than one lobe's width. Posteriorly, sides with long straight hairs. In side view, the convex profiles of sternites VI and VII overlapping anterior margins of sternites VII and VIII, respectively. Sternite VIII regularly curved, the posterior sclerotized edge directed obliquely upward. Paraprocts and cerci normal. Spermatheca not examined.

*Affinities*

*L. kykladica* males resemble other species of the *fusca*-group, e.g., *L. candiae* and *L. rhodoica*. *L. kykladica* differs in the shape of processes on tergites, and in the similar length of paraproct styles and specilla; in the other species the styles are clearly shorter. The female subgenital plate tends to be bilobed with medial notch in the entire complex of species (ZWICK, 1978); however, in all other species the notch is either much narrower (as in *L. candiae* and *L. graeca*), or else the distal edge of the lobes is rounded (e.g., *L. moreae*, *L. cypria*, *L. rhodoica*), instead of truncate in the present species.

*Leuctra minoica* PARDO et ZWICK, sp. n.

*Material*

GREECE, Crete: E Ag. Ioannis, (35°03'N/25°53'E), 470 m, 25.2.1982, holotype male; paratypes: 3 males, 17 females; E Ag. Ioannis, (35°03'N/25°53'E), 450 m, 16.12.1981, 2 males, 6 females, 1 nymph.

Medium-sized species belonging to the *fusca*-group. Forewing, male: 7-7.5 mm; female: 7.5-9 mm. General colouration chestnut, wings slightly lighter, infuscated around veins.

*Male (Fig. 6a-c)*

Tergites I-V simple, posteromedian parts of tergites III-V membranous, increasingly distinctly so from III to V. Tergites VI-X modified, only VI with processes. Tergite VI with large bell-shaped membranous area extending to near antecosta medially. The sclerotized edge in front of this area carries two wide plate shaped lobes near midlength; beyond these, the border of sclerite becomes diffuse, and the membrane is covered by long thin hairs. The processes are about twice their width apart; in side view, they rise as blunt triangles at about 45° from the tergite.

Antecosta of tergite VII interrupted for about one fourth of segment width, ends sharply pointed; the semicircular soft central area behind it with fine hairs. A small area of sclerotized sides adjacent to membranous area may be darker than rest; this area is beset with long hairs. Tergite VIII largely membranous, antecosta divided by nearly half the segment width, ending in sharp points. Medial edges of lateral sclerites strongly sclerotized, covered with long hairs. A postero-central curved sclerotized band meets the sclerotized sides just behind midlength.

Antecosta IX narrowly interrupted, free ends finger-shaped. Most of tergite membranous, with an isolated central sclerotization consisting of two medially

connected triangles. Tergite X with bilobed anterior margin and re-entrant posterior edge from which the long sclerotized stalk of epiproct originates; distally it meets a dark, small oval area.

Sternites simple, no vesicle on sternite IX. Styles of paraprocts ending in a sharp point, with two small subterminal hairs; styles shorter than the inner lobes (specilla), which are normal. Cerci simple.

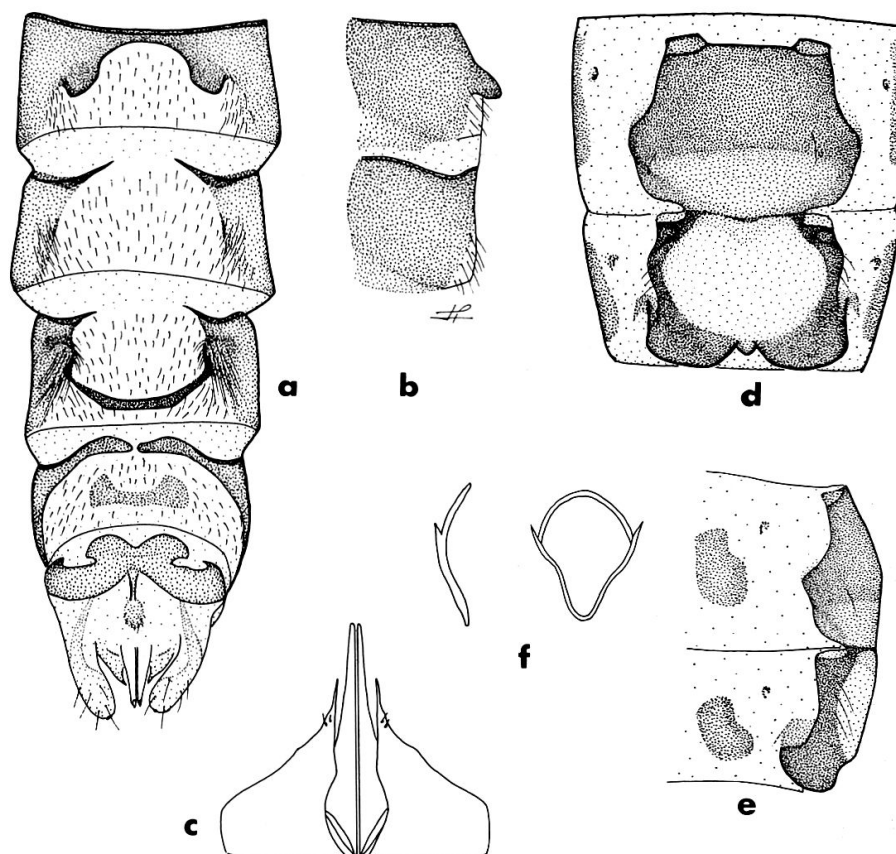


Fig. 6. *Leuctra minoica* sp. n.: male abdominal tip in dorsal view (a), lateral view of tergites VI + VII (b), posterior view of paraprocts (c); segments VII + VIII of the female ventrally (d), laterally (e), and spermathecal sclerite in lateral and ventral views (f).

#### *Female (Fig. 6d-f)*

Tergites I-VIII membraneous, each with transverse row of 4 pigmented spots; tergites IX and X largely or completely sclerotized, respectively. Anterior sternites simple. Sternite VII paler in posterior half than anteriorly, large, widened posteriorly, medially fused to sternite VIII. Sternite VIII is a large, medially pale subgenital plate ending in two lateral, wide plate-like lobes separated by a shorter small, less pigmented central nipple. In side view, sternites VII and VIII together describe a gently curved line; sternite VIII slightly slanting backwards, largely flat, with a small subterminal depression. Pigmentation of sternite IX anteromedially projecting. Paraprocts normal.

Spermathecal sclerite of the usual ring shape, with very poorly developed lateral arms, very thin and delicate.

#### *Affinities*

*L. minoica* is closely related with the two other species of the genus on Crete, *L. candiae* and *L. cretica* ZWICK; male *L. minoica* are easily distinguished from the former species but are very similar to *L. cretica*, with which they occasionally co-exist. *L. cretica* differs mainly by lack of a distinct sclerotized arch connecting the processes on tergite VI, while on the other hand it has distinct processes on tergite VII, which are lacking in *L. minoica*. The paraprocts are very similar to *L. cretica* but styles are a little longer and not as acute.

Females, although all following the general pattern of a bilobed, narrowly divided subgenital plate, are not very similar; in *L. minoica*, the median notch is more distinct than in any of the close relatives and contains a small nipple which is absent in both other species of *Leuctra* on the Island of Crete. Female *L. minoica* have some distant resemblances with *L. cypria*, from Cyprus, which belongs to the same group but cannot possibly be confused with any of the Crete species.

#### *Leuctra graeca* ZWICK, 1978

Mitt. schweiz. ent. Ges. 51: 222

GREECE, mainland, Pelion, above Portaria (39°23'N/23°01'E), 830 m, 21.9.-13.10.1980, 1 male, 1 female. Euboea, above Stropones (38°36'N/23°53'E), , 700 m, 10.-12.10.1980, 2 males, 2 females; Ano Steni (38°35'N/23°53'E), 550 m, 10.-12.10.1980, 21 males, 17 females.

*L. graeca* occurs in the south of the Balkanian Peninsula, from Montenegro to the Peloponnesos, and the Olymp Mt. in the East. Its discovery on Euboea is no surprise.

#### *Leuctra moreae* ZWICK, 1978

Mitt. schweiz. ent. Ges. 51: 224.

GREECE, Peloponnesos, stream along road to Megaspoleon (38°09'N /22°14'E), 130 m, 22.4.-21.5.1984, 1 female.

This very distinctive species is known only by a few females, all from the Peloponnesos; unfortunately, the male remains unknown.

#### *Leuctra fusca* (LINNAEUS, 1758)

*Phrygaena fusca* LINNAEUS, 1758, Systema Naturae, ed. 10, 1: 549.

GREECE, Thasos, near Mariés (40°42'N/24°40'E), 15.-17.10.1980: 5 km E, 600 m, 1 male; above Mariés, 460 m, 8 males, 4 females, 2 male nymphs. Thasos, above Prinos (40°44'N/24°39'E), 780 m, 15.-17.10.1980, 1 male, 1 female nymphs.

*L. fusca* had not previously been recorded from Thasos, but is widespread on the adjacent Balkanian mainland.

#### *Leuctra digitata* KEMPNY, 1899

Verh. zool.-bot. Ges. Wien 49: 13.

SPAIN, Sierra de Montseny (N Barcelona), Sta Fé (41°45'N/2°24'E), 850 m, 28./29.9.1981, 28 males, 33 females, 6 nymphs.



First record from Spain supported by adequate material. Apart from an old dubious record by NAVAS (see SANCHEZ ORTEGA & ALBA TERCEDOR, 1987), PUIG *et al.*, (1984) claimed the existence of this species in Asturia. These authors do not list their material, but, by their methods of collection, can only have collected larvae. Certainly, this is no sound basis for records of doubtful species outside their confirmed range, particularly so in a large genus known for its difficult larval taxonomy. The mountain stream fauna of the Sierra de Montseny has evident resemblances with that of the Eastern Pyrenees (e.g., among the Diptera: Blephariceridae, ZWICK, 1992) to which it is geographically close. *L. digitata* is known from the French Pyrenees (BERTHÉLEMY, 1966).

*Leuctra major* BRINCK, 1949

Opusc. Ent., Suppl. 11: 12.

GREECE, mainland: Ano Kastritsi (38°16'N/21°50'E), 500 m, 26.9.1980, 2 males; E Chania (39°25'N/23°06'E), 930 m, 21.9.-13.10.1980, 2 females; Pelion, above Portaria (39°23'N/23°01'E), 830 m, 13.10.1980, 1 male, 1 female. GREECE, Euboea, Ano Steni (38°35'N/23°53'E), 550 m, 10.-12.10.1980, 1 male, 1 female.

The species is widespread in South-central Europe; its occurrence evidently depends on the availability of extensive hyporheic habitats where the nymph dwells at great depth (BERTHÉLEMY, 1969). In southeast Europe it was known from the former Yugoslavian Makedonia (e.g., IKONOMOV, 1979b, 1980, 1983), Bulgaria (BRAASCH & JOOST, 1976). It is new for Greece; the present collections mark the southeastern extreme of its occurrence.

*Leuctra bronislawi* SOWA, 1970

Bull. Acad. Pol. Sci., Cl. II, 18: 154 (publ. 30 May).

*Leuctra procera* KACANSKI ET ZWICK, Mitt. schweiz. ent. Ges. 43: 9 (publ. 1 June 1970).

GREECE, Thasos, near Mariés (40°42'N/24°40'E), 15.-17.10.1980: 5 km E, 3males, 5 females; above Mariés, 460 m, 28 males, 60 females; Thasos, above Prinos (40°44'N/24°39'E), 780 m, 15.-17.10.1980, 1 male, 2 females.

This slender autumnal species remained unknown until 1970, when it was almost simultaneously described from Poland and the former Yugoslavia, respectively. It has since been shown to be widespread on the Balkan Peninsula, including the Peloponnesos and Bulgaria (BRAASCH, 1972; ZWICK, 1978; SIVEC, 1980). Its collection on Thasos is a marginal extension of range.

*Leuctra joosti* BRAASCH, 1970

Ent. Nachr. 14: 20.

BULGARIA, Rodope Mts, 5 km W Pamporovo (41°40'N/24°43'E), 1300 m, 21.-22.6.1980, 1 male. (Malicky; 28) [1/0/0]

This remarkable species is only known from the Vitoscha and Pirin Mountains. Its presence in the Rila and Rodope Mountains was anticipated (BRAASCH & JOOST, 1971) and is now confirmed for the latter.

*Leuctra metsovonica* AUBERT, 1957 (?)

Mitt. schweiz. ent. Ges. 30: 299.

ITALY, Marche: 5 km E Visso (42°56'N/13°07'E), 700 m, 1.8.1980, 4 females; spring of the Nera r., 900 m, (42°54'N/13°11'E), 1.8.1980, 1 female.

By the pale basal antennal segments and by the pale erect cone at the base of sternite VIII, the present specimens appear to be *L. metsovonica*, which is only known from the Col de Metsovon, in Greece. However, a large number of species has been named in the *inermis*-group of *Leuctra* and we find many of them difficult to identify because in populations of single species (e.g., *L. inermis* KEMPNY in the Rhön Mts in Hesse, Germany, but others too) individual variation of allegedly distinctive characters is much more important than would appear to be the case after AUBERT's revision (1957). Accordingly, we report this species from Italy with doubts.

## ACKNOWLEDGEMENTS

We sincerely thank Universitäts-Dozent Dr. Hans MALICKY, of Lunz/Austria, for the gift of this valuable material, and the patience with which he has tolerated the delay in its study. E. DÖRING, G. FLEISCHER and G. STÜBER (Schlitz) are thanked for careful technical help. We acknowledge funding of a research visit of I. PARDO to Schlitz by the Government of Galicia, permitting this study.

## ZUSAMMENFASSUNG

Es werden mehrere neue Arten der Gattung *Leuctra* (Plecoptera: Leuctridae) benannt und zwar: *L. tunisica* (Tunesien), *L. balearica* (Mallorca), *L. aegaeica* (Andros, Euböa, Naxos), *L. rhodoica* (Rhodos), *L. kykladica* (Naxos), und *L. minoica* (Kreta); ihre kennzeichnenden Genitalmerkmale werden abgebildet. Neue Funde, die Erweiterungen des bekannten Verbreitungsgebietes einiger bereits bekannter mediterraner *Leuctra* bedeuten, werden ebenfalls mitgeteilt.

## REFERENCES

- AUBERT, J. 1954. Contribution à l'étude du genre *Leuctra* STEPHENS et description de quelques espèces nouvelles de ce genre. *Mitt. schweiz. ent. Ges.* 27: 124-136.
- AUBERT, J. 1956. Contribution à l'étude des Plécoptères d'Espagne. *Mém. Soc. vaud. Sci. nat.* 11: 209-276.
- AUBERT, J. 1957. Les *Leuctra* du groupe *inermis* KEMPNY et quelques espèces inermes isolées (Plécoptères Leuctridae). *Mitt. schweiz. ent. Ges.* 30: 285-312.
- AUBERT, J. 1959. Plecoptera. *Insecta Helvetica, Fauna 1*: 1-140.
- AUBERT, J. 1962. Quelques *Leuctra* nouvelles pour l'Europe (Plécoptères Leuctridae). *Mitt. Schweiz. ent. Ges.* 35: 155-169.
- BERTHÉLEMY, C. 1966. Recherches écologiques et biogéographiques sur les Plécoptères et Coléoptères d'eau courante (Hydraena et Elminthidae) des Pyrénées. *Annls Limnol.* 2: 227-458.
- BERTHÉLEMY, C. 1969. Contribution à la connaissance des Leuctridae. *Annls. Limnol.* 4 (1968): 175-198.
- BRAASCH, D. 1970. *Leuctra joosti* n.sp. (Plecoptera) aus Bulgarien. *Ent. Nachr.* 14: 20-22.
- BRAASCH, D. 1972. Neue Funde von Plecopteren in Bulgarien. *Ent. Nachr.* 16: 81-90.
- BRAASCH, D. & JOOST, W. 1971. Zur Plecopterenfauna Bulgariens. *Limnologica* 8: 265-294.
- BRAASCH, D. & JOOST, W. 1976. 11. Beitrag zur Plecopterenfauna Bulgariens. *Ent. Nachr.* 20: 25-28.
- BRINCK, P. 1949. Studies on Swedish stoneflies (Plecoptera). *Opusc. Ent., Suppl.* 11: XII + 250 pp.
- FOCETTI, R. Biochemical systematics and biogeographical patterns of the Italian and Corsican species of the *Protonemura corsicana* group of species (Plecoptera: Nemouridae). *Aquatic Insects* (in print).
- HYNES, H.B.N. 1977. *A key to the adults and nymphs of the British stoneflies (Plecoptera) with notes on their ecology and distribution.* 3rd edition, Freshwat. Biol. Ass. Sci. Publ. 17, 92 pp.
- IKONOMOV, P. 1979: Plécoptères (Insectes) dans le bassin de la rivière Radika. *Ann. Fac. Biol. Univ. Skopje*, 32: 45-60 (in Makedonian, French Résumé).
- IKONOMOV, P. 1980. Contribution à la connaissance des Plécoptères (Insecta) en Macédoine occidentale. *Ann. Fac. Biol. Univ. Skopje*, 33: 15-23 (in Makedonian, French Résumé).

- IKONOMOV, P. 1983. Nouvelle contribution à la connaissance des Plécoptères (Insecta) de la plaine de Skopje. *Ann. Fac. Biol. Univ. Skopje*, 36: 5-20 (in Makedonian, French Résumé).
- ILLIES, J. 1966. Katalog der rezenten Plecoptera. *Das Tierreich* 82: I-XXX, 1-631.
- KACANSKI, D. & ZWICK, P. 1970. Neue und wenig bekannte Plecopteren aus Jugoslawien. *Mitt. schweiz. ent. Ges.* 43: 1-16.
- KEMPNY, P. 1899. Zur Kenntnis der Plecopteren. II. Neue und ungenügend bekannte *Leuctra*-Arten. II. und III. Theile. *Verh. zool.-bot. Ges. Wien* 49: 9-15, 269-278.
- LEVANIDOVA, I.M. & ZHILTOVA, L.A. 1979. An annotated List of the Stoneflies (Plecoptera) of the Soviet Far East. *Int. Rev. ges. Hydrobiol.* 64: 551-576.
- LILLEHAMMER, A. 1988. *Stoneflies (Plecoptera) of Fennoscandia and Denmark*. Fauna Ent. Scand. 21, 165 pp.
- LINNAEUS, C. 1758. Neuroptera. pp. 543-552 In: *Systema Naturae* 1; 10th edition.
- MALICKY, H. 1988. Spuren der Eiszeit in der Trichopterenfauna Europas. *Riv. Idrobiol.* 27: 247-297
- PUIG, M. A., GONZALEZ, A. & SORIANO, O. 1984. Introducción al estudio de las comunidades macrobentónicas de los ríos asturianos: efemerópteros, plecópteros, tricópteros, simúlidos y quironómidos. *Limnetica* 1: 187-196.
- SANCHEZ ORTEGA, A. & ALBA TERCEDOR, J. 1987. Lista faunística y bibliográfica de los Plecópteros (Plecóptera) de la Península Ibérica. *Lista de la flora y fauna de las aguas continentales de la Península Ibérica* 4: 1-133.
- SIVEC, I. 1980. *Plecoptera*. Catalogus Faunae Jugoslaviae III/6, 30 pp.
- SOWA, R. 1970. Note sur quelques Plécoptères de la Pologne. *Bull. Acad. Pol. Sci., Cl. II*, 18: 153-157.
- STEWART, K.W., STARK, B.P. & STANGER, G. 1988. *Nymphs of North American Stonefly Genera (Plecoptera)*. The Thomas Say Foundation XII: 460 pp. and pp. 328-331, 414-417.
- ZWICK, P. 1972. Insecta Plecoptera. Phylogenetisches System und Katalog. *Das Tierreich* 94: I-XXXII, 1-465.
- ZWICK, P. 1978. Steinfliegen (Insecta, Plecoptera) aus Griechenland und benachbarten Ländern. *Mitt. schweiz. ent. Ges.* 51: 21-38, 213-239.
- ZWICK, P. 1982. Das Mittelmeergebiet als glaziales Refugium für Plecoptera. *Acta entomol. Jugosl.* 17: 107-111. [1981].
- ZWICK, P. 1992. Notes on the Spanish Net-Winged Midges (Diptera: Blephariceridae), with Descriptions of Two New Species. *Misc. Zool., Barcelona*, 15: 147-163.

(received May 8, 1993; accepted September 27, 1993)