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The cave crickets of the genus *Dolichopoda* from Evvia and Skyros islands: formal description of *D. octhoniai* and *D. saraolacosi* (Orthoptera: Rhaphidophoridae)

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Abstract
Two species, *D. octhoniai* from Evvia and *D. saraolacosi* from Skyros island (Greece) are morphologically described. These two species were collected for the first time at the end of the '70s but they were recorded only as *nomina nuda* without any formal taxonomic description. *D. octhoniai* is very similar to the other Evvian species *D. makrikapa* and to *D. vandeli* and *D. petrochilosi* from Viotia and Attiki respectively, differing from them only by a few morphological characters. On the other hand *D. saraolacosi* is very different from all the other species of Central Greece and West Aegean showing some affinity only with the Attiki species *D. insignis* and with the South Evvian species *D. cassagnaui*. Relationships among the species inhabiting caves of this area of Greece are discussed in relation to the complex geological history of the West Aegean area and the adjacent mainland.

Key words: Orthoptera, Rhaphidophoridae, Dolichopodainae, cave crickets, Greece.

Introduction

In the Central Eastern mainland of Greece and West Aegean islands, the cave crickets of the genus *Dolichopoda* Bolivar 1880 occur with 7 species widespread from Viotia (Boeotia), Evvia isl. (Euboea), Skyros isl. and Attiki (Attica) (Fig. 1). Among these, 3 species inhabit caves of the mainland: *D. vandeli* Boudou-Saltet, 1970 from Viotia, *D. petrochilosi* Chopard, 1954 and *D. insignis* Chopard, 1955 from Attiki; Other 3 species are known from Evvia: *D. makrykapa* Boudou-Saltet, 1980, *D. cassagnaui* Boudou-Saltet, 1971 and *D. ochtoniai* Boudou-Saltet, 1983 (*nomen nudum*); finally one species is reported from caves of Skyros isl., *D. saraolacosi* Boudou-Saltet 1983 (*nomen nudum*). All these species, on the basis of the bifurcation of the apex of the median process of the epiphallus, form a homogeneous group previously considered a subgenus of *Dolichopoda* (*Petrochilosina* Boudou-Saltet, 1980).

As discussed for the other subgenera already established in this genus (*Chopardina*, *Dolichopoda* and *Capraiacris*), the morphological grounds for the distinction of this subgenus are considered rather weak and of low taxonomic value. Therefore, as discussed for the Italian species (Rampini & Di Russo 2012), the articulation of *Dolichopoda* into subgenera can be abandoned and only the existence (when easily recognizable) of species groups sharing some morphological characters should be considered.

Two species, *D. ochtoniai* and *D. saraolacosi*, although collected by the end of '70s (Skouras 1983-88), are formally represented only by *nomina nuda*, reported for the first time in Boudou-Saltet (1983); these names completely lack any formal morphological description, and, as already outlined, any indication of depository location. Material of both taxa is likely present among the rather large collection of the late Mme. Boudou-Saltet, recently acquired by the Muséum National d'Histoire Naturelle, Paris (Laure Desutter-Grandcolas personal communication 2015). Unfortunately, most of this material is not labeled, lacking locality of collecting and taxonomic identification, therefore resulting useless for taxonomic purposes. Therefore the formal description of these two taxa is given here and the geographic distribution and morphological relationships of the species inhabiting caves of this area of Greece are discussed, basing on recently collected material.

Material and Methods

All the studied specimens were collected by hand on the wall of the caves during three recent field trips (August,

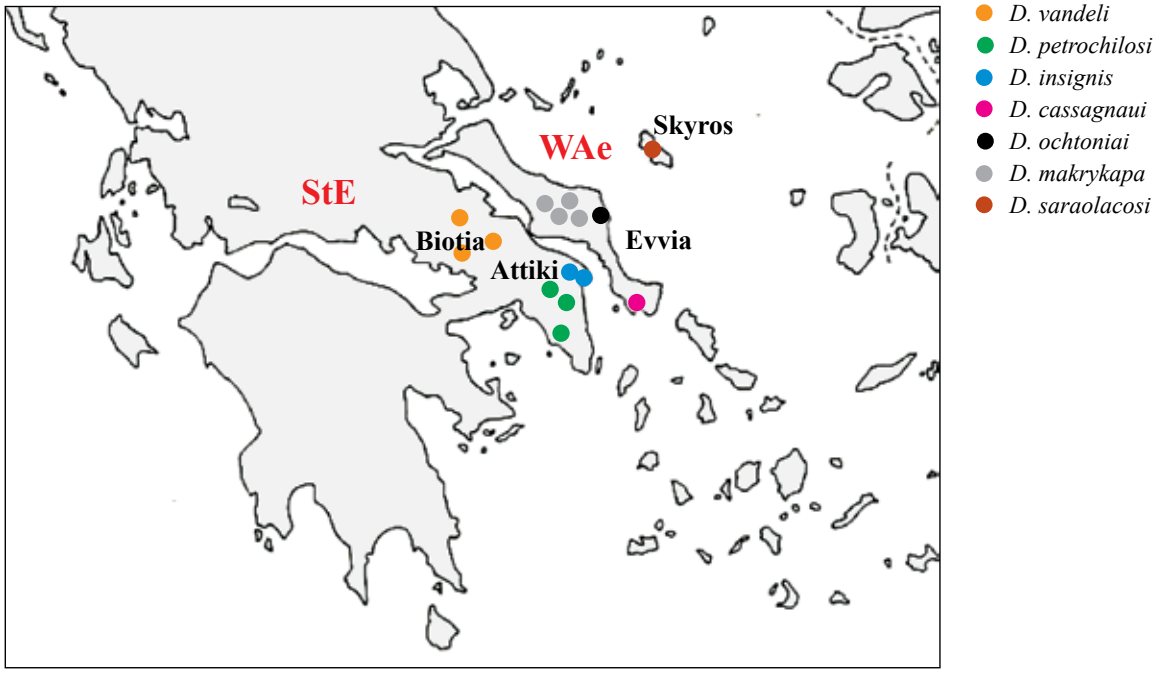


Fig. 1 – Geographic distribution of the studied species (StE: Sterea Ellas; WAe: West Aegean).

October and December 2014). Specimens were preserved in 70% ethanol and deposited in the collection of the Museum of Zoology of the University "La Sapienza" of Rome, Italy (MZUR). Duplicates are deposited in the collection of Zoological Museum of the University of Athens (ZMUA). Permissions for collection of samples were obtained by the Ephorate of Palaeoanthropology and Speleology of the Ministry of Culture, Education and Religious Affairs.

The specimens were studied with a Leica MZ12.5 stereomicroscope. All measurements are in mm. Photographs were taken with a Nikon Coolpix S9500 digital camera. The photographs and distribution map were processed using ACDSee Pro 8. For the morphological analysis nine external body characters were utilized: shape of the lobes of the IX and X terga; median process of the epiphallus; shape of the bifurcation of the apex of the median process of the epiphallus; size of the styli; amount of spinulation of the hind tibia; number of denticles on the inner valvae of the ovipositor; presence of spines on the hind femur; shape of the female subgenital plate.

Results /Taxonomy

***Dolichopoda ochtoniai* Rampini & Di Russo sp. n.**
(Figs 2-8)

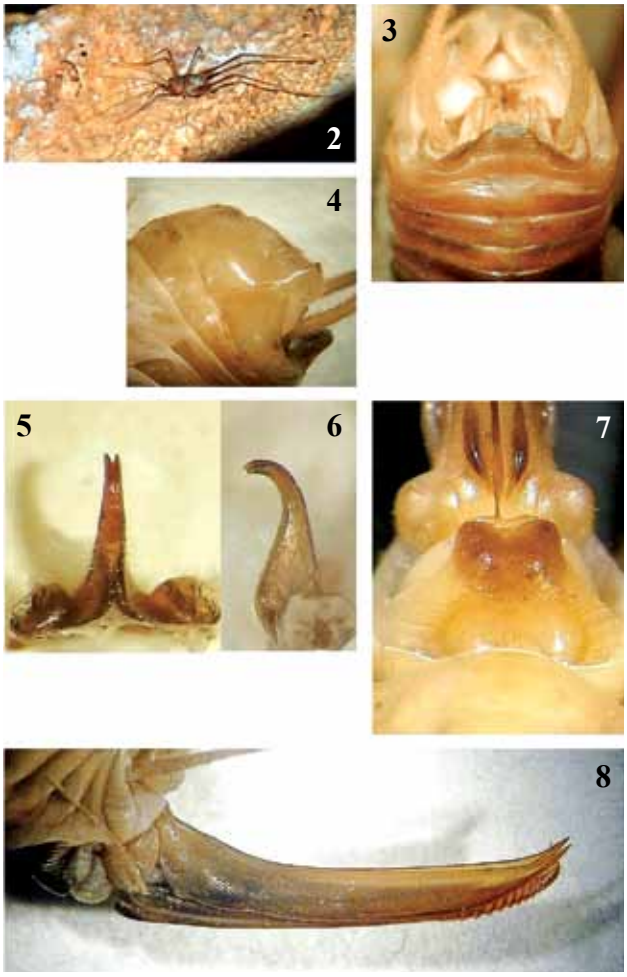
Diagnosis. The size is relatively small with the hind legs elongated. This species is very close to the Evvian species *D. makrykapa*, as well as to *D. vandeli and D. petrochilosi* from Viotia and Attiki respectively, but differs from them by the ninth tergum which has the posterior edge strongly concave and by the median process of the epiphallus which is relatively long, with a strongly bifurcated apex.

The female subgenital plate is similar to that of *D. makrykapa* but differs from it because it is wider, with the posterior lobes less rounded and the median incision more marked. Furthermore it differs from those of *D. vandeli* and *D. petrochilosi* for the absence of the two lateral constrictions.

Type locality. The Graspilea Cave is situated in the Eastern part of Evvia, near Ochtonia village. The cave opens at the elevation of 440 m a.s.l., on the south-eastern slope of the homonymous massif.

Type material. Holotype ♂. Greece, W Aegean, Evvia isl., Ochtonia, Graspilea Cave, 38°30'41.76" N, 24°11'28.33"E, 29 Dec 2014, S. Alexiou leg. (MZUR). Paratypes: 2 ♂♂, 4 ♀♀ and 3 nymphs, same data and collector as for holotype (MZUR, ZMUA); 1 ♂, immature and 9 nymphs, same locality, 02 Aug 2014, C. Di Russo leg. (MZUR).

Description. *Male* (holotype)**.** Body colour testaceous, uniform with the exception of the posterior margins of the first six tergites, which are darker. Legs long, slender, yellow-testaceous, with unarmed femora. Fore tibia armed with 4/5 spines on both sides of the inferior edge and a pair of spurs of equal length on the apex. Mid tibia with 4/4 short spines on both sides of the upper edge, 4/5 spines



Figs 2-8 – *Dolichopoda ochtoniai* **sp. n. 2**, habitus of a ♀. Male: **3**, tergum IX and X, dorsal view; **4**, subgenital plate, lateral view; **5**, epiphallus, dorsal view; **6**, epiphallus, lateral view. Female: **7**, subgenital plate, ventral view; **8**, ovipositor.

on the lower edge and two apical spurs similar to those of the fore tibia. The hind tibia is longer, with 18/19 spines of different length on both sides of the upper edge and 1/3 homogeneous spines on the lower edge.

Ninth tergum widely triangular with the posterior edge strongly concave; tenth tergum on the posterior edge with two elongated and flattened lateral lobes showing sinuous apexes (Fig. 3).

Subgenital plate globular at the bottom, with a short median incision that runs for half of the total length; symmetrical lateral lobes triangular with rounded posterior edges, styli cylindrical and short (Fig. 4). Epiphallus sclerotized, its median process relatively long, with a strongly bifurcated apex; from the side, the median process is more curved on the distal portion; the basal processes are rather developed (Figs 5-6). The accessory apparatus is slightly sclerotized, trilobate, with a conical median lobe.

Length (mm): body 17.0; pronotum 3.5; fore femur 15.0; middle femur 15.0; hind femur 21.0; fore tibia 17.0; middle tibia 18.0; hind tibia 27.0; hind tarsus 10.0; 1st article of hind tarsus 9.8.

Female. The length of the body ranges between 16-19 mm (ovipositor excluded) and the general form of the female is similar to the male. The subgenital plate is trapezoidal (Fig. 7), with the distal part more sclerotized, bilobate, with a narrow incision on the middle of the posterior margin.

The uniformly elongated ovipositor has an average length of 11 mm, with a pointed apex curved upwards. The shorter inferior valves, rather enlarged at the base and little curved on the superior edge, have 16 denticles (Fig. 8).

Etymology. The species name refers to the Octhonia village and mountain, where the Graspilea cave is situated.

***Dolichopoda saraolacosi* Rampini & Di Russo sp. n.**
(Figs 9-15)

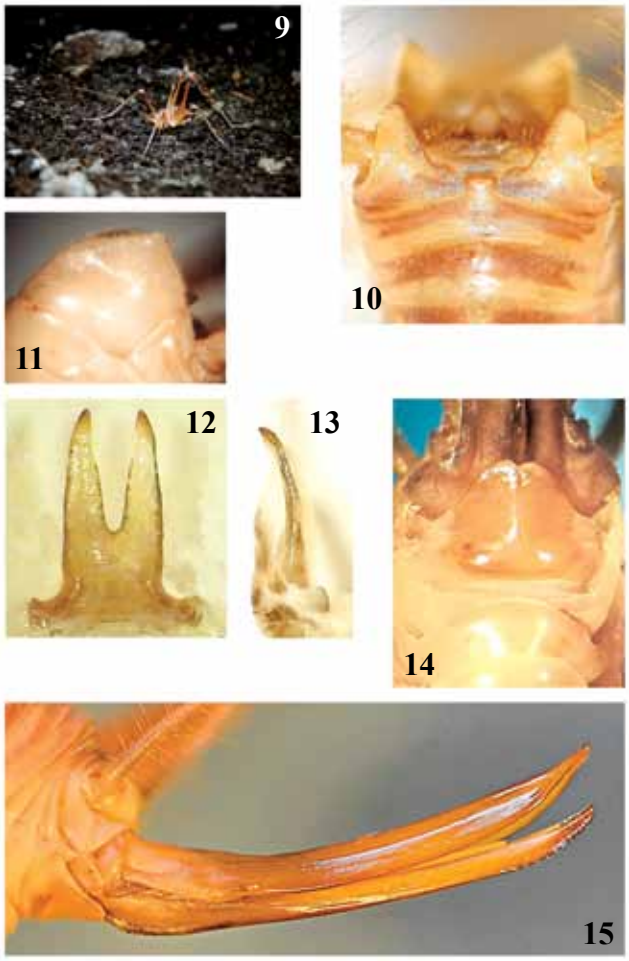
Type-locality. The first specimens of this species were collected in the Saraolakos cave by Th. Skouras, during a field trip on Skyros island in the August of 1979. The specimens were sent to Dr. Boudou-Saltet for identification but at present no specification of depository site is available. The material described below was collected by one of us (S. Alexiou) in an abandoned iron mine near the village of Atsitsa in the North-Western part of the island.

Type material. Holotype ♂. Greece, West Aegean, Skyros isl., Atsitsa, abandoned mine, 38°54'48.02"N, 24°28' 20.21"E, 19 Oct 2014, S. Alexiou leg. (MZUR). Paratypes: 2 ♂♂, 3 ♀♀ and 2 nymphs, same data and collector as for holotype (MZUR, ZMUA).

Diagnosis. Relatively large-sized, with elongated hind legs.

This species shows morphological affinities both with the Attican species *D. insignis* and the Southern Evvian species *D. cassagnaui*. Affinities of *D. saraolacosi* with *D. insignis* are obvious by the ninth tergum with median rectangular process, while by the wide triangular lobes of the tenth tergum, the strongly bifurcated rectangular median process of the epiphallus and the triangular subgenital plate of the female suggest affinities to *D. cassagnaui*. However *D. saraolacosi* differs from all the other species of the area examined by the presence of few spines on the ventral edge of the hind femurs. This character is shared only by the Macedonian species *D. remyi* Chopard, 1934 and *D. lustriae* Rampini & Di Russo 2008 from Aetolia-Akarnania (Western Greece).

Description. *Male* (holotype). Body colour testaceous, uniform with the exception of the posterior margins of the tergites, which are darker. Pronotum finely ornamented with drawings on the anterior margins. Legs long, slen-



Figs 9-15 – *Dolichopoda saraolacosi* **sp. n. 9**, habitus of a ♂. Male: **10**, tergum IX and X, dorsal view; **11**, subgenital plate, lateral view; **12**, epiphallus, dorsal view; **13**, epiphallus, lateral view. Female: **14**, subgenital plate, ventral view; **15**, ovipositor.

der, testaceous, with the first pairs of two femora unarmed. Hind femora with 1-2 spines on the ventral edge. Fore tibia armed with 5/5 spines on both sides of the inferior edge and a pair of spurs of equal length on the apex. Mid tibia with 3/3 short spines on both sides of the upper edge, 6/5 spines on the lower edge and two apical spurs similar to those of the fore tibia. The hind tibia is longer with 18/17 spines of different length on both sides of the upper edge and 4/3 homogeneous spines on the lower edge. Ninth tergum showing in the middle a short rectangular process rounded at the apex (Fig. 9). Tenth tergum on the posterior edge with two wide lateral lobes triangular in shape with sinuous internal margin (Fig. 10).

Subgenital plate globular at the bottom, with a very short median incision; symmetrical lateral lobes divergent and strictly triangular; styli evident, conical (Fig. 11).

The epiphallus is strongly sclerotized and shows a big rectangular median process strongly bifurcated for more than half of its length; in side view, the median process is more curved on the distal portion; the basal processes are poorly developed (Figs 12-13). The accessory apparatus is slightly sclerotized forming a conical lobe.

Length (mm): body 20.0; pronotum 4.0; fore femur 16.0; middle femur 15.8; hind femur 24.16; fore tibia 17.0; middle tibia 17.5; hind tibia 30.5; hind tarsus 13.0; 1st article of hind tarsus.

Female. The length of the body ranges between 17-22.5 mm (ovipositor excluded) and the general form of the female is similar to the male one. The subgenital plate is wide, triangular (Fig. 13), with a narrow incision on the middle of the rounded posterior margin. At the base it shows two little diverging enlargements. The uniformly elongated ovipositor, with an average length of 11mm, has a pointed apex curved upwards. The shorter inferior valves rather enlarged at the base and slightly curved on the superior edge have 16 denticles (Fig. 14).

Etymology. The species name refers to the Saraolakos cave, Kalikri, where Th. Skouras collected the first specimens in 1979 (Skouras 1995-2000).

Discussion

Evvia and Skyros islands belong to West Aegean area. Both islands are strongly connected to each other and/or to continental Greece, both phytogeographically (Trigas et al. 2008) and zoogeographically (Parmakelis et al. 2005; Fet et al. 2014). The complex geological history of the West Aegean area (and the adjacent mainland) has influenced the distribution of all seven *Dolichopoda* species of this region (i.e., *D. saraolacosi*, *D. cassagnaui*, *D. makrykapa*, *D. octhoniai*, *D. petrochilosi*, *D. insignis* and *D. vandeli*). The tremendous geological events, such as submergence and re-emergence of landmasses, that have occurred since the late Tertiary, leading to the faunal diversity that we observe today, blur the phylogeographic histories within species of genus *Dolichopoda*.

Dolichopoda octhoniai is very close to *D. makrykapa* and to the mainland species *D. vandeli* and *D. petrochilosi*, differing from them only by the concave shape of ninth tergum, the relatively long median process of the epiphallus with a strongly bifurcated apex and the wider subgenital plate of the female. All together these four species form a homogeneous group, suggesting a common phylogenetic origin. This may indicate that a widespread ancestral taxon was isolated in rather recent times on the main karstic massifs of Viotia, Attiki and Evvia, at times when Evvia was connected to the mainland, and diverged to a series of related species. This conclusion is in accordance with the geological history of the West Aegean area (Dermitzakis 1990) that indicates a recent (postglacial) geographic isolation of Evvia from Sterea Ellas (Trigas et al. 2008). On the contrary *D. saraolacosi* is very different from all the other species of this area, showing some morphological affinities only with the Attikan species *D. insignis* (ninth ter-

gum with median rectangular process) and the Evvian species *D. cassagnaui* (strongly bifurcated rectangular median process of the epiphallus). Furthermore *D. saraolacosi* differs from all the other species of the area examined by the presence of few spines on the ventral edge of the hind femur. This character is shared only by the Macedonian species *D. remyi* and *D. lustriae* from Aetolia-Akarnania (Western Greece). The isolation of Skyros occurred ca. 4.5 mya (Dermitzakis 1990) and the morphological peculiarity of *D. saraolacosi* could be explained by the long-time isolation of this species caused by this early separation of Skyros island from Evvia and the mainland.

The morphological similarity of *D. saraolacosi* with *D. insignis,* a species known from NE Attiki, is very intriguing. This is not in accordance with recent zoogeographic studies that indicate a close connection of Evvia and Skyros (Parmakelis et al. 2005; Fet et al. 2014), but manifests the great uncertainty regarding the geological history of the examined area.

The observed morphological affinity of *D. saraolacosi* with *D. cassagnaui* from Agia Triada cave, Southern Evvia, is also very interesting, especially because it appears to contradict with recent zoogeographic studies (Casale & Giachino 2004; Fet et al. 2014) that indicate a more isolated position for the cave fauna of the Southern Evvia area.

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