

The cave crickets of northeast Turkey and transCaucasian regions, with descriptions of two new species of the genera Dolichopoda and Troglophilus (Orthoptera, Rhaphidophoridae)

Authors: Di Russo, Claudio, Rampini, Mauro, and Landeck, Ingmar

Source: Journal of Orthoptera Research, 16(1) : 67-76

Published By: Orthopterists' Society

URL: [https://doi.org/10.1665/1082-6467\(2007\)16\[67:TCCONT\]2.0.CO;2](https://doi.org/10.1665/1082-6467(2007)16[67:TCCONT]2.0.CO;2)

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

The cave crickets of northeast Turkey and transCaucasian regions, with descriptions of two new species of the genera *Dolichopoda* and *Troglophilus* (Orthoptera, Rhaphidophoridae)

Accepted March 31, 2007

CLAUDIO DI RUSSO, MAURO RAMPINI AND INGMAR LANDECK

(CDR, MR) Dipartimento di Biologia Animale e dell'Uomo, Università degli Studi di Roma "La Sapienza", Viale dell'Università 32, 00185 Rome, Italy. Email: mauro.rampini@uniroma1.it

(IL) Research Institute for post-mining Landscapes, Brauhausweg 2, D-03238 Finsterwalde, Germany. Email: i.landeck@fib-ev.de

Abstract

Until now, of the total 53 or so species of cave crickets in the genera *Troglophilus* Krauss 1879 and *Dolichopoda* Bolivar 1899, seven are known from Turkey. Collecting journeys in 2000 and 2001 allowed us to obtain samples from the Pontic Mountains (northeastern Turkey). Based on this material, we now describe two new species, one for each of the above genera. *Dolichopoda noctivaga* sp. n. is very closely related to the transCaucasian species *D. euxina* and *D. hyrcana*, but can be distinguished from them by the shape of the epiphallus, rounded not truncate apically, by the occurrence of styli on the male subgenital plate, and by the unemarginate apex of the female subgenital plate. The second newly discovered species, *Troglophilus tatyanae* sp. n., differs from all other Turkish species in the uniformly brown coloration of its body, and by its small size — the smallest species known for the genus *Troglophilus*. Both *T. tatyanae* and *D. noctivaga* are apparently limited to the Black Sea region of northeast Turkey. *D. noctivaga* has been found in four localities scattered across the Pontic Mountains. By contrast, *T. tatyanae* occurs only in one locality, that in the Artvin district where it is syntopic with *D. noctivaga*. Both species have only a slight degree of adaptation to cave habitats, which seem to be used only as seasonal shelter.

Key words

cave cricket, *Dolichopoda*, *Troglophilus*, new species, Turkey

Introduction

The family Rhaphidophoridae is divided into nine subfamilies (Gorochov 2001), considered by many authors as phylogenetically old, both for their morphology and their wide, disjunct, geographic distribution across the temperate areas of the Boreal and Austral hemispheres (Di Russo & Sbordoni 1998).

Members of the subfamilies Dolichopodinae and Troglophilinae are restricted to the Northern hemisphere, with several species belonging to the genera *Dolichopoda* Bolivar 1880 and *Troglophilus* Krauss 1879, found in caves of Europe and Asia Minor. About 40 species from the genus *Dolichopoda* and about 13 from the genus *Troglophilus* have been described (Heller *et al.* 1998, Otte 2000). Both groups have their highest species richness in southern and southeastern Europe (Mediterranean basin, Appennines, Balkans and Peloponnesus).

Three species of *Dolichopoda* (*D. aranae* Bolivar 1899, *D. pusilla* Bolivar 1899 and *D. sbordonii* Di Russo & Rampini 2006) and four of *Troglophilus* (*T. escalerae* Bolivar 1899, *T. adamovici* Us 1974, *T. gajaci* Us 1974 and *T. bicakcii* Rampini & Di Russo 2003) have been reported for caves in the eastern and western Toros mountains (Southern Turkey). They have partially overlapping geographic distributions; in a few circumstances the two genera and/or different species within the same genus may occur in syntopy (Cobolli *et al.* 1999). In the

Caucasian area, only two species of *Dolichopoda* are known so far: *D. euxina* Semenov 1901 described from some specimens collected in two caves of the western slopes of the Caucasus, in the Suchumi district, and *D. hyrcana* Bey-Bienko 1969, from the Lenkoran (Talysh) district in eastern Transcaucasia.

In this paper we present the description of two new cave cricket species (one each for *Dolichopoda* and *Troglophilus*) from the Pontic region of northeastern Turkey and we discuss the biogeographical and phylogenetic implications of our findings in light of the extensive molecular data available for both genera.

Methods

Investigation area.—Throughout most of northern Turkey the coast plunges steeply into the Black Sea which is almost devoid of islands. In the East (Lazistan, the eastern subregion of the Black Sea region *sensu* Erol 1982), the ranges of the Pontic or Black-Sea Mountains are high, continuous and close to the sea, the highest peaks being in the Tatos Dağları northeast of Rize within the Kaçkar massif. These mountains consist mainly of two parallel main ranges running from West to East (Kürschner *et al.* 1995), and they create a very effective climatic barrier. The summits rise to elevations of 2500 m in the west and about 4000 m in the east. The longest and largest basin is that of the Coruh river valley (Fig. 1). All collecting sites were located in these Pontic Mountains at the south border of the Black Sea basin.

Geologically the region belongs to the Eastern Pontides with horst and graben structure. The oldest formation consists of early Paleozoic rocks (Kraeff 1963a, b). There are two contemporary facies in the region. In the south the Jurassic and Cretaceous are represented by volcanogenic and carbonated flysch. An upper Cretaceous limestone series occurs in the central and eastern part of the area with developed karst morphologies.

In contrast to the rest of Turkey, the most striking climatic feature of this region is its heavy rainfall, which continues all year round. The northern slopes of the coastal range are characterized by a permanent humid-temperate climate with high precipitation (2201 mm/y at Rize). In this region a dry season is absent, temperatures in summer are not very hot and in winters they are mild (mean annual temperature: Rize 14.4 °C, Zonguldak 13.9 °C). The average monthly minima of the coldest month never falls below 0 °C, and the absolute minima not below -10 °C.

This type of climate, the so-called euxinic Beech-fir-forest climate, is primarily responsible for the occurrence of Colchic deciduous wet forests (Frey & Kürschner 1989, Kikvidze & Oshawa 2001).



Fig. 1. Surroundings of the Coruh Valley, collecting site of *Dolichopoda noctivaga*, 10 km east of Ispir.



Fig. 2. Eroded site with rocky outcrops of slaty structure, with numerous cuts caused by road-building activities and with natural scrub vegetation (e.g., *Rhododendron* spp.) and trees (*Picea orientalis*, *Fagus orientalis*).



Fig. 3. Pontic Beech and Oriental fir mixed forests with dense understory at an altitude of 1300 m.

The coastal zone of the Black Sea is widely covered by evergreen thermophylic trees, relicts of a previously widely distributed Mediterranean sclerophyll vegetation (*Pseudomacchia*). At an elevation of about 560 m, these formations are replaced by deciduous Pontic beech forests (*Fagus orientalis*) of mountain zones with an evergreen understory (Fig. 2). The boreal zone is characterized by Pontic evergreen coniferous forests (hardy wet forests) consisting of *Abies nordmanniana* and *Pinus sylvestris* together with Oriental spruce (*Picea orientalis*) in the Eastern Black Sea region (Fig. 3). Hardy Pontic Pine

and spruce forests (*Pinus nigra* ssp. *palasiana*, *Pinus sylvestris*, *Picea orientalis*) are typical for the drier Southern main range. The inner valleys and basins are widely covered by short dense grass, dwarf scrub and other shrub vegetation as well as riverine alder forests (Kürschner *et al.* 1995).

Sampling and studying methods.—Both species were collected by a method normally used for night-active ground beetles. The collection was carried out by one or, when possible, two people, equipped with both a LED head lamp and a hand lamp. By slowly searching the ground, specimens were collected from outside caves and cracks on rocky slopes, within litter, as well as on tracks and forest roads.

Measurements and drawings were performed using a “camera lucida” attached to a stereomicroscope Leica MZ 12.5. All measurements of dimensions are in mm.

Comparisons with specimens of *D. euxina* (1♂ and 1♀, Adjara region, Kintrishschii; 2♀ nymphs, Krasnodar region, Vorontzovka, in cave) and *D. hyrcana* (1♂ and 1♀, Ghircanschii region, Gorki) from Caucasus were made using specimens kindly provided by Dr. A.V. Gorochof of the Zoological Institute of the Russian Academy of Science of St. Petersburg and by Dr. V. Vedenina from the Institute for Information Science of Moscow.

Results

Dolichopodinae

Dolichopoda (s. str.) *noctivaga* Di Russo, Rampini sp. n.
(Figs 4-10)

Diagnosis.— *Dolichopoda noctivaga* sp. n., based upon the short size of its epiphallus, triangular and rounded distally, appears strongly related to the transCaucasian species *D. euxina* and *D. hyrcana* and to the southern Turkey species, *D. sbordonii*. This important character effectively diagnoses this group of species from other western congeneric taxa in which the epiphallus is elongated and apically acute. *D. noctivaga* shares with *D. euxina* of the Caucasus the lack of a pronounced fastigium vertex, and is very closely related to it on the basis of the shapes of the subtrapezoidal tenth tergite and of the subgenital plate in the male. *D. noctivaga* can be distinguished from *D. euxina* and *D. hyrcana* by an epiphallus that

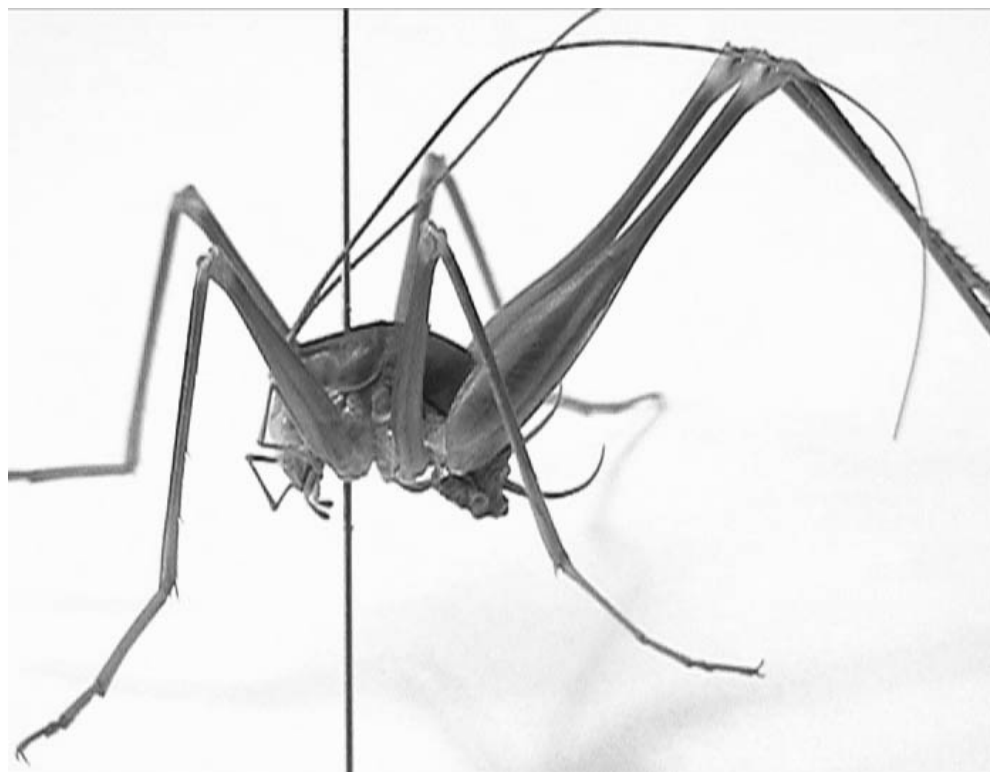


Fig. 4. Male habitus of *Dolichopoda noctivaga* sp. n.

is not truncate distally and by the female subgenital plate, which has no apical emargination. Furthermore in *D. euxina* the styli are absent from the subgenital plate, though present both in *D. hyrcana* and *D. sbordonii*.

Material examined.—Holotype: Turkey, eastern Black Sea region, Artvin district, Kafkasor, 1263 m, lat 41° 09' 77" N, long 41° 47' 54" E, 29/30 jun. 2000, I. Landeck, W. Döhring, J. Kulbe leg. 1♂ (MZUR). Paratypes: same locality, data and collectors as for holotype 1♀ (MZUR); same locality, 1300–1700 m, 31 may/3 jun. 2001, I. Landeck leg., 1♂ nymph (MZUR); Artvin district, W Düzköy, 520 m, lat 41° 22' 31" N, long 41° 33' 49" E, 2 jun. 2001, I. Landeck, J. Kulbe leg. 10♀ (PCL); 1♀ nymph (MZUR). Other localities: Erzurum district, Ispir, 10 km E, Coruh valley, 1250 m, 16 jul. 2001, M. Ochse leg., 1♀ (MZUR). Giresun district, 10 km W Esbiye, tidal caves, 3–10 m, 02 aug. 1983, K.-G. Heller et coll. leg., 3♀ (PCH).

Depositories—Museum of Zoology, University of Rome "La Sapienza" (MZUR), Private Collection I. Landeck (PCL) and Private Collection K.-G. Heller (PCH).

Holotype male description.—Measures (mm): body 14.2, pronotum 4.1, fore femora 11.6, middle femora 11.5, hind femora 18.1, fore tibia 11.5, middle tibia 11.4, hind tibia 21.3, hind tarsum 9.5, first article of hind tarsum 5.3.

Size relatively small. Body color light brown to testaceous. Legs more amber colored (Fig. 4).

Fastigium verticis not pronounced, formed by two elliptical tubercles sulcated longitudinally.

Pronotum wide, with rounded anterior edge. Lateral lobe edges narrowed and rounded. Legs relatively elongated with respect to body size. All femora unarmed below; fore and middle femora with 2 apical spines on apex. Fore tibia armed with one spine on upper side and 3 to 4 spines on both sides of ventral edge. The apex bears a

little spur. Middle tibia with 3 to 4 spines on both upper and ventral edges. Apex as in fore tibia. Hind tibia armed with 16 to 17 spines on both sides of upper edge and 1 to 2 spines on ventral edge. The hind tibia bears 3 spurs, of which the bottom one is stronger and more elongate.

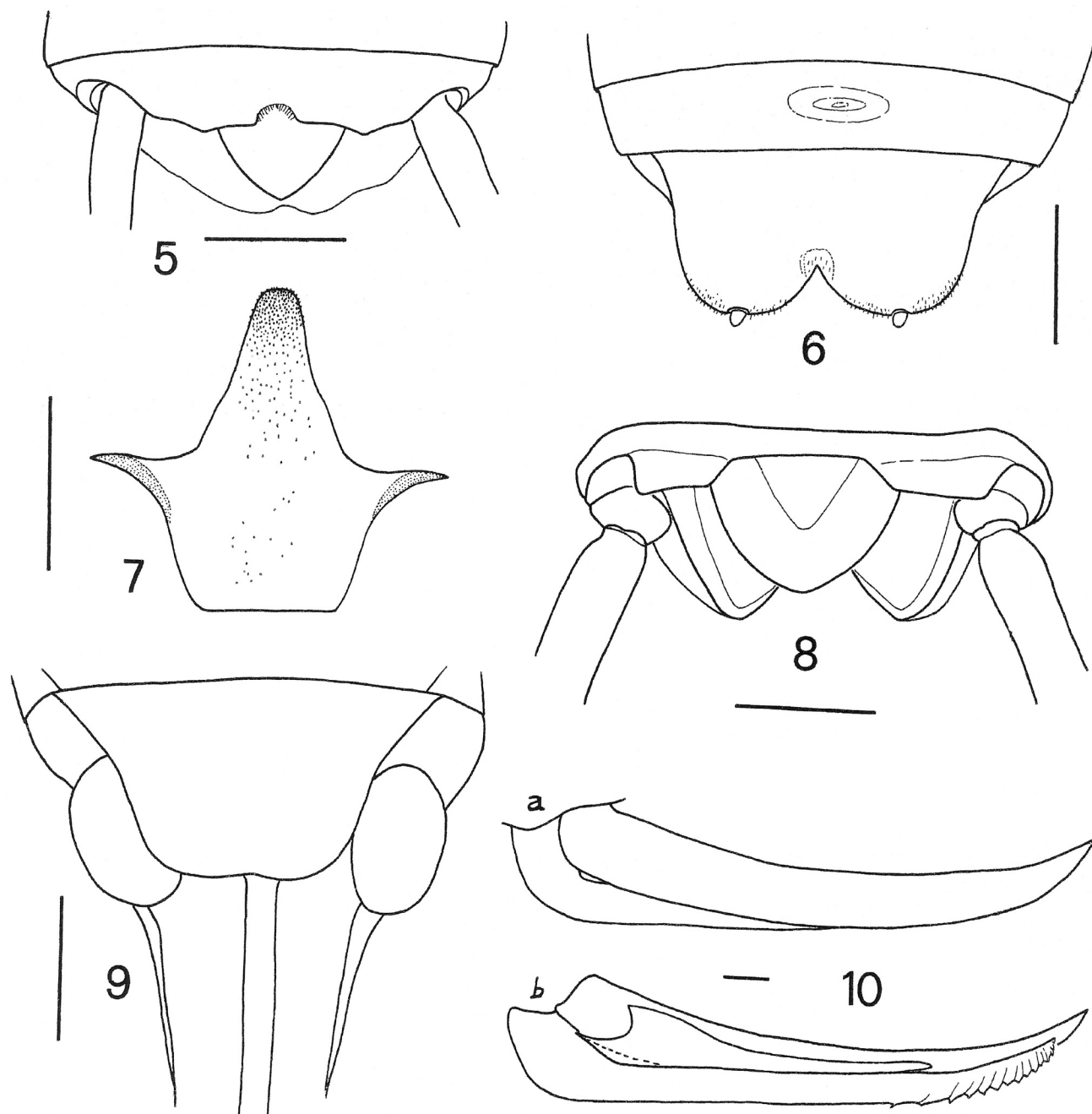
Tenth tergite transverse (Fig. 5), with two wide lateral expansions separated by a concave margin clearly incised in the middle. Subgenital plate with two rounded lobes separated by a deep incision narrowed apically (Fig. 6); lobes having two short cone-like styli. Epiphallus short and moderately sclerotized (Fig. 7). Median process short, triangular in shape, somewhat enlarged at the base. In lateral view apically curved. Distal part rounded and very finely tuberculate. Basal process wide, trapezoidal in shape, with short lateral processes.

Female description (paratypes).—Similar to that of the male for general aspect and leg spination. Tenth tergite only anteriorly transverse with a broad rectangular emargination in the middle separating two posterior expansions (Fig. 8). Subgenital plate wide, trapezoidal, moderately incised on posterior margin (Fig. 9). Ovipositor on average 12.5 mm long, nearly straight, with sharp curved apex (Fig. 10a). Bearing 17 denticles on ventral valves (Fig. 10b).

In Table 1 the measures of ten male morphological parameters for *Dolichopoda* species of Turkey and Caucasus are reported.

Etymology.—The new *Dolichopoda* species is named in response to its behavior, as it normally walks on forest roads and tracks at night.

Habitat.—Small caves and crevices of rocks (probably large caves as well). The variety of vegetation types of the areas in which this species has been found encompasses dry dwarf scrub vegetation, Pontic coniferous and mixed forests and Pontic beech forests in the permanently wet valleys. Additionally, fragments of Colchic broad-leaved forests, with evergreen understory, occur in the same area.



Figs 5-10. *Dolichopoda noctivaga* sp. n.: 5. Male tenth tergite. 6. Male subgenital plate. 7. Epiphallus. 8. Female tenth tergite. 9. Female subgenital plate. 10a. Ovipositor. 10b. Internal and ventral valves of ovipositor. Scale bar 1 mm.

Troglophilinae

Troglophilus tatyanae Di Russo, Rampini sp. n.
(Figs 11-15)

Diagnosis.— *Troglophilus tatyanae* sp. n. exhibits the absence of any extensions or protuberances on the tenth male tergite. This character is common to all other Turkish species and appears also to occur in some Aegean species (*T. spinulosus* Chopard 1921 and *T. marinae* Rampini & Di Russo 2003). *T. tatyanae* differs from all the known species of *Troglophilus* in its very small size and strong brown coloration. It differs from the species of southern Turkey

in the trapezoidal shape of the male and female subgenital plate, shape of the ovipositor and by its possession of 13 denticles on the inner valves of the ovipositor.

Material examined.—Holotype: Turkey, Eastern Blacksea-region, Artvin district, Kafkasor, 1300 m, lat 41°09'8"N, long 41°47'5"E, 29/30 jun. 2000, I. Landeck, W. Döhring, J. Kulbe leg., 1♂ (MZUR). Paratypes: same locality, 31 may/3 jun. 2001, I. Landeck, J. Kulbe leg., 1♀; 1♀nymph. (MZUR and PCL).

Depositories.— Museum of Zoology University of Rome "La Sapienza" (MZUR), Private Collection I. Landeck (PCL).

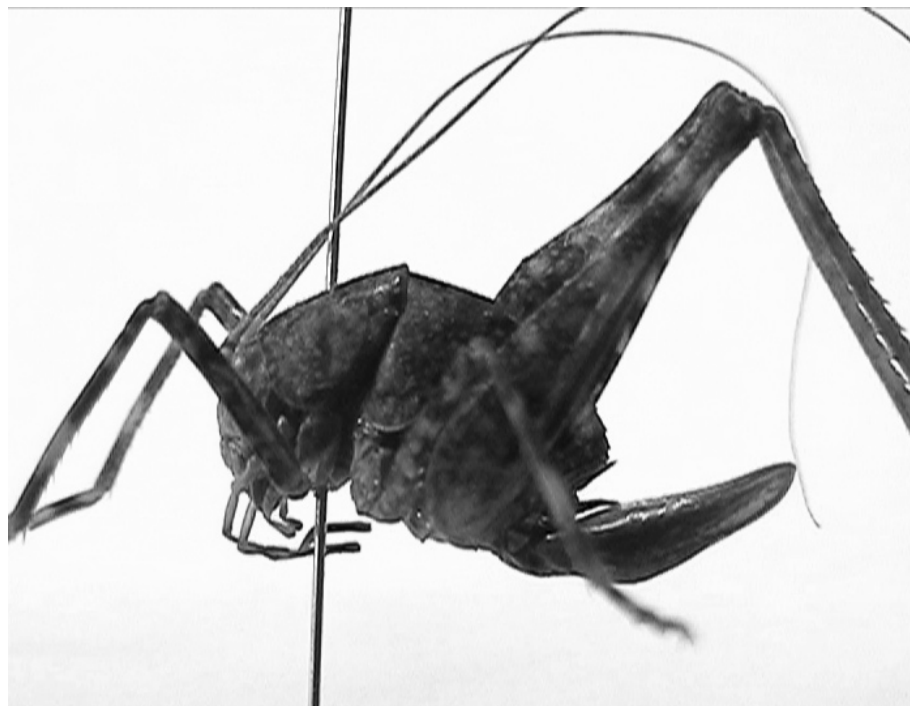


Fig. 11. Female habitus of *Troglophilus tatyanae* sp. n.

Holotype male description.— Measures (mm): body 12.5, pronotum 3.0, fore femora 5.8, middle femora 5.5, hind femora 11.6, fore tibia 5.7, middle tibia 5.4, hind tibia 12.2, hind tarsus 5.1, first article of hind tarsus 2.4.

Size rather small. Body color uniformly brown, with dorsal polygonal green-yellowish markings (spots). All legs well-pigmented, especially the femora, which show brown stripes and a reticular pattern.

Fastigium verticis not pronounced, formed by two elliptical tubercles sulcated longitudinally. Pronotum wide with rounded anterior edge. Legs relatively short. Fore and middle femora unarmed; the hind femora show two short spines on the ventral inner edges. Fore tibiae armed with 12 pairs of spines on the ventral edge. Middle tibiae with 10 spines on ventral edge and 2 pairs of short spines on

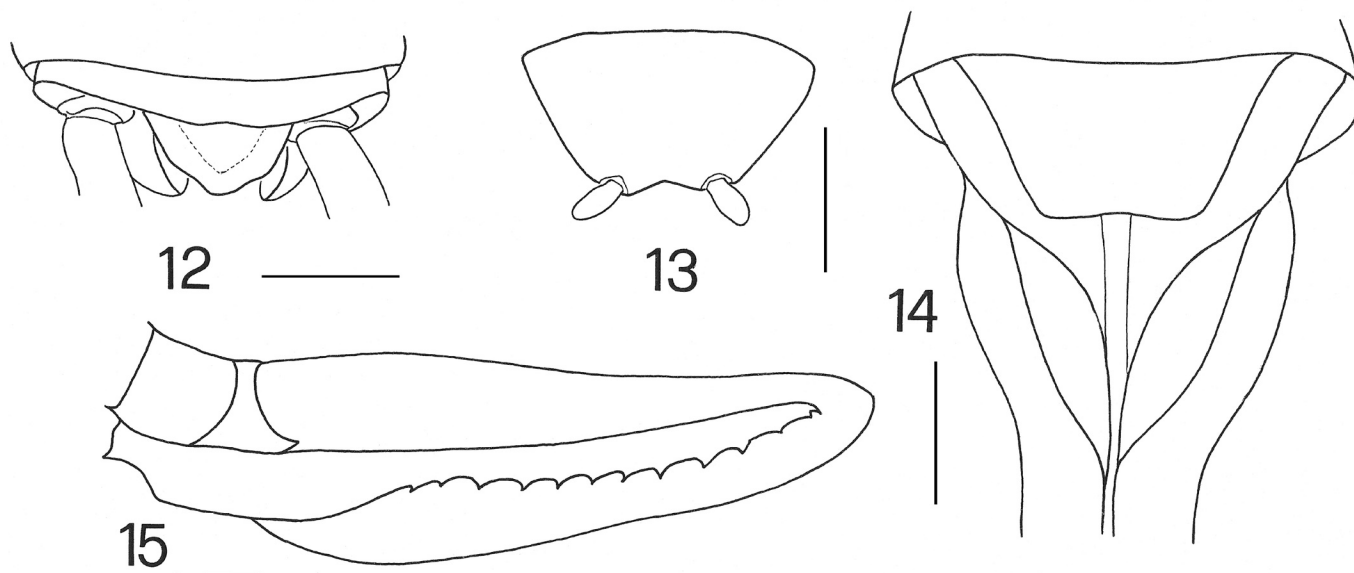
both upper and lower edges. Hind tibiae, longer than middle ones, bearing 54 strong spines on both internal and external sides of the upper edges. Twenty-five spines occur on the ventral edge.

First article of hind tarsus laterally compressed and as long as the other three together. It bears 8/9 spines, of which the apical is most developed.

Tenth tergite transverse, with its posterior edge convex, moderately incised at the middle, without any extension or protuberance (Fig. 12).

Subgenital plate wide, trapezoidal in shape. In dorsal view it appears moderately incised in the middle and on the lateral apices are two short cylindrical styli (Fig. 13).

Copulatory organ membranous and subconic in shape.



Figs 12-15. *Troglophilus tatyanae* sp. n. 12. Male tenth tergite. 13. Male subgenital plate. 14. Female subgenital plate. 15. Ovipositor. Scale bar 1 mm.

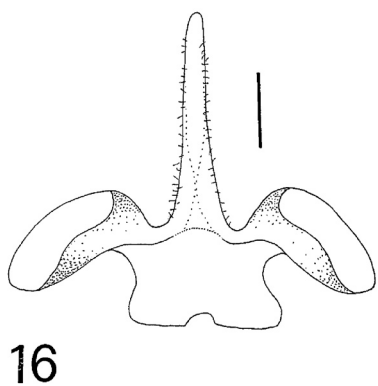
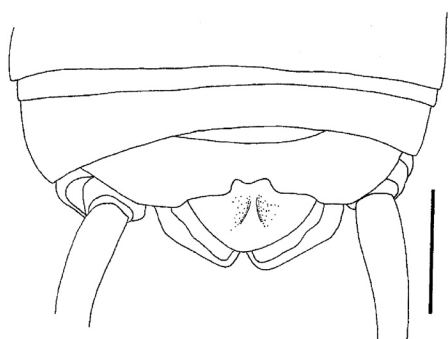
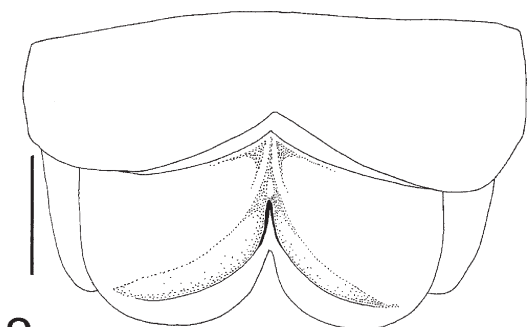


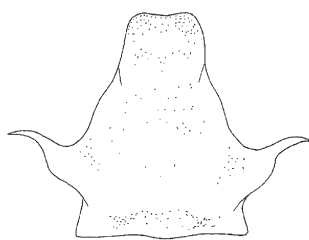
Fig. 16. *Dolichopoda dalensi* from Peloponnisos, Greece. Epiphallus. Scale bar 0.5 mm.



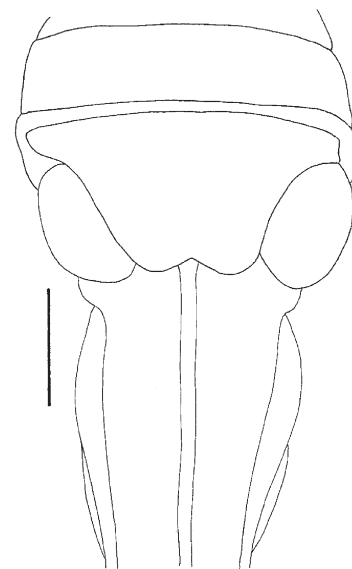
17



18



19



20

Figs 17-20. *Dolichopoda euxina*. 17. Male tenth tergite. 18. Male subgenital plate. 19. Epiphallus. Scale bar 0.5 mm. 20. Female subgenital plate. Scale bar 1 mm.

Female description (paratype).— Almost same color as male (Fig. 11).

Pronotum disproportionately large in relation to body size in comparison to other species. Tibiae of first and second pair of legs have 10 spines on each of their ventral edges, while their upper edges are spineless. Additionally, tibiae of the second pair of legs have 2 spines on their upper edges. Distribution of spines on tibiae of the third pair of legs is the same found in the male. Tenth tergite has no special characteristics whatsoever. Cerci reach 1/3 of the length of ovipositor.

Subgenital plate trapezoidal (Fig. 14). Ovipositor more than half as long as body, broad, and elliptical-ovoid. Its dorsal edge is slightly concave, ventral edge distinctly convex. It attains its greatest width between the end of the first third of its length and the beginning of the second third. Ovipositor not pointed but with a broad short tip. Each of the ventral internal valves has 13 denticles (Fig. 15). The upper internal valves are short and strongly sclerotized.

In Table 2 the measures of ten male morphological parameters for Turkish *Troglophilus* are reported.

Etymology.— The new *Troglophilus* species is dedicated to Tatyana, the wife of Ingmar Landeck.

Habitat.— Small caves and rock crevices. The vegetation type in which the species has been found belongs to the Pontic coniferous and mixed forests with evergreen understory. *T. tatyanae* occurs at high altitude together with *D. noctivaga*.

Discussion

Dolichopoda noctivaga, one of the two new species described here, can be easily placed in the subgenus *Dolichopoda* s. str. because it lacks spines on its femora, while showing spines on the fore tibiae and having a nonbifurcate epiphallus apex. This species shares a number of morphological characters with the transCaucasian *D. euxina* (Figs 17-20) and *D. hyrcana* (Figs 21-24) and with the southern Turkey species *D. sbordonii* (i.e., short epiphallus triangular in shape and rounded at its distal part). These important diagnostic characters will consistently distinguish this group of species from the other western congeneric taxa, which have an epiphallus elongated and acute in its distal part (Fig. 16: epiphallus of *D. dalensi* - Greece).

In particular *D. noctivaga* has a close morphological affinity to *D. euxina*. Both species lack a pronounced fastigium verticis, and have similar shapes of the male tenth tergite and male subgenital plate (Figs 17, 18). However it can be readily distinguished from the latter species by some other morphological traits. Firstly, its size is relatively small in comparison with that of the transCaucasian species and the epiphallus is not truncated at its distal part, as is the case in *D. euxina* and *D. hyrcana* (Figs 19, 23). Furthermore, the new species has two styli on the male subgenital plate, as do *D. hyrcana* (Fig. 22) and *D. sbordonii*: these styli are absent in *D. euxina* (Fig. 18). Finally the female subgenital plate in *D. noctivaga* has no apical emargination. Rather, in *D. euxina* and in *D. hyrcana* this plate is strongly incised forming two acuminate lobes (Figs 20, 24).

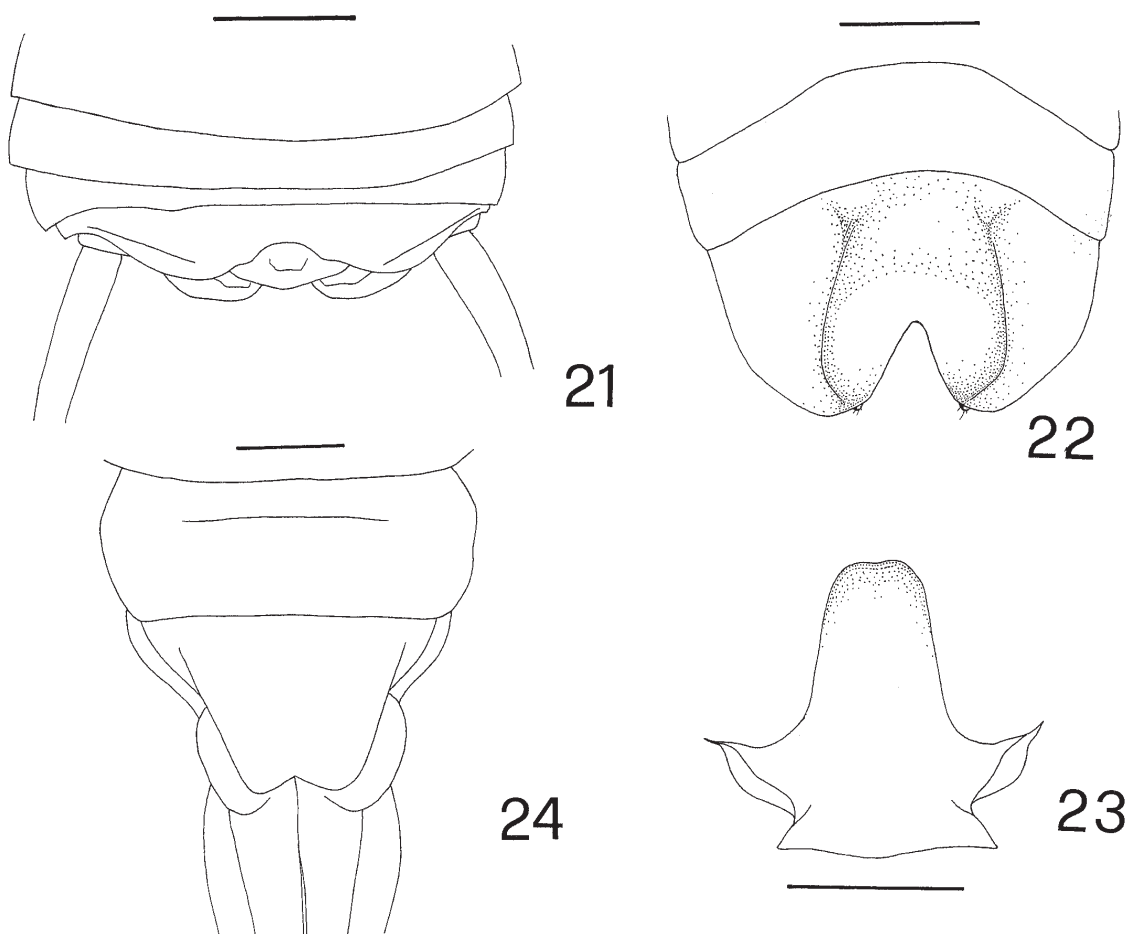
Dolichopoda noctivaga sp. n. occurs in the most eastern mountains of Turkey (Pontic mountains). As far as we know, its distribution spans the area between Giresum in the West, the Coruh river valley in the South, Batumi in the east, and the Black Sea coastline in the North (Fig. 25). Consequently all previous citations of *D. euxina* for this area (Bey-Bienko 1969) are most likely attributable to *D. noctivaga*. The new species lives in small caves and rock crevices (and probably also in large caves) and is active outside at night. The low value of the hind tibia/pronotum length ratio, 5.98, an index commonly used as an indication of cave specialization in raphidophorid species (Leroy 1967, Di Russo & Sbordonii 1998),

suggests a weak degree of adaptation to cave habitats, which are probably used by these crickets only as seasonal shelters.

The other new species described here belongs to the genus *Troglophilus* that, as outlined in the introduction, includes four species from the southern region of Turkey. The new species shows no extensions or protuberances on the tenth male tergite, as normally found in all other species described for Asia Minor; however, this lack is also seen in some Aegean species: *T. spinulosus* from Crete and *T. marinae* from Santorini island (Boudou Saltet 1978, Rampini & Di Russo 2003a).

T. tatyanae differs from all Turkish species of its genus in the uniformly brown coloration of its body and its small size: it is the smallest known species of *Troglophilus*. Moreover, *T. tatyanae* shows other peculiar morphological characteristics, such as the shape of the male and female subgenital plate and the number of denticles on the inner valves of the ovipositor. However, with regard to the shape of the ovipositor, it has a certain affinity with *T. escalerae*, from the Toros mountains: in both species, the ovipositor has a characteristic enlargement of its middle part. A similar situation is also observed in *T. biçakçii*, but there the dilation is more pronounced (Rampini & Di Russo 2003b).

To now, the range of this new species is limited to a single locality in the Pontic Mts of Turkey (Artvin district), where it is syntopic with *D. noctivaga* (Fig. 25). As outlined in the introduction, other instances of syntopic occurrence of these two genera have been



Figs 21-24. *Dolichopoda hyrcana*: 21. Male tenth tergite. 22. Male subgenital plate. 23. Epiphallus. 24. Female subgenital plate. Scale bar 1 mm.

documented for Southern Turkey (Di Russo & Rampini 2006). And syntopy is also known for some caves in Crete (Kollaros *et al.* 1991) and along the Italian peninsula (Bernardini *et al.* 1997).

T. tatyanae lives in small caves and rock crevices that open to mountain and forest habitats (1300 m above sea level and higher). However its general morphology does not suggest any particular cave adaptation. Litter and soil of mountain forests are most likely the primary habitats of this species.

The genus *Troglophilus* has a geographic distribution limited to the eastern Mediterranean. The distribution of the genus *Dolichopoda* is wider, from the Pyrenees to the Caucasus, and only partially overlaps that of *Troglophilus* (Baccetti 1982). A common oriental origin was postulated for both genera, with a hypothetical center of dispersal in the former Aegean plate (Jeannel 1947, Ruffo 1955). The great number of *Dolichopoda* and *Troglophilus* species presently occurring in Italy and Greece seems to confirm this hypothesis. In this context, the Anatolian raphidophorids, including *D. noctivaga* and *T. tatyanae* from the Pontic area, as well as the transCaucasian *D. euxina* and *D. hyrcana*, can be considered descendants of an old lineage that has colonized the northeastern portion of the Aegean plate. In the Oligocene and Upper Miocene this tectonic plate, (Steininger & Rogl 1984), formed a large part of Anatolia and gave rise to many taxa of present-day Turkish fauna

A recent phylogenetic reconstruction based on molecular data (Allegrucci *et al.* 2006) strongly supports this hypothesis, suggesting a more ancient origin of the Anatolian-Caucasian *Dolichopoda*

species, compared to the western species of the genus. In that study *D. euxina* and *D. sbordonii* are separated by a divergence time ranging from 5.9 to 6.7 Mya. These estimates are consistent with a Miocene vicariance scenario based on the split of Anatolian and Caucasian areas from the Aegean plate (La Greca 1999, Ciplak 2004). Subsequently the south Aegean raphidophorid stocks gave rise to numerous endemic species while spreading northwards across the western portion of the Paleo-Mediterranean regions.

The epiphallus morphology shared between Anatolian and Caucasian species of *Dolichopoda*, appears in good agreement with this proposed scenario as well as with the early separation of these groups of species — the eastern from the western ones. The latter have a common morphology of the epiphallus which is elongated and apically acuminate. Similarly a molecular study conducted on several species of the *Troglophilus* genus (Ketmaier *et al.* 2006) supports an Aegean origin of the group, which probably dates back to the early Miocene. The major speciation events are apparently linked to the main tectonic events that affected the east-Mediterranean area from the middle Miocene to the Pliocene. *T. tatyanae* and all the other species from Asia Minor share a lack of extensions on the tenth male tergite. This is in partial agreement with the molecular data, which support an early separation of most of the Anatolian species from the western ones. However this morphological feature also occurs in two species presently confined to the Aegean insular area (*i.e.*, *T. spinulosus* from Crete and *T. marinae* from Santorini island). This could be explained by land connections between the

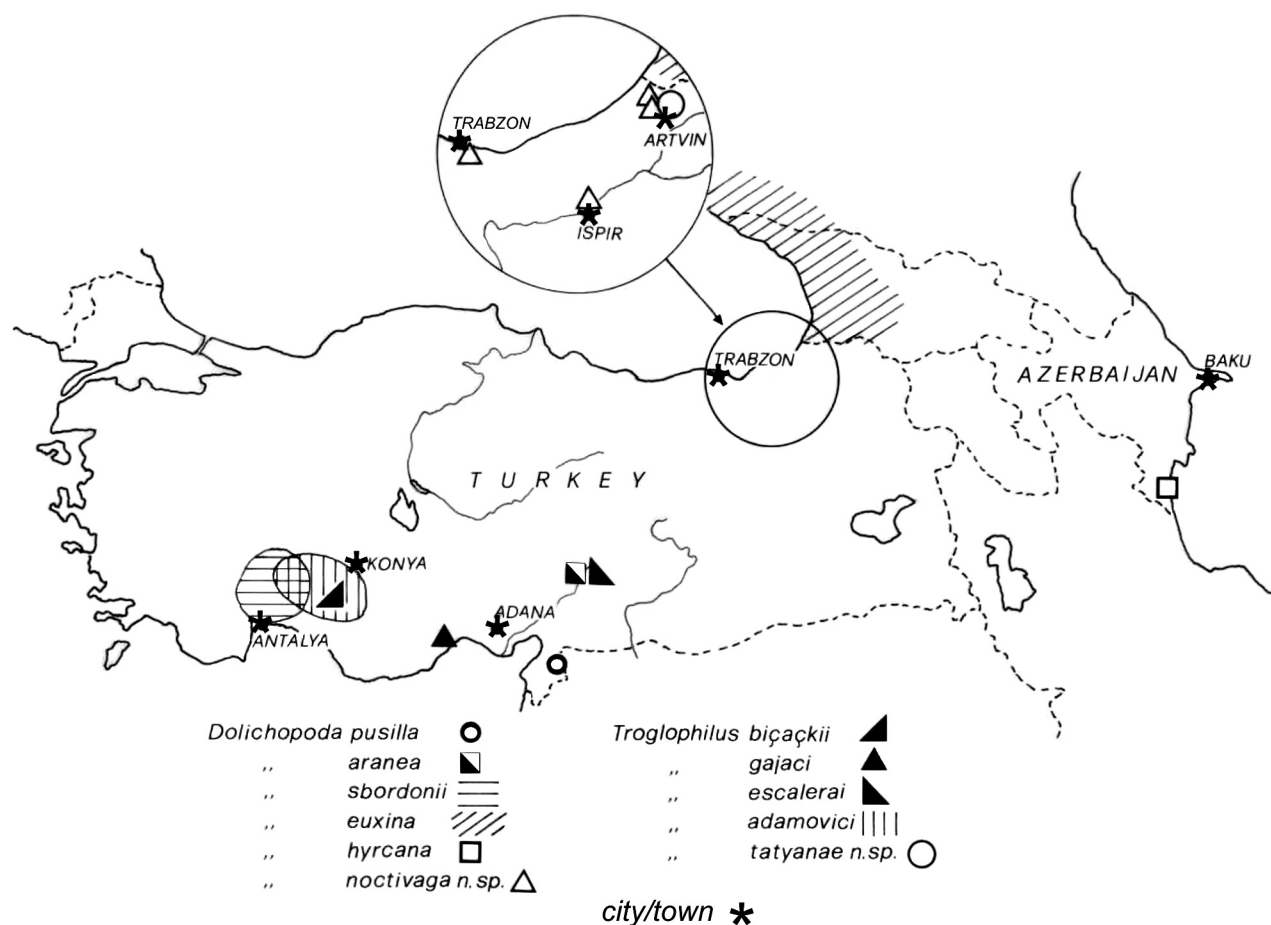


Fig. 25. Geographic distribution of *Dolichopoda* and *Troglophilus* species in Turkey and in the trans-Caucasian area.

Table 1. Measures (mm) of ten morphological parameters for *Dolichopoda* species of Turkey and Caucasus.

Species	<i>D. noctivaga</i> (1)	<i>D. euxina</i> (2)	<i>D. hyrcana</i> (2)	<i>D. aranea</i> (3)	<i>D. sbordonii</i> (4)
	♂	♂	♂	♂	♂
Body	14.18	15.29	17.52	16.12	15.16
Pronotum	4.07	3.81	4.17	3.21	3.48
Prothoracic femur	11.63	11.22	11.58		15.21
Mesothoracic femur	11.52	11.57	11.92		13.94
Metathoracic femur	18.11	18.94	19.17	23.24	24.42
Prothoracic tibia	11.55	10.81	11.37		17.16
Mesothoracic tibia	11.42	10.99	12.32		17.74
Metathoracic tibia	21.33	20.27	21.48	31.12	31.82
Metatarsum	9.54	8.8	9.22		10.1
First art. metatarsum	5.26	4.36	5.24		5.1

(1): holotypus and paratypus, present paper; (2): male from Gorochov collection; (3): data from Bolivar 1899; (4): data from Di Russo & Rampini 2006

Table 2. Measures (mm) of ten morphological parameters for *Troglophilus* species of Turkey.

Species	<i>T. tatyanae</i> (1)	<i>T. bicakcii</i> (2)	<i>T. escalerae</i> (2)	<i>T. gajaci</i> (2)	<i>T. adamovici</i> (2)
	♂	♂	♂	♂	♂
Body	12.5	16.5	17	16	20
Pronotum	3	4	5	4	4.5
Prothoracic femur	5.8	8.5	8	8.5	8.5
Mesothoracic femur	5.5	8	7.5	8	8
Metathoracic femur	11.6	16.5	16	15.5	17
Prothoracic tibia	5.7	9	8	8	8.5
Mesothoracic tibia	5.4	9.5	7.5	8.5	8.5
Metathoracic tibia	12.2	19.5	18	18.5	18
Metatarsum	5.1	7.2	8.5	6.5	8
First art. metatarsum	2.4	3.5	4.5	4	4

(1): holotypus and paratypus, present paper; (2) data from Rampini and Di Russo 2003

former Hellenic arc and Anatolia, which probably occurred repeatedly during the late Miocene and Pliocene (Ciplak 2004).

Acknowledgements

K. -G. Heller (University of Erlangen) allowed us to examine his cave crickets, collected near Trabson. Dr. V. Vedenina (Institute for Information Science, Moscow) and Dr. A.V. Gorochov (Zoological Institute of the Russian Academy of Science, St. Petersburg) sent us specimens of *D. euxina* and *D. hyrcana* for comparative analysis. Further, we wish to thank Mr. M. Ochse (Schwarzheide) for an additional record of *D. noctivaga*.

We wish to thank Mr. Fer Willemse, Dr. K.-G. Heller, Dr. V. Vedenina and Dr. V. Ketmaier for critical discussion of the manuscript.

We also wish to thank Mr. Niccolò Falchi and Mrs. Francesca Pavesi for the drawings, the plates and the illustrations in the text.

Finally, we thank the coleopterists J. Kulbe (Greifswald) and W. Döhrring (Stralsund), and the lepidopterist H. Pautz (Lübbenau) for their help in the field collection.

References

- Allegrucci G., Todisco V., Rampini M., Sbordon V. 2006. Molecular phylogeography of the Eastern Mediterranean *Dolichopoda* cave crickets species: comparing different molecular dating methods. 1° Congresso SIBE- 2° Congresso dei Biologi Evoluzionisti Italiani. 4-7 Settembre 2006: 72-73.

- Baccetti B. 1982. Ortotteri cavernicoli italiani (Notulae orthopterologicae XXXVI). Lavori della Società Italiana di Biogeografia, Verona 1978 (n.s.) 6: 195-200.
- Bey-Bienko G.J. 1969. On the cavernicolous grasshopper of the genus *Dolichopoda* Bol. (Orthoptera) from the Caucasus. Actes IVe CIS 4-5: 24-25.
- Bolivar J. 1899. Orthoptères du voyages de M. Martinez Escalera dans l'Asie Mineure. Annales de la Société Entomologique de Belgique 43: 583-607.
- Boudou-Saltet P. 1978. Sur les *Troglophilus* (Orth. cavernicoles) de Crète. Bulletin de la Société d'Histoire Naturelle de Toulouse 114: 115-121.
- Cobolli M., Ketmaier V., De Mattheis E., Di Russo C., Marsili D., Rampini M. 1999. Sistematica biochimica e rapporti evolutivi tra popolazioni e specie del genere *Troglophilus* della penisola Anatolica (Orthoptera). Biogeographia 20: 201-211.
- Çiplak B. 2004. Biogeography of Anatolia: the marker group Orthoptera. Memorie della Società Entomologica Italiana 82: 357-372.
- Di Russo C., Sbordoni V. 1998. Gryllacridoidea, pp. 989-1001. In: Juberthie C., Decu V. (Eds) Encyclopedia Biospeleologica Vol. II. Moulis - Bucarest.
- Di Russo C., Rampini M. 2006. A new species of *Dolichopoda* from caves of Southern Turkey (Orthoptera, Rhaphidophoridae). Fragmenta Entomologica Roma 38: 7-14.
- Erol O. 1982. Türkei. Naturräumliche Gliederung. Karte A VII 2, Tübinger Atlas des Vorderen Orients. Reichert, Wiesbaden. 1 pp.
- Frey W., Kürschner H. 1989. Vorderer Orient. Vegetation. 1: 8 <Mill., Karte A VI 1, Tübinger Atlas des Vorderen Orients. - Wiesbaden.
- Heller K.-G., Korsunovskaya O., Ragge D.R., Vedenina V., Willemse F., Zhantiev R.D., Frantsevich L. 1998. Check-list of European Orthoptera. Articulata, Behieth 7: 1-61.
- Jeannel R. 1943. Les fossiles Vivants des Cavernes, 321 pp. Gallimard, Paris.
- Leroy Y. 1967. Gryllides et Gryllacrides cavernicoles. Annales de Spéléologie 22: 659-722.
- Ketmaier V., Di Russo C., Rampini M., Cobolli M. 2006. Molecular biogeography in East-Mediterranean area as revealed from the phylogeny of the cave cricket genus *Troglophilus* (Orthoptera, Rhaphidophoridae). XVIII International Symposium of Biospeleology, Cluj-Napoca, Romania, 10-15 July 2006: 41
- Kikvidze Z., Oshawa M. 2001. Richness of Colchic vegetation: comparison between refugia of south-western and East Asia. BMC Ecology 1: 1-10.
- Kollaros D., Paragamian K., Legakis A. 1991. Revision of the genus *Troglophilus* (Orthoptera, Rhaphidophoridae) in Crete, Greece. International Journal of Speleology 20: 37-45.
- Kürschner H., Raus T., Venter J. 1995. A radionuclide tracer study of arthropod food chains. In: A Pflanzen der Türkei, Ägäis, Taurus, Inneranatolien. 1. Aufl. Quelle & Meyer, Wiesbaden.
- Kraeff A. 1963a. Geology and mineral deposits of the Hopa-Murgul region (western part of the province of Artvin, NE Turkey). Bulletin of the Mineral Research and Exploration Institute of Turkey 60: 45-60.
- Kraeff A. 1963b. A contribution to the geology of the region between Sirya and Ardanuc. Bulletin of the Mineral Research and Exploration Institute of Turkey 60: 37-44.
- La Greca M. 1999. Il contributo degli Ortotteri (Insecta) alla conoscenza della biogeografia dell'Anatolia: la componente gondwaniana. Biogeographia 20: 179-200.
- Otte D. 2000. Orthoptera species file. Vol. 8, Gryllacrididae, Stenopelmatidae, Cooloolidae, Schizodactylidae, Anostomatidae, Rhaphidophoridae. The Orthopterists Society, Philadelphia. 97 pp.
- Rampini M., Di Russo C. 2003a. Una nuova specie di *Troglophilus* di Turchia (Orthoptera, Rhaphidophoridae). Fragmenta Entomologica, Roma 34: 235-247.
- Rampini M., Di Russo C. 2003b. Una nuova specie del genere *Troglophilus* Krauss, 1879 (Orthoptera, Rhaphidophoridae) delle Cicladi, Grecia. Bollettino del Museo di Storia Naturale di Verona, 27, 2003 Botanica Zoologia: 23-29.
- Ruffo S. 1955. Le attuali conoscenze della fauna cavernicola della regione pugliese. Memorie di Biogeografia Adriatica 3: 1-143.
- Steininger F.F., Rögl F. 1984. Paleogeography and palinspatic reconstruction of the Neogene of the Mediterranean and Paratethys, pp 659-668. In: Dixon J.E. and Robertson A.H.F. (Eds) The Geological Evolution of the Eastern Mediterranean: The Geological Society, Blackwell Scientific, Oxford, UK.