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MICROCHTHONIUS ELEGANTISSIMUS N. SP., A NEW TROGLOBITIC PSEUDOSCORPION (PSEUDOSCORPIONES, CHTHONIIDAE) FROM CROATIA

B. P. M. ĆURČIĆ[1], T. RAĐA[2], S. B. ĆURČIĆ[1], B. S. ILIĆ[1], V.T. TOMIĆ[1], and S. E. MAKAROV[1]

[1] *Institute of Zoology, Faculty of Biology, University of Belgrade,* 11000 Belgrade, Serbia
[2] *Speleological Society "Špiljar",* 21000 Split, Croatia

Abstract. — A new eyeless false scorpion, *Microchthonius elegantissimus* n. sp. from inside an underground (cave) system, i.e. Jama Golubinka u Kalaševin Dugin Njivaman Cave (= Kalaševa Jama Pit), Kladnjice, Croatia, is described. This new pseudoscorpion differs from all other congeners. There exists a probability that the new false scorpion belongs to relicts of an old tropical area incorporating the northern subtropical part of the Mediterranean. Morphometric ratios, linear measurements and figures of the taxon are presented in detail.

Key words: Pseudoscorpiones, Chthoniidae, *Microchthonius*, *M. elegantissimus* n. sp., caves, karst fauna, Croatia.

INTRODUCTION

Located centrally and to the west of the Balkan Peninsula, the Croatian coast lies at the convergence of a large tectonic unit, namely the main mountain system which belongs to the Dinaric massif and, in general, is a typical Mediterranean climate region (Dov Por and Dimentman, 2006), but also a specific category of oceanic water bodies. In the recent time-span of the tectonic history of the region mentioned here, the level of the world's ocean fluctuated between +30 to -40 m in the middle Pliocene and below -50 m during the Glacial Maxima.

The Adriatic Sea is an epicontinental sea of the eastern Mediterranean. The Strait of Otranto, which separates this sea, is not a shallow sill but a gradually deepening area. During the repeated Pleistocene glaciations, most of the Adriatic was exposed and dry. With its current lower marine salinity values, the Adriatic also served in the past as a gateway for an influx from the Pannonian basin of the brackish Ponto-Caspian inland sea.

Terrestrial endemism is generated mostly by clear-cut allopatry, like for instance on the islands and continental areas of the Mediterranean (including the Adriatic). Athanasiadis (2002) differentiates between 'palaeo-endemic' species which originated from an ancient Peri-Tethyan stock and survived the Messinian, 'neo-endemic' species which originated from the re-colonizing Pliocene warm-climate fauna, and 'plain endemic' species which have not been found till now outside the Mediterranean area.

Once present throughout the Dinarides, a relatively shallow sea existed in the northeastern Mediterranean before the main orogenesis. There were also larger and smaller reefs, together with other areas in their immediate vicinity that were suitable for formation of plastic clay and sandy sediments. These areas of sedimentation were not in any strict series, but a certain order in the direction of the geosynclinal axis nevertheless existed between them (Ćurčić et al., 2008).

Processes of erosion exerted significant influence on relief formation along the Adriatic coast. Their in-

tensity depended on the strength of the agent in question, i.e. on the susceptibility of certain rocks to mechanical and chemical decomposition on the duration of phases of terrain resting on climatic conditions and their changes during individual periods, etc.

The origin of the rich endemic and relict troglobitic fauna of the Dinarides (including arachnids and pseudoscorpions in particular) has been largely affected by several factors: (i) the exceptionally high heterogeneity of the ancient epigean fauna populating the Proto-Balkans in the remote past; by continuity of the continental phase in different areas of the Balkans, which has been maintained since the Paleozoic Era; (ii) by the presence of deep limestone sediments; (iii) by intensive karstification and subsequent development of the (underground) karst relief; (iv) by a succession of suitable climatic conditions, which made possible the survival of both endangered and vanishing species; and (v) by the adaptive radiation of species in newly emerged habitats (Ćurčić et al., 1998; Savić, 2008).

The Dinaric karst of Croatia can be divided into four regions: lowlands, highlands, the Mediterranean Coast, and the islands of the Adriatic Sea. The Croatian highlands are part of the Dinaric massif. This region is a high karstic belt from mountains to foothill areas with "islands" of impenetrable rocks, karst valleys, and river valleys. A peculiarity of the region is the great geomorphological diversity of both underground and epigean karstic forms. The Mediterranean Coast and Adriatic Islands are well known as homes to the majority of the region's invertebrates, particularly cave-dwelling pseudoscorpions and other arachnids that live underground.

In this study, a single specimen of a new species of the genus *Microchthonius* Hadži was found by one of us (TR), carefully dissected, and thoroughly analyzed. Setal designations are as described by Beier (1963).

MATERIALS AND METHODS

We examined material from a sample collected in the Jama Golubinka u Kalaševin Dugin Njivaman Cave (= Kalaševa Jama Pit), Kladnjice, Croatia. This species is a cave-dwelling endemic form.

The aim of this study is to present a description of the mentioned taxon and to discuss its probable origin.

SYSTEMATIC PART

CHTHONIIDAE DADAY, 1888

MICROCHTHONIUS HADŽI, 1933

MICROCHTHONIUS ELEGANTISSIMUS, NEW SPECIES (Figs. 1-9, Table 1)

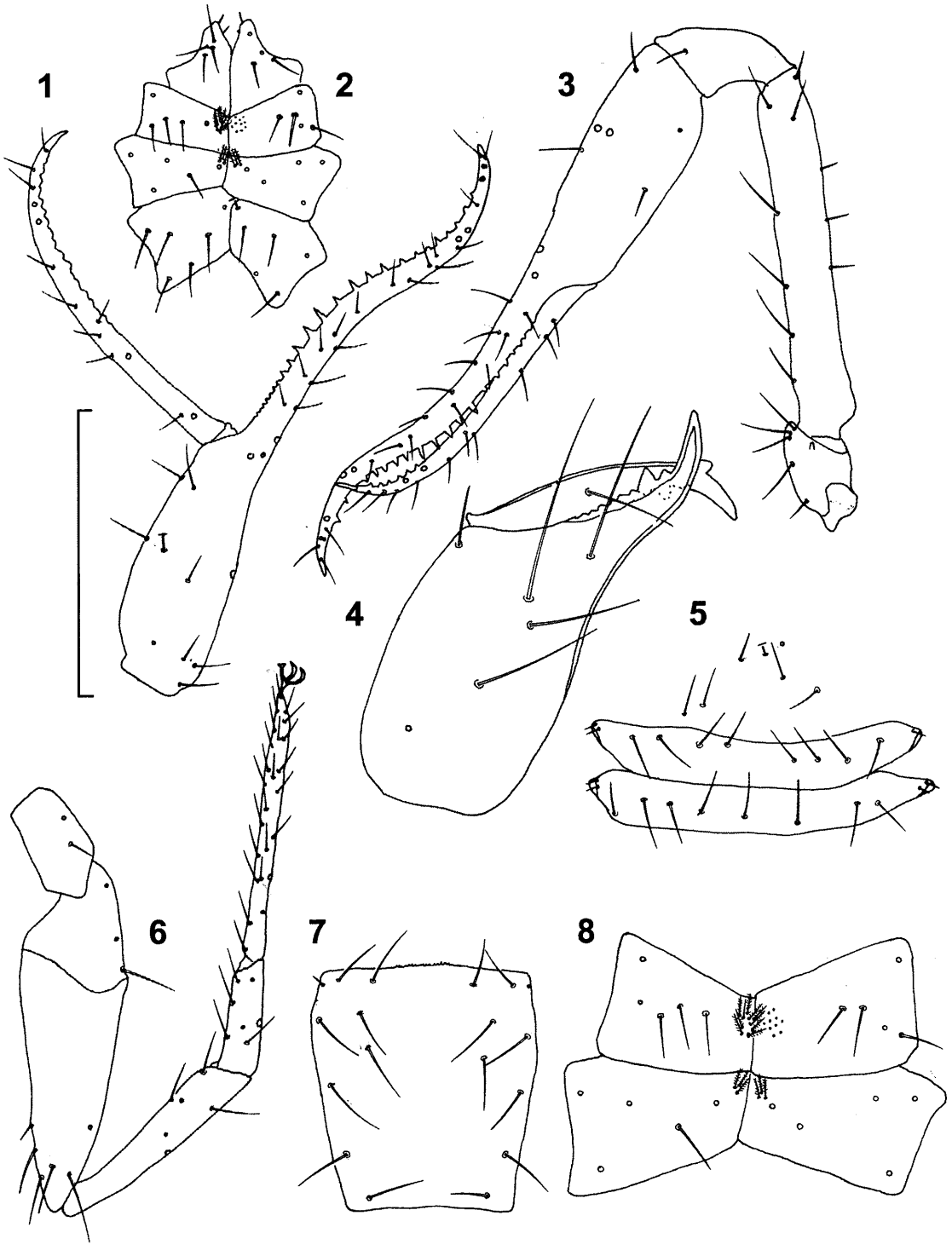
Etymology – After the delicacy, small size and transparency of its body.

Material examined – Holotype female, from the Jama Golubinka u Kalaševin Dugin Njivaman Cave (= Kalaševa Jama Pit), Kladnjice, near Drniš, Croatia; 26 November 2011, collected by Tonći Rađa (Fig. 9).

Description – The dorsal surface of the carapace reaches its maximum breadth at the level behind the 'ocular' setal row and is in general longer than wider (Fig. 1, Table 1). The anterior margin of the carapace is broader than the posterior and the carapace resembles a regular trapezium (Fig. 7); the tiny serrations are obvious between the anterior median setae. Neither eyes nor eyespots are developed (Fig. 7).

The carapace carries 16 setae and these lie in five rows. Four setae constitute the anterior row, six setae belong to the 'ocular' series, two to the median row, two to the intermedian row and only two setae constitute the posterior series. A single small seta is developed in each preocular recess (Fig. 7).

The setal formula of abdominal tergites I – X can be expressed as 2 – 2 – 2 – 4 – 4 – 4 – 4 – 6 – 6 – 6 and is remarkable for the low number of setae on tergites I – III. Sternite II of the female has seven setae ar-



Figs. 1 – 8. *Microchthonius elegantissimus* n. sp., holotype female from the Jama Golubinka u Kalaševin Dugin Njivaman Cave (= Kalaševa Jama Pit), Kladnjice, Croatia; 1 – pedipalpal chela, 2 – coxal area, 3 – pedipalp, 4 – chelicera, 5 – female genital area, 6 – leg IV, 7 – carapace, 8 – coxal spines on coxae II and III. Scale lines = 0.25 mm (Figs. 4, 5, and 8) and 0.50 mm (Figs. 1 – 3, 6, and 7).

Table 1. Linear measurements (in millimeters) and morphometric ratios in *Microchthonius dernisi* Ćurčić & Rađa, *M. rogatus* Beier, *M. karamani* Hadži, and *M. elegantissiumus* n. sp. Abbreviations: ♀ = female, ♀♀ = females, ♀♂ = female, male.

	M. dernisis	*M. rogatus*	*M. karamani*	*M. elegantissimus* n.sp.
Character	♀	♀♀	♀♂	♀
Body				
Length (1)	1.45	1.70-2.00	1.40	1.41
Cephalothorax				
Length (2)	0.53	-	0.425	0.44
Breadth (2a)	0.43	-	0.36	**0.315**
Ratio 2/2a	1.23	-	1.18	1.14
Abdomen				
Length	0.93	-	1.00	0.97
Chelicerae				
Length (3)	0.41	-	0.36	0.43
Breadth (4)	0.16	-	0.16	0.17
Length of movable finger (5)	0.18	-	-	0.20
Ratio 3/5	2.28	-	-	2.15
Ratio 3/4	2.56	-	2.25	2.53
Pedipalps				
Length with coxa (6)	2.81	-	2.50	**2.77**
Ratio 6/1	1.94	-	1.79	1.96
Length of coxa	0.38	-	-	0.47
Length of trochanter	0.24	-	0.20	0.21
Length of femur (7)	0.815	0.84	0.75	0.75
Breadth of femur (8)	0.12	0.13	0.09	0.10
Ratio 7/8	6.79	6.50 (6.46)	8.33	**7.50**
Ratio 7/2	1.54	-	1.76	1.70
Length of patella (tibia) (9)	0.275	0.31	0.28	0.26
Breadth of patella (tibia) (10)	0.12	0.13	0.14	0.10
Ratio 9/10	2.29	2.30 (2.38)	2.00	**2.60**
Length of chela (11)	1.10	1.27	1.08	1.08
Breadth of chela (12)	0.18	0.16	0.165	0.17
Ratio 11/12	6.11	7.80 (7.94)	6.55	**6.35**
Length of chelal palm (13)	0.46	0.51	0.42	0.43
Ratio 13/12	2.555	3.19	2.55	**2.93**
Length of chelal finger (14)	0.64	0.71	-	0.65
Ratio 14/13	1.39	1.39	-	**1.51**
Leg IV				
Total length	2.355	-	2.02	**2.13**
Length of coxa	0.275	-	0.18	0.25
Length of trochanter (15)	0.22	-	0.15	0.22
Breadth of trochanter (16)	0.12	-	0.115	0.11
Ratio 15/16	1.83	-	1.30	**2.00**
Length of femur + patella (17)	0.67	-	0.58	0.53
Breadth of femur + patella (18)	0.20	-	0.21	0.19
Ratio 17/18	3.35	-	2.76	**2.80**
Length of tibia (19)	0.45	-	0.41	0.41
Breadth of tibia (20)	0.09	-	0.05-0.08	0.08
Ratio 19/20	5.00	-	5.125-8.20	5.125
Length of metatarsus (21)	0.21	-	0.20	0.22
Breadth of metatarsus (22)	0.07	-	0.07	0.05
Ratio 21/22	3.00	-	2.86	**4.40**
Length of tarsus (23)	0.53	-	0.50	0.50
Breadth of tarsus (24)	0.04	-	0.045	0.04
Ratio 23/24	13.25	-	11.11	**12.50**
TS ratio - tibia IV	0.38	-	-	0.365
TS ratio - metatarsus IV	0.48	-	-	0.41
TS ratio - tarsus IV	0.21	-	-	0.265

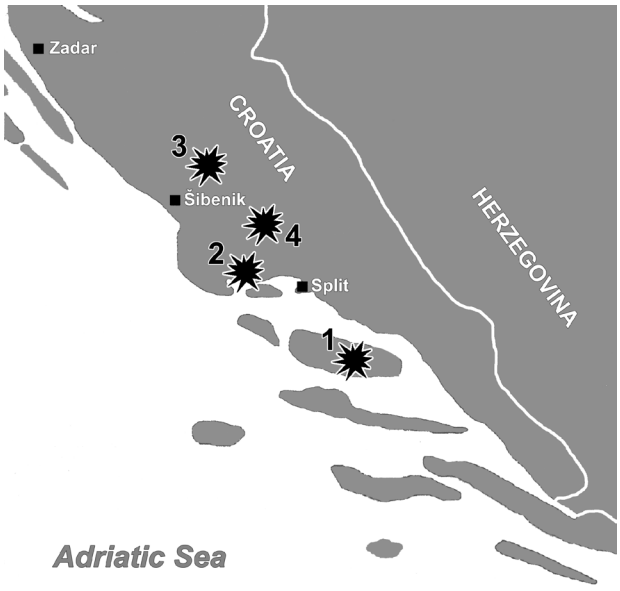


Fig. 9. Distribution of the genus *Microchthonius* Hadzi in Dalmatia, Croatia: 1 - *M. rogatus* (Isle of Brač), 2 - *M. karamani* (Sv. Filip i Jakov), 3 - *M. dernisi* (Škarin Samograd Cave, nr. Drniš), 4 - *M. elegantissimus* n. sp (Kladnjice).

ranged in the form of a triangle. Sternite III carries eight posterior setae and one or two suprastigmal setae on either side. The fourth sternite has eight setae (Fig. 5) and the sternites V – X carry 7 – 6 – 6 – 7 – 6 – 6 posterior setae.

The cheliceral spinneret is represented by a distinct sclerotic knob on the movable finger (Fig. 4). Immediately below, on the inner margin, there is an isolated tooth. The other large teeth are contiguous, with a row of small teeth that end in the region below the insertion site of the galeal seta. On the fixed cheliceral finger, the teeth are larger, particularly the first two, and they extend proximally, diminishing abruptly in size, below those on the movable finger (Fig. 4).

The pedipalpal coxae (Fig. 2) carry five long setae: two at the anterior end (manducatory process) and three to four on the posterior border of the trochantic foramen (Fig. 4). The femur is 7.50 times longer than broad and 1.70 times longer than carapace (Table 1). The patella is tulip-like; at its distal end it is broader than the femur (Fig. 3). The flagellum is nine-bladed, a characteristic of the genus.

Eight trichobothria are carried on the fixed and four on the movable chelal fingers (Figs. 1 and 3). A single accessory seta (or two small setae) lies immediately in front of the most distal trichobothrium (Fig. 1), while *it* and *est* on the fixed finger are distal to the level of *t* and *it* on the movable finger (Fig. 1). The two basal trichobothria (*isb* and *ib*) lie near the palm, on the dorsal side, at its maximum breadth. Both chelal fingers are apically curved inwards (Figs. 1 and 3).

The chelal palm is 2.93 times as long as the chela; the ratio of the pedipalpal chelal length-to-breadth ratio is 6.35 (Table 1). The teeth of the fixed chelal finger (27) are triangular, interspaced, and occupy almost the whole length of the finger; on the movable chelal finger, the teeth (22-23) are smaller and merge basally into a dental lamella (Fig. 1).

The pedal coxae have 10 or 11 spines on coxa II, and 3 spines on coxa III (Fig. 8). The intercoxal tubercle is absent (Fig. 8).

The measurements and morphometric ratios of the different structures, as well as the tactile seta ratios are presented in Table 1. The tibia IV, metatarsus IV, and tarsus IV each carry a long tactile seta (Fig. 6, Table 1).

Remarks – Apart from *M. elegantissimus* n. sp., three more species of *Microchthonius* have been known up to now: *M. rogatus* (from the Island of Brač, Croatia), *M. karamani* (from nr. Sv. Filip i Jakov, Dalmatia), and *M. dernisi* (from a cave near Drniš, Croatia) (Fig. 9) (Ćurčić et al., 2012). From all known congeners, the new species is easily distinguished in the length of the pedipalps, length-to-breadth ratio of the pedipalpal femur, pedipalpal patella length-to-breadth ratio, chelal palm length-to-breadth ratio, metatarsus IV length-to-breadth ratio, tarsus IV length-to-breadth ratio, etc. (Table 1). In addition, *M. elegantissimus* n. sp. differs from other species of the genus in the tergal and sternal setation, number of the coxal spines on coxae II and III, and chelal dentition.

Distribution – Not all parts of the Balkans are of equal zoogeographical importance in both scientific

and conservation sense. The various zones are usually inhabited by a unique and difficult to understand mixture of animal diversity. Such is the case with the pseudoscorpion genus *Microchthonius* and its four species. It is clear that these taxa represent endemic forms or a case of adaptive radiation, but in mid-Dalmatia only this implies that the ancestors of *Microchthonius* are of remote age, while its species are much younger. They all represent remainders of an old faunistic stock that is probably of the early Tertiary age (Ćurčić and Decu, 2008).

Finally, it is likely that the distinction of the subterranean *Microchthonius* pseudoscorpions is part of the Miocene (or a pre-Miocene) area of the tropical Tethys (Ćurčić, 1988). It is therefore possible that the existence of analyzed taxa in the Croatian Dinarides presents the old constellation and is therefore in line with contemporary worldwide records (Beier, 1963; Ćurčić, 1972, 2008; Ćurčić et al., 2004, 2011, 2012; Hadži, 1937).

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REFERENCES

Athanasiadis, A. (2002) Taxonomy and systematics of Rhodophyta with reference to the Mediterranean taxa. *Flora Mediterranea*, **12**, 93-167.

Beier, M. (1963). Ordnung Pseudoscorpionidea (Afterskorpione). In : *Bestimmungsbücher zur Bodenfauna Europas,* Vol. 1. - Akademie Verlag, Berlin, 1-313.

Ćurčić, B. P. M. (1972). Nouveaux pseudoscorpions cavernicoles de la Serbie et de la Macédoine. *Acta Mus. Mac. Sc. Nat. Skopje* **12**, 141-161.

Ćurčić, B. P. M. (1988). *Cave-Dwelling Pseudoscorpions of the Dinaric Karst.* - Acad. Sci. Art. Slov., Cl. IV, Hist. Nat., Opera 26, Inst. Biol. Ioannis Hadži, 8, Ljubljana, 1-192.

Ćurčić, B. P. M., Makarov, S. E., and *L. R. Lučić* (1998) On two endemic species of *Chthonius* C. L. Koch and *Roncus* L. Koch from Montenegro, Yugoslavia (Pseudoscorpiones, Arachnida). *Revue Arachnologique, Aramon*, **12 (7)**, 69-77.

Ćurčić, B. P. M., Dimitrijević, R. N., Ćurčić, S. B., Tomić, V. T., and *Ćurčić, N. B.* (2004) On some new high altitude, cave and endemic pseudoscorpions (Pseudoscorpiones, Arachnida) from Croatia and Montenegro. *Acta Entomologica Serbica*, **7**, 83–110.

Ćurčić, B. P. M., Dimitrijević, R. N., and *A. Legakis* (2004) The Pseudoscorpions of Serbia, Montenegro, and the Republic of Macedonia. Monographs, 8. - Institute of Zoology – Faculty of Biology – University of Belgrade, Hellenic Zoological Society, Committee for Karst and Speleology – Serbian Academy of Sciences and Arts, Institute of Nature Conservation of the Republic of Serbia, Belgrade-Athens, 1-400.

Ćurčić, B. P. M. and *V. Decu* (2008) The false scorpions (Pseudoscorpiones) of Dobruja: from origins to the present day and directions of future study. *Académie serbe des sciences et des arts, Édition spèciales, Vol. DCLXIII, Classe de mathématique, de physique et des geo-sciences, Vol. 4, Recueil des rapports du Comité pour le karst et la spéléologie,* **9**, 81–91.

Ćurčić, B. P. M, Decu, V. and *C. Juberthie* (2008) Cave-dwelling invertebrates in Montenegro. In: Advances in Arachnology and Developmental Biology, Papers Dedicated to Prof. Dr. Božidar P. M. Ćurčić, eds. S.E. Makarov and R.N. Dimitrijević, pp. 57–81. *Belgrade–Vienna–Sofia: Institute of Zoology, Faculty of Biology, University of Belgrade – Committee for karst and speleology, Serbian Academy of Sciences and Arts – UNESCO MAB Committee Serbia – Faculty of Life Sciences, University of Vienna – Institute of Zoology, Bulgarian Academy of Sciences.*

Ćurčić, B. P. M., Rađa, T., Makarov, S. E., Ćurčić, S. B., Ilić, B. S., and *R. N. Dimitrijević* (2011). A cavernicolous pseudoscorpion of the genus *Chthonius* (*Chthonius*) C. L. Koch from Dalmatia. *Arch. Biol. Sci.*, *Belgrade*, **63 (2),** 493-498.

Ćurčić, B. P. M., Makarov, S. E., Ćurčić, S. B., Rađa, T., Tomić, V. T. and *B. S. Ilić* (2012) A new rare representative of *Microchthonius* Hadži (Chthoniidae, Pseudoscorpiones) from Dalmatia, Croatia. *Acta Zoologica Bulgarica*, **64 (3)**, 229–234.

Dov Por, F. and *C. Dimentmani* (2006) Mare Nostrum. Pensoft, Sofia—Moscow, 1-349.

Hadži, J. (1937) Pseudoskorpioniden aus Südserbien. *Glasnik Skopskog naučnog društva*, *Skopje*, **18,** 13-38.

Savić. I. R. (2008) Diversification of the Balkan fauna: its origin, historical development and present status. In: Advances in Arachnology and Developmental Biology, Papers Dedicated to Prof. Dr. Božidar P. M. Ćurčić, eds. S.E. Makarov and R.N. Dimitrijević, pp. 39–57. *Belgrade–Vienna–Sofia: Institute of Zoology, Faculty of Biology, University of Belgrade – Committee for karst and speleology, Serbian Academy of Sciences and Arts – UNESCO MAB Committee Serbia – Faculty of Life Sciences, University of Vienna – Institute of Zoology, Bulgarian Academy of Sciences.*