

ON TWO NEW SPECIES OF PSEUDOSCORPIONS FROM THE DINARIC KARST

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Abstract — A careful analysis of samples of pseudoscorpions (Neobisiidae, Pseudoscorpiones) from two epigeal habitats, one near Split (Croatia) and the other on Mt. Orjen (Montenegro), has yielded two species of the genus *Roncus* L. Koch new to science: *Roncus diocletiani* n. sp. and *R. orjensis* n. sp. Both new species are described, thoroughly illustrated, and diagnosed. Some biogeographical and evolutionary characteristics of the two taxa are briefly discussed.

Key words: Pseudoscorpions, Neobisiidae, *Roncus*, cave fauna, speciation, Dalmatia, Croatia, Montenegro

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INTRODUCTION

There exists no deeper karst than that situated in Dalmatia, Herzegovina, and Montenegro. Even a drop of water would not remain long on the surface; all water sinks through various subterranean passages — potholes, ponors, fissures, and crevices. Most water drains towards the Neretva River, while some drains towards the Zeta and Morača Rivers, and Lake Skadar (Cvijić, 1926; Gavrilović, 1974). The study of pseudoscorpions in such underground habitats, a fauna whose composition is the result of a long and complicated history, enables us to evaluate the importance of the influence of long geomorphological isolation on the development of cave biota. Because of the age of these caves, different groups of pseudoscorpions have enjoyed the possibility of uninterrupted development and autochthonous differentiation. Such long isolation must have directed evolution towards greater ecological differentiation within the framework of the cave system (Ćurčić, 1988).

In studying some Balkan pseudoscorpions from two small collections, one made by Tonći Rađa in Dalmatia and the other by Ivo Karaman in Montenegro, we concentrated on two species belong-

ing to the genus *Roncus* L. Koch (Neobisiidae). The former was represented by two males and one female, the latter by one male and one female. The specimens of *Roncus* from Dalmatia turned out to be a new species, *Roncus diocletiani* n. sp., and the two specimens of the genus from Montenegro belong to another new species *Roncus orjensis* n. sp. In the present paper, both species are thoroughly described, diagnosed, and illustrated. In addition, some taxonomic, biogeographical, and evolutionary traits of these new taxa are briefly discussed.

MATERIAL AND METHODS

The pseudoscorpion specimens studied were mounted on slides in gum chloral medium (Swan's fluid); they are deposited in the collection of the Institute of Zoology, Faculty of Biology, University of Belgrade, 11000 Belgrade, Serbia, and in that of the Natural History Museum, Split, Croatia.

Setal designations follow B e i e r, 1963.

SYSTEMATIC PART

NEOBISIIDAE J. C. CHAMBERLIN

RONCUS L. KOCH

RONCUS DIOCLETIANI ĆURČIĆ,
DIMITRIJEVIĆ & RAĐA, NEW SPECIES
(Figs. 1-17; Table 1)

Etymology. – After the Roman Emperor Diocletian, whose imperial residence is located in Split.

Specimens examined. – Holotype female, allotype male, and paratype male, Marasovića, Split, Dalmatia (Croatia), 18 October 2005, collected by Tonći Rađa.

Description. – Carapace considerably longer than broad (Table 1). A single pair of small eyes (or eyespots) present (Fig. 5). Epistome small and rounded (Fig. 4). Carapacial setal formulae: 4 + 6 + 8 + 9 = 27 (female) and 4 + 6 + 6 + 9 = 25 (male) setae.

Tergal formulae: 10-10-10-11-12-12-12-11-11-11 (female) and 9-10-10-10-11-11-10-10-10-10 (male). Female genital area: sternite II with 12 median posterior setae, sternite III with 13 posterior setae and two or three suprastigmatic microsetae on either side, sternite IV with 12 posterior setae and three microsetae along each stigma. Sternites V-X with 16-14-13-12-12-11 posterior setae.

Male genital area: sternite II with 16 setae, sternite III with three anterior setae, 12 posterior setae, and three suprastigmatic microsetae on either side; sternite IV with 14 posterior setae and three microsetae on either side; and sternites V-X with 14-13-12-12-11-10 posterior setae. Twelfth abdominal segment with two pairs of small setae. Pleural membranes granulostrate.

Galea low and rounded (Fig. 8). Cheliceral palm with six setae, movable finger with one seta only (Fig. 8). Flagellum with one short proximal blade and seven longer blades distally, as characteristic of the genus *Roncus*. Dentition of cheliceral fingers as in Fig. 8.

Apex of pedipalpal coxa with four long acuminate setae. Small extero-lateral tubercle present on pedipalpal femur. Trochanter, femur, and chelal palm with distinct granulations (Figs. 1, 2).

A single tiny tubercle is present on the latero-

distal part of the chelal palm (Fig. 2) Group of microsetae proximal to trichobothria **eb** and **esb** not developed; instead, five to seven microsetae present distal to **eb** and **esb** (Fig. 1). Fixed chelal finger with 63 (female) and 65 (male) teeth; movable chelal finger with 57 (female) and 60 (male) teeth. Chelal finger slightly shorter than chelal palm (Table 1). Disposition of trichobothria as illustrated in Fig. 1.

Tibia IV, metatarsus IV, and tarsus IV each with a long sensitive seta (Table 1).

Morphometric ratios and linear measurements (in *mm*) are presented in Table 1.

Differential diagnosis. – *Roncus diocletiani* n. sp. differs significantly from all *Roncus* species known to date in the presence (*vs.* absence) of a well-developed sclerotic knob on the base of the interior lateral surface of the pedipalpal femur of the male (Figs. 10, 12). The absence of such a tubercle in the female (Fig. 2) points to the existence of marked sexual dimorphism, a phenomenon which has still been neglected in the study of both *Roncus* and other genera.

From its geographically close congener *R. pripegala* Ćurčić, 1988 from Dalmatia, the new species differs clearly by the carapacial setal formula of the male (4 + 8 + 6 + 6 = 24 *vs.* 4 + 6 + 6 + 9 = 25); the number of setae on tergites I-VI of the male (6-6-7-6-7-9 *vs.* 9-10-10-10-11-12); the number of setae on sternites II (23 *vs.* 16) and III (8 + 9 *vs.* 3 + 12) of the male; the number of teeth on the fixed (92 *vs.* 65) and movable (85 *vs.* 60) chelal finger of the male; male body length (4.46 *mm vs.* 2.92 *mm*); pedipalpal length in the male (6.585 *mm vs.* 3.98 *mm*); pedipalpal femur length in the male (1.35 *mm vs.* 0.835 *mm*); the pedipalpal femur length to breadth ratio in the male (2.72 *vs.* 2.25); the pedipalpal chelal length to breadth ratio in the male (3.69 *vs.* 2.86); leg IV length of the male (4.17 *mm vs.* 2.71 *mm*); the presence/absence of eyes in the male (absent *vs.* present); and habitat preference (cave *vs.* epigeal).

Distribution. – Marasovića, Split, Dalmatia (Croatia) probably endemic (epigeal, under stones and rotten wood).

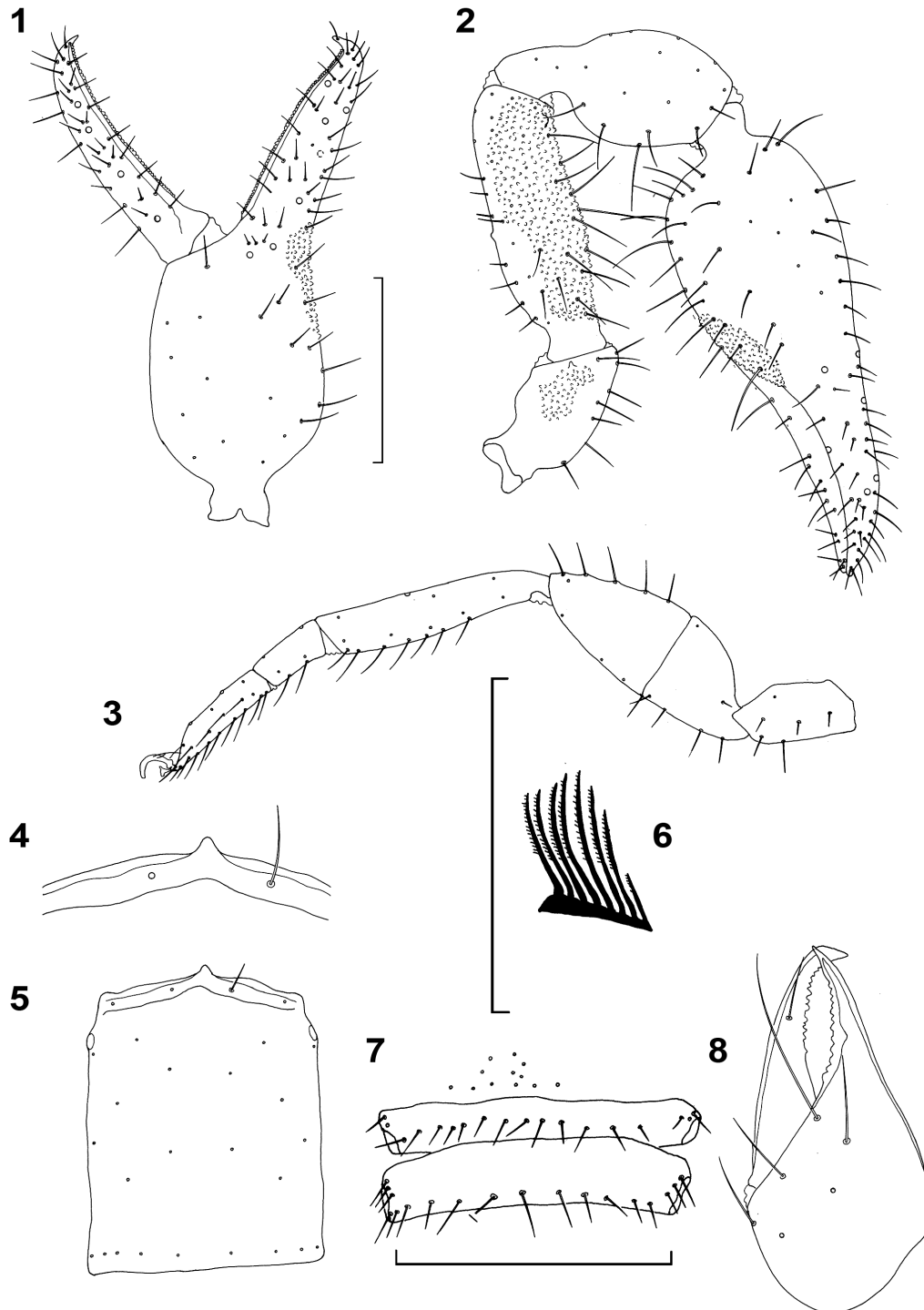


Fig. 1-8. *Roncus diocletiani* n. sp., holotype female from Dalmatia. 1 – pedipalpal chela; 2 – pedipalp; 3 – leg IV; 4 – epistome; 5 – carapace; 6 – flagellum; 7 – female genital area; 8 – chelicera. Scales = 0.50 mm (Figs. 1-3, 5, 7) and 0.25 mm (Figs. 4, 6, 8).

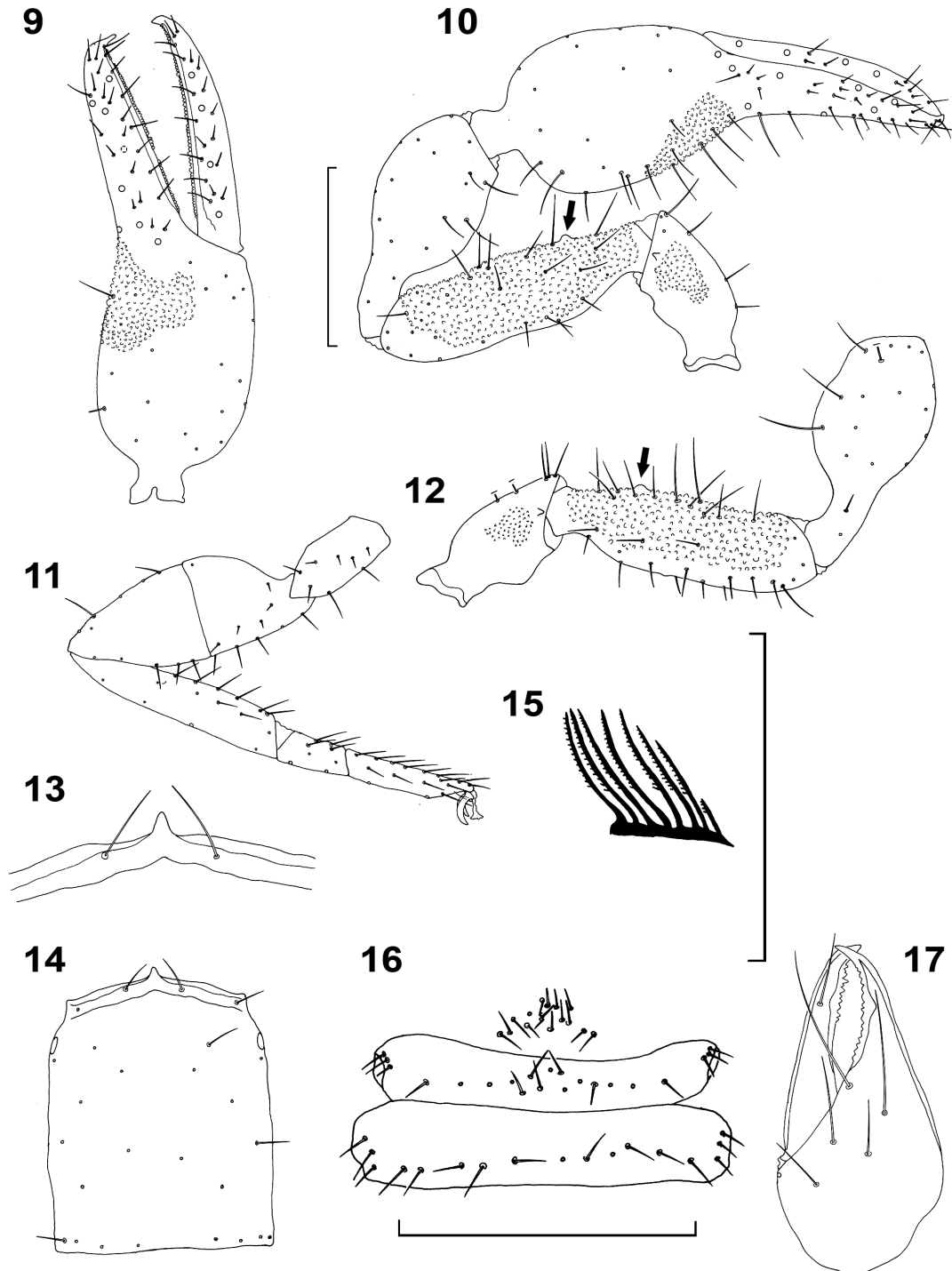


Fig. 9-17. *Roncus diocletiani* n. sp., allotype male from Dalmatia. 9 – pedipalpal chela; 10 – pedipalp; 11 – leg IV; 12 – pedipalpal trochanter, femur, and tibia (paratype male); 13 – epistome; 14 – carapace; 15 – flagellum; 16 – male genital area; 17 – chelicera. Scales = 0.50 mm (Figs. 9-12, 14, 16) and 0.25 mm (Figs. 13, 15, 17).

RONCUS ORJENSIS ĆURČIĆ & DIMITRIJEVIĆ,
NEW SPECIES

(Figs. 18-33; Table 1)

Etymology. – After its type locality, Mt. Orjen.

Specimens examined. – Holotype female and allotype male from Bijela Gora (Dubovac), Mt. Orjen (Montenegro), collected on 11 June 2005 by Ivo Karaman.

Description. – Epistome knob-like and rounded or blunt apically (Figs. 20, 30). A single pair of eyes with reduced lenses present (Figs. 21, 31). Carapacial setal formulae: $4 + 6 + 8 + 6 = 24$ (female) and $4 + 6 + 8 + 6 = 24$ (male) setae. Tergites I-X setation: 6-9-10-12-14-14-13-12-10-8 (female) and 6-10-11-11-10-11-11-11-10-9 (male).

Female genital area: sternite II with eight median posterior setae; sternite III with 12 posterior setae and three microsetae along each stigma; sternite IV with nine posterior setae and three microsetae on each side; and sternites V-X with 13-13-15-13-12-11 posterior setae.

Male genital area: sternite II with 16 setae; sternite III with six anterior, 10 posterior, and three suprastigmatic microsetae on either side; and sternite IV with 10 posterior setae and three microsetae on either side; and sternites V-X each with 14-14-14-13-13-11 posterior setae. Twelfth abdominal segment with two pairs of microsetae. Pleural membranes granulostriate.

Galea a low hyaline convexity (Figs. 25, 33). Cheliceral palm with six setae, movable finger with one seta. Flagellum with one short proximal blade and six (female) or seven (male) longer blades distally, characteristic of the genus. Dentition of cheliceral fingers as in Figs. 25 and 33.

Manducatory process with four long setae. Small exterior lateral tubercle present on pedipalpal femur (Figs. 19, 27); femur and chelal palm with distinct interior granulations (Figs. 19, 27), patella smooth. Single tiny tubercle present on latero-distal side of chelal palm. Group of microsetae proximal to trichobothria **eb** and **esb** not developed; instead,

four or five small setae distal to **eb** and **esb** present (Figs. 18, 26). Fixed chelal finger with 50 (female) and 52 (male) teeth; movable chelal finger with 53 (female) and 51 (male) teeth. Chelal finger only slightly longer than chelal palm and shorter than pedipalpal femur (Table 1).

Trichobothriotaxy as illustrated in Figs. 18 and 26.

Tibia IV, metatarsus IV, and tarsus IV each with a long sensitive seta (Figs. 23, 29).

Morphometric ratios and linear measurements (in *mm*) are presented in Table 1.

Differential diagnosis. – From its phenetically close congener *R. belbogi* Ćurčić, Makarov & Lučić, 1998 from Montenegro, *R. orjensis* n. sp. differs in many important respects, such as: the carapacial setal formula in the female ($4 + 6 + 2 + 3 + 2 + 5 = 22$ and $4 + 6 + 3 + 4 + 2 + 6 = 25$ vs. $4 + 6 + 8 + 9 = 27$) and male ($4 + 6 + 2 + 4 + 2 + 7 = 25$ vs. $4 + 6 + 6 + 9 = 25$); tergite I-V setation (6-6/9-9/10-9/12 vs. 9/10-10-10-10/11); the setation of sternites II in the female (9 vs. 12) and male (23 vs. 16); the number of setae on sternites III in the female (16-17 vs. 13) and male (26 vs. 14); the number of teeth on the fixed chelal finger in the female (74-78 vs. 63) and male (72 vs. 65); the number of teeth on the movable chelal finger in the female (75-79 vs. 57) and male (78 vs. 60); form of the pedipalps (elongated vs. massive); body length in adults (3.38-3.51 *mm* vs. 2.24-2.545 *mm*); pedipalpal length in both sexes (5.65-5.735 *mm* vs. 2.93-3.10 *mm*), the pedipalpal femur length to breadth ratio in adults (4.14.-4.52 vs. 3.28-3.315); the pedipalpal tibia length to breadth ratio in adults (2.605-2.72 vs. 1.96-2.125); the pedipalpal chelal length to breadth ratio in the male (2.72 vs. 1.96); leg IV length in adults (3.735-3.81 *mm* vs. 2.055-2.095 *mm*); and habitat preference (cavernicolous vs. epigeal) (Ćurčić et al., 1988).

Distribution. – Bijela Gora (Dubovac), Mt. Orjen (Montenegro), probably an endemic (epigeal) form.

CONCLUDING REMARKS

It is not easy to analyze the origin and history

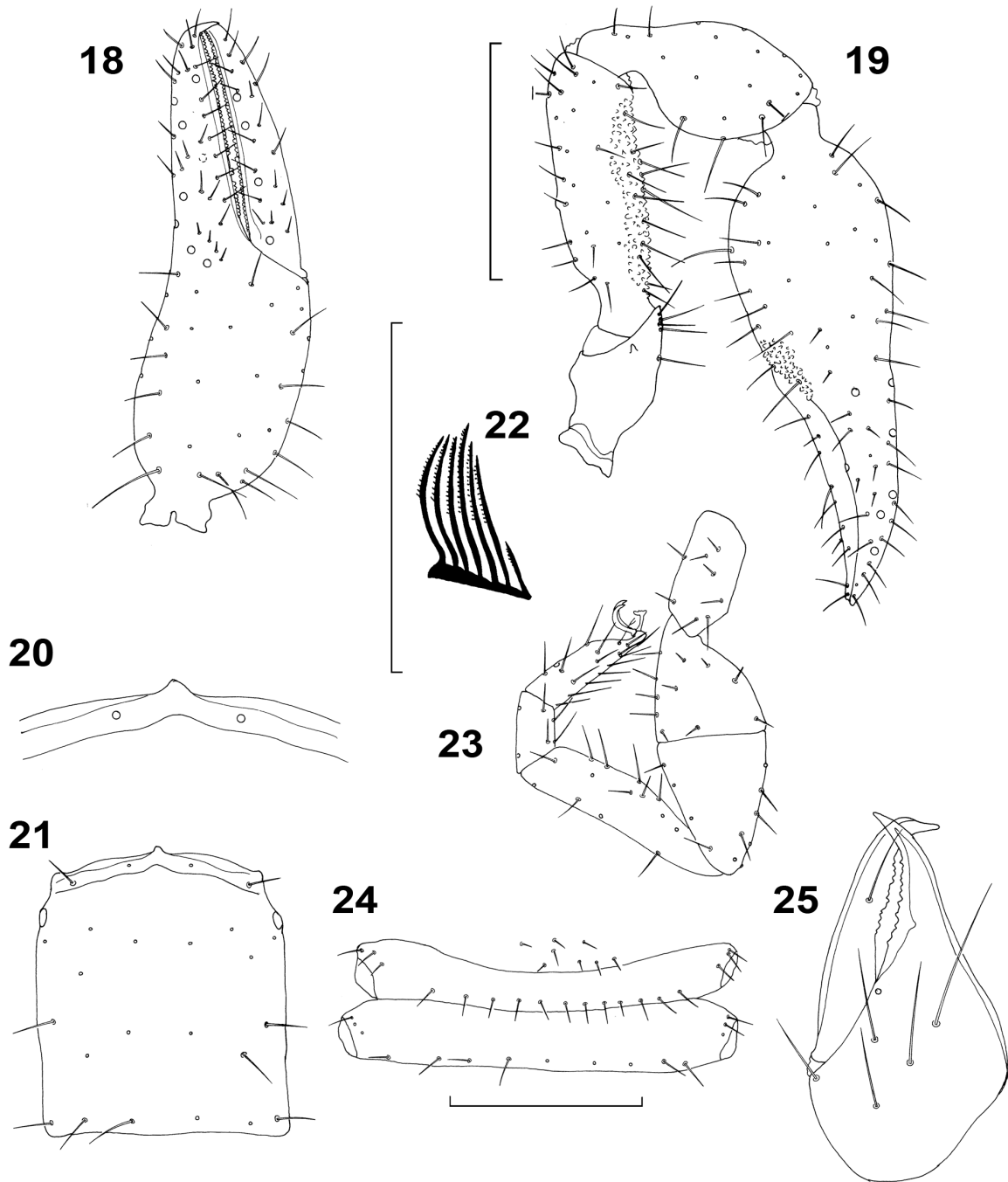


Fig. 18-25. *Roncus orjensis* n. sp., holotype female from Montenegro. 18 – pedipalpal chela; 19 – pedipalp; 20 – epistome; 21 – carapace; 22 – flagellum; 23 – leg IV; 24 – female genital area; 25 – chelicera. Scales = 0.50 mm (Figs. 18, 19, 21, 23-25) and 0.25 mm (Figs. 20, 22).

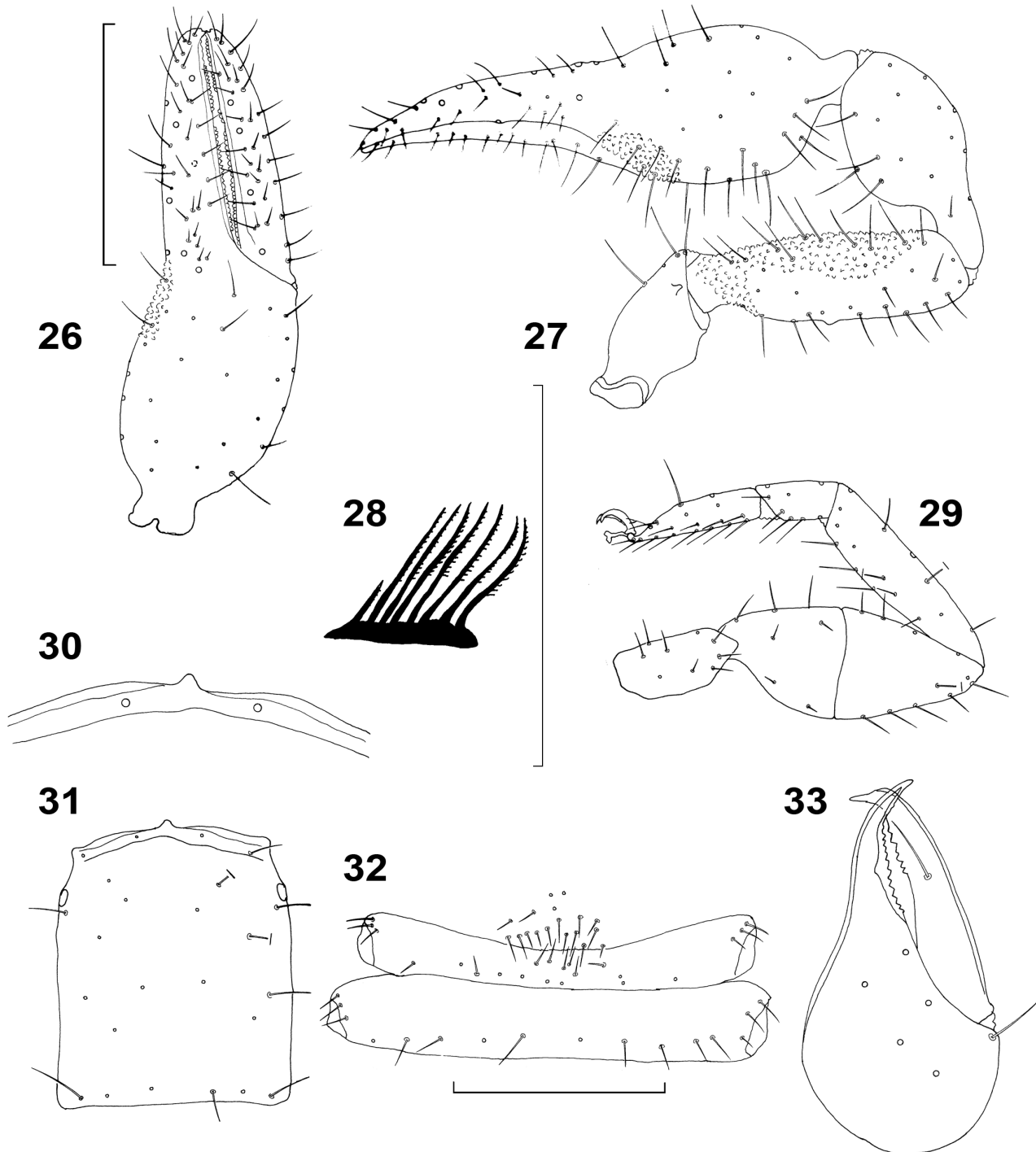


Fig. 26-33. *Roncus orjensis* n. sp., allotype male from Montenegro. 26 – pedipalpal chela; 27 – pedipalp; 28 – flagellum; 29 – leg IV; 30 – epistome; 31 – carapace; 32 – male genital area; 33 – chelicera. Scales = 0.50 mm (Figs. 26, 27, 29, 31-33) and 0.25 mm (Figs. 28, 30).

Table 1. Linear measurements (in millimetres) and morphometric ratios in *Roncus diocletiani* n. sp. (from Dalmatia, Croatia) and *R. orjensis* n. sp. (from Montenegro). Abbreviations: F = female, M = male.

Character/Species	<i>R. diocletiani</i>		<i>R. orjensis</i>	
	F	M	F	M
Body				
Length (1)	3.115	2.92	2.545	2.24
Cephalothorax				
Length (2)	0.815	0.79	0.63	0.61
Breadth (2a)	0.61	0.60	0.51	0.50
Ratio 2/2a	1.35	1.32	1.23	1.22
Abdomen				
Length	2.30	2.13	1.915	1.63
Chelicerae				
Length (3)	0.48	0.46	0.39	0.315
Breadth (4)	0.25	0.23	0.21	0.19
Length of movable finger (5)	0.34	0.33	0.26	0.25
Ratio 3/5	1.41	1.39	1.50	1.26
Ratio 3/4	1.92	2.00	1.86	1.66
Pedipalps				
Length with coxa (6)	3.98	3.815	3.10	2.93
Ratio 6/1	1.28	1.31	1.21	1.31
Length of coxa	0.60	0.57	0.47	0.40
Length of trochanter	0.49	0.48	0.38	0.37
Length of femur (7)	0.835	0.815	0.63	0.59
Breadth of femur (8)	0.24	0.23	0.19	0.18
Ratio 7/8	3.48	3.54	3.315	3.28
Ratio 7/2	1.02	1.03	1.00	0.97
Length of patella (tibia) (9)	0.71	0.68	0.51	0.49
Breadth of patella (tibia) (10)	0.315	0.305	0.24	0.25
Ratio 9/10	2.25	2.23	2.125	1.96
Length of chela (11)	1.345	1.27	1.11	1.08
Breadth of chela (12)	0.47	0.45	0.34	0.295
Ratio 11/12	2.86	2.82	3.26	3.66
Length of chelal palm (13)	0.69	0.66	0.55	0.53
Ratio 13/12	1.47	1.47	1.62	1.80
Length of chelal finger (14)	0.65	0.61	0.56	0.55
Ratio 14/13	0.94	0.92	1.02	1.04
Leg IV				
Total length	2.71	2.65	2.095	2.055
Length of coxa	0.43	0.41	0.34	0.33
Length of trochanter (15)	0.34	0.33	0.26	0.26
Breadth of trochanter (16)	0.16	0.14	0.12	0.13
Ratio 15/16	2.125	2.36	2.17	2.00
Length of femur + patella (17)	0.74	0.71	0.56	0.555
Breadth of femur + patella (18)	0.26	0.26	0.23	0.22
Ratio 17/18	2.85	2.73	2.43	2.52
Length of tibia (19)	0.63	0.64	0.49	0.48
Breadth of tibia (20)	0.12	0.13	0.11	0.10
Ratio 19/20	5.25	4.92	4.45	4.80
Length of metatarsus (21)	0.21	0.20	0.17	0.17
Breadth of metatarsus (22)	0.09	0.09	0.08	0.08
Ratio 21/22	2.33	2.22	2.125	2.125
Length of tarsus (23)	0.36	0.36	0.275	0.26
Breadth of tarsus (24)	0.08	0.08	0.07	0.07
Ratio 23/24	4.50	4.50	3.93	3.71
TS ratio - tibia IV	0.60	0.57	0.56	0.58
TS ratio - metatarsus IV	0.19	0.15	0.235	0.235
TS ratio - tarsus IV	0.31	0.37	0.37	0.35

of the endemic soil-dwelling members of the genus *Roncus* inhabiting the Dinarids because they represent an adaptive and selective fauna. The colonization of soil and hypogean habitats there must have begun a long time ago and has passed through successive stages during different geological periods. It is probable that the Dinarid region was colonized at the beginning of its existence by many lineages of *Roncus*, which already inhabited the Mediterranean forests. The survival of relicts has been sustained by continuity of the continental phase, by the relative constancy of life conditions in soil and caves, and by isolation of underground habitats (Guéorguiev, 1977; Deeleman-Reinhold, 1978; Ćurčić, 1988; Ćurčić et al., 2004).

This study of pseudoscorpions inhabiting the Dinaric Karst has offered further proofs of their great age and probably different origin. These species or their stem forms inhabited both leaf-litter and humus of Dinaric forests during or even before the Tertiary. Finally, such forms represent the last vestiges of an old thermophilous and hygrophilous fauna, vestiges which found shelter in the underground domain (humus, soil, caves) of the Balkans and elsewhere.

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REFERENCES

Beier, M. (1963). *Ordnung Pseudoscorpionidea (Afterskorpione)*.

In: *Bestimmungsbücher zur Bodenfauna Europas*, Vol. 1. - Akademie Verlag, Berlin. 313 pp.

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. 192 pp.

Ćurčić, B. P. M., R. N. Dimitrijević, 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. 400 pp.

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

Cvijić, J. (1926). *Morphologie terrestre. II*. - Drž. štamp. Kralj. SHS, Belgrade. 506 pp.

Deeleman-Reinhold, C. L. (1978). Revision of the cave-dwelling and related spiders of the genus *Troglohyphantes* Joseph (Linyphiidae), with special reference to the Yugoslav species. - Acad. Sci. Art. Slov., Cl. IV, Hist. Nat., Opera 23, Inst. Biol. Ioannis Hadži, 6, Ljubljana. 221 pp.

Gavrilović, D. (1974). Die serbische Karstterminologie. - *Verb. geogr. Inst. Jugosl., Komm. Karstterm. jugosl. Volker*, 2, Belgrade. 73 pp.

Guéorguiev V. B. (1977). *La faune troglobie terrestre de la péninsule Balkanique*. - Ed. Academie bulgare des Sciences, Sofia. 182 pp.

О ДВЕ НОВЕ ВРСТЕ ПСЕУДОСКОРПИЈА ИЗ ДИНАРСКОГ КРША

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Пажљивом анализом узорака необизидних псеудоскорпија из два епигејска станишта, једног у близини Сплита (Хрватска), а другог на планини Орјен (Црна Гора) утврђене су две врсте рода *Roncus* L. Koch, нове за науку: *Roncus diocletiani*

n. sp. и *R. orjensis* n. sp. Презентовани су описи оба нова таксона, урађене су прецизне илустрације и дијагнозе. У истој студији извршена је анализа биогеографских и еволуционих својстава два новоутврђена облика из динарског крша.