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New and little-known species of Chthoniidae and Neobisiidae (Pseudoscorpiones, Arachnida) from the Movile Cave in southern Dobrogea, Romania

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Abstract

Two species of *Roncus* L. Koch, 1873 (Neobisiidae), new to science (*R. ciobanmos* n. sp. and *R. dragobete* n. sp.), and one species of *Neobisium* Chamberlin, 1930 [*N.* (*N*). *biharicum* Beier, 1939], collected in the Movile Cave, southern Dobrogea, Romania, have been described, diagnostic characters illustrated, and their geographic distribution analyzed. In addition, the description of *Chthonius* (*Chthonius*) *monicae* Boghean, 1989 (Chthoniidae), otherwise known only from two females, has been amended. The possible relationships of these species are discussed in view of the importance of some diagnostic characters and of the evolution of their cave habitat.

Résumé

Deux nouvelles espèces du genre *Roncus* L. Koch, 1873 (Neobisiidae), ainsi qu'une espèce du genre *Neobisium* Chamberlin, 1930 [*N.* (*N.*) *biharicum* Beier, 1939], recueillies dans la grotte Movile en Dobroudja méridionale, Roumanie, sont décrites, leur caractères diagnostiques sont illustrés, et leur répartition est présentée. Une description supplémentaire de *Chthonius* (*Chthonius*) *monicae* Boghean, 1989 (Chthoniidae), est aussi fournie. Les affinités possibles des taxa étudiés sont discutées compte tenu de l'importance de quelques caractères diagnostiques, ainsi que de l'évolution de leur habitat souterrain.

Introduction

Eleven species of *Chthonius* C. L. Koch, 1843 (subgenus *Chthonius*) (Chthoniidae), are presently recorded for Romania, viz.: *Chthonius* (*C.*) *cavernarum* Ellingsen, 1909; *C.* (*C.*) *diophthalmus* Daday, 1888; *C.* (*C.*) *heterodactylus* Tömösváry, 1882; *C.* (*C.*) *irregularis brevis* Cîrdei, Bulimar & Malcoci, 1967; *C.* (*C.*) *jonicus* Beier, 1931; *C.* (*C.*) *leruthi* Beier, 1939; *C.* (*C.*) *monicae* Boghean, 1989; *C.* (*C.*) *motasi* Dumitresco & Orghidan, 1964; *C.* (*C.*) *orthodactylus* (Leach, 1817); *C.* (*C.*) *submontanus* Beier, 1963; and *C.* (*C.*) *tenuis* L. Koch, 1873 (Ionescu, 1936; Beier, 1963; Cîrdei et al., 1967; Boghean, 1989; Harvey, 1991). Of these, only four are endemic: *C.* (*C.*) *irregularis brevis* (from Masivul Repedea, near Iaşi), *C.* (*C.*) *leruthi* (from Iara, near Turda), *C.* (*C.*) *monicae* (from a cave in Dobrogea), and *C.* (*C.*) *motasi* (from caves in northern, central, and southern Dobrogea).

Three representatives of *Roncus* L. Koch, 1873 (Neobisiidae) are presently known from Romania: *R. lubricus* L. Koch, 1873; *R. alpinus* L. Koch, 1873; and *R. transsilvanicus* Beier, 1928 (Cîrdei et al., 1967; Harvey, 1991). The presence of *R. lubricus* in Romania is doubtful since this species is considered to be distributed only in northeastern North America and western Europe (Gardini, 1983; Ćurčić et al., 1992); moreover, *R. alpinus* occurs in France, Italy, Switzerland, Austria, and Slovenia (Beier, 1963; Ćurčić, 1988a) but its presence in Romania (Cîrdei et al., 1967) is questionable, as was already noted by Harvey (1991). The occurrence of *R. transsilvanicus* in Romania was subsequently confirmed by Beier (1963) and Harvey (1991). The distribution range of this species ex-

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tends from Czechoslovakia and Poland in the north-west as far as Ukraine in the south-east.

As far as *Neobisium* Chamberlin, 1930 (subgenus *Neobisium*) (Neobisiidae) is concerned, the majority of its representatives from Romania are widespread in other European countries. These are: *Neobisium* (*N.*) *blothroides* Tömösváry, 1882); *N.* (*N.*) *brevidigitatum* (Beier, 1928); *N.* (*N.*) *carcinoides* (Hermann, 1804) [= *N. muscorum* (Leach, 1817)], *N.* (*N.*) *carpaticum* Beier, 1935; *N.* (*N.*) *cephalonicum* (Daday, 1888); *N.* (*N.*) *crassifemoratum* (Beier, 1928); *N.* (*N.*) *erythrodactylum* (L. Koch, 1873); *N.* (*N.*) *fuscimanum* (C. L. Koch, 1843); *N.* (*N.*) *macrodactylum* (Daday, 1888); *N.* (*N.*) *minimum* (Beier, 1928); *N.* (*N.*) *polonicum* Rafalski, 1936; *N.* (*N.*) *reitteri* (Beier, 1928); and *N.* (*N.*) *sylvaticum* (C. L. Koch, 1843) (Harvey, 1991). The presence of *N.* (*N.*) *distinctum* (Beier, 1928) in Romania is questionable (Cîrdei et al., 1967; Harvey, 1991). Only four species are endemic to the area: *N.* (*N.*) *biharicum* Beier, 1939 (from the Bihor area); *N.* (*N.*) *bucegicum* Beier, 1964 (from the Bucegi Mts.); *N.* (*N.*) *dolicodactylum latum* Cîrdei, Bulimar & Malcoci, 1967 (from Masivul Repedea, near Iaşi); and *N.* (*N.*) *granulosum* Beier, 1939 (from Sebeş, Alba) (Cîrdei et al., 1967; Beier, 1963; Harvey, 1991).

During the biological investigations of the Movile Cave in southern Dobrogea, Romania, the third author collected four species of pseudoscorpions belonging to three genera: *Chthonius* (*C.*) *monicae*, *Roncus ciobanmos* n. sp., *R. dragobete* n. sp., and *Neobisium* (*N.*) *biharicum*. The three former species are sympatric relicts, endemic to the area. The fourth species, *N.* (*N.*) *biharicum*, is epigean and its presence in the Movile Cave is accidental.

It is worth mentioning that the Movile Cave was discovered accidentally in 1986, when an artificial shaft intercepted a low cave passage. The richness of the terrestrial troglobitic community in this cave was surprising. Of the 29 species of troglobites, 21 appeared to be new to science (Sarbu, 1991; Sarbu & Popa, 1992); this number is likely to increase, due to subsequent investigations.

The aim of the present paper is to present a redescription of *C.* (*C.*) *monicae*, so far known only from two females; to describe the new species of *Roncus*; and to offer additional details on the external morphology of *N.* (*N.*) *biharicum*. Furthermore, some taxonomic and biogeographic features of these species are discussed in view of the evolution of their underground habitat.

All pseudoscorpion specimens under study were mounted on slides in Swan's fluid (gum chloral medium) and deposited in the collections of the Institute of Zoology, Faculty of Science (Biology), University of Belgrade, Belgrade, Yugoslavia (FSB); the Museum "Grigore Antipa", Bucharest, Romania (MGAB); and the Department of Entomology (Arachnida & Myriapoda), National Museum of Natural History, Smithsonian Institution, Washington, U.S.A. (USNM).

All abbreviations of setal names are in accordance with Beier (1963).

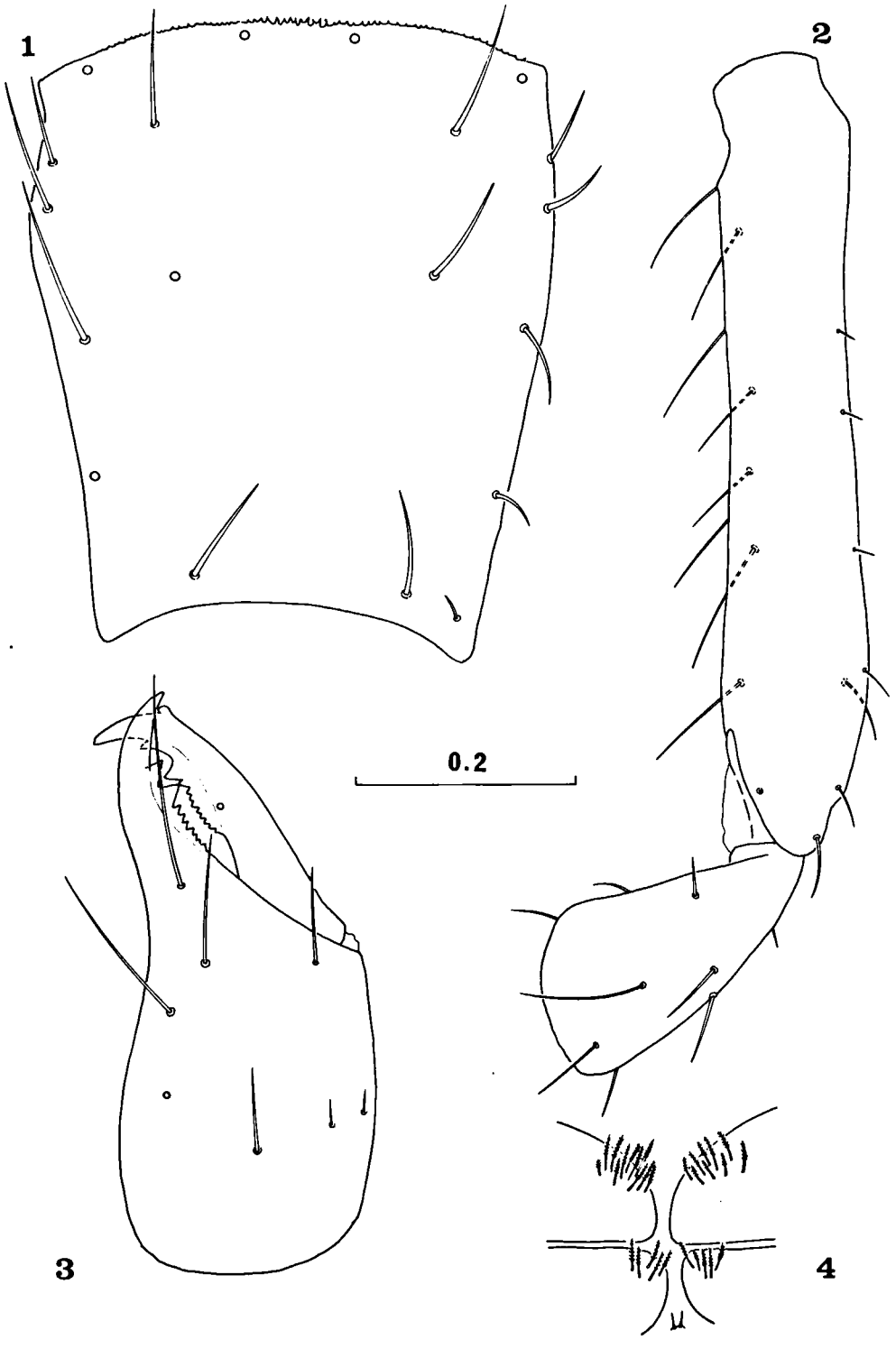
Descriptive part

CHTHONIIDAE Daday, 1888

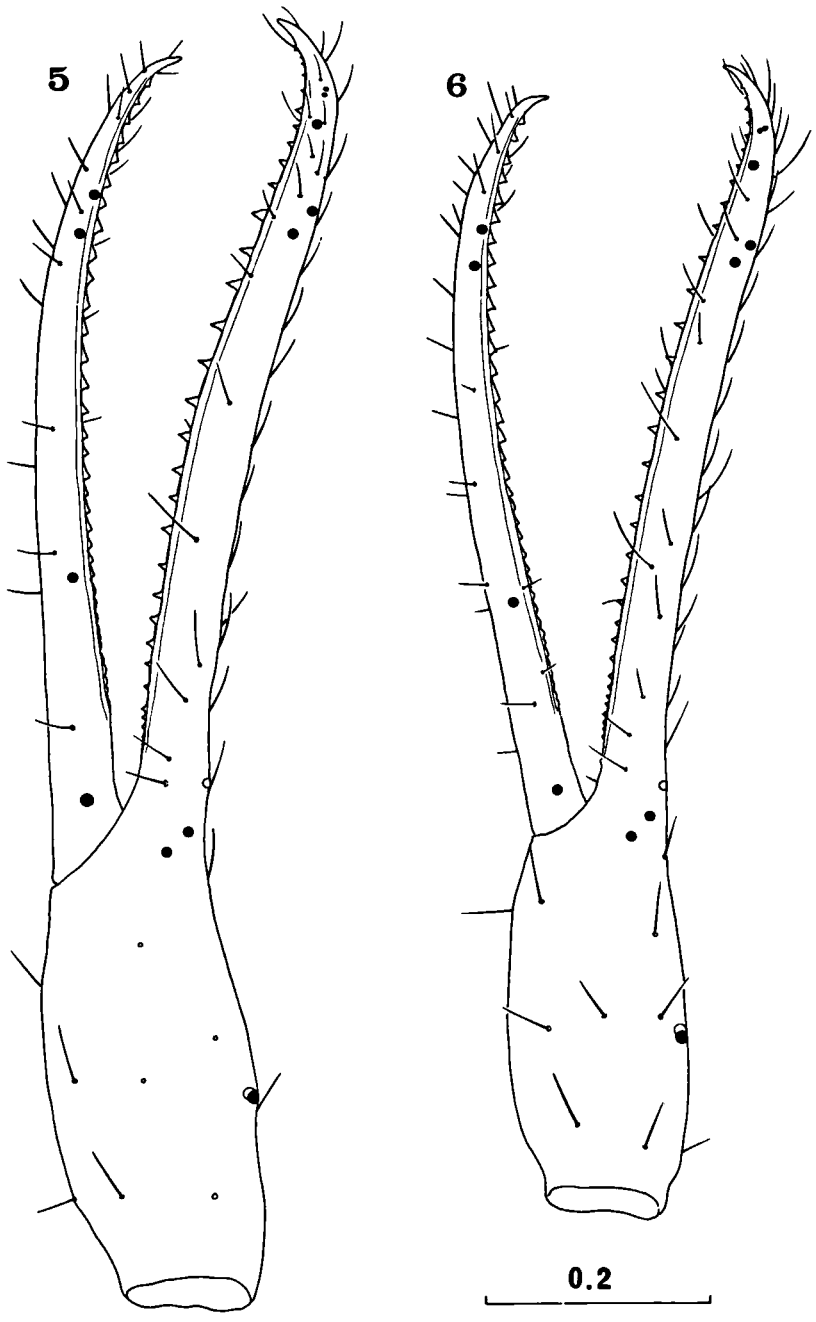
Chthonius (*Chthonius*) *monicae* Boghean, 1989 (Figs. 1–13; Table I)

Specimens examined. – Movile Cave, near Mangalia, southern Dobrogea (type locality), Romania, Serban M. Sarbu leg., 1 ♀, 3 ♂♂ (FSB), 17 Aug. 1990; 2 ♀♀, 2 ♂♂ (FSB), 4 Jan. 1991; 1 ♀ and 1 tritonymph (FSB), 15 Dec. 1991; 4 ♀♀ and 1 ♂ (MGAB), 20 June 1992; 1 ♀ and 5 ♂♂ (USNM), 20 Sept. 1992; 1 ♀ (USNM), 25 Sept. 1992 (all same locality and collector).

Description (amended). – Epistome not developed; small chitinous points on anterior margin of carapace between the two median and anterior setae (Figs. 1, 7 & 10). Neither eyes nor eye spots are developed. Carapace somewhat longer than broad (Table I); 4 long setae along anterior margin of carapace, 6 in the ocular row, 4 in the median row, 2 in the intermediary row, and 2 (rarely 3) setae in the posterior row. (Only in a single female, an additional microseta is borne lateral to the right posterior seta; Fig. 1.) Preocular microsetae: one microseta in each preocular recess (Boghean, 1989) or without microsetae (in presently examined specimens; see also Fig. 1 in Boghean, 1989). Setal formula: 4 + 6 + 4 + 2 + 2 = 18 setae (rarely: 4 + 6 + 4 + 2 + 3 = 19 setae) (*not* 20, as noted by Boghean, 1989).



Figs. 1–4. Chthonius (Chthonius) monicae Boghean, 1989, ♀ (FSB), from the Movile Cave, Romania: 1, carapace; 2, pedipalpal femur and tibia; 3, chelicera; 4, coxal spines. Scale in mm.



Figs. 5–6. Chthonius (Chthonius) monicae Boghean, 1989, from the Movile Cave, Romania: 5, pedipalpal chela, ♀ (FSB); 6, pedipalpal chela, ♂ (FSB). Scale in mm.

Tergite I with 4 (rarely 2 or 3) setae, tergites II–IV each with 4 setae, tergites V–IX each with 6 setae, tergite X with 4 setae. Male genital area: sternite II with 10 or 11 setae in the form of a triangle (of these, 4 setae along posterior margin), sternite III with 3 suprastigmatic microsetae on each side, 9 posterior setae, and 6 or 7 setae along each side of a median groove. Sternite IV with 7 setae and 3 suprastigmal microsetae on each side. Female genital area: sternite II with 8–10 setae in the form of

a triangle; sternite III with 7 or 8 posterior setae (5 according to Boghean, 1989) and 3 suprastigmatic microsetae on either side; sternite IV with 7 marginal setae and 3 small setae along each stigmatic plate. In both sexes, sternites V–X each with 6 (rarely 7) setae.

Galea small and rounded (Figs. 3, 9 & 13); 5 (in tritonymph) or 6 (rarely 5 in adults) long setae on cheliceral palm, and 1 long seta on movable cheliceral finger. Flagellum with 10 or 11 blades, characteristic of the genus *Chthonius*. Cheliceral dentition as in Figs. 3, 9 & 13; movable chelal finger with a distal isolated tooth; teeth on both cheliceral fingers diminish in size proximally.

Apex of pedipalpal coxa with 2 long setae. Fixed chelal finger with a total of 20 teeth in tritonymph and 28–30 in adults (26 according to Boghean, 1989); distal and median teeth triangular, pointed and interspaced, the most proximal teeth rounded, low and closely set. Movable chelal finger with 26 teeth in tritonymph and 33–34 in adults (20 according to Boghean, 1989); distal teeth asymmetrical (retroconical) and only slightly interspaced, proximal teeth low, rounded, and closely set (Figs. 5, 6 & 11). One denticle in tritonymph and 3–4 in adults distal to *ds*. Pedipalpal femur longer than carapace, chelal fingers considerably longer than chelal palm; fixed chelal finger somewhat longer than movable chelal finger. Shape of pedipalpal femur and tibia presented in Figs. 2, 8 & 12, and form of chelal fingers as illustrated in Figs. 5, 6 & 11.

Trichobothriotaxy (adults; Figs. 5 & 6): *ib* and *isb* on middle of chelal palm on dorsal side. Setae *et-est-it* in distal finger half, *ist-est-eb* on finger base. Tritonymphal trichobothriotaxy as in Fig. 11.

Coxa II with 9 or 10 spines in tritonymph and 8–10 in adults (6 spines according to Boghean, 1989), coxa III with 5 or 6 spines in tritonymph and 4–6 in adults (Fig. 4). Intercoxal tubercle with 2 small setae (Fig. 4). Leg IV: tibia, basitarsus, and telotarsus each with a long tactile seta.

For morphometric ratios and linear measurements of various structures, see Table I.

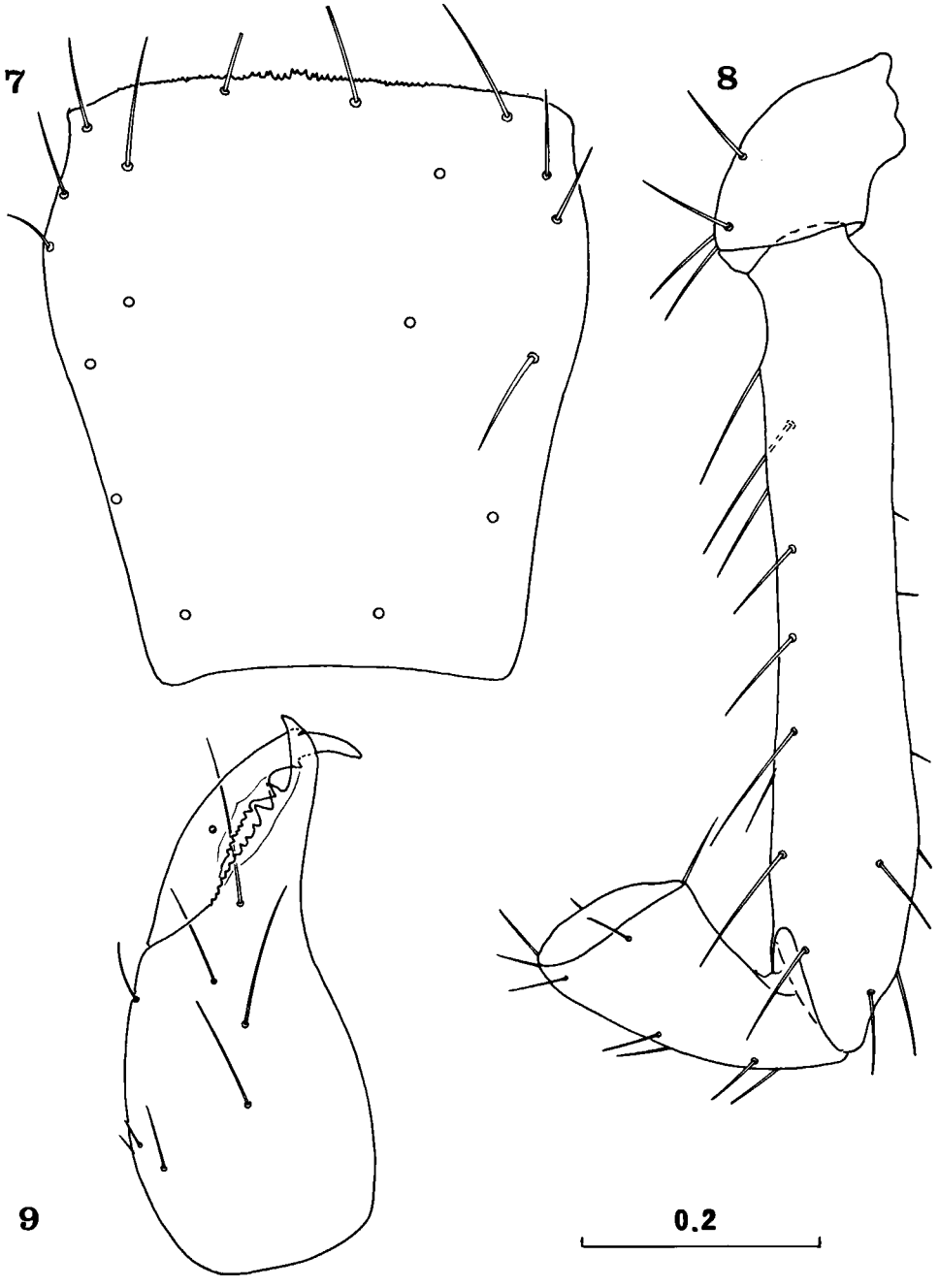
Distribution. – Endemic species of southern Dobrogea, Romania (Movile Cave).

Remarks. – *C.* (*C.*) *monicae* is easily distinguished from *C.* (*C.*) *bogovinae* Ćurčić, 1972, from eastern Serbia, Yugoslavia, in the dentition of the movable chelal finger (median teeth retroconical and asymmetrical vs. median teeth pointed, triangular, and symmetrical), the presence or absence of denticles distal to *ds* (present vs. absent), the length of the pedipalpal femur of females (0.68–0.75 mm vs. 1.00–1.13 mm) and males (0.63–0.73 mm vs. 0.90–0.98 mm), the length of the chelal finger of females (0.68–0.795 mm vs. 0.88–1.01 mm) and males (0.64–0.73 mm vs. 0.85–1.02 mm) (see also Ćurčić, 1972a).

In addition, *C.* (*C.*) *monicae* differs considerably from *C.* (*C.*) *iugoslavicus* Curčić, 1972, from southeastern Serbia, Yugoslavia, in number of setae on carapace (18 vs. 20), lateral setae in the posterior carapace row (absent vs. present), ratio of pedipalpal femur length to carapace length of females (1.28–1.49 vs. 1.53–1.76), ratio of chelal finger length to chelal palm length of females (1.75–2.15 vs. 1.67–1.74), length of femur IV (0.62–0.70 mm vs. 0.50–0.60 mm), shape of the proximal teeth of the movable chelal finger (low and rounded vs. forming a basal lamella) (see also Ćurčić, 1972a, 1972b, 1988a, 1988b).

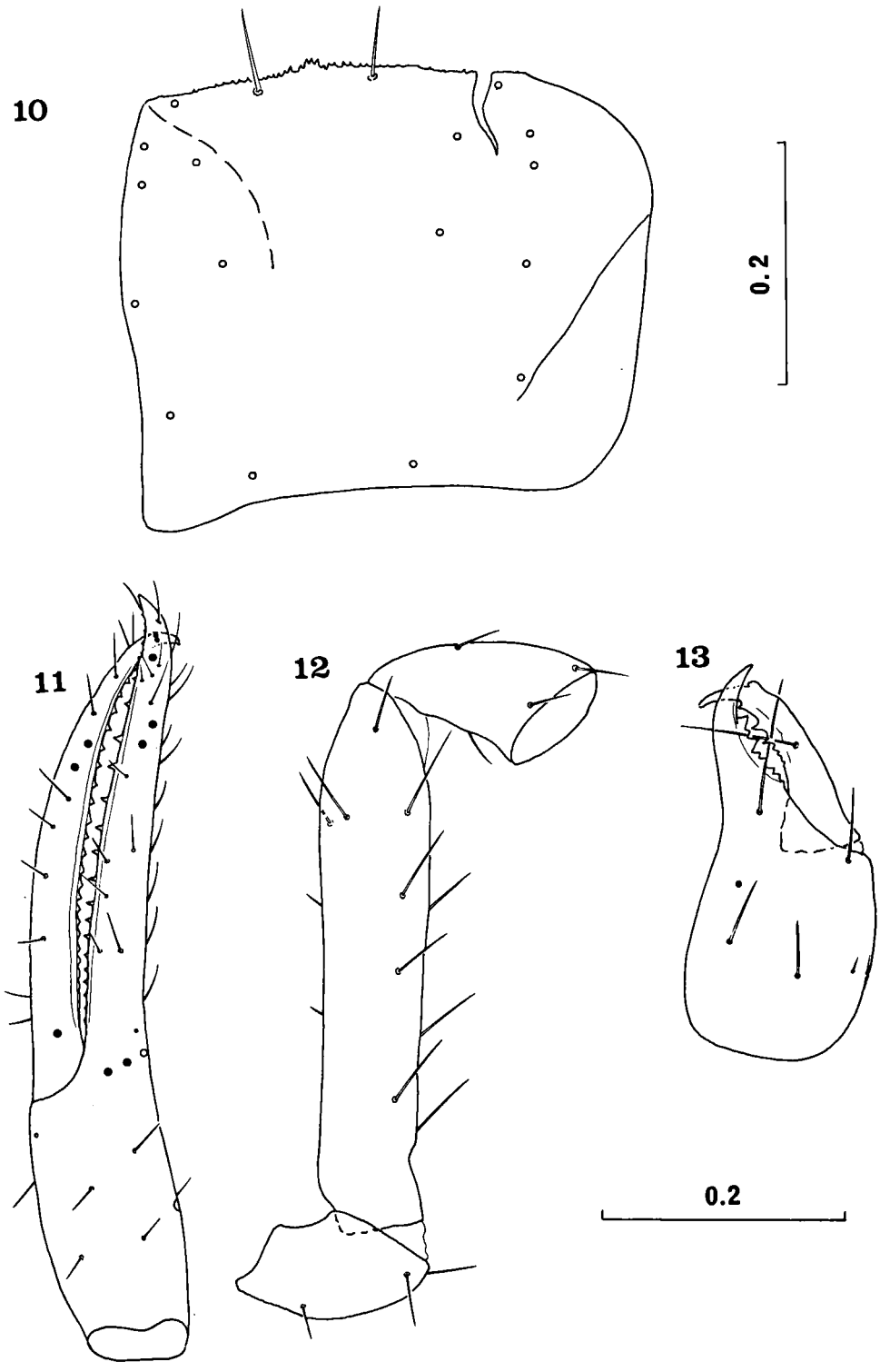
However, *C.* (*C.*) *troglodites* Redikorzev, 1928, and *C.* (*C.*) *cavophilus* Hadži, 1939, both from Bulgarian caves, are phenetically most similar to *C.* (*C.*) *monicae*. From *C.* (*C.*) *troglodites*, *C.* (*C.*) *monicae* differs in carapace setation (20 vs. 18 setae), carapace length (0.60–0.72 mm vs. 0.425–0.535 mm), pedipalpal femur length (1.12–1.18 vs. 0.63–0.75 mm), pedipalpal femur length to breadth ratio (7.30–11.20 vs. 5.21–6.08), and pedipalpal chela length (1.46–1.53 mm vs. 0.945–1.165 mm). The distinctions between *C.* (*C.*) *monicae* and *C.* (*C.*) *cavophilus* are manifested by the setation of the posterior carapace row (2 long setae vs. 2 long and 2 short setae), by the presence/absence of eyes (absent vs. present), by the presence/absence of small teeth distal to *ds* (present vs. absent), by the pedipalpal chela length of males (0.945–1.02 mm vs. 0.80 mm), and by the pedipalpal chela length to breadth ratio (5.82–6.50 vs. 5.30) (see also Redikorzev, 1928; Hadži, 1939).

Interestingly, *C.* (*C.*) *monicae* exhibits variation



Figs. 7–9. Chthonius (Chthonius) monicae Boghean, ♂ (FSB), from the Movile Cave, Romania: 7, carapace; 8, pedipalpal trochanter, femur, and tibia; 9, chelicera. Scale in mm.

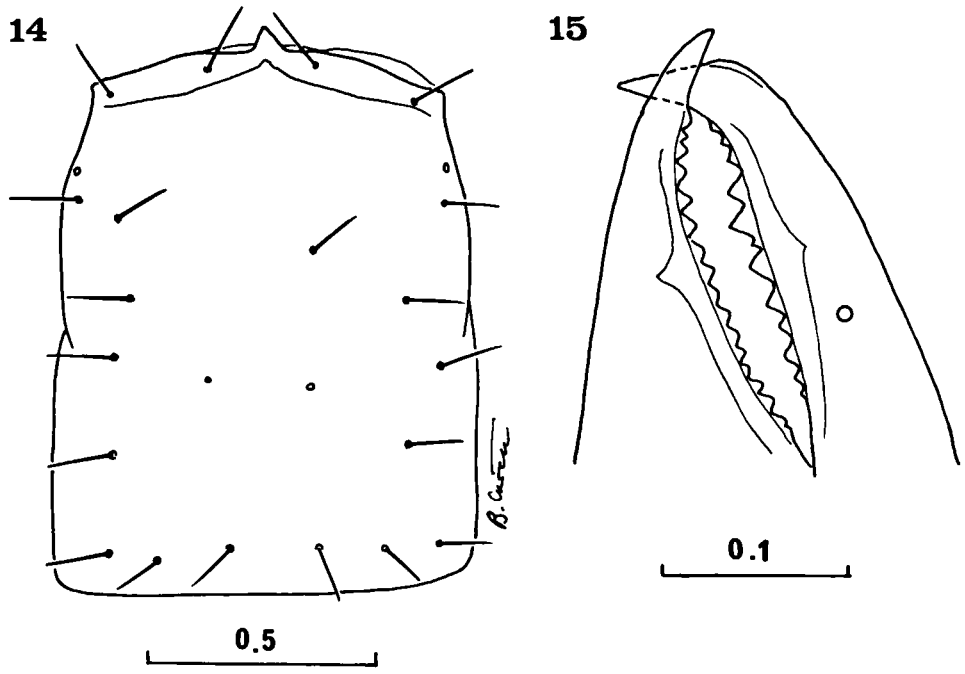
in the number of posterior carapace setae (2, rarely 3), in the number and position of setae on tergite I (4, rarely 2 or 3), and in the presence/absence of preocular microsetae (present or absent). It should be noted that in the case of fewer setae on tergite I, it is always the left lateral seta (when only 3 tergal setae remain), or both lateral setae (when only 2 tergal setae remain), that are missing. The pronounced variation in number of carapacal and tergal setae was also noted in other cave pseudoscorpions from



Figs. 10–13. Chthonius (Chthonius) monicae Boghean, 1989, tritonymph (FSB), from the Movile Cave, Romania: 10, carapace; 11, pedipalpal chela; 12, pedipalpal trochanter, femur, and tibia; 13, chelicera. Scales in mm.

Table I. Linear measurements (in mm) and morphometric ratios in *Chthonius* (*C.*) *monicae* Boghean, from Romania. Abbreviations: trito. = tritonymph, TS = tactile seta.

Character	♀♀	♂♂	trito.
Body			
Length (1)	1.48–2.63	1.60–1.89	1.09
Cephalothorax			
Length (2)	0.49–0.57	0.47–0.55	0.36
Breadth	0.44–0.50	0.43–0.46	0.36
Abdomen			
Length	0.99–2.06	1.10–1.37	0.73
Breadth	0.51–0.96	0.58–0.75	0.34
Chelicerae			
Length (3)	0.49–0.535	0.425–0.48	0.32
Breadth (4)	0.21–0.23	0.185–0.205	0.15
Length of movable finger (5)	0.26–0.28	0.21–0.26	0.185
Length of galea	0.01	0.01	0.01
Pedipalps			
Length with coxa (6)	2.70–2.905	2.515–2.72	1.755
Ratio 6/1	1.08–1.82	1.33–1.70	1.61
Length of coxa	0.47–0.51	0.42–0.47	0.34
Length of trochanter	0.22–0.25	0.205–0.22	0.15
Length of femur (7)	0.68–0.75	0.63–0.73	0.44
Breadth of femur (8)	0.12–0.14	0.11–0.12	0.09
Ratio 7/8	5.21–5.83	5.46–6.08	4.89
Ratio 7/2	1.28–1.49	1.145–1.47	1.22
Length of tibia (9)	0.25–0.29	0.25–0.28	0.18
Breadth of tibia (10)	0.14–0.15	0.13–0.15	0.12
Ratio 9/10	1.785–2.07	1.785–2.00	1.50
Length of chela (11)	1.04–1.165	0.945–1.02	0.645
Breadth of chela (12)	0.16–0.18	0.15–0.17	0.12
Ratio 11/12	6.11–6.875	5.82–6.50	5.375
Length of chelal palm (13)	0.34–0.37	0.29–0.32	0.205
Ratio 13/12	2.00–2.50	1.705–2.10	1.71
Length of chelal finger (14) (fixed finger)	0.68–0.795	0.64–0.73	0.44
Length of chelal finger (movable finger)	0.63–0.71	0.59–0.69	0.40
Ratio 14/13	1.75–2.15	2.03–2.52	2.15
Leg IV			
Total length	2.265–2.44	2.155–2.36	1.475
Length of coxa	0.27–0.30	0.25–0.27	0.205
Length of trochanter (15)	0.205–0.25	0.205–0.23	0.16
Breadth of trochanter (16)	0.13–0.15	0.13–0.15	0.10
Ratio 15/16	1.53–1.71	1.53–1.615	1.60
Length of femur (17)	0.62–0.70	0.61–0.68	0.40
Breadth of femur (18)	0.205–0.25	0.23–0.25	0.16
Ratio 17/18	2.58–3.17	2.56–2.78	2.50
Length of tibia (19)	0.42–0.44	0.39–0.45	0.27
Breadth of tibia (20)	0.09–0.10	0.09–0.10	0.08
Ratio 19/20	4.25–4.67	3.90–4.67	3.375
Length of basitarsus (21)	0.22–0.25	0.21–0.25	0.14
Breadth of basitarsus (22)	0.065–0.08	0.07–0.08	0.06
Ratio 21/22	2.93–3.69	2.75–3.33	2.33
Length of telotarsus (23)	0.49–0.54	0.44–0.535	0.30
Breadth of telotarsus (24)	0.04–0.05	0.04–0.045	0.04
Ratio 23/24	9.80–13.00	9.78–13.375	7.50
TS ratio – tibia IV	0.46–0.55	0.46–0.52	0.51
TS ratio – basitarsus IV	0.36–0.42	0.35–0.46	0.38
TS ratio – telotarsus IV	0.31–0.43	0.35–0.39	0.295



Figs. 14–15. Roncus ciobanmos n. sp., holotype ♀ (FSB), from the Movile Cave, Romania: 14, carapace; 15, cheliceral fingers. Scales in mm.

Dobrogea (Dumitresco & Orghidan, 1964) and the Dinaric Karst (Ćurčić, 1988a). Such variation in *C.* (*C.*) *monicae* is probably caused by a process of character reduction or differentiation in the underground habitat. The loss of pigment, eyes, and preocular microsetae support this assumption. It is evident that *C.* (*C.*) *monicae* is a true cave dweller, since both adult and tritonymph stages bear neither eyes nor eye spots. Furthermore, the presence in caves of a preadult stage (tritonymph) proves that the life cycle of this species can be completed in its cave environment.

NEOBISIIDAE Chamberlin, 1930

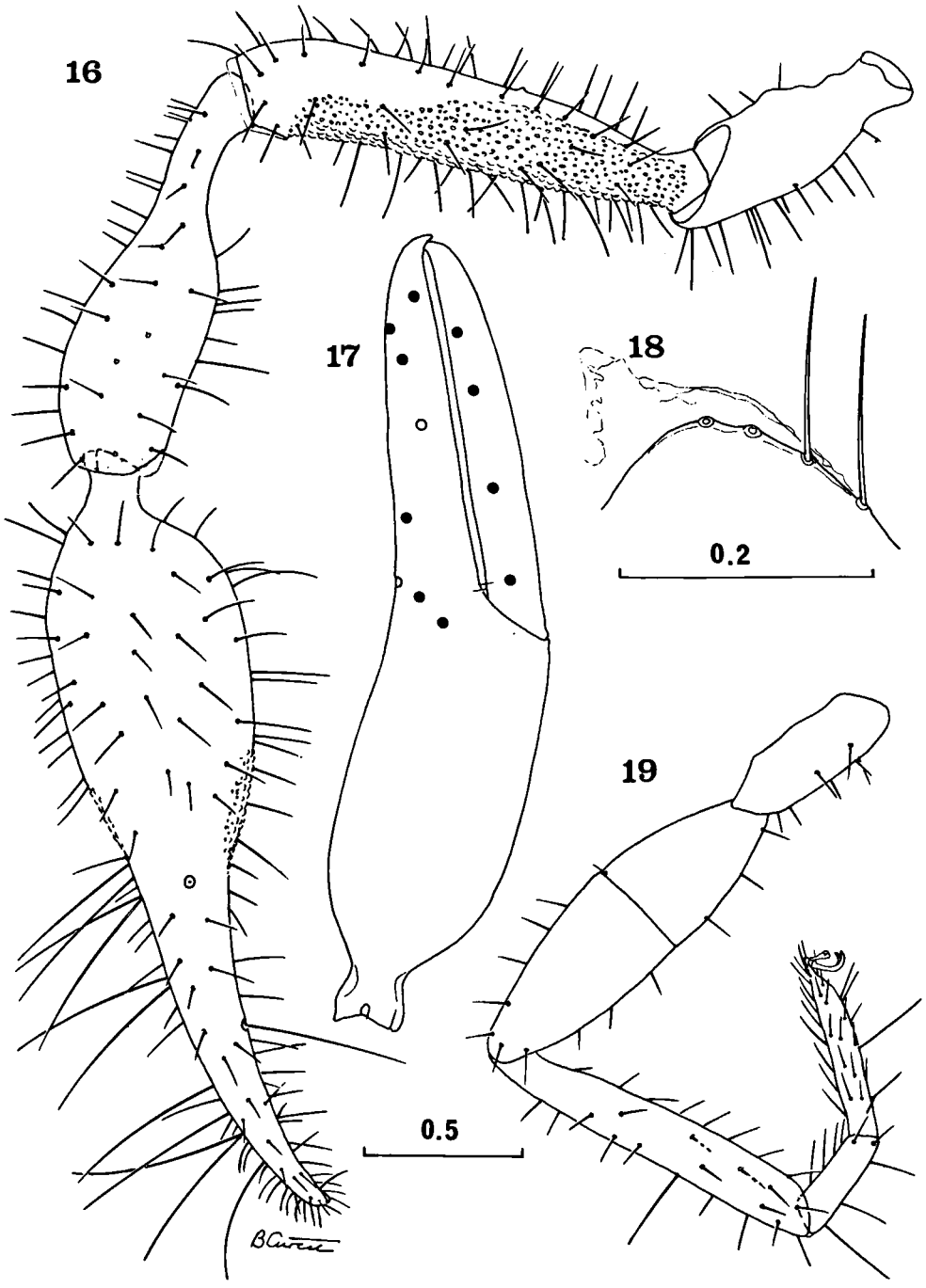
Roncus ciobanmos n. sp.
(Figs. 14–29, 38–42; Table II)

Etymology. – In Romanian mythology, Cioban Moş (= Zeu Moş) is the principal deity of shepherds (Vulcănescu, 1985).

Specimens examined. – Movile Cave, near Mangalia, southern Dobrogea, Romania; holotype ♀ and 1 paratype ♀ (FSB), 20 June 1992 (Serban M. Sarbu leg.); 1 paratype ♀ (MGAB), 18 June 1991; 1 paratype ♀ (MGAB), 20 June 1992; 1 paratype tritonymph (FSB), 18 June 1991; 1 paratype ♀ and 1 paratype tritonymph (USNM), 15 Dec. 1991 (all same collector and locality).

Description. – Carapace longer than broad (Figs. 14, 23 & 25; Table II). Epistome triangular, apically pointed (or slightly blunt) (Figs. 14, 23 & 25). Two weakly developed eye spots. Tapetum absent in female but present in tritonymph. Anterior row with 4, ocular with 6, median and intermedian rows with 6–10, and posterior row with 6 setae. Setal formula of carapace: 4–6, 22–26 (female). Tritonymphal setation: 4 + 1 + 6 + 4 + 2 + 6 = 23.

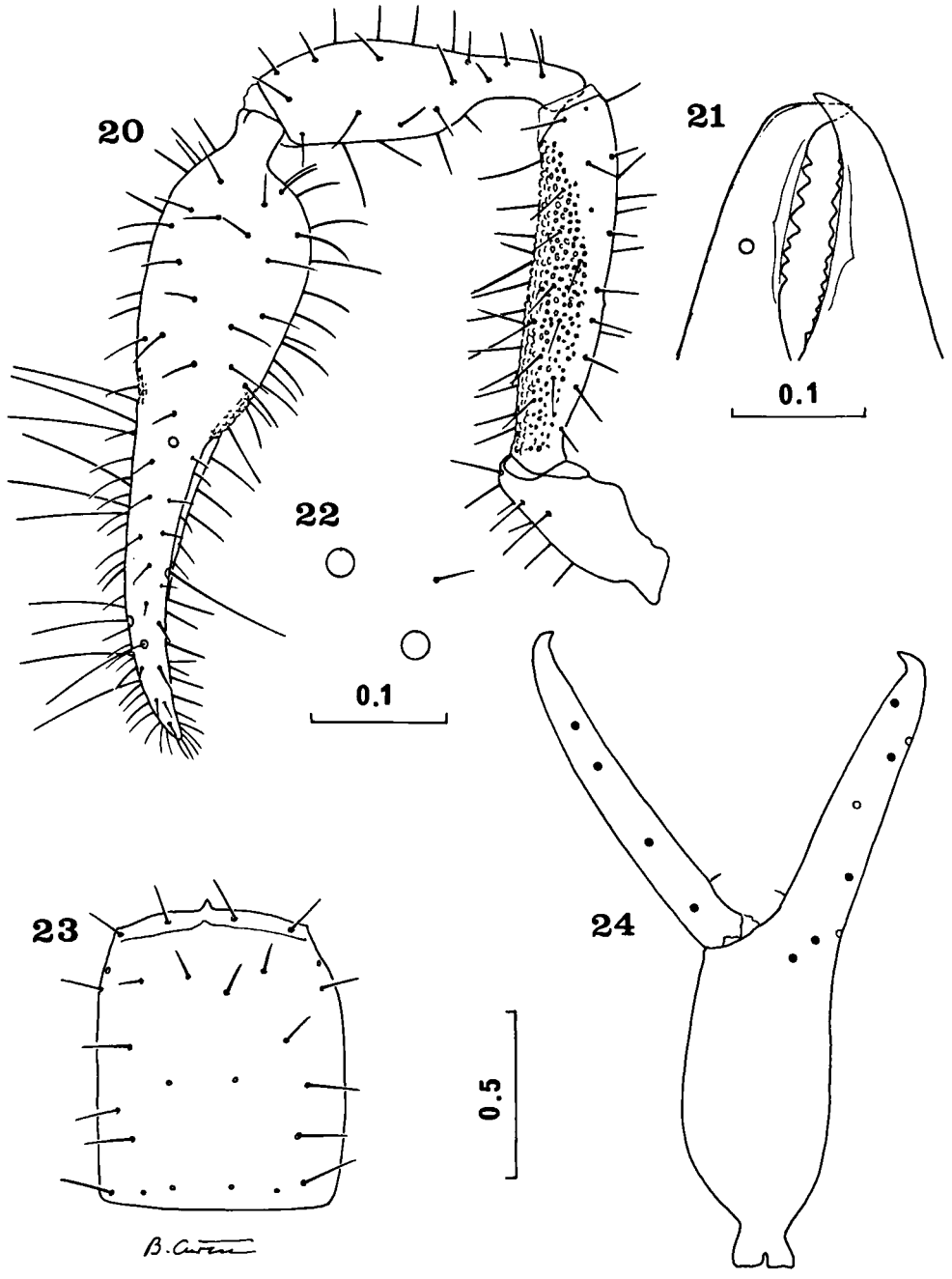
Tergite I with 6 setae, tergite II with 7 setae in tritonymph and 8 or 9 in adults, tergite III with 8 or 9 setae in tritonymph and 10 or 11 in females. Subsequent tergites (IV–X) each with 9–11 setae in tritonymph and 10–12 in females. Male genital area unknown. Female genital area: sternite II with 9–12 small setae (in form of two barely distinguishable groups, close to each other), sternite III with 12–14 setae and 3 microsetae along each stigma.



Figs. 16–19. Roncus ciobanmos n. sp., holotype ♀ (FSB), from the Movile Cave, Romania: 16, pedipalp; 17, pedipalpal chela 18, apex of pedipalpal coxa; 19, leg IV. Scales in mm.

Tritonymph: sternite II with 2 or 3 setae, and sternite III with 6 or 7 setae. Sternites V–X each with 11–13 setae in tritonymph and 12–15 marginal setae in females. Setae on sternites V–X arranged in transverse rows; anterior and median setae lacking.

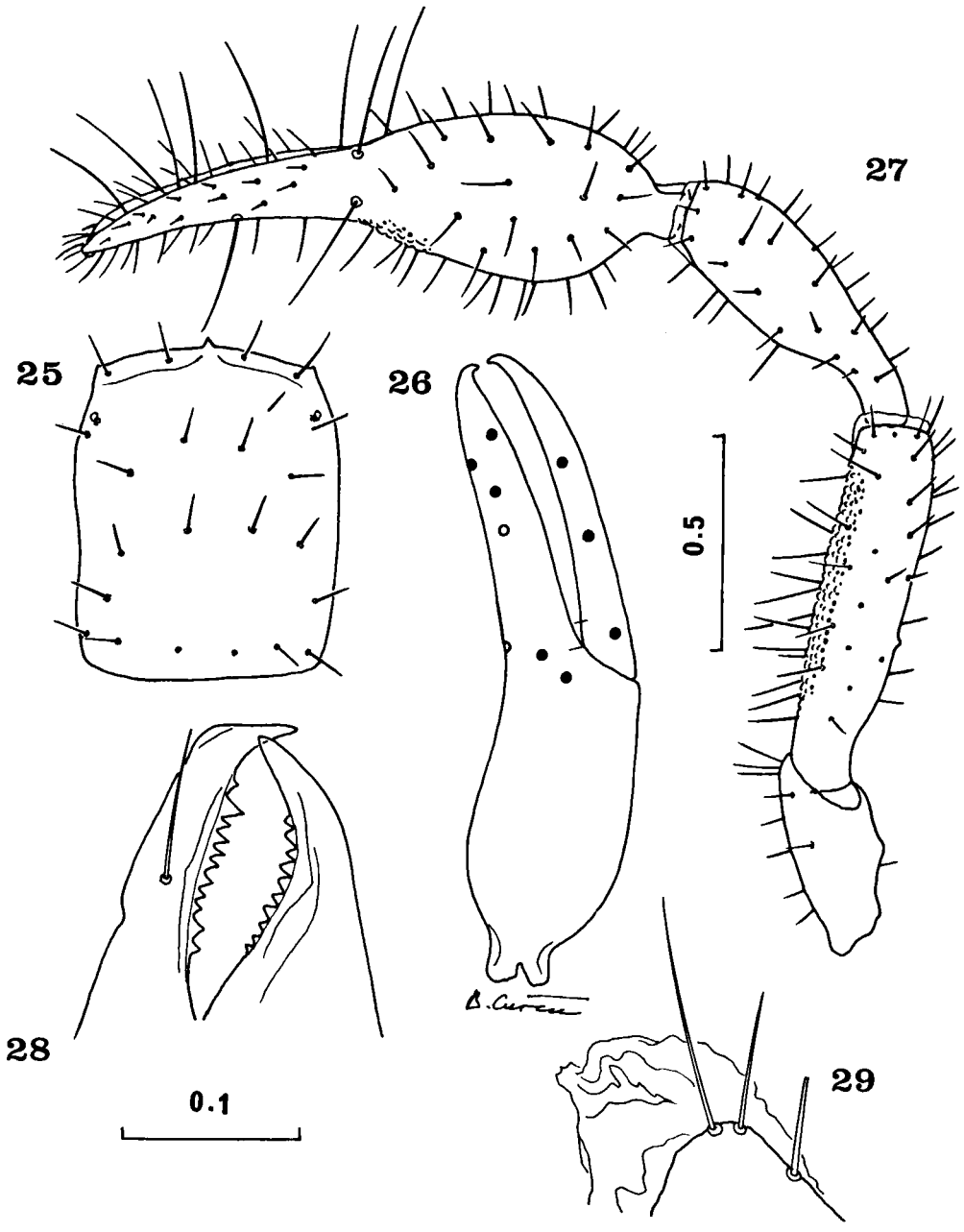
Galea as a low hyaline convexity (Figs. 15, 21 & 28). Cheliceral palm with 6 setae, movable finger with only 1 seta. Flagellum with 1 short proximal



Figs. 20–24. Roncus ciobanmos n. sp., paratype ♀ (FSB), from the Movile Cave, Romania: 20, pedipalp; 21, cheliceral fingers; 22, microseta distal to *eb-esb*; 23, carapace; 24, pedipalpal chela. Scales in mm.

blade and 7 longer blades distally, characteristic of the genus *Roncus*. All blades pinnate along their anterior margins.

Apex of pedipalpal coxa with 3 setae in tritonymph and 3 or 4 long ones in females (Figs. 18, 29). Pedipalpal trochanter with a small lateral tubercle and 1–4 small interior setae (no stout chaetae!); femur with a small exterolateral tubercle, and



Figs. 25–29. Roncus ciobanmos n. sp., paratype tritonymph (FSB), from the Movile Cave, Romania: 25, carapace; 26, pedipalpal chela; 27, pedipalp; 28, cheliceral fingers; 29, apex of pedipalpal coxa. Scales in mm.

with some interior and lateral granulations (Figs. 16, 20 & 27). Tibia smooth (Figs. 38–42). Chelal palm with some interolateral granulations and rare, inconspicuous and flattened tubercles on its exterolateral side (these tubercles are absent in tritonymph) (Figs. 16, 20 & 27). Single tiny tubercle present on laterodistal side of chelal palm. Group of microsetae proximal to trichobothria *eb* and *esb* not developed (Fig. 22). Fixed chelal finger with 63–66 teeth in tritonymph and 85–110 in females;

distal teeth asymmetrical, followed by small, closely set, and slightly retroconical teeth. Movable chelal finger with 62–64 teeth in tritonymph and 87–101 in females. Only distal teeth pointed and retroconical, others rounded or square-cusped. Sensillum between 14th and 17th tooth in tritonymph, and between 12th and 26th tooth in female (either proximal to, distal to, or at the level of *sb*).

Chelal fingers equal to or longer than chelal palm and somewhat shorter than pedipalpal femur (Table II). Trichobothrial patterns (Figs. 17, 24 & 26): *sb* slightly closer to *b* than to *st*, *st* closer to *t* than to *sb*; *ist* slightly closer to *est* than to *isb* (Figs. 17, 24 & 26).

Tibia IV, basitarsus IV, and telotarsus IV each with a long tactile seta (Fig. 19). Only in one paratype female, the right telotarsus IV carries an additional subproximal tactile seta (somewhat shorter than other tactile setae); the setation of the left telotarsus IV is here apparently normal. Morphometric ratios and linear measurements are presented in Table II.

Distribution. – Endemic species of southern Dobrogea, Romania (Movile Cave).

Relationships of *R. ciobanmos* and other species. – *R. ciobanmos* is related to four eastern Serbian (Yugoslav) cavernicolous species: *R. talason* Curčić, Lee & Makarov, 1993, *R. timacensis* Ćurčić, 1981, *R. remesianensis* Ćurčić, 1981, and *R. pljakici* Ćurčić, 1973.

The new species is distinct from *R. talason*, its phenetically most similar species, in the pedipalpal femur length to breadth ratio (3.975–4.83 vs. 5.20), the pedipalpal chela length to breadth ratio (3.89–4.71 vs. 4.85), the granulations on the exterolateral surface of the chelal palm (present vs. absent), the number of teeth on the movable chelal finger (87–101 vs. 83), the form of the pedipalpal articles, and in body size (greater vs. smaller).

R. ciobanmos and *R. timacensis* are distinct in many important aspects, such as the relative position of *ist* (equidistant from *est* and *isb* vs. closer to *est* than to *isb*), the granulations on the exterolateral surface of the chelal palm (present vs. absent), the eye spots (present vs. absent), the form of the pedipalpal podomeres (less elongate vs. more elongate), and the body size (greater vs. smaller).

R. ciobanmos and *R. remesianensis* exhibit considerable differences in the eye spots (present vs. absent), in the granulations on the exterolateral surface of the chelal palm (present vs. absent), in the number of teeth of the movable chelal finger (87–101 vs. 80–86), in the pedipalpal tibia length to breadth ratio (3.18–3.38 vs. 2.65–3.03), in the pedipalpal chela length to breadth ratio (4.23–4.71 vs. 3.85–4.11), and in body size (greater vs. smaller).

The troglobitic *R. ciobanmos* and *R. pljakici* are easily distinguished by the granulations on the exterolateral side of the chelal palm (present vs. absent), by the relative position of *ist* (equidistant from *est* and *isb* vs. closer to *est* than to *isb*), by the pedipalpal length (5.365–7.58 mm vs. 5.14 mm), by the pedipalpal tibia length (0.97–1.32 mm vs. 0.87 mm), by the pedipalpal tibia length to breadth ratio (3.18–3.38 vs. 2.64), by the pedipalpal chela length to breadth ratio (4.23–4.71 vs. 4.09), by the form of the pedipalpal podomeres (more elongate vs. less elongate), and by the body size (greater vs. smaller).

R. ciobanmos is easily distinguished from the other sympatric species, *R. dragobete*, in the majority of linear measurements and morphometric ratios: carapace length (0.95–1.23 mm vs. 0.59 mm), cheliceral length (0.54–0.70 mm vs. 0.38 mm), pedipalpal femur length (1.11–1.60 mm vs. 0.65 mm), pedipalpal femur breadth (0.24–0.36 mm vs. 0.18 mm), pedipalpal tibia length (0.97–1.32 mm vs. 0.51 mm), pedipalpal chela length (1.985–2.92 mm vs. 1.16 mm), femur IV length (1.01–1.21 mm vs. 0.56 mm), pedipalpal femur length to breadth ratio (4.44–4.83 vs. 3.61), pedipalpal tibia length to breadth ratio (3.18–3.38 vs. 2.22), and femur IV length to breadth ratio (3.39–4.04 vs. 3.03). In addition, *R. ciobanmos* differs from *R. dragobete* in the number of teeth on the fixed (85–110 vs. 54) and movable chelal fingers (87–101 vs. 52), in the granulations on the pedipalpal tibia (absent vs. present), in the form of the pedipalpal podomeres (elongate vs. stout), and in body size (greater vs. smaller).

There is pronounced individual variation of a

Table II. Linear measurements (in mm) and morphometric ratios in *Roncus ciobanmos* n. sp., *R. dragobete* n. sp., and *Neobisium* (*N.*) *biharicum* Beier, from Romania. Abbreviations: trito. = tritonymph, TS = tactile seta.

Character	*ciobanmos*		*dragobete*	*biharicum*
	♀♀	trito.	♀	♀
Body				
Length (1)	2.93–3.84	2.31–3.27	1.89	5.21
Cephalothorax				
Length (2)	0.95–1.23	0.73	0.59	1.23
Breadth	0.74–0.94	0.60–0.66	0.56	1.32
Abdomen				
Length	1.85–2.61	1.58–2.54	1.30	3.98
Breadth	0.96–1.20	0.89	0.72	1.85
Chelicerae				
Length (3)	0.54–0.70	0.435–0.44	0.38	0.905
Breadth (4)	0.26–0.35	0.23	0.20	0.46
Length of movable finger (5)	0.36–0.48	0.36–0.37	0.25	0.59
Length of galea	0.01	0.01	–	0.05
Pedipalps				
Length with coxa (6)	5.365–7.58	3.895–4.06	3.14	9.13
Ratio 6/1	1.54–2.22	1.19–1.76	1.66	1.75
Length of coxa	0.66–0.89	0.57–0.59	0.44	1.18
Length of trochanter	0.63–0.85	0.43–0.48	0.38	0.92
Length of femur (7)	1.11–1.60	0.795–0.84	0.65	2.02
Breadth of femur (8)	0.24–0.36	0.20–0.205	0.18	0.41
Ratio 7/8	4.44–4.83	3.975–4.10	3.61	4.93
Ratio 7/2	1.17–1.35	1.09–1.15	1.10	1.64
Length of tibia (9)	0.97–1.32	0.65–0.71	0.51	1.43
Breadth of tibia (10)	0.305–0.41	0.23–0.24	0.23	0.48
Ratio 9/10	3.18–3.38	2.83–2.96	2.22	2.98
Length of chela (11)	1.985–2.92	1.42–1.44	1.16	3.58
Breadth of chela (12)	0.46–0.62	0.34–0.37	0.32	0.85
Ratio 11/12	4.23–4.71	3.89–4.18	3.625	4.21
Length of chelal palm (13)	0.95–1.34	0.71	0.54	1.56
Ratio 13/12	2.065–2.16	1.92–2.09	1.69	1.835
Length of chelal finger (14)	1.035–1.58	0.71–0.73	0.62	2.02
Ratio 14/13	1.00–1.18	1.00–1.03	1.15	1.29
Leg IV				
Total length	3.65–4.555	2.645–2.73	2.225	6.61
Length of coxa	0.46–0.59	0.40–0.425	0.35	0.89
Length of trochanter (15)	0.43–0.555	0.31–0.34	0.32	0.78
Breadth of trochanter (16)	0.17–0.20	0.14	0.14	0.29
Ratio 15/16	2.31–2.775	2.21–2.43	2.285	2.69
Length of femur (17)	1.01–1.21	0.71–0.73	0.56	1.81
Breadth of femur (18)	0.25–0.35	0.19–0.205	0.185	0.41
Ratio 17/18	3.39–4.04	3.56–3.74	3.03	4.41
Length of tibia (19)	0.93–1.19	0.61–0.64	0.49	1.45
Breadth of tibia (20)	0.11–0.18	0.11	0.09	0.21
Ratio 19/20	6.44–7.285	5.545–5.82	5.44	6.90
Length of basitarsus (21)	0.33–0.41	0.23–0.24	0.185	0.69
Breadth of basitarsus (22)	0.09–0.12	0.08–0.09	0.075	0.18
Ratio 21/22	3.30–3.45	2.555–3.00	2.47	3.83
Length of telotarsus (23)	0.49–0.61	0.36–0.38	0.32	0.99
Breadth of telotarsus (24)	0.08–0.10	0.08–0.09	0.075	0.13
Ratio 23/24	5.555–6.125	4.22–4.50	4.27	7.615
TS ratio – tibia IV	0.56–0.62	0.54–0.55	0.58	0.36
TS ratio – basitarsus IV	0.155–0.24	0.22–0.26	0.26	0.11
TS ratio – telotarsus IV	0.37–0.48	0.39–0.46	0.38	0.19
	–	–	–	0.57

number of morphological features in *R. ciobanmos*, viz.: carapace setation (number and relative position of carapace setae), setation of the apex of the pedipalpal coxa, number of chelal teeth, and, particularly, form and size of pedipalpal articles (Figs. 16, 20 & 38–42) and body size (Table II). In our opinion, one of the main causes of this variation should be sought among the factors affecting the process of adaptation of *R. ciobanmos* to the subterranean environment. Similar phenomena have been observed in a number of pseudoscorpion species inhabiting caves of the Dinaric Karst (Ćurčić, 1988a) and elsewhere (pers. comm.: Mahnert to Ćurčić, 23 November 1992).

R. ciobanmos is closely related to a number of cavernicolous species (*R. talason*, *R. pljakici*, *R. timacensis*, and *R. remesianensis*), from eastern and southeastern Serbia, Yugoslavia. All these species are considered either descendants of the Balkanic epigean species *R. parablothroides* Hadži, 1937, or having a common origin with this species (Ćurčić, 1991). The finding of *R. ciobanmos* is thus further proof of the endemic differentiation or pronounced radiation of *R. parablothroides*-related species, by means of intensive colonization of cave habitats in different karstic areas of the Balkans and adjoining regions.

It is suggested that the ancestral population of *R. ciobanmos* might have populated underground habitats well before the formation of the Movile Cave (perhaps in the form of a "lithoclassicolous" population; Dumitresco & Orghidan, 1964), or at the beginning of the cave formation, i.e. some 5.5 to 5.2 million years ago (Lascu, 1989; Sarbu & Popa, 1992).

R. ciobanmos probably colonized its type locality recently; the presence of eye spots in both adult and subadult stages, and the presence of tapetum in the tritonymph stage support this assumption. Nevertheless, this species is a true troglobite and its life cycle is fully established in the underground habitat (as its cave-adapted tritonymph lives in the cave as well).

Roncus dragobete n. sp.
(Figs. 30–37, 43; Table II)

Etymology. – In Romanian mythology, Dragobete is a wizard, the patron of joy and entertainment (Vulcănescu, 1985).

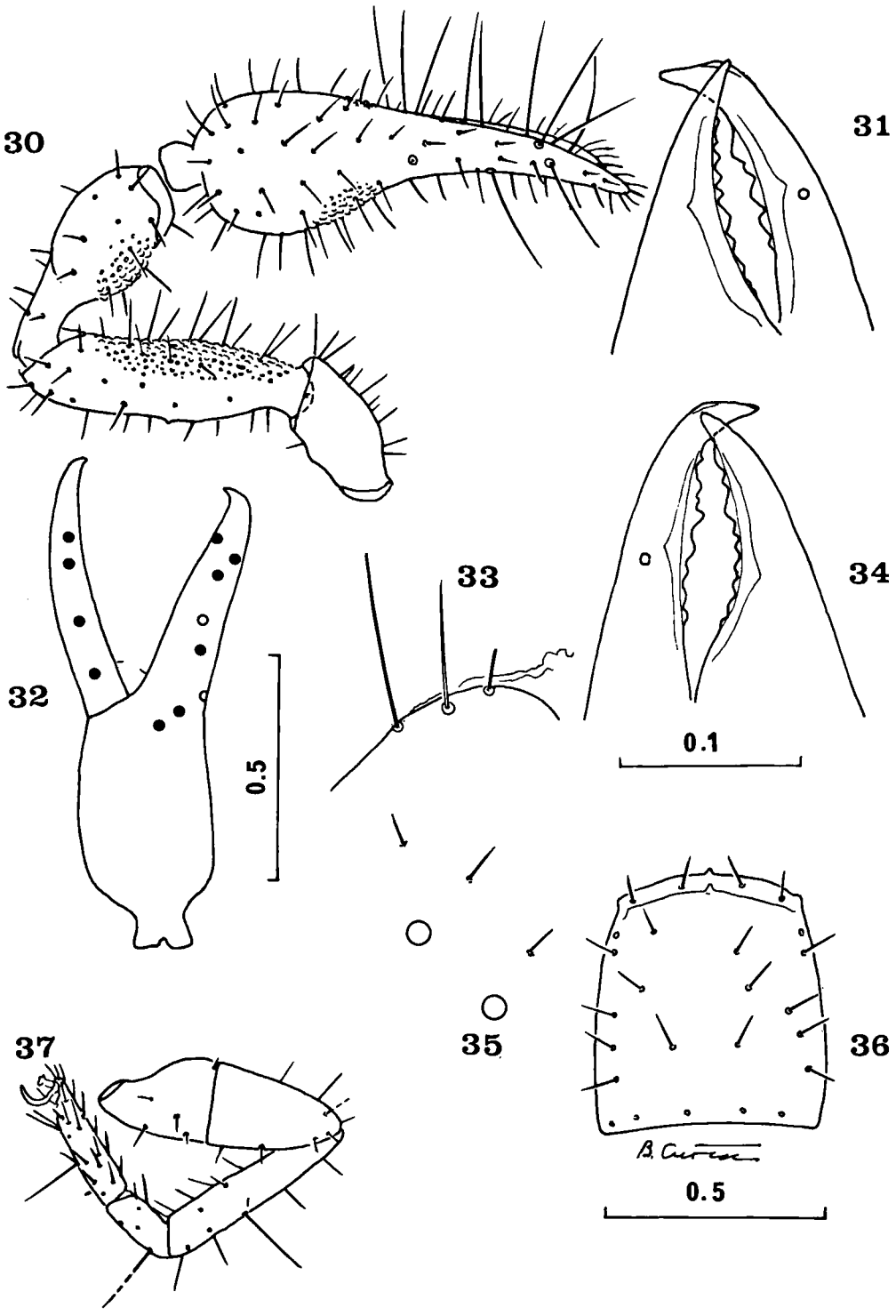
Specimen examined. – Holotype ♀ (FSB), from the Movile Cave, near Mangalia, southern Dobrogea, Romania, 18 June 1991, Serban M. Sarbu leg.

Description. – Carapace with two tiny eye spots. Epistome triangular (Fig. 36). Setal formula: 4 + 6 + 2 + 4 + 2 + 5 = 23; the basic pattern is probably 4 + 6 + 2 + 4 + 2 + 6 = 24 setae.

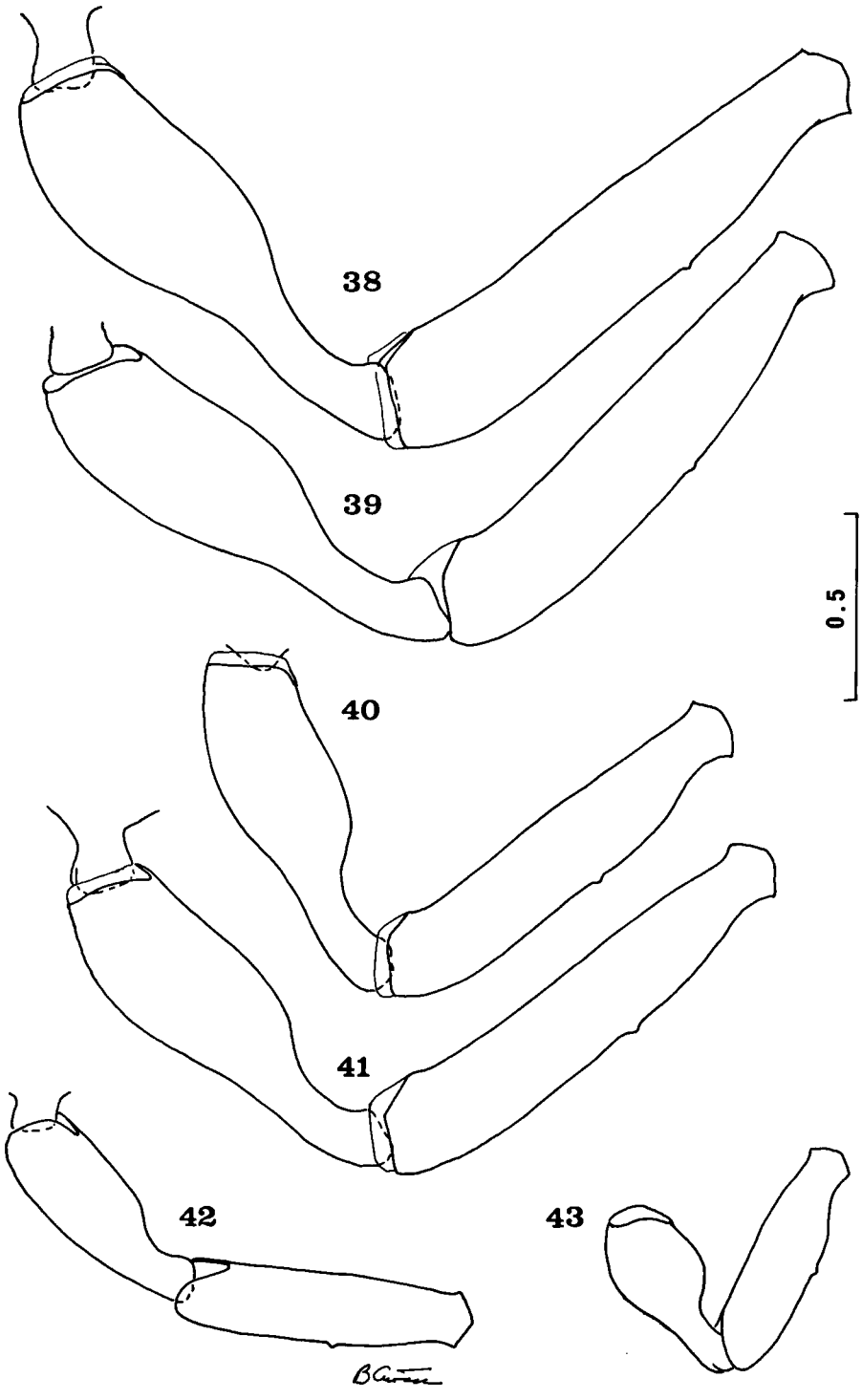
Tergites I–X bearing 6–8–9–10–10–11–11–11–11–10 setae. Male genital area unknown. Female genital area: sternite II with 6 small median and posterior setae, in two barely distinguishable groups. Sternite III with 7 posterior setae and 2 or 3 suprastigmal microsetae on either side, sternite IV with 8 marginal setae and 2 or 3 microsetae along each stigma. Sternites V–X each with 11–13 setae. Setae on sternites VI–X arranged in transverse rows, without anterior and median setae.

Galea low and flattened (Figs. 31, 34). Cheliceral palm with 6 setae and movable finger with 1 seta. Flagellum with 1 short proximal blade and 7 longer blades distally, characteristic of the genus *Roncus*.

Apex of pedipalpal coxa with 2 or 3 long setae (Fig. 33). Pedipalpal trochanter with a small interior tubercle, femur with a small exterolateral tubercle and some interior and dorsal granulations (Figs. 30, 43). Tibia tulip-shaped; surface with conspicuous distal granulations on interolateral side. Chelal palm with well-developed interolateral granulations and some weakly developed exterolateral ones (Fig. 30). Fixed chelal finger with 54 teeth; only distal teeth pointed and asymmetrical, other teeth small, closely set and retroconical. Movable chelal finger with 52 teeth; only distal teeth of this finger are pointed and retroconical, these are gradually merging into rounded or square-cusped teeth. Patch of microsetae proximal to *eb* and *esb* absent (Fig. 35); single tubercle on laterodistal side of chelal palm present. Sensillum at level of 13th tooth, slightly proximal to *sb*.



Figs. 30–37. Roncus dragobete n. sp., holotype ♀ (FSB), from the Movile Cave, Romania: 30, pedipalp; 31, cheliceral fingers (right chelicera); 32, pedipalpal chela; 33, apex of pedipalpal coxa; 34, cheliceral fingers (left chelicera); 35, microsetae distal to *eb-esb*; 36, carapace; 37, leg IV. Scales in mm.



Figs. 38–43. Pedipalpal femora and tibiae (setae and granulation omitted): 38, *R. ciobanmos* n. sp., holotype ♀ (FSB); 39, *R. ciobanmos* n. sp., paratype ♀ (FSB); 40, *R. ciobanmos* n. sp., paratype ♀ (MGAB); 41, *R. ciobanmos* n. sp., paratype ♀ (USNM); 42, *R. ciobanmos* n. sp., paratype tritonymph (USNM); 43, *R. dragobete* n. sp., holotype ♀ (FSB). Scale in mm.

Chelal palm ovate in dorsal view. Chelal finger slightly longer than chelal palm, but shorter than pedipalpal femur. Pedipalpal femur longer than carapace (Table II). Trichobothrial pattern (Fig. 32): *ist* closer to *isb* than to *est*; seta *sb* equidistant from *st* and *b*; seta *st* closer to *t* than to *sb*. Tibia IV, basitarsus IV, and telotarsus IV each with a single tactile seta (Fig. 37).

Morphometric ratios and linear measurements are presented in Table II.

Distribution. – Endemic species of southern Dobrogea, Romania (Movile Cave).

Relationships of *R. dragobete* and other species. – For comparison with *R. ciobanmos*, see p. 233.

The distinctions between *R. dragobete* and the epigean *R. svarozici* Ćurčić, 1992, inhabiting eastern Serbia, Yugoslavia, are manifested in the granulation of the pedipalpal femur (femur granulated along its interior surface vs. femur with interior and distal granulations only), in the granulations on the pedipalpal tibia (present vs. absent) and on the exterolateral side of the chelal palm (present vs. absent), in the pedipalpal femur length to carapace length ratio (femur longer than carapace vs. femur shorter than carapace), in the position of *ist* (closer to *isb* than to *est* vs. equidistant from *isb* and *est*), in the cheliceral length (0.38 mm vs. 0.775–0.80 mm), in the pedipalpal length (3.14 mm vs. 3.97–3.985 mm), in the pedipalpal femur length (0.65 mm vs. 0.78–0.79 mm), in the pedipalpal femur length to breadth ratio (3.61 vs. 3.12–3.16), in the pedipalpal chela length to breadth ratio (3.625 vs. 3.20–3.33), in the shape of the pedipalpal articles (less robust vs. more robust), and in body size (greater vs. smaller).

The distinctions between *R. dragobete* and its phenetically most similar species, the epigean *R. transsilvanicus*, are manifested by the granulation of the pedipalpal femur (femur granulated along its interolateral surface vs. femur with interior and distal granulations only), by the granulations on the pedipalpal tibia (present vs. absent), by the chelal finger length to chelal palm length ratio (finger longer than chelal palm vs. finger as long as chelal palm; see also Beier, 1963), by the relative position of *ist* (closer to *isb* than to *est* vs. closer to *est* than to *isb*, or equidistant from these; Beier, 1963), by the pedipalpal femur length to breadth ratio (3.61 vs. 4.10; Beier, 1963), by the pedipalpal tibia length to breadth ratio (2.22 vs. 2.50; Beier, 1963), by the pedipalpal femur length (0.65 mm vs. 1.02 mm; Beier, 1963) and tibia length (0.51 vs. 0.85 mm; Beier, 1963), by the chelal finger length to breadth ratio (3.625 vs. 3.30; Beier, 1963), and by the body size (smaller vs. greater).

It seems that *R. dragobete* colonized the cave habitat quite recently; this is supported by the presence of eye spots and by the relatively robust appendages in this species. In any case, it is probable that *R. dragobete* populated the underground milieu much later than its sympatric species *R. ciobanmos*.

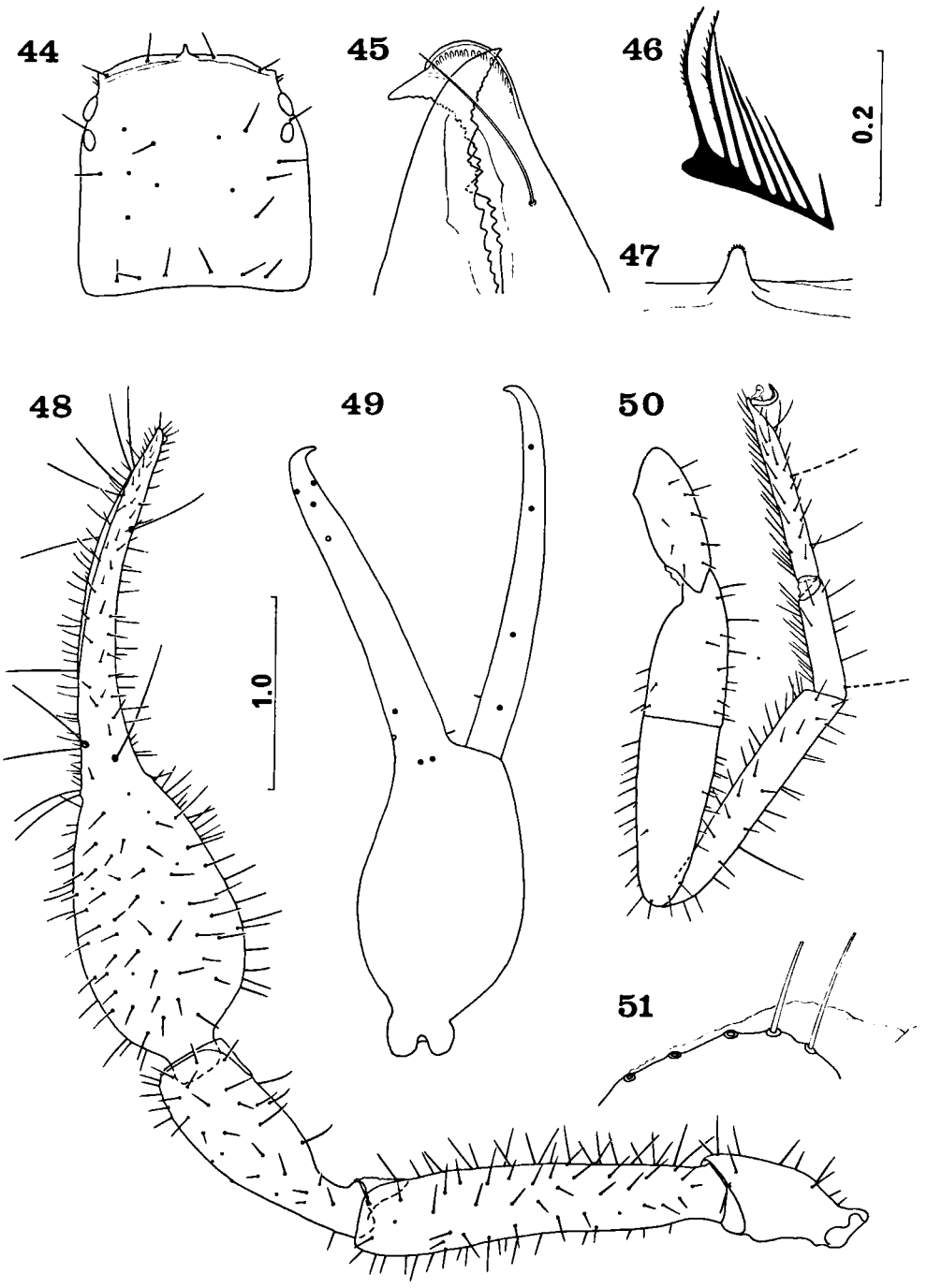
Neobisium (*Neobisium*) *biharicum* Beier, 1939
(Figs. 44–51; Table II)

Specimen examined. – Movile Cave, near Mangalia, southern Dobrogea, Romania, 4 Jan. 1992, one ♀ (FSB), Serban M. Sarbu leg.

Description. – Epistome triangular, with some apical chitinous points (Figs. 44, 47). Four well-developed eyes present, posterior eyes slightly less prominent than anterior eyes (Fig. 44). One or two microsetae in each preocular recess. Setal formula: 4 + 6 + 6 + 2 + 6 = 24. Carapace reticulate.

Abdominal tergites I–X with 6–6–7–11–10–10–10–10–11–10 setae. Male genital area unknown. Female genital area: sternite II with 11 (6 + 5) setae [of these, 9 (5 + 4) along posterior sternal border, and 2 (1 + 1) anteriorly and medially]; setae on this sternite grouped into two barely distinguishable groups, each on either side of the midline. Sternite III with 24 dense and almost transversely arranged setae and 5 suprastigmatic microsetae on either side. Sternite IV with 3 or 4 microsetae along each stigma and 12 posterior setae. Sternites V–X with 18–16–16–15–15–14 setae.

Galea prominent, crest-like (Fig. 45). Cheliceral palm with 7 setae, movable finger with 1 seta. Flagellum eight-bladed (Fig. 46); the two distalmost



Figs. 44–51. Neobisium (N.) biharicum Beier, 1939, ♀ (FSB), from the Movile Cave, Romania: 44, carapace; 45, cheliceral fingers; 46, flagellum; 47, epistome; 48, pedipalp; 49, pedipalpal chela; 50, leg IV; 51, apex of pedipalpal coxa. Scales in mm.

blades with some median denticulations which merge into distal pinnules, other blades smooth and diminishing in size from distal to proximal (characteristic of *Neobisium*).

Apex of pedipalpal coxa with 5 long setae (Fig. 51). Pedipalpal articles smooth (Fig. 48); trochanter with a small interior and lateral tubercle, chelal palm ovate (both dorsal and lateral views!).

Fixed chelal finger with 105 closely-set teeth; distal teeth asymmetrical and pointed. Proximal teeth asymmetrical and slightly rounded apically; these eventually merge into small and rounded teeth. Movable chelal finger with 93 closely-set teeth; only distal teeth pointed and asymmetrical, others square-cusped and eventually rounded. Pedipalpal femur longer than carapace and shorter than chelal fingers, chelal fingers longer than chelal palm (Table II). Trichobothriotaxy as in Figs. 48, 49; *ist* closer to *est* than to *isb*.

Leg IV: tibia and basitarsus each with a long tactile seta, telotarsus with one subproximal (0.34 mm) and one subdistal tactile seta (0.44 mm) (Fig. 50). For morphometric ratios and linear measurements, see Table II.

Distribution. – Probably endemic species of Romania; epigean and occasionally in caves.

Remarks. – The values of the linear measurements, morphometric ratios (Table II) and qualitative features of this specimen are within the variation range of these characters as stated by Beier (1963). Some minor distinctions are merely the result of intraspecific variation.

Concluding remarks

Immediately after its discovery in 1986, the Movile Cave in southern Dobrogea, Romania, drew the attention of numerous biologists. Surprisingly, most species inhabiting the cave were previously undescribed and are characterized by a high degree of troglomorphy (Sarbu & Popa, 1992).

This underground habitat is inhabited by three cavernicolous pseudoscorpion species: *Chthonius* (*C.*) *monicae* (Chthoniidae), *Roncus ciobanmos*, *R. dragobete*, and by a surface and occasional cave dweller, *Neobisium* (*N.*) *biharicum* (Neobisiidae). All these species are considered endemic to Romania. It is evident that *C.* (*C.*) *monicae* is closely related to *C.* (*C.*) *troglodites* and *C.* (*C.*) *cavophilus*, both inhabiting some Bulgarian caves (Redikorzev, 1928; Hadži, 1939). On the other hand, *R. ciobanmos* is phenetically most similar to *R. talason* from eastern Serbia, Yugoslavia, while *R. dragobete* is closely related to the epigean *R. transsilvanicus* from Romania. Finally, *N.* (*N.*) *biharicum* is related to some Balkan, Russian, and Georgian species [e.g.: *N.* (*N.*) *labinskyi* Beier, 1937; cf. Beier, 1963].

Interestingly enough, both *C.* (*C.*) *monicae* and *R. ciobanmos* are true troglobites, and their life cycle is fully established in their cave habitat; the same might hold true for *R. dragobete*, although this species has preserved its "epigean" appearance (presence of pigment and eye spots, relatively robust appendages, and comparatively short body setae). In addition, both *C.* (*C.*) *monicae* and *R. ciobanmos* show considerable variation in a number of qualitative and quantitative features, such as: pigmentation, presence/absence of preocular microsetae, number of posterior carapace setae, and setation of tergite I (*C. monicae*), as well as carapace setation, setation of the apex of the pedipalpal coxa, number of chelal teeth, form and size of pedipalpal articles, and some linear measurements and morphometric ratios (*R. ciobanmos*).

It is known that some populations of cave-dwelling arthropods that are apparently recent cave isolates show great variation in pigmentation, eye development, and some other morphological traits (Culver, 1982); such variation may be due to hybridization with the epigean ancestor after isolation in caves. Bearing this in mind, the statement "that the terrestrial troglobitic fauna of the Movile Cave became isolated from the surface at the end of the Miocene (5.5 to 5.2 million years ago)" (Lascu, 1989) is not sufficiently supported. Actually, part of the interest in regressive evolution arises from the fact that it may provide a clue to the amount of evolutionary time since the isolation in caves. Such a procedure is probably justified when regressive evolution is proceeded by neutral mutation or when the species are under similar selective regimes. In both cases the rate of evolution is constrained. If, on the other hand, the selective regimes differ (and the regressed characters are under selection; see e.g. Jones et al., 1992), for example in the degree of food limitation, regressive evolution is not even a crude measure of time (Culver, 1982; Ćurčić, 1988c). Therefore, much more remains to be learned

about the evolution and ecology of the pseudoscorpions from the Movile Cave before we can judge the period in which *C. (C.) monicae*, *R. ciobanmos*, and *R. dragobete* have been isolated from the surface.

From the biogeographic point of view, it is clear that *C. (C.) monicae*, *R. ciobanmos*, and *R. dragobete* originated from the old Balkanic fauna of pseudoscorpions, while the epigean *N. (N.) bihariicum* is probably related both to the Balkanic and Caucasian forms. All these species are autochthones, and they probably represent relict forms. This supports the view that the Balkan Peninsula and adjoining regions represent the main refugium of a previously existing and varied fauna of Mediterranean pseudoscorpions (Ćurčić, 1988c).

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