

## ON TWO NEW CAVE-DWELLING AND RELICT PSEUDOSCORPIONS OF THE GENUS *CHTHONIUS* C. L. KOCH (CHTHONIIDAE, PSEUDOSCORPIONES) FROM BOSNIA

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**Abstract.** - The pseudoscorpion sample from a cave in Bosnia has been studied. Two new species have been described herein: *Chthonius (Chthonius) protobosniacus* n. sp. and *C. (C.) kladanjensis* n. sp. Both taxa are considered endemic of Bosnia and the Balkan Peninsula. In this paper, diagnostic characters of the analyzed forms are thoroughly described and figured. Taxonomic interrelationship and geographic distribution are briefly discussed.

**Key words:** Pseudoscorpions, *Chthonius (Chthonius) protobosniacus* n. sp., *C. (C.) kladanjensis* n. sp., cave fauna, endemism, Bosnia.

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### INTRODUCTION

In the present study, material from a sample of pseudoscorpions collected in 2002 by one of us (TR) has been examined. The sample from the Djevojačka Pećina Cave consists of two previously undescribed species, *Chthonius (Chthonius) protobosniacus* n. sp. and *C. (C.) kladanjensis* n. sp. Both taxa, described in this paper are probably endemic and relict forms inhabiting a single cave nr. Kladanj in Bosnia.

Setal designations follow Beier (1963).

### SYSTEMATIC PART

CHTHONIIDAE DADAY, 1888

*CHTHONIUS* C. L. KOCH, 1843

*CHTHONIUS (CHTHONIUS) PROTOBOSNIACUS*  
ĆURČIĆ, DIMITRIJEVIĆ & RAĐA,  
NEW SPECIES

(Figs. 1-8, Table 1)

**Etymology.** - After Bosnia, its terra typica.

**Material examined.** - Holotype female, from Djevojačka Pećina Cave, village Brateljevići; 6 km from Kladanj, Bosnia; 20 July 2002, collected by Tonći Rađa.

**Description.** - The carapace reaches its maximum breadth on the level of the 'ocular' setal series and is in general as long as broad (Table 1). The anterior carapacial margin is broader than the posterior and the carapace as a whole resembles regular trapezium (Fig. 5).

The epistome is inconspicuous (Figs. 4 and 5); its tiny serrations can be seen on the margin almost up to the lateral anterior setae (Figs. 4 and 5). Anterior eyes are well developed, posteriors spot-like (Fig. 5).

The dorsal surface of the carapace carries 20 setae. Setal carapacial formula is  $4 + 6 + 6 + 4 = 20$ . Two preocular microsetae are formed in each preocular recess (Fig. 5). The number of setae on tergites I-X is 4-4-4-4-6-6-6-6-6-6 (female). In the female, sternite

II with 10 setae, sternite III with 10 posterior setae and three suprastigmatic microsetae on either side, sternite IV with seven or eight setae and two small microsetae along each of the stigma, sternites V-X: 9-8-6-6-6-7 setae, and 9-7-6-6-6-6 setae. Both sternites III and IV carry each three or two suprastigmatic microsetae on either side. Anal papilla with two pairs of small setae. Pleural membranes granulostriate.

The cheliceral spinneret is represented by a small sclerotic knob on the movable finger, and below on the inner margin is an isolated tooth (Fig. 7). The other tooth is contiguous with a row of smaller teeth which end below the insertion site of *gs* (Fig. 7). On the fixed cheliceral finger the teeth are larger, diminishing in size proximally, below those on the movable finger (Fig. 7). Cheliceral teeth are variable in size and form.

The movable cheliceral finger carries one large galeal seta and six setae on the cheliceral palm (Fig. 7). The cheliceral flagellum is composed of nine or ten bipinnate blades arranged in pairs.

The pedipalpal coxae carry five setae: two at the anterior and three on the posterior border of the trochantic foramen. The pedipalpal femur is 5.82-6.10 times (female) as long as broad and 1.275-1.29 (female) times longer than the carapace (Table 1). Eight trichobothria are carried on the fixed and four on the movable finger (Figs. 1 and 2). Both fingers are only apically curved inwards, and the movable finger is slightly more bent inwards than the fixed finger. The fixed chelal finger is 1.05-1.12 times as long as the chelal palm; the ratio of the pedipalpal chela length to breadth is 4.705-4.94 (female). The teeth of the fixed finger (20) in the female are distally triangular, apically pointed, interspaced; the proximal teeth of this finger are low, close-set, apically rounded, and somewhat inclined backwards. The teeth of the movable finger (20) in the female are low, triangular, and interspaced (Fig. 1); these merge into small, low, rounded and close-set teeth proximally. In general, proximal and distal teeth of both fin-

gers are smaller than the median teeth (Fig. 1). Chelal palm distinctly ovate (Fig. 1).

Pedal coxae II and III carry spines medially in a distinct group, six or seven on coxa II of the female. Five spines are carried on coxa III by the female (Fig. 8). The intercoxal tubercle carries two small setae (Fig. 8).

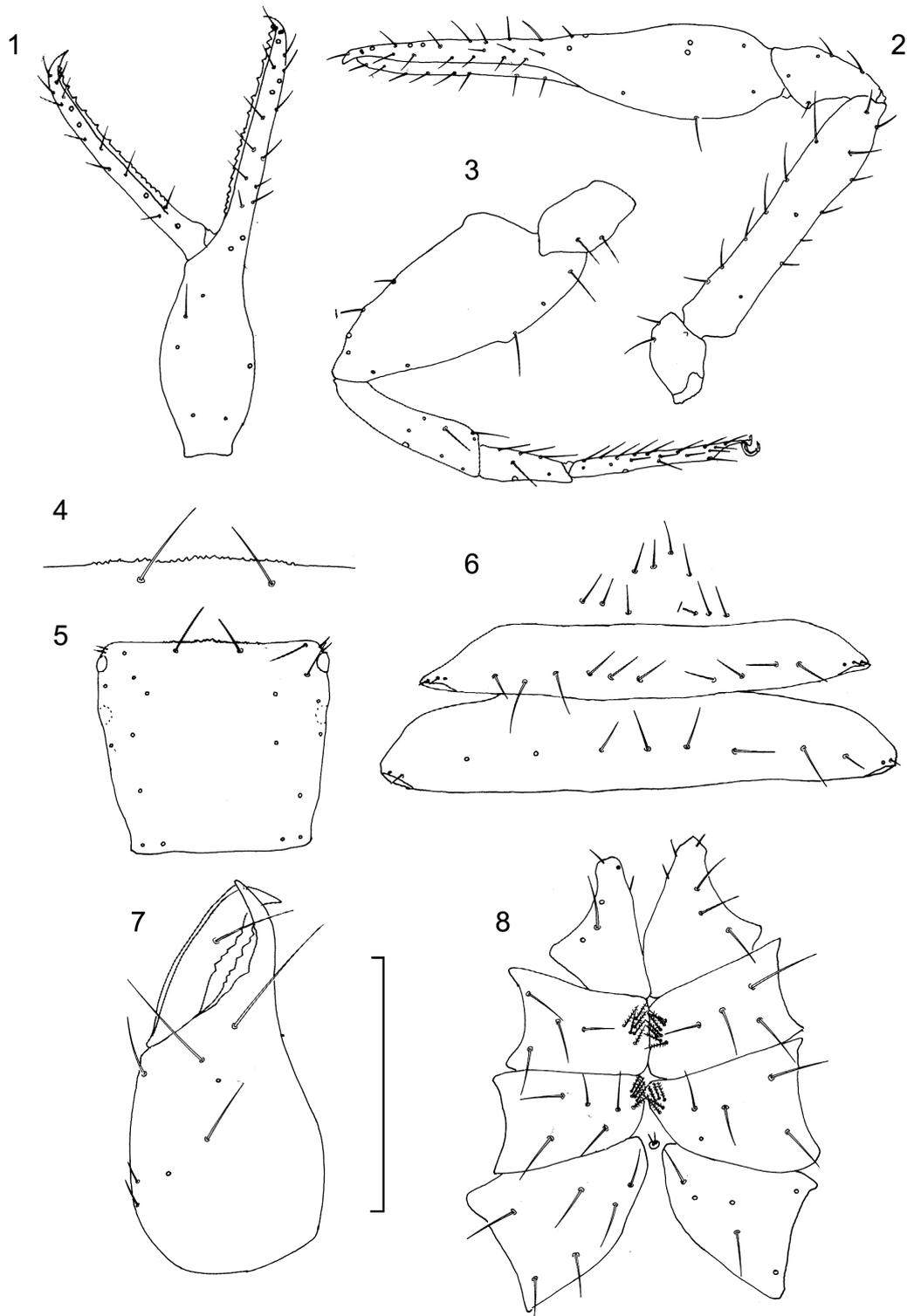
Tibia IV, metatarsus IV, and tarsus IV each carry a long sensitive seta (Fig. 3).

The measurements (in mm) and morphometric ratios of different body structures are presented in Table 1.

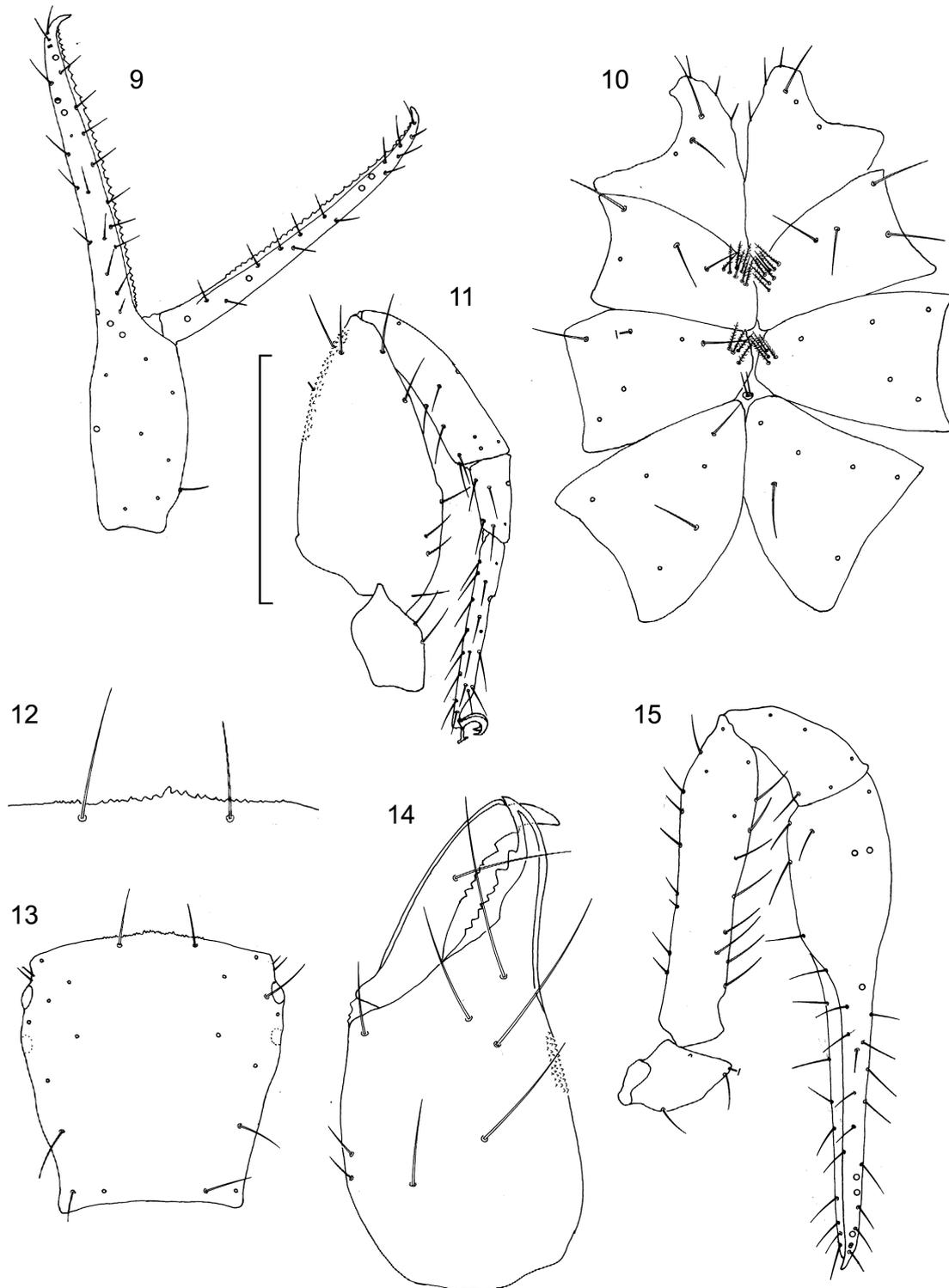
*Remarks.* - The new species is easily distinguished from *C. (C.) subterraneus* Beier in the body size (1.65-1.75 mm vs. 2.30 mm), in the form of the pedipalpal articles, in the length of pedipalpal chela (0.80-0.98 mm vs. 1.42-1.45 mm), in the length of the chelal palm (0.39-0.42 mm vs. 0.54-0.55 mm), in the ratio of chelal palm length to its breadth (2.00-2.33 vs. 1.69-1.72), in the length of the chelal finger to length of chelal palm ratio (1.05-1.12 vs. 1.63-1.64), as well as in other measurements and ratios (Table 1).

From *C. (C.) meuseli* Beier, the new species differs in the size of the body (1.50 mm vs. 1.65-1.75 mm), in the length to breadth ratio of the chela (5.30 vs. 4.705-4.94), in the length of the chelal palm (0.33 mm vs. 0.39-0.42 mm), in the chelal palm length to its breadth ratio (1.80 vs. 2.00-2.33), in the length of the chelal finger (0.64 mm vs. 0.41-0.58 mm), in the length of chelal finger to length of chelal palm ratio (1.94 vs. 1.05-1.12), in the form of pedipalpal articles, as well as in many linear measurements and morphometric ratios (Table 1).

From *C. (C.) onaei* Čurčić, Dimitrijević. Čurčić, and Čurčić, *C. (C.) protobosniacus* n. sp. differs clearly in the body size of the female (2.30 mm vs. 1.65-1.75 mm), in the form of posterior eyes (distinct vs. eye-spots), in the form of chelal fingers (almost straight vs. slightly bent inwards), in the form and number of teeth on the fixed chelal finger,



**Figs. 1-8.** *Chthonius (Chthonius) protobosniacus* n. sp., holotype female, from Bosnia. 1 - pedipalpal chela, 2 - pedipalp, 3 - leg IV, 4 - epistome, 5 - carapace, 6 - female genital area, 7 - chelicera, 8 - coxae I-IV. Scale lines = 0.25 mm (Figs. 4 and 6-8) and 0.50 mm (Figs. 1-3 and 5).



**Figs. 9-15.** *Chthonius (Chthonius) kladanjensis* n. sp., holotype male, from Bosnia. 9 - pedipalpal chela, 10 - coxae I-IV, 11 - leg IV, 12 - epistome, 13 - carapace, 14 - chelicera, 15 - pedipalp. Scale lines = 0.25 mm (Figs. 9, 11, 13, and 15) and 0.50 mm (Figs. 10, 12, and 14).

in the form of the pedipalpal articles, as well as in different measurements and morphometric ratios (Table 1).

Compared with *C. (C.) kladanjensis* n. sp., *C. (C.) protobosniacus* n. sp. differs in the body size (1.85 mm vs. 1.65-1.75 mm), in the pedipalpal length (2.635 mm vs. 2.105-2.265 mm), in the pedipalpal femur length to breadth ratio (5.07 vs. 5.82-6.10), in the chelal palm length to breadth ratio (2.00 vs. 2.29-2.33), in the leg IV length (2.125 mm vs. 1.805-1.91 mm), as well as in many morphometric ratios and linear measurements (Table 1).

*Distribution.* - The new pseudoscorpion species inhabits a cave in central Bosnia; it represents probably a form that has been subjected to colonization in underground habitats (troglophilic element) (Beier, 1939, 1963; Ćurčić, 1972, 1988; Ćurčić et al., 1993, 1997a, b, 1999, 2004, 2008, 2010, 2011a, b, c, d, Hadži, 1937).

*CHTHONIUS (CHTHONIUS) KLADANJENSIS*  
URČIĆ, DIMITRIJEVIĆ & RAĐA,  
NEW SPECIES

(Figs. 9-15, Table 1)

*Etymology.* - After Kladanj, the nearest city to the type locality of this species.

*Material examined.* - Holotype male from Djevojačka Pećina Cave, village Brateljevići; 6 km from Kladanj, Bosnia; 20 July 2002, collected by Tonći Rađa.

*Description.* - The carapace reaches its maximum breadth on the level of the 'ocular' setal series and is in general as long as broad (Table 1). The anterior carapacial margin is broader than the posterior and the carapace as a whole resembles regular trapezium (Fig. 13).

The epistome is inconspicuous (Fig. 13); its tiny serrations can be seen on the margin almost up to the lateral anterior setae (Figs. 12 and 13). Anterior eyes are well developed, posteriors spot-like (Fig. 13).

The dorsal surface of the carapace carries 20 setae. Setal carapacial formula is 4 + 6 + 6 + 4 = 20. Two preocular microsetae are formed in each preocular recess (Fig. 13). The number of setae on tergites I-X is 4-4-4-4-6-6-6-6-6-6 (male). In the male, sternite II with 11 setae, sternite III with seven or nine setae along each side of a V-shaped groove and nine posterior setae, sternite IV with 10 posterior setae. Both sternites III and IV carry each three suprastigmatic microsetae on either side. Sternites V-X with 9-8-6-6-6-7 setae. Anal papilla with two pairs of small setae. Pleural membranes granulostriate.

The cheliceral spinneret is represented by a small sclerotic knob on the movable finger, and below on the inner margin is an isolated tooth (Fig. 14). The other large tooth is contiguous with a row of smaller teeth which end below the insertion site of *gs* (Fig. 14). On the fixed cheliceral finger the teeth are larger, diminishing in size proximally, below those on the movable finger (Fig. 14). Cheliceral teeth are variable in size and form.

The movable cheliceral finger carries one large galeal seta and the six setae on the cheliceral palm (Fig. 14). The cheliceral flagellum is composed of nine bipinnate blades arranged in pairs.

The pedipalpal coxae carry five setae: two at the anterior and three on the posterior border of the trochantic foramen. The pedipalpal femur is 5.07 times (male) as long as broad and 1.42 (male) times longer than the carapace (Table 1). Eight trichobothria are carried on the fixed and four on the movable finger (Figs. 9 and 15). Both fingers are only apically curved inwards, and the movable finger is slightly more bent inwards than the fixed finger. The fixed chelal finger is 1.45 times as long as the chelal palm; the ratio of the pedipalpal chela length to breadth is 4.90 (male). The teeth of the fixed finger (36) in the male are triangular, apically pointed, interspaced, and inclined backwards; the proximal teeth of this finger are low and apically rounded. The teeth of the movable finger (31) in the male are low, triangular, and interspaced (Fig. 9); these merge into small, low, rounded, and close-set teeth proximally. In general, proximal and

**Table 1.** Linear measurements (in millimeters) and morphometric ratios in *Chthonius* (*Chthonius*) *protobosniacus* n. sp., *C. (C.) kladanjensis* n. sp., *C. (C.) subterraneus* Beier, *C. (C.) meuseli* Beier, and *C. (C.) onaei* Ćurčić, Dimitrijević, Rada, Ćurčić & Ćurčić. Abbreviations: ♀ = female, ♀♀ = females, ♂ = male.

| Character                       | <i>C. (C.) protobosniacus</i> | <i>C. (C.) kladanjensis</i> | <i>C. (C.) subterraneus</i> | <i>C. (C.) meuseli</i> | <i>C. (C.) onaei</i> |       |
|---------------------------------|-------------------------------|-----------------------------|-----------------------------|------------------------|----------------------|-------|
|                                 | ♀♀                            | ♂                           | ♀♂                          | ♂                      | ♀                    | ♂     |
| Body                            |                               |                             |                             |                        |                      |       |
| Length (1)                      | 1.65-1.75                     | 1.85                        | 2.30                        | 1.50                   | 2.30                 | 1.86  |
| Cephalothorax                   |                               |                             |                             |                        |                      |       |
| Length (2)                      | 0.45-0.46                     | 0.54                        | -                           | -                      | 0.63                 | 0.54  |
| Breadth (2a)                    | 0.45-0.46                     | 0.53                        | -                           | -                      | 0.60                 | 0.53  |
| Ratio 2/2a                      | 0.98-1.02                     | 1.02                        | -                           | -                      | 1.05                 | 1.02  |
| Abdomen                         |                               |                             |                             |                        |                      |       |
| Length                          | 1.19-1.30                     | 1.31                        | -                           | -                      | 1.67                 | 1.32  |
| Chelicerae                      |                               |                             |                             |                        |                      |       |
| Length (3)                      | 0.38-0.40                     | 0.49                        | -                           | -                      | 0.56                 | 0.49  |
| Breadth (4)                     | 0.18                          | 0.23                        | -                           | -                      | 0.295                | 0.24  |
| Length of movable finger (5)    | 0.18-0.19                     | 0.25                        | -                           | -                      | 0.315                | 0.275 |
| Ratio 3/5                       | 2.105-2.11                    | 1.96                        | -                           | -                      | 1.78                 | 1.78  |
| Ratio 3/4                       | 2.11-2.22                     | 2.13                        | -                           | -                      | 1.90                 | 2.04  |
| Pedipalps                       |                               |                             |                             |                        |                      |       |
| Length with coxa (6)            | 2.105-2.265                   | 2.635                       | -                           | -                      | 2.845                | 2.92  |
| Ratio 6/1                       | 1.275-1.29                    | 1.42                        | -                           | -                      | 1.24                 | 1.57  |
| Length of coxa                  | 0.275-0.295                   | 0.39                        | -                           | -                      | 0.40                 | 0.48  |
| Length of trochanter            | 0.18-0.19                     | 0.24                        | -                           | -                      | 0.285                | 0.25  |
| Length of femur (7)             | 0.61-0.64                     | 0.71                        | -                           | -                      | 0.76                 | 0.76  |
| Breadth of femur (8)            | 0.10-0.11                     | 0.14                        | -                           | -                      | 0.16                 | 0.16  |
| Ratio 7/8                       | 5.82-6.10                     | 5.07                        | -                           | -                      | 4.75                 | 4.75  |
| Ratio 7/2                       | 1.33-1.42                     | 1.31                        | -                           | -                      | 1.21                 | 1.57  |
| Length of patella (tibia) (9)   | 0.24-0.25                     | 0.315                       | -                           | -                      | 0.36                 | 0.34  |
| Breadth of patella (tibia) (10) | 0.10-0.11                     | 0.14                        | -                           | -                      | 0.14                 | 0.15  |
| Ratio 9/10                      | 2.27-2.40                     | 2.25                        | -                           | -                      | 2.57                 | 2.27  |
| Length of chela (11)            | 0.80-0.89                     | 0.98                        | 1.42-1.45                   | 0.97                   | 1.04                 | 1.09  |
| Breadth of chela (12)           | 0.17-0.18                     | 0.20                        | 0.32                        | 0.18                   | 0.24                 | 0.20  |
| Ratio 11/12                     | 4.705-4.94                    | 4.90                        | 4.80                        | 5.30                   | 4.33                 | 5.45  |
| Length of chelal palm (13)      | 0.39-0.42                     | 0.40                        | 0.54-0.55                   | 0.33                   | 0.42                 | 0.40  |
| Ratio 13/12                     | 2.29-2.33                     | 2.00                        | 1.69-1.72                   | 1.80                   | 1.75                 | 2.00  |
| Length of chelal finger (14)    | 0.41-0.47                     | 0.58                        | 0.88-0.90                   | 0.64                   | 0.62                 | 0.69  |
| Ratio 14/13                     | 1.05-1.12                     | 1.45                        | 1.63-1.64                   | 1.94                   | 1.48                 | 1.725 |
| Leg IV                          |                               |                             |                             |                        |                      |       |
| Total length                    | 1.805-1.91                    | 2.125                       | -                           | -                      | 2.25                 | 2.26  |
| Length of coxa                  | 0.25-0.295                    | 0.295                       | -                           | -                      | 0.275                | 0.275 |
| Length of trochanter (15)       | 0.21-0.22                     | 0.24                        | -                           | -                      | 0.22                 | 0.285 |
| Breadth of trochanter (16)      | 0.11-0.12                     | 0.14                        | -                           | -                      | 0.13                 | 0.13  |
| Ratio 15/16                     | 1.83-1.91                     | 1.71                        | -                           | -                      | 1.69                 | 2.19  |
| Length of femur + patella (17)  | 0.53-0.55                     | 0.62                        | -                           | -                      | 0.66                 | 0.64  |
| Breadth of femur + patella (18) | 0.23-0.25                     | 0.295                       | -                           | -                      | 0.26                 | 0.25  |
| Ratio 17/18                     | 2.20-2.30                     | 2.10                        | -                           | -                      | 2.54                 | 2.56  |
| Length of tibia (19)            | 0.315-0.34                    | 0.40                        | -                           | -                      | 0.43                 | 0.43  |

**Table 1.** Continued

| Character                  | <i>C. (C.) protobosniacus</i> | <i>C. (C.) kladanjensis</i> | <i>C. (C.) subterraneus</i> | <i>C. (C.) meuseli</i> | <i>C. (C.) onaei</i> |       |
|----------------------------|-------------------------------|-----------------------------|-----------------------------|------------------------|----------------------|-------|
|                            | ♀♀                            | ♂                           | ♀♂                          | ♂                      | ♀                    | ♂     |
| Ratio 19/20                | 3.50-3.78                     | 3.64                        | -                           | -                      | 3.91                 | 3.91  |
| Length of metatarsus (21)  | 0.16-0.19                     | 0.19                        | -                           | -                      | 0.23                 | 0.22  |
| Breadth of metatarsus (22) | 0.07                          | 0.07                        | -                           | -                      | 0.08                 | 0.08  |
| Ratio 21/22                | 2.285-2.71                    | 2.71                        | -                           | -                      | 2.875                | 2.875 |
| Length of tarsus (23)      | 0.315-0.34                    | 0.38                        | -                           | -                      | 0.41                 | 0.41  |
| Breadth of tarsus (24)     | 0.03-0.04                     | 0.05                        | -                           | -                      | 0.05                 | 0.05  |
| Ratio 23/24                | 8.50-10.50                    | 7.60                        | -                           | -                      | 8.20                 | 8.20  |
| TS ratio - tibia IV        | 0.45-0.48                     | 0.51                        | -                           | -                      | 0.48                 | 0.50  |
| TS ratio - metatarsus IV   | 0.37-0.375                    | 0.42                        | -                           | -                      | 0.22                 | 0.18  |
| TS ratio - tarsus IV       | 0.33                          | 0.30                        | -                           | -                      | 0.30                 | 0.30  |

distal teeth of both fingers are smaller than the median teeth (Fig. 9).

Pedal coxae II and III carry seven spines medially in a distinct group. Four of five spines are carried on coxa III in the male. The intercoxal tubercle carries two small setae (Fig. 10).

Tibia IV, metatarsus IV, and tarsus IV each carry a long sensitive seta (Fig. 11).

The measurements (in mm) and morphometric ratios of different body structures are presented in Table 1.

*Remarks.* - The new species is easily distinguished from *C. (C.) subterraneus* Beier in the body size (1.85 mm vs. 2.30 mm), in the form of the pedipalpal articles, in the length of pedipalpal chela (0.98 mm vs. 1.42-1.45 mm), in the length of the chelal palm (0.40 mm vs. 0.54-0.55 mm), in the ratio of chelal palm length to its breadth (2.00 vs. 1.69-1.72), in the length of the chelal finger to length of chelal palm ratio (1.45 vs. 1.63-1.64), as well as in other measurements and ratios (Table 1).

From *C. (C.) meuseli* Beier, the new species differs in the size of the body (1.50 mm vs. 1.85 mm), in the length to breadth ratio of the chela (5.30 vs.

4.90), in the length of the chelal palm (0.33 mm vs. 0.40 mm), in the chelal palm length to its breadth ratio (1.80 vs. 2.00), in the length of the chelal finger (0.64 mm vs. 0.58 mm), in the length of chelal finger to length of chelal palm ratio (1.94 vs. 1.45), in the form of pedipalpal articles, as well as in many linear measurements and morphometric ratios (Table 1).

From *C. (C.) onaei* Ćurčić, Dimitrijević. Ćurčić, and Ćurčić, *C. (C.) protobosniacus* n. sp. differs clearly in the form of posterior eyes (distinct vs. eyespots), in the form of chelal fingers (almost straight vs. slightly bent inwards), in the number of teeth on the fixed chelal finger (36 vs. 20), in the form of pedipalpal articles, as well as in different measurements and morphometric ratios (Table 1).

For comparison between *C. (C.) protobosniacus* n. sp. and *C. (C.) kladanjensis* n. sp. see „Remarks“ of *C. (C.) protobosniacus* n. sp.

*Distribution.* - The new pseudoscorpion species inhabits a cave in central Bosnia together with *Chthonius (C.) protobosniacus* n. sp.; it represents probably a form that has been subjected to colonization in underground habitats (troglophilic element) (Beier, 1939, 1963; Ćurčić, 1972, 1988; Ćurčić et al., 1993, 1997a, b, 1999, 2004, 2008, 2010, 2011a, b, c, d, Hadži, 1937).

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