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Authors: Mahnert, Volker, and Li, Yun-chun

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Cave-inhabiting Neobisiidae (Arachnida: Pseudoscorpiones) from China, with description of four new species of *Bisetocreagris* Ćurčić

Volker Mahnert[1] & Yun-chun Li[2*]

[1] *Muséum d'histoire naturelle, C.P. 6434, CH-1211 Genève 6, Switzerland. E-mail: volker.mahnert@wanadoo.fr*
[2] *College of Plant Protection, Southwest University, Beibei, Chongqing 400700, China.*
* *Corresponding author: liyunchun2260@126.com*

Abstract: Four new species of the genus *Bisetocreagris* Ćurčić are described from caves in the provinces of Guizhou (*B. chuanensis* n. sp.), Sichuan (*B. baozinensis* n. sp., *B. juanxuae* n. sp., and *Bisetocreagris* sp.) and Chongqing (*B. cavernarum* n. sp.). On the basis of the trichobothrial pattern and the apparent fragility of the galea in this group, the following species are transferred to *Bisetocreagris*: *Parobisium martii* Mahnert, 2003, *P. titanium* Mahnert, 2003, *P. scaurum* Mahnert, 2003, and *Stenohya chinacavernicola* Schawaller, 1995.

Keywords: Taxonomy - *Stenohya* - *Parobisium* - new combinations - biospeleology.

INTRODUCTION

Intensive speleological research has been carried out in collaboration between Chinese institutes and mainly European speleologists since at least 1985 (about 157 expeditions; see e.g. www.grottes-et-karsts-de-chine.org and Senior, 1995), but biospeleological collections seem to be rare. Systematic biospeleological exploration of caves in China commenced in 1992 with collaboration between the French Federation of Speleology (Aventures Karstiques Lointaines) and the Institute of Technology in Chengdu, China. Eight expeditions were organized between 1992 and 2009, and hundreds of caves and cavities have been explored and described. Collecting in caves in the provinces of Yunnan, Sichuan and Hubei yielded 10 new species of Chthoniidae, Neobisiidae and Chernetidae which were described by Mahnert (2003, 2009), with more material of the families Chernetidae and Chthoniidae waiting for identification. Since 1992 important biospeleological research has also been carried out during 15 Italian expeditions supported by the Museo Civico di Storia Naturale Verona (Zorzin & Latella, 2007; Latella & Zorzin, 2008), e.g. to the Guizhou Province in 2000/2001, with highly interesting results (see Mauriès, 2005; Latella & Hu, 2008). Schawaller (1995) described the species *Stenohya chinacavernicola* from a cave in the Sichuan Province which was collected by the Italian expedition of the Centro Ibleo Ricerche Speleo-Idrogeologique in 1993 (see Ruggieri, 1994; Galletti, 1995; Gardini, 1995). In spite of the hundreds of caves explored in course of all these projects, and of about 200 caves in Yunnan, Sichuan, Chongqing, Guizhou, Guanxi and Henan Provinces visited by the junior author (Y-c. L.) during the last few years, the number of recorded cave-inhabiting pseudoscorpions is low. This might be explained not only by insufficient biospeleological research, but also by environmental factors. Some caves might be too humid, many others are disturbed or even destroyed by human activities and touristic development (Senior, 1995; Y-c. L., pers. obs.).

MATERIAL AND METHODS

The specimens used in this study were initially preserved in 95% ethanol and later transferred to 75% ethanol. They were cleared in lactic acid for 12-24 hours at room temperature and after study returned to alcohol, after rinsing in distilled water. Some specimens were kept in water (10-15 minutes), then cleared in a 15% KOH solution for about 15 minutes at 30° C and immerged in water until they became transparent. Dissected parts were studied with a compound microscope on temporary slides in lactic acid or glycerol, then placed in microvials and stored together with the body in a vial. Measurements are given in mm; proportions and measurements of pedipalp and carapace correspond to length/breadth, those of legs to length/depth. Terminology follows mainly Chamberlin (1931) and Harvey (1992), measurements follow Beier (1932).

The primary type specimens of the new species are deposited in the collections of the Museum of Southwest University (MSWU), Chongqing City, China. Some paratypes will be stored in the collections of the Muséum d'histoire naturelle, Geneva (MHNG) and of the Museo Civico di Storia Naturale di Verona (MCSNV).

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TAXONOMIC CONSIDERATIONS

Since the redefinition of the genus *Microcreagris* Balzan by Mahnert (1979a), most Asian species previously placed in this genus have been revisited by Ćurčić (1983) and transferred to three new genera, *Bisetocreagris*, *Chinacreagris* and *Levigatocreagris*. Subsequently *Levigatocreagris* was synonymized with *Stenohya* Beier by Harvey (1991), and *Chinacreagris* with *Bisetocreagris* by Harvey (1999).

Some confusion has been caused by the descriptions of three cave-dwelling neobisiid species by Mahnert (2003) who placed them in the genus *Parobisium* Chamberlin, due to the presence of a flattened or rounded spinneret on the movable cheliceral finger, a feature that defines the subfamily Neobisiinae. However, those "rounded or flattened" spinnerets were simply the result of a damaged galea, this organ being apparently highly fragile in this group of species. This observation was proved by specimens collected by the junior author, which retained their galea. Therefore the three species described in the genus *Parobisium* by Mahnert (2003) are here transferred to the genus *Bisetocreagris*, principally based on the trichobothrial pattern which characterizes the latter genus. We also transfer *Stenohya chinacavernicola* to *Bisetocregaris.* This troglobitic species from Sichuan Province was described by Schawaller (1995) who expressed doubt about the generic placement of the species. Although used as the primary difference between the subfamilies Microcreagrinae and Neobisiinae, the presence/absence of a galea has been observed by Mahnert (1974, 1976) and Judson (1992) to be variable within the genera *Acanthocreagris* Mahnert and *Roncocreagris* Mahnert which include species with a rounded spinneret or an elongate galea. Species with an elongate galea or a highly developped spinneret were also described in the genus *Neobisium* Chamberlin [*N. galeatum*: see Beier, 1953; *N. chironomum* (L. Koch): see Mahnert, 1979b).

Harvey (1991) redefined the genus *Stenohya*, mainly on the basis of the trichobothrial pattern: *et, est* and *it* near finger tip, *eb, esb, isb* and *ib* near base of fixed finger, *ist* isolated between both groups. *Bisetocreagris*, on the other hand, is characterized by a quite different trichobothrial pattern: *et-it* near distal finger tip, *est* isolated in distal half of fixed finger, *ib-isb-ist* grouped closely together at the finger base, *eb-esb* on lateral distal side of hand, thus five trichobothria grouped basally. This particular pattern is present in the genus *Microcreagris* (possessing a galea), and also in some North American and Asian species attributed to the genus *Parobisium* which is characterized by the absence of an elongate galea. Some species in the latter genus are also characterized by the presence of a distinct rounded spinneret (Hong, 1996; Morikawa, 1960; Schuster, 1966).

Adopting these taxonomic re-assessments, four neobisiid genera are known from China (see also Schawaller, 1995): *Bisetocreagris* Ćurčić, *Microcreagris* Balzan, *Stenohya* Beier, and *Microbisium* Chamberlin. The following new combinations are proposed: *Bisetocreagris martii* n. comb., *Bisetocreagris titanium* n. comb., *Bisetocreagris scaurum* n. comb., *Bisetocreagris chinacavernicola* n. comb.

The holotype ♂ of *B. chinacavernicola* is housed in the collections of the MHNG; sternite III has the anteromedian groove with one tiny seta on each side that is characteristic of the genus *Bisetocreagris* (see Ćurčić, 1983).

DESCRIPTIONS

http://zoobank.org/NomenclaturalActs/urn:lsid:zoobank.org:pub:7D59A703-571B-4802-BB25-79D016A0FE18

Bisetocreagris chuanensis n. sp.

Figs 1-5

Holotype: MSWU; ♂; China, Guizhou Province, Xin Hua Town, Jin Sha, Chuan Cave, alt. 1387 m, 27°23.797'N 106°06.104'E; 30 April 2010, coll. Yu-Cheng Lin. This large cave has a length of 700 m and is 70 m high; the pseudoscorpion was collected by hand under rocks, together with some spiders.

Paratypes: 1♂ (in MCSNV), 1♀ (in MHNG); China, Guizhou Province, Qianxi, Hong Lin Village, Wang Tian Dong, alt. 1500 m, cave length 770 m, 27°06'59''N, 105°53'37''E; 13 November 2001; coll. L. Latello & G. Gozzo.

Diagnosis: Troglobiomorphic habitus; carapace with 2 small eyes with indistinct lenses, 8 setae on posterior margin; anterior tergites with 10-11 marginal setae; pedipalp smooth excepted for hand with finely granular dorsodistal part; pedipalp slender, femur 4.4-4.8 times (length 1.56-1.70), patella 3.1-3.5 times (length 1.39-1.53), club of patella 1.16-1.34 times longer than pedicel and about half the length of entire patella, hand with pedicel 1.7-2.0 times (length 1.22-1.42), chela with pedicel 3.7-4.0 times (length 2.57-2.83) longer than broad, finger as long as or longer than hand with pedicel. Chelicera: rallum with 8-9 pinnate setae, distal one with an expanded base.

Etymology: Latinized adjective, derived from the name of the locus typicus, the Chuan cave.

Description of males (female in parentheses): Carapace in anterior half reddish or yellow, basal part lighter and with several unsclerotized areas; pedipalp and chelicera reddish to light brown; abdominal segments yellowish. Carapace smooth, with 2 (anterior) eyes with indistinct lenses, about 2 diameters from the anterior margin; anterior margin with a small rounded knob, without a distinct epistome; a shallow transversal furrow present; chaetotaxy: 6/8-9/6/7-8: 27-29 (6/6/4/7: 23). Tergites undivided, chaetotaxy: 10-11/10/9-10/9-

11/11/10/10-11/10/10/8/6-8 (7/7/7/8/7/7/9/9/10/11/9/7), X-XI with numerous pores. Anal cone 2+2. Manducatory process with 5 (4) marginal setae; pedipalpal coxa with 6-8 (4) setae, two round lyrifissures, coxa I 8-9 (5), II 6-8 (5-6), III 4-6 (3), IV 8-10 (6); genital operculum with 31 setae (posterior ones longer than anterior ones)(♀: 10 medial marginal and discal setae), genital opening with 4/4 simple interior setae, median genital sac undivided, apically enlarged, short (reaching anterior half of sternite IV); lateral genital sacs short, caudally bent and apically inflated. Sternite III with anteromedian groove flanked by one small seta on each side, with 18 long setae (7 medial discal setae)+ 5/6 (4) suprastigmal setae, IV-XI: 11+2x5/17/15/14/13/14/12/4 (2 lateral tactile setae) (♀: 11+2x4/16/14/13/12/12/10/8), VI-X with 2 submedial, submarginal setae. Pleural membrane granular.

Chelicera (Fig. 1): Hand with 6-7 setae, fixed finger with 13-15 small, pointed teeth, movable finger with 12-14 pointed teeth (medial ones on a slightly thickened lamella), subgaleal seta short, not reaching finger tip; galea (Fig. 2a, b): one male with a transparent rounded spinneret, the other one with a rounded spinneret (left) and a short transparent stump (right), indicating the presence of a broken galea; female with a short galea with two tiny apical branchlets (Fig. 2b); serrula exterior 36-40, serrula interior 30-34 blades (distal one deeply forked). Rallum (Fig. 3) with 8 (9) pinnate setae, distal one separated and with expanded base, proximal one short.

Pedipalp (Figs 4, 5): Smooth excepted for dorsodistal part of hand with fine granulation; trochanter with a small rounded ventral hump, 2.3 (2.5) times, femur distally enlarged, 4.4-4.6 (4.8) times, patella 3.1 (3.5) times longer than broad, club 1.6-1.7 (2.0) times longer than broad and 1.16-1.24 (1.34) times longer than pedicel, hand with pedicel 1.7-2.0 (1.9) times, chela with pedicel 3.7-4.0 (4.0) times, without pedicel 3.4-3.7 (3.7) times longer than broad, finger as long as or 1.14-1.21 (♀♂ paratypes) times longer than hand with pedicel. Fixed finger with 104-109 (91) cusped teeth, row shorter than on movable finger, movable finger with 103-112 (85) teeth, about 20 distal ones with tiny cusps. Trichobothria (Fig. 5): 12 (8+4) (♀: 8+3 on left finger: *st* absent), *eb-esb* on hand, *ib-isb-ist* grouped at fixed finger base, *it* distal of *et*, *est* distinctly nearer to *et* than to *ist*; *sb* on movable finger halfway between *b* and *st*; very short venom duct in fixed finger.

Leg I: Femur 4.1-4.4 (4.5) times, patella 3.1-3.4 (3.1) times, tibia 5.8-6.1 (6.65) times, basitarsus 2.9-3.0 (3.0) times, telotarsus 4.6-5.0 (4.8) times longer than deep, femur 1.5-1.6 (1.6) times longer than patella, telotarsus 1.5-1.7 (1.7) times longer than basitarsus.

Leg IV: Femur+patella 4.5-4.8 (5.1) times longer than deep, femur shorter than patella, tibia 7.7-7.9 (7.3) times, basitarsus 3.0-3.4 (3.2) times, telotarsus 5.1 (5.2) times longer than deep; tibia with one tactile seta in middle (TS=0.47-0.55), basitarsus with two tactile setae (basally, distally) (TS= 0.13, TS= 0.83-0.86), telotarsus with a tactile seta near middle (TS=0.46-0.47); subterminal seta forked and dentate, claws slender and smooth, arolia undivided and distinctly shorter than claws.

Measurements of holotype ♂ (of paratype ♂; ♀ in parentheses): Body length 4.43 (3.50; 3.45); carapace 1.24/1.12 (1.28/1.12; 1.12/0.96). Pedipalp: trochanter 0.92/0.39 (-; 0.89/0.34), femur 1.70/0.38 (1.61/0.35; 1.56/0.33), patella 1.53/0.50 (1.39/0.45; 1.44/0.41), length of pedicel 0.69 (0.64; 0.62), hand with pedicel 1.42/0.70 (1.22/0.72; 1.26/0.65), length of pedicel 0.25 (0.21; 0.21), length of finger 1.41 (1.49; 1.43), length of chela with pedicel 2.83 (2.69; 2.57). Leg I: femur 0.96/0.22 (0.94/0.23; 0.87/0.19), patella 0.59/0.19 (0.64/0.19; 0.55/0.18), tibia 0.87/0.15 (0.86/0.14); 0.78/0.12), basitarsus 0.38/0.13 (0.37/0.12; 0.35/0.12), telotarsus 0.58/0.13 (0.62/0.1; 0.58/0.12). Leg IV: femur+patella 1.59/0.35 (1.60/0.33; 1.48/0.29), length of femur 0.71 (0.70; 0.67), tibia 1.62/0.21 (1.48/0.19; 1.33/0.18), basitarsus 0.52/0.17 (0.51/0.15; 0.45/0.14), telotarsus 0.73/0.14 (0.73/0.14; 0.72/0.14).

Remarks: This new species is similar, in pedipalpal measurements and proportions, to *B. martii* n. comb. from the Guo Quan Dong Cave (Yunnan Province) and to *B. lampra* (Chamberlin, 1931) from Gu Shan, Fukien Province. All three belong to a group of species in which the pedicel of the patella is about half the length of the patella. Compared to *B. martii* n. comb., the new species has only two tiny eyes (four distinct ones in *B. martii* n. comb.), smooth pedipalpal segments except for the chelal hand, and more numerous teeth on the pedipalpal fingers (fixed/movable finger: 109/122 vs 83/81 vs 81). *Bisetocreagris chuanensis* n. sp. differs from *B. lampra* by the presence of only two eyes on the carapace (vs four in *B. lampra*), by the smooth pedipalpal femur and patella, by a more slender pedipalpal femur (4.4 times vs 3.56 times) and a more slender patella (3.1 times vs 2.3 times), and by a stouter chela with pedicel 4.0 times (vs 4.7 times) longer than broad. Furthermore, trichobothria *et/it* are distinctly distal to *t* in *B. chuanensis* n. sp., but on the same level of *t* in *B. lampra*, *st* is on the same level of *est* in the new species, but distinctly distal to *est* in *B. lampra*.

***Bisetocreagris cavernarum* n. sp.**

Figs 6-10

Holotype: MSWU; ♂; China, Chongqing, Bei Bei, Jin Dao Xia Town, Ert Long Cave, alt. 776 m, 30°05539'N 106°62385'E; 8 October 2015; coll. Yun-chun Li. The cave is about 1200 m long, 7 m high, with an underground river. Pseudoscorpions were collected by hand under rocks, together with some spiders.

Paratype: MHNG; 1♀; same data as for holotype.

Diagnosis: Troglobiomorphic habitus; carapace with 2 tiny plus 2 indistinct eyes; epistome absent; carapace with 6 setae on posterior margin, tergite I with 8-9 setae; teeth on movable cheliceral finger on thickened lamella, galea with several branches; pedipalp slender, smooth, excepted for fine granulation in distal half of hand; femur 5.8 times (length 1.92-2.1), patella 4.3-4.7 times (length 1.78-2.01) longer than broad, pedicel (length 0.95-1.00) about half of total length of patella and as long as club, hand with pedicel 2.3 times (length 1.37-1.48), chela with pedicel 5.3-5.4 (length 3.27-3.51) times longer than broad, finger 1.4 (length 1.93-2.05) times longer than hand with pedicel. Trichobothrium *est* nearer to *et* than to *isb*, *sb* halfway between *b* and *st*.

Etymology: From the Latin word caverna (= cave), genitive plural (meaning coming from caves).

Description of holotype (paratype in parentheses): Pedipalps, chelicerae and anterior half of carapace yellowish red, carapace in basal half and tergites yellowish. Carapace smooth, 1.1 times longer than broad, anterior margin with a small rounded median knob, with 4 small eyes, 2 anterior eyes with indistinct lens, 1.5 diameters from anterior carapace margin, 2 posterior eyes indistinct and difficult to observe; with 27 (7-8-6-6) (holotype) to 32 (8-11-7-6) (paratype) setae; tergites undivided, chaetotaxy: 8/9/10/10/11/13/13/12/13/11/8 (4 tactile setae) (9/8/9/9/11/12/12/13/10/12/8). Manducatory process with 5 marginal setae, pedipalpal coxa with 7 (♀ 9-11) setae and 2 round lyrifissures (anteromedially, laterobasally), coxa I 7 (11) setae, lateral corner short and rounded, medial corner rectangular, II 9, III 5/6 (6), IV 11 (12/13). Genital operculum with about 75 long acute setae, genital opening with 4/4 short acute interior setae, median genital sac undivided and short (reaching anterior half of sternite IV), wrinkled and with enlarged apex, lateral sacs wrinkled, dilated apically and bent anteriorly; sternite III with a small anteromedian groove (with 1/2 short setae at its margins) and with 22 setae (5 medial discal setae, not counting the tiny groove setae) (♀: 14) + 7/8 suprastigmal setae, IV 12 (11) + 2x5, 16 (18)-17-18 (16)-19 (17)-15 (16)-17(15)-6 (2 submedial tactile setae), submedial setae submarginally placed on VII-X. Pleural membrane granular.

Chelicera (Fig. 6): Hand with 7 long, acute setae; fixed finger with about 16 small, acute, uniform teeth; movable finger with about 14 pointed teeth, the median ones on enlarged lamella, subgaleal seta reaching tip of galea. Galea (Fig. 7a, b) divided in 2 main branches (♂: left galea with one main branch broken), each one forked apically; serrula exterior with about 44-48 blades, serrula interior with about 34, distal blade not forked. Rallum (Fig. 8) with 9 (8) pinnate setae, the first one with expanded base and separated from second one, proximal one shortest.

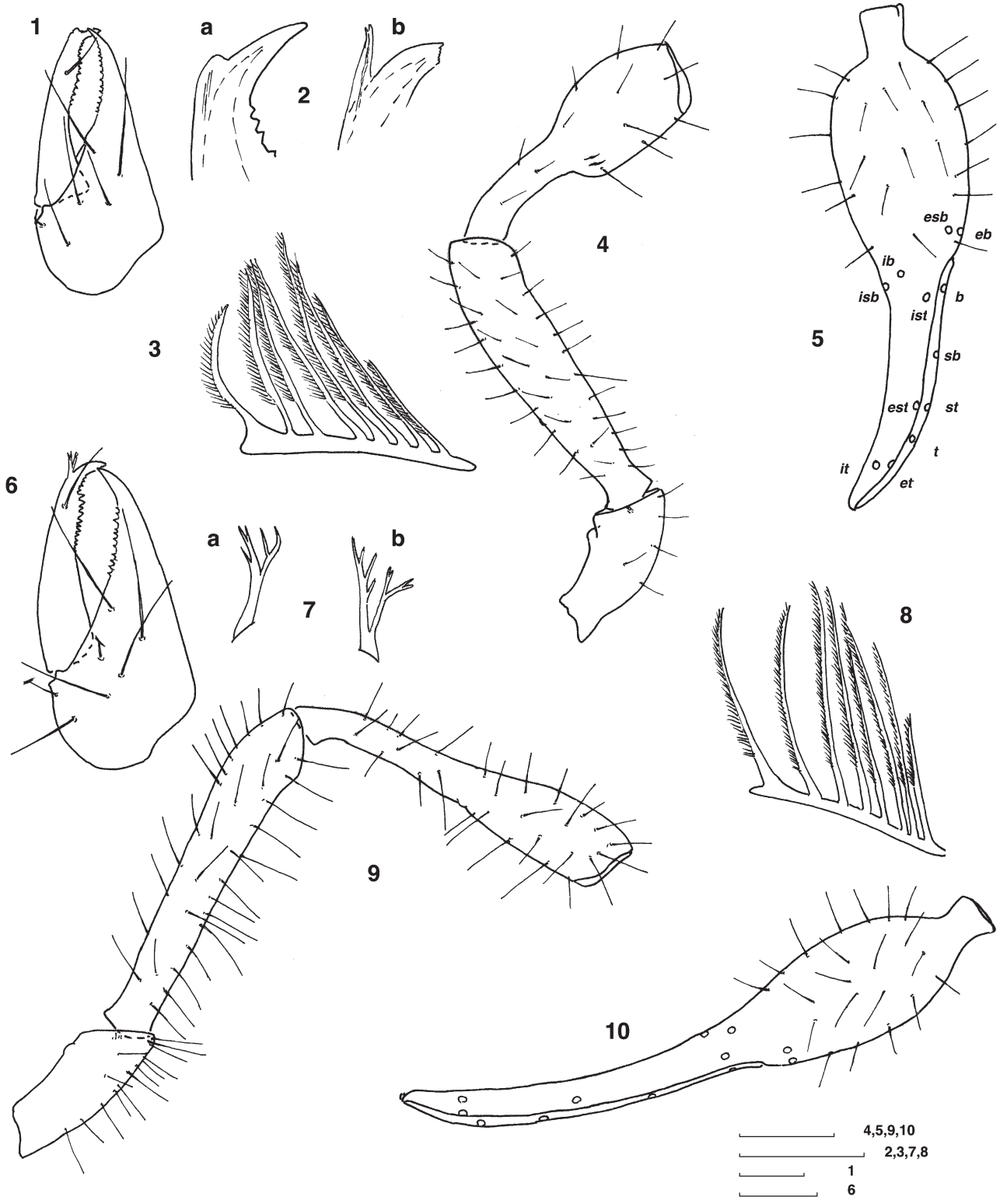
Pedipalp (Figs 9-10): Femur and patella smooth, distal part of hand dorsally and medially finely granular; trochanter 2.5 (2.7) times, with a distinct small ventral hump, femur 5.8 (5.8) times, patella 4.3 (4.7) times, club 2.0 (2-4) times longer than broad, pedicel as long as or longer than club, hand with pedicel 2.3 (2.3) times, chela with pedicel 5.4 (5.3) times, without pedicel 5.0 (4.9) times longer than broad, finger 1.4 (1.4) times longer than hand with pedicel. Fixed finger with 121 (122) small conical uniform teeth, tooth row as long as on movable finger, movable finger with 119 (122) small teeth, in distal row part with small cusps, others rounded; a very short venom duct present in fixed finger. Trichobothria*: eb-esb* on lateral side of hand, *ib-isb-ist* grouped at level of *b* (movable finger), *est* nearer to *et/it* and proximal of *st, sb* on movable finger halfway between *b* and *st.*

Leg I: Femur 4.9 (5.5) times longer than deep and 1.5-1.6 times longer than patella; patella 4.1 (4.1) times, tibia 6.8 (6.3) times, basitarsus 3.9 (3.2) times, telotarsus 6.1 (4.7) times longer than deep and 1.6 (1.5) times longer than basitarsus.

Leg IV: Femur+patella 6.5 (6.5) times longer than deep, femur distinctly shorter than patella, tibia 9.4 (9.2) times, with one or two longer setae in distal half, basitarsus with a basal tactile seta, 4.0 (3.9) times, telotarsus with a tactile seta near middle of segment, 6.8 (5.6) times longer than deep and 1.5 times longer than basitarsus; claws long and slender, smooth, subterminal seta forked and dentate, arolia shorter than claws.

Measurements of holotype ♂ (paratype ♀ in parentheses): Body length 4.40 (5.03); carapace 1.17/10.05 (1.31/1.22). Pedipalp: trochanter 0.88/0.35 (1.01/0.38), femur 1.92/0.33 (2.10/0.36), patella 1.78/1.41 (2.01/0.43), pedicel length 0.95 (1.00); hand with pedicel 1.37/0.60 (1.48/0.66), length of pedicel 0.24 (0.27), finger length 1.93 (2.05), chela length with pedicel 3.27 (5.32), without pedicel 3.03 (3.24). Leg I: femur 1.11/0.23 (1.23/0.22), patella 0.75/0.18 (0.78/0.19), tibia 0.98/0.14 (1.03/0.16), basitarsus 0.47/0.12 (0.46/0.15), telotarsus 0.75/0.12 (0.71/0.15). Leg IV: femur+patella 1.87/0.29 (1.98/0.30), femur length 0.82 (0.88), tibia 1.74/0.18 (1.85/0.20), basitarsus 0.60/0.15 (0.61/0.16), telotarsus 0.90/0.14 (0.89/0.16).

Remarks: The new species, *B. cavernarum,* is most similar to *B. chinacavernicola,* sharing with this species a similar size, elongate pedipalps, a long patellar pedicel (about half of the total length of patella), 6 or 7 setae on posterior margin of carapace, and 8 or 9 setae on anterior tergites. *Bisetocreagris cavernarum* n. sp. differs from *B. chinacavernicola,* recorded from the caves Dei (=Xian Nin) and Chao-Tian (both near Huaying), by the presence of indistinct lenses on the 2 anterior eyes and the presence of 2 indistinct posterior eye-spots, by the fine granulation of the palpal hand, a more slender chela (without pedicel 4.9-5.0 vs 4.4-4.86 times longer than broad), the position of trichobothrium *st* which is distinctly nearer to *t* than to *sb* (halfway



Figs 1-10. (1-5) *Bisetocreagris chuanensis* n. sp., holotype ♂. (1) Left chelicera. (2) "spinneret" (broken?) of ♂ (a) and of ♀ (b). (3) Rallum. (4-5) Pedipalp (vestitural setae of chela fingers omitted), trochanter to patella (4) and hand (5). (6-10) *Bisetocreagris cavernarum* n. sp., holotype ♂. (6) Left chelicera. (7) Galea of ♂ (a) and of ♀ (b). (8) Rallum. (9-10) Pedipalp (vestitural setae of chelal fingers omitted), trochanter to patella (9) and hand (10). Scales: 0.5 mm (4-5, 9-10); 0.2 mm (2-3, 7-8; 1; 6).

between *sb* and *t* in *chinacavernicola*) and perhaps by shorter legs (e.g. femur+patella IV 1.87-1.98 vs 2.18).

Bisetocreagris baozinensis n.sp.

Figs 11-16

Holotype: MSWU; ♀; China, Sichuan Province, Gu Lin, Yu Hua Town, Bao Zi Cave, alt. 954 m, 28°01458'N 106°05209'E; 22 April 2014; coll. Yun-chun Li and Yu-Cheng Lin.

Paratypes: 1♂ (in MSWU), 1♂, 1♀ (in MHNG); same data as for holotype.

Diagnosis: Troglobiomorphic habitus; carapace without eyes or eye-spots, with 6-8 setae on posterior margin; anterior tergites with 6-8 marginal setae; teeth on movable cheliceral finger on thickened lamella; galea present, divided into two main branches, each with forked apex; 6-7 setae on hand; rallum with 9-11 pinnate setae, distal one with an expanded base. Pedipalp: femur 7.0-7.7 times (length 2.17-2.33), patella 6.0-7.0 (length 2.05-2.29) longer than broad, club slightly longer (1.10-1.18 times) than pedicel, hand with pedicel 3.0-3.3 times (length 1.54-1.71), chela with pedicel 7.2-8.2 times (length 3.81-4.08) longer than broad, finger 1.34-1.47 times longer than hand with pedicel (length 2.22-2.42). Trichobothria: *et-it* at same level near fingertip, *est* slightly nearer to *et* than to *ist*, 5 trichobothria at finger base and on hand, *sb* on movable finger indistinctly nearer to *b* than to *st*.

Etymology: Latinized adjective derived from the name of the cave Bao Zi.

Description of females (males in parentheses, if different): Carapace, chelicerae and pedipalps yellowish brown, legs and abdominal segments yellowish. Carapace nearly as long as broad to 1.2 times longer than broad, smooth, anterior margin without epistome but with a small rounded knob; eyes or eye-spots absent; with 23-25 setae (6/7/3-5/7). Tergites with 7-9 (exceptionally 6 or 10) marginal setae, tergite XI 7 (with at least 2 tactile setae, most setae broken off). Manducatory process rounded, with 5 (1♀ with 4 on left side) marginal setae, pedipalpal coxa with 6-8 setae, coxa I with rounded medial corner, 6-8, II 5-8, III 4-5, IV 8-10. Genital operculum of ♀ with 18-19 medial setae (2 groups: 8-9/10 in marginal and discal position), sternite III with 18-21 marginal setae (a few medial ones in submarginal position)+2x4-5; IV 12+2x4 suprastigmal setae, followed by mainly 13-15 (♂ 15-16) uniseriate setae, XI 4-6 setae; genital operculum of ♂ with about 46-48 setae, genital opening with 6-7 short internal setae on each side; median genital sac short (reaching anterior half of sternite IV), wrinkled and widened distally, lateral sacs short, caudally bent; sternite III with anteromedian groove flanked on each side with 1 stout tiny seta; III with 26-29 setae (9-11 in discal position)+2x5, IV 12-13+2x3-4 suprastigmal setae. Anal cone with 2/2 setae. Pleural membrane granular.

Chelicera (Fig. 11): With 6-7 long, slender setae on hand, fixed finger with 11-14 triangular uniform teeth, movable finger with 14-16 teeth, the medial ones on elevated lamella; galea (Fig. 12) divided in 2 main branches, each one apically forked (only one of the 8 galeae examined undamaged), subgaleal seta not reaching fingertip; serrula exterior with 36-42, serrula interior with 28-32 blades. Rallum (Fig. 13) with 9-11 pinnate setae, base of first seta slightly enlarged.

Pedipalp (♂♀) (Figs 14-15): All segments smooth, setae long and smooth; trochanter 2.9-3.1 times longer than broad, with a tiny ventral hump distal of middle, femur distally slightly thickened, 7.0-7.7 times, patella 6.0-6.1 (♂: 6.4-7.0) times longer than broad, pedicel about half of patella length, club 1.1-1.2 times longer than pedicel, hand with pedicel 3.0-3.3 times, chela with pedicel 7.2-8.2 times, without pedicel 6.5-7.6 times longer than broad, finger 1.3-1.5 times longer than hand with pedicel; fixed finger with 171-184 small cusped teeth (row about 10 teeth shorter than on movable finger), movable finger with 172-192 small teeth, cusped only in distal fourth of finger; very short venom duct in fixed finger. Five trichobothria grouped at base of fixed finger and on hand, *est* slightly distal of finger middle, *et-it* on same level near fingertip, on movable finger *st* nearer to *t* than to *sb*, the latter slightly nearer to *b* than to *st* (Fig. 15).

Leg I: Femur 5.3-5.9 times, patella 4.0-4.7 times, tibia 7.4-9.0 times, basitarsus 3.8-4.3 times, telotarsus 4.9-5.6 times longer than deep, femur 1.5 times longer than patella, telotarsus 1.3-1.4 times longer than basitarsus.

Leg IV (Fig. 16): Femur+patella 6.3-7.4 times longer than deep, femur shorter than patella, tibia 10.1-10.6 times, basitarsus 3.8-4.6 times, telotarsus 5.3-5.8 times longer than deep, telotarsus 1.2-1.3 times longer than basitarsus; subterminal seta (Fig. 16a) forked in distal half; both branches dentate, claws slender and smooth; arolia shorter than claws; tactile setae probably present on tibia (TS=0.43-0.46), on basitarsus (TS=0.13), and on telotarsus (TS= about 0.50), but all setae fallen off.

Measurements of ♀ (♂ in parentheses): Body length 4.48-4.59 (3.97-4.48); carapace 1.14-1.29/1.00-1.16 (1.17-1.24/1.00-1.10). Pedipalp: trochanter 1.07-1.08/0.34-0.37 (0.98-1.07/0.32-0.34), femur 2.25-2.27/0.32-0.33 (2.17-2.33/0.30), patella 2.12-2.13/0.35 (2.05-2.29/0.32-0.33), length of pedicel 0.97-0.99 (0.97-1.08), hand with pedicel 1.66-1.71/0.53-0.55 (1.54-1.65/0.47-0.53), length of pedicel 0.31-0.32 (0.27-0.34), length of finger 2.40-2.42 (2.22-2.27), length of chela with pedicel 4.04-4.08 (3.81-3.84), without pedicel 3.72-3.77 (3.49-3.55). Leg I: femur 1.22-1.23/0.22-0.23 (1.21-1.31/0.21-0.22), patella 0.81-0.82/0.20-0.21 (0.80-0.86/0.18-0.19), tibia 1.17-1.31/0.15-0.16

1.15-1.21/0.13-0.14), basitarsus 0.54-0.55/0.14 (0.54-0.56/0.13-0.14), telotarsus 0.76-0.77/0.14-0.15 (0.72-0.76/0.15-0.16). Leg IV: femur+patella 2.07-2.08/0.28-0.32 (1.96-2.14/0.29-0.31), length of femur 0.93-0.95 (0.90-0.93), tibia 1.97-2.02/0.19-0.20 (1.95-2.14/0.19-0.20), basitarsus 0.70/0.16-0.18 (0.64-0.73/0.15), telotarsus 0.87-0.88/0.16-0.17 (0.84-0.85/0.14-0.15).

Remarks: *Bisetocreagris baozinensis* n. sp. belongs to a group of species (*B. chinacavernicola* n. comb., *B. cavernarum* n. sp., *B. martii* n. comb., *B. chuanensis* n. sp.) possessing a long patellar pedicel which is about half of the total patella length. The new species clearly differs from *B. martii* n. comb. by the absence of eyes and by much more slender and longer pedipalps (e.g. femur 7.0-7.7 times, length 2.17-2.33 vs 4.25 times, length 1.58). *Bisetocregaris cavernarum* n. sp. and *B. chuanensis* n. sp. possess two or four indistinct eyes (vs absence of eye-spots in *B. baozinensis* n. sp.) and have stouter and shorter pedipalps (e.g. femur max. 5.8 times longer than broad, length max. 2.10 vs min. 7.0 times, length min. 2.17 in *B. baozinensis*).

***Bisetocreagris juanxuae* n. sp.**

Figs 17-23

Holotype: MSWU; ♀; China, Sichuan Province, Xing Wen, Shi Hai Town, Dao Cave, alt. 840 m, 28°18900'N 105°12118'E; 17 October 2015; coll. Yun-chun Li. This big cave is about 1000 m long and 50 m high; the pseudoscorpions were collected by hand under rocks, together with some spiders.

Paratype: 1♂ (in MHNG); same data as for holotype.

Diagnosis: Troglobiomorphic habitus; carapace with 2 indistinct anterior eyes possessing indistinct lenses, about 2 diameters from the anterior margin, with 10-12 setae on posterior margin; tergite I with 12-13 marginal setae, the following ones with 7-8 setae. Chelicera: teeth of movable finger on thickened lamella; rallum with 9-11 pinnate setae, anterior seta without or with an only slightly expanded base, two basal setae distinctly shorter. Pedipalp smooth, very slender, femur 8.6 times longer than broad (length 4.65), patella 9.1 times (length 4.99), club 3.1 times longer than pedicel, hand with pedicel 4.3 times, chela with pedicel 10.0 times longer than broad, finger 1.3 times longer than hand with pedicel.

Etymology: This species is dedicated to Mrs Juan Xu, the wife of the junior author.

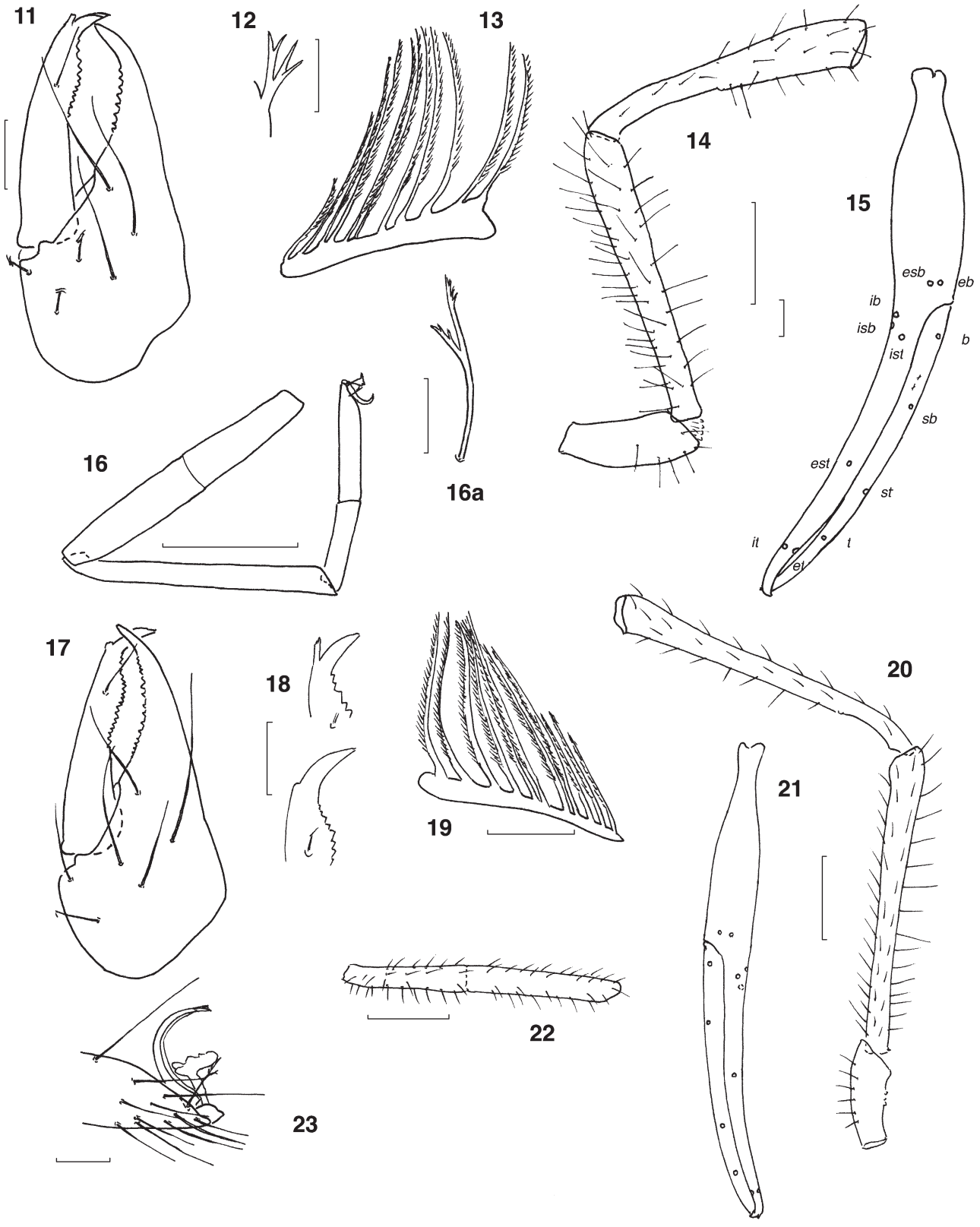
Description of ♂ and ♀: Carapace and pedipalp reddish brown, chelicera darker, abdominal segments and legs yellowish. Carapace 1.1-1.2 times longer than broad, anterior margin with a small irregularly rounded median knob, two indistinct small eyes with indistinct lenses situated about two diameters from anterior margin, with 31 (♂: 7/7/7/10) and 35 (♀: 6/6/11/12) setae; tergite I with 12 (♂) or 13 (♀) setae, the following tergites with 7-8, the last ones with 9-10 setae, tergite XI with 2 tactile setae. Manducatory process rounded, with 5 marginal setae; pedipalpal coxa with 5-8 setae and two round lyrifissures (mediodistally and laterobasally), coxa I 9-11, II 8-9, III 5-6 (in apical third), IV 19 setae; genital operculum of ♂ with about 80 short and thickened setae, genital opening with 4 (or 5) simple setae on each side of entrance, median genital sac short and wrinkled, lateral sacs short, apically inflated; genital operculum of ♀ with 6/6 medial marginal setae, genitalia not studied; sternite III of ♂ with an anteromedian groove, flanked by one tiny seta on each side and with 19 marginal and 18 medial discal setae and 6/6 suprastigmal setae (♀: 18+2x5); IV 16+2x5 (♀: 19+2x3); V-X (♂♀) with about 18-20 setae, without distinct submarginal setae; XI 4 (2 tactile setae). Anal cone with 2+2 simple setae. Pleural membrane granular.

Chelicera (Fig. 17): 6-7 long, fine setae on hand; fixed finger with 12-17 uniform, triangular teeth, movable finger with 14-17 small, triangular teeth, medial ones on thickened lamella, subgaleal seta not reaching fingertip; galea of holotype (Fig. 18) a short slender transparent rod on right chelicera, on left chelicera a low transparent tubercle; right chelicera of ♂ with a short galea, its single branch forked apically and carrying a short subapical branchlet; left chelicera with distal part of galea apparently broken; serrula exterior with about 42-47 blades, serrula interior not counted. Rallum (Fig. 19) with 9-11 pinnate setae, the distal one without expanded base in ♀ (♂: base slightly expanded).

Pedipalp of holotype (Figs 20-21) (of ♂ paratype in parentheses): All segments smooth, trochanter with 3 tiny ventral tubercles (= bases of broken setae?), 2.9 times (3.2 times) longer than broad, femur distally enlarged, 8.6 (9.0) times, patella 9.1 (9.6) times longer than broad, club much longer than pedicel (3.05, ♂ 3.01 times), hand with pedicel 4.3 (4.8) times, chela with pedicel 10.0 (10.8) times, without pedicel 9.6 (10.3) longer than broad, finger 1.34 (1.25) times longer than hand with pedicel; fixed finger with 146-148 small cusped teeth, movable finger with 152 teeth, rounded in basal third of finger; a very short venom duct present in fixed finger. Twelve trichobothria (8+4), *et-it* at same level near finger tip, *est* indistinctly nearer to *ist* than to *et*, *eb-esb* on distal lateral side of hand, *sb* on movable finger distinctly nearer to *b* than to *st.*

Leg I of holotype (paratype ♂): Femur 6.7 (7.4) times, patella 5.0 (4.9) times, tibia 10.3 (12.6) times, basitarsus 5.2 (5.5) times, telotarsus 7.8 (7.7) times longer than deep, femur 1.65 (1.74) times longer than patella, telotarsus 1.29 (1.27) times longer than basitarsus.

Leg IV (Figs 22-23): Femur+patella 10.8 (10.6) times longer than deep, femur shorter than patella, tibia 14.4 (15.1) times, basitarsus 5.6 (5.3) times, telotarsus 6.9



Figs 11-23. (11-16) *Bisetocreagris baozinensis* n. sp., holotype ♀. (11) Left chelicera. (12) Galea. (13) Rallum. (14-15) Pedipalp (vestitural setae on chela omitted), trochanter to patella (14) and hand (15). (16) Leg IV (vestitural setae omitted, most fallen off), with detail of subterminal seta (16a). (17-23) *Bisetocreagris juanxuae* n. sp., holotype ♀. (17) Left chelicera. (18) Galea of left and right cheliceral finger. (19) Rallum. (20-21) Pedipalp (vestitural setae of chela omitted), trochanter to patella (20) and hand (21). (22) Leg IV, femur+patella. (23) Tip of tarsus IV. Scales: 0.1 mm (12-13, 16a); 0.3 mm (11,17, 23); 1.0 mm (14-15; 16; 20-21; 22).

(7.6) times longer than deep, tactile setae probably present (most setae lacking) on basitarsus (near middle of segment) and on telotarsus (TS 0.63/0.59); subterminal setae forked and dentate in distal half, claws smooth and slender, longer than arolia.

Measurements of holotype ♀ (♂ paratype in parentheses): Body length 5.3 (5.0); carapace 1.90/1.64 (1.68/1.52). Pedipalp: trochanter 1.65/0.57 (1.63/0.51), femur 4.65/0.54 (4.19/0.47), patella 4.99/0.55 (4.71/0.49), length of pedicel 1.23 (1.18), hand with pedicel 3.13/0.73 (3.03/0.64), length of pedicel 0.33 (0.30), of finger 4.21 (3.81), of chela with pedicel 7.31 (6.86). Leg I: femur 2.38/0.35 (2.28/0.31), patella 1.44/0.29 (1.31/0.27), tibia 2.35/0.23 (2.49/0.20), basitarsus 0.99/0.19 (0.94/0.17), telotarsus 1.28/0.17 (1.20/0.16). Leg IV: femur+patella 4.18/0.39 (3.88/0.37), length of femur 1.86 (1.75), tibia 4.09/0.28 (3.95/0.26), basitarsus 1.22/0.22 (1.16/0.22), telotarsus 1.53/0.22 (1.41/0.19).

Remarks: This particular species belongs to a group of species that is characterized by the very short pedicel of the pedipalpal patella (about one fourth of total patella length), by the chelal finger distinctly longer than the hand with pedicel, by very slender pedipalp with a considerable length (about 17-18 mm). The new species shares with *B. titanium* n. comb. a similar size and a similar slenderness of its pedipalp, but both species can be easily distinguished by the short chelal fingers of *B. titanium* n. comb., which are much shorter than the hand. *Bisetocreagris junaxuae* n. sp. might be related to *B. scaurum* n. comb., known only from one tritonymphe from the Da Hei Dhong Cave (Yunnan Province).

Bisetocreagris sp.

Material examined: 1♀ (in MSWU), 1♂ (in MHNG); China, Henan Province, Nei Xiang, Ban Chang Town, Tian Xian Cave, alt. 683 m, 33º26.732'N 111º38.795'E; 24 May 2014; coll. Yun-chun Li and Yu-Cheng Lin.

Description (based mainly on ♀): Carapace nearly as long as broad, smooth, with anterior margin slightly protruding medially, 4 big eyes with distinct lenses present, anterior ones about their diameter away from anterior carapace margin, chaetotaxy: 6/4/6/7-8; tergites mostly with 11-13 marginal setae. Manducatory process with 3-4 setae, pedipalpal coxa 8, coxa I 8-9, II 6, III 4-5, IV 10; genital operculum with 10 (5/5) medial marginal and discal setae; sternite III with anteromedian groove; III and IV with 6 and 4-5 suprastigmal setae, respectively, the following sternites with 18-20 marginal setae, on VI-X 2 submedial setae placed submarginally. Pleural membrane granular.

Chelicera: 7 setae on hand, fixed finger with 10 triangular teeth, movable finger with 14 teeth without thickened lamella; galea: a short broad stump on left chelicera (clearly broken), on right chelicera a transparent broad hump; serrula exterior with 36 blades. Rallum with 8 pinnate setae, the distal one with an expanded base.

Pedipalp: Femur and club of patella on medial face finely granular (in part indistinctly), hand on medial face indistinctly granular; trochanter with a small ventral hump, 2.2 times, femur 4.4 (♂ 4.2) times, patella 3.0 (♂ 2.8) times, club distinctly (2.51/♂ 2.25 times) longer than pedicel, hand with pedicel 1.8 (♂ 2.0) times, chela with pedicel 3.6 (♂ 4.5) times, without pedicel 3.45 times longer than broad; finger 1.08 (♂ 1.27) times longer than hand with pedicel. Fixed finger with 74 teeth (cusped in distal third of tooth row), movable finger with 78 teeth (only the distal 18 cusped). Trichobothria (8+4): on fixed finger *it* indistinctly proximal *et*, *est* in middle of finger slightly nearer to *et* than to *ist*; five trichobothria at finger base and on hand; movable finger: *st* distinctly nearer to *t* than to *sb*, *sb* nearer to *b* than to *st*.

Measurements of pedipalp of ♀ (♂ in parentheses): Femur 1.10/0.25 (1.01/0.24), patella 0.93/0.36 (0.85/0.31), length of pedicel 0.27 (0.26), hand with pedicel 0.95/0.54 (0.81/0.40), length of pedicel 0.13 (0.09), length of finger 1.03 (1.03), of chela with pedicel 1.96 (1.83).

Remarks: This seems to be an edaphic species occasionally occurring in caves. It is similar to *Bisetocreagris orientalis* (Chamberlin), as defined by Harvey (1999), but differs by the somewhat more slender pedipalpal segments. Variability of those characters being unknown and knowledge of the neobisiid genera and species (particularly of *Bisetocreagris*) from this region being fragmentary, we refrain from attributing these specimens to a described species.

DISCUSSION

Twenty-five species and one subspecies are now placed in the genus *Bisetocreagris*, with 18 species recorded from China (without Taiwan) (Harvey, 2013; this paper). Nine named and one unnamed species in this genus are troglobitic or troglophilous. Within the species of *Bisetocreagris* from Chinese caves, three quite different groups can be recognized, but these groups will need refinement as further species are described and studied:

Group 1 - chelal finger clearly shorter than hand with pedicel: *B. titanium* n. comb.

Group 2 - pedicel of pedipalpal patella about half as long as patella (about the same length as club): *B. baozinensis* n. sp., *B. cavernarum* n. sp., *B. chinacavernicola* n. comb., *B. chuanensis* n. sp., *B. martii* n. comb.

Group 3 - pedicel of pedipalpal patella much shorter (about one third or one fourth) than patella (much shorter than club): *B. juanxuae* n. sp., *B. scaurum* n. comb., *B. titanium* n. comb. (the position of the latter species

is uncertain, it may belong to Group 1 or to Group 3; perhaps Group 1 is just a sub-group of Group 3).
Unfortunately, our knowledge of cave pseudoscorpions and of pseudoscorpions in general from China is highly fragmentary, and we are just beginning to understand the diversity of this group. Distinguishing between edaphic and endogaeic species will require additional collecting in many different habitats and more studies.

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