

**BACULENTULUS XIZANGENSIS SP. NOV. FROM TIBET, CHINA**  
(PROTURA: ACERENTOMATA, BERBERENTULIDAE) WITH A KEY TO THE  
GROUP OF *BACULENTULUS* SPP. WITH FORETARSAL SENSILLUM B'

YI BAI<sup>1,2</sup> AND YUN BU<sup>3,\*</sup>

<sup>1</sup>School of Life Sciences, Taizhou University, Taizhou, 317000, China

<sup>2</sup>Institute of Zoology, Shaanxi Normal University, Xi'an, 710062, China

<sup>3</sup>Institute of Plant Physiology & Ecology, Shanghai Institutes for Biological Sciences,  
Chinese Academy of Sciences, Shanghai 200032, China

\*Corresponding author, E-mail: ybu@sibs.ac.cn

ABSTRACT

*Baculentulus xizangensis* sp. nov. from Tibet Autonomous Region, China is described. The new species is characterized by the presence of sensillum *b'* on foretarsus, short sensillum *a'*, one pair of *A*-setae (*A5*) on tergite VII, one pair of *P*-setae (*P1*) on sternite I, and comb with few teeth and straight hind margin. It is similar to *Baculentulus ogawai* (Imadaté, 1965) from Thailand, but differs in the length of sensilla *a'* and *b'*, shape of maxillary gland and comb, and in the chaetotaxy on sternite I. The key to the group of *Baculentulus* spp. with foretarsal sensillum *b'* present is provided.

Key Words: Protura, taxonomy, chaetotaxy, Tibet, sensillum

RESUMEN

Se describe *Baculentulus xizangensis* sp. nov. de la región autónoma del Tíbet, China. La nueva especie se caracteriza por la presencia del sensilio *b'* sobre el tarsus anterior, el sensilio corto *a'*, un par de setas-A (*A5*) en terguito VII, un par de setas-P en esternito I, y un peine con pocos dientes y margen posterior recto. Esta especie es similar a *Baculentulus ogawai* (Imadate, 1965) de Tailandia, pero difiere en la longitud de sensilio *a'*, la posición de sensilio *d*, la forma de la glándula maxilar y el peine, y en la quetotaxia del esternito IX. Se provee una clave para los congéneres con sensilios completos sobre el tarsus anterior.

Palabras Clave: Protura, taxonomía, quetotaxia, Tíbet, sensillum

The genus *Baculentulus* Tuxen, 1977 including 38 species distributed all over the world (Szeptycki 2007; Wu & Yin 2008; Nakamura & Likhitrakarn 2009; Shrubovych 2010; Rusek et al. 2012). Among them, 9 species have been reported from China (Yin 1999; Wu & Yin 2008). It is characterized by baculiform sensillum *t1* on foretarsus, sensillum *b'* present (in 9 species) or absent (in 29 species), calyx of maxillary gland smooth, heart-shaped, the reduced striate band on abdominal segment VIII, and sternite VIII has 4 setae.

The Protura fauna of Tibet Autonomous Region of China have been studied by Yin (1981, 1982, 1983a, 1983b, 1990). Twelve species belong to the families Protentomidae, Berberentulidae, Eosentomidae and Antelientomidae have been recorded in this region so far (Yin 1999). In 2009, we investigated this region again and many proturan specimens were obtained. Among them, one new species of *Baculentulus* was found and described in the present paper. The key to the *Baculentu-*

*lus* species with foretarsal sensillum *b'* was also provided.

MATERIALS AND METHODS

Specimens were extracted by means of the Tullgren funnels from soil samples. They were mounted on the slides using Hoyer's solution and dried up in an oven at 45 °C. Specimens were identified and drawn with the aid of NIKON E600 phase contrast microscopes.

RESULTS

*Baculentulus xizangensis* sp. nov. (Figs. 1 -29, Table 1)

Material Examined

HOLOTYPE female (no. XZ-P09030) collected from bush forest, Sangduo town, Leiwuqi County, Changdu District, Tibet Autonomous Region (Xi-



Fig. 1. *Baculentulus xizangensis* sp. nov. (holotype). Habitus. Scale bar: 100  $\mu$ m.

zang), CHINA, N 31° 12' 21" E 96° 35' 10", 3,964 m asl, 14-VIII-2009, coll. W. J. Chen. Paratype. 1 male (no. XZ-P09028), collected from the soil sample between the rock beside the road, Tuoba town, Jiangda County, Changdu District, Tibet Autonomous Region (Xizang), China, 31° 17' 42" N 97° 30' 24" E, 3926 m elev., 12-VIII-2009, coll. W. J. Chen. Type specimens are deposited at Shanghai Entomological Museum (SEM).

#### Description

Adult body length 1050  $\mu$ m ( $n = 2$ ), pale yellow in color (Fig. 1).

Head. Elliptic, length 100  $\mu$ m, width 75  $\mu$ m. Setae *sd4* and *sd5* short and sensilliform, *sd6* absent (Fig. 2). Pseudoculus length 8  $\mu$ m, PR = 12.5 (Fig. 3). Maxillary gland with smooth, heart-shaped calyx. Posterior filament of maxillary gland length 16  $\mu$ m, CF = 6.4 (Fig. 4). Maxillary palps with 2 subequal sensilla (Fig. 5). Labial palps with 3 setae and one short, slender sensillum (Fig. 6). Frontal pore (*fp*) present on dorsal side of head (Fig. 2).

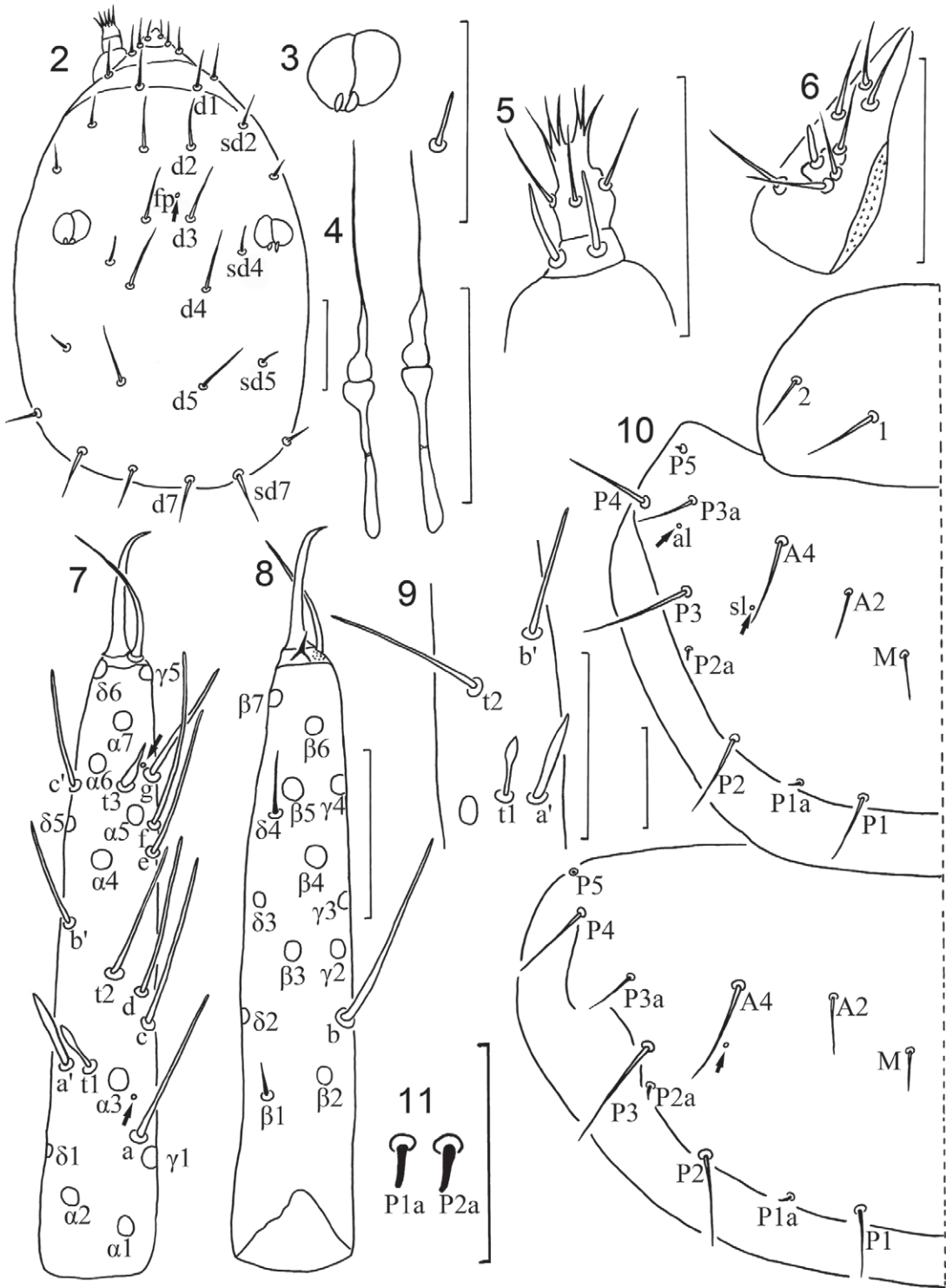
Foretarsus. Length 76  $\mu$ m, claw length 16  $\mu$ m, TR = 5.4; empodium length 5  $\mu$ m, EU = 0.38. Dorsal sensillum *t1* baculiform, *t2* thin and long, *t3* short and lanceolate, BS = 0.50. All other sensilla slender, parallel sided, with exception of broad sensillum *a'*. Exterior sensillum *a* long, its apex reaching base of *d*, *b* and *c* on same level, *b* longer than *c* and surpassing base of  $\beta 4$ , *d* closer to *c* than to *e*, *e* slender, *f* and *g* reaching base of claw. Interior sensillum *a'* broad, short, close to *t1*, not reaching base of *b'* (Fig. 9), *b'* short, its apex surpassing base of  $\delta 5$ , and *c'* short, its apex reaching base of  $\delta 6$ . (Figs. 7 and 8). Relative length of sensilla:  $t3 < t1 < a' < b' < (g = c') < t2 < (a = d) < e < (c = f) < b$ . Seta  $\delta 1$  and  $\delta 4$  setiform, 5  $\mu$ m and 12  $\mu$ m in length respectively. Pores present on exterior part of foretarsi near bases of seta  $\alpha 3$  and sensillum *g*. Claw slender, without inner flap. Empodial appendage 5  $\mu$ m in length. Length of middle tarsus 35  $\mu$ m, claw length 15  $\mu$ m. Length of hind tarsus 37  $\mu$ m, claw length 16  $\mu$ m.

Thorax. Thoracic chaetotaxy formula given in Table 1. On pronotum, length ratio of *I*:2 as 1.5:1. On meso- and metanotum, *A2* subequal to *M*, 8  $\mu$ m in length. Accessory setae *P1a* and *P2a* on meso- and metanotum short and sensilliform (Fig. 11). Length ratio of *P1*:*P1a*:*P2* on mesonotum as 4.3: 1: 5.0. Seta *P5* on mesonotum pin-shaped, on metanotum rudimentary (Fig. 10). Setae *A2* and *M2* on prosternum, *A2* on meso- and metasternum sensilliform (Figs. 12-14). Mesonotum with pores *al* and *sl*, metanotum with pore *sl* only (Fig. 10). Pro-, meso- and metasternum without pores. (Figs. 12 and 13).

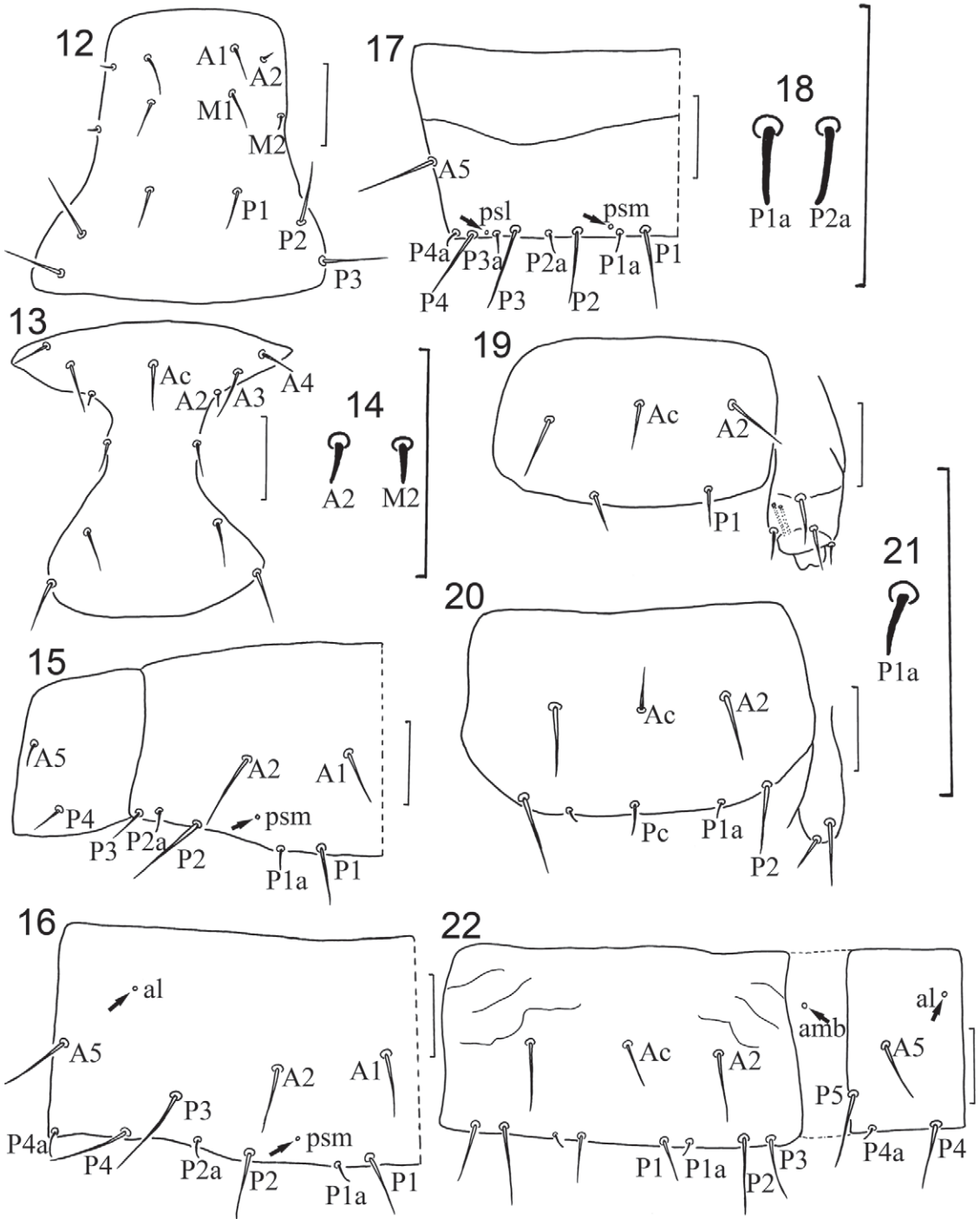
Abdomen. Abdominal chaetotaxy given in Table 1. Tergites I-VI with 3 pairs of anterior setae (Figs. 15 and 16), VII with one pair of anterior setae (Fig. 17). Seta *P3* on tergites II-VI anterior to other *P*-row setae (Fig. 16), and the same level with other *P*-row setae on tergites I and VII (Figs. 15 and 17). Sternite I with one pair of *P*-setae (Fig. 19). Accessory setae on tergites and sternites I-VII short, sensilliform (Figs. 18 and 21), 4- 5  $\mu$ m in length.

Tergite I with pores *psm* (Fig. 15). Tergites II-VI with pores *psm* and *al* (Fig. 16), VII with pores *psm*, *psl* and *al* (Figs. 17 and 24). Pore *psm* on tergite VIII with several surrounding teeth (Fig. 26). Tergites IX-XI without pores, XII with single median pore on serrate line (Fig. 26). Sternites I-IV without pores (Figs. 19, 20 and 22). Membrane between tergites and sternites IV-VI each with 1+1 anteromembranal (*amb*) pore (Figs. 22 and 23). Sternites V-VI with a pair of pores close to *P1* (Fig. 23), sternite VII with single asymmetrically pore close to one of *P1* (Fig. 24), sternites VIII-XI without pores (Fig. 25). Sternite XII with 1+1 anterolateral pores (Fig. 25).

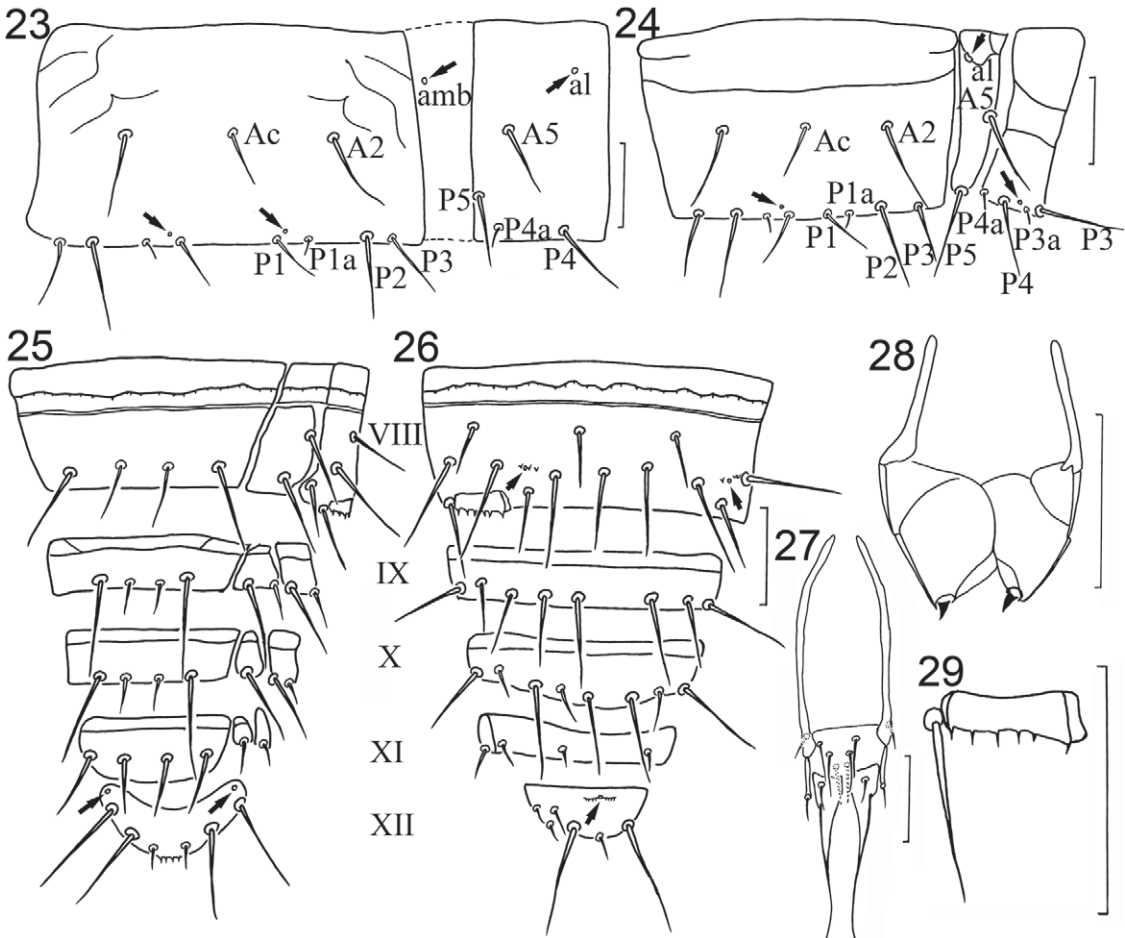
Abdominal appendages with 4, 2, 2 setae, 2 glands and 2 pores present on each of abdominal appendage I (Figs. 19 and 20). Length ratio of subapical and apical seta of second and third appendages as 1.9:1 (Figs. 20). Striate band on abdominal segment VIII reduced (Figs. 25 and 26). Comb on abdomen VIII rectangular, with 6 short teeth (Fig. 29). Lateral and posterior margins of tergites and sternites VIII-XI smooth. Hind mar-



Figs. 2-11. *Baculentulus xizangensis* sp. nov. (holotype). 2. head, dorsal view ( $d1-d7$  = dorsal setae;  $sd2-sd7$  = subsdorsal setae;  $fp$  = frontal pore); 3. pseudoculus; 4. canal of maxillary gland; 5. maxillary palp; 6. labial palp; 7. foretarsus, exterior view; 8. foretarsus, interior view; 9. foretarsus, dorsal view show the position of  $t1$  and  $a'$ ; 10. nota, left side ( $sl$  = sublateral pore;  $al$  = anterolateral pore); 11. accessory setae  $P1a$  and  $P2a$  on meso- metanotum. Arrows show pores, Scale bars: Fig. 11, 10  $\mu\text{m}$ , others, 20  $\mu\text{m}$ .



Figs. 12-22. *Baculentulus xizangensis* sp. nov. (holotype). 12. prosternum; 13. mesosternum; 14. setae A2 and M2 on prosternum and mesosternum; 15. tergite I, left side (psm = posterosubmedial pore); 16. tergite IV, left side (al = anterolateral pore); 17. tergite VII, left side (psl = posterosublateral pore); 18. accessory setae P1a and P2a on tergites I-VII; 19. sternite I; 20. sternite II; 21. accessory setae P1a on sternites II-VII; 22. sternite IV (amb = anteromembranal pore); Arrows show pores, Scale bars: 20  $\mu$ m.



Figs. 23-29. *Baculentulus xizangensis* sp. nov. 23. sternite V; 24. sternite VII; 25. sternites VIII-XII; 26. tergites VIII-XII; 27. male squama genitalis; 28. female squama genitalis; 29. comb of tergite VIII. Fig. 27, paratype, others, holotype. Arrows show pores, Scale bars: 20  $\mu$ m.

gin of tergite XII with few teeth. Seta 1 and 1a on tergite IX length 15 and 22  $\mu$ m respectively.

Male squama genitalis with 4+4 dorsal setae and 2+2 ventral setae (Fig. 27). Female squama genitalis with short pointed acrostyli (Fig. 28).

**Etymology.**

The species name was derived from Tibet Autonomous Region (Xizang) where the species were collected.

**Distribution.**

China (Tibet Autonomous Region).

**Diagnosis.**

*Baculentulus xizangensis* sp. nov. is characterized by the presence of sensillum *b'* on foretar-

sus, short sensillum *a'*, one pair of *A*-setae (*A5*) on tergite VII, one pair of *P*-setae (*P1*) on sternite I, and comb with few teeth and straight hind margin.

**Remarks.**

*Baculentulus xizangensis* sp. nov. is similar to *B. ogawai* (Imadaté 1965) from Thailand, *B. numatai* (Imadaté 1965) from Nepal, *B. africanus* (Nosek 1976), *B. evansi* (Condé 1961) and *B. nyinabitabuensis* (Condé 1961) from Africa in having foretarsal sensilla *b'* present and only one pair of *A*-setae on tergite VII. It differs from *B. ogawai* in having one pair *P*-setae on sternite I (2 pairs in *B. ogawai* respectively), in the short sensillum *a'*, not reaching base of *b'* (*a'* surpassing base of *b'* in *B. ogawai*), in the length of sensillum *b'*, not reaching base of *c'* (*b'* surpassing base of *c'* in *B. ogawai*), and in the comb with few teeth



TABLE 1. ADULT CHAETOTAXY OF *BACULENTULUS XIZANGENSIS* SP. NOV.

Segment	Dorsal		Ventral	
	Formula	Setae	Formula	Setae
Th. I	4	1, 2	$\frac{4-4}{6}$	A1, 2, M1, 2 P1, 2, 3
II-III	$\frac{6}{16}$	A2, 4, M P1, 1a, 2, 2a, 3, 3a, 4, 5	$\frac{7-2}{4}$	Ac, 2, 3, 4, M P1, 2
Abd. I	$\frac{6}{12}$	A1, 2, 5 P1, 1a, 2, 2a, 3, 4	$\frac{3}{2}$	Ac, 2 P1
II-III	$\frac{6}{16}$	A1, 2, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5	$\frac{3}{5}$	Ac, 2 Pc, 1a, 2
IV-VI	$\frac{6}{16}$	sA1, 2, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5	$\frac{3}{8}$	Ac, 2 P1, 1a, 2, 3
VII	$\frac{2}{18}$	A5 P1, 1a, 2, 2a, 3, 3a, 4, 4a, 5	$\frac{3}{8}$	Ac, 2 P1, 1a, 2, 3
VIII	$\frac{6}{16}$	A1, 4, 5 M1, 2, 3, 4, P2, 3, 4, 5	$\frac{4}{0}$	1, 2
IX	14	1, 1a, 2, 2a, 3, 3a, 4	4	1, 2
X	12	1, 2, 2a, 3a, 4	4	1, 2
XI	6	1, 3, 4	4	1, 3
XII	9		6	

and straight hind margin (comb with 14 teeth and hind margin oblique in *B. ogawai*). It differs from *B. numatai* in one pair of *P*-setae on tergite I and 8 pairs of *P*-setae on tergites II-VI (2 and 9 pairs in *B. numatai* respectively), in the presence of *A1* seta on tergite VIII (*A1* absent in *B. numatai*). It differs from *B. africanus*, *B. evansi* and *B. nyinabitabuensis* in having 3 pairs of *A*-seta on tergite VIII (2 pairs in those 3 species), and in the 7 pairs of setae on tergite IX (6 pairs in those 3 species). It also differs from *B. africanus* in the short sensillum *a'*, not reaching base of *b'* (*a'* reaching base of *b'* in *B. africanus*), from *B. evansi* and *B. nyinabitabuensis* in the short posterior filament of

maxillary gland (posterior filament of maxillary gland long in *B. evansi* and *B. nyinabitabuensis*), and in the sensillum *a'* situated at same level to *t1* (posterior to *t1* in *B. evansi*, anterior to *t1* in *B. nyinabitabuensis*).

Except those 5 species mentioned above, *B. celisi* (Condé, 1955) from Congo, *B. tuxeni* (Nosek & Hüther 1974) and *B. becki* (Tuxen 1976) from Brazil, and *B. Chiangmaiensis* Nakamura & Likhitrakarn, 2009 from Thailand also have foretarsal sensilla *b'* present. The 10 species of *Baculentulus* with sensillum *b'* on foretarsus can be distinguished by the following key.

KEY TO *BACULENTULUS* SPP. WITH FORETARSAL SENSILLUM *B'*

1. Tergite VII with one pair of *A*-setae ..... 2
- Tergite VII with 2 to 4 pairs of *A*-setae ..... 7
2. Tergites I-VI with seta *P1a'* ..... *B. numatai* (Imadaté, 1965); Nepal
- Tergites I-VI without seta *P1a'* ..... 3
3. Tergite VIII with 3 pairs of *A*-setae ..... 4
- Tergite VIII with 2 pairs of *A*-setae ..... 5
4. Sternite I with one pair of *P*-setae, sensillum *a'* not reaching base of *b'* .....  
 ..... *B. xizangensis* sp. nov.; China (Tibet)

- Sternite I with 2 pairs of *P*-setae, sensillum *a'* surpassing base of *b'* . . . . . *B. ogawai* (Imadaté, 1965); Thailand
- 5. Foretarsal sensillum *a* reaching base of seta  $\gamma 3$  . . . . . *B. africanus* (Nosek, 1976); Rwanda
- Foretarsal sensillum *a* not reaching base of seta  $\gamma 3$  . . . . . 6
- 6. Small body size (800  $\mu\text{m}$ ), accessory setae on tergites about 1/4 length of principal setae . . . . . *B. evansi* (Condé, 1961); Uganda
- Large body size (1050 -1400  $\mu\text{m}$ ), accessory setae on tergites about 1/9 length of principal setae . . . . . *B. nyinabitabuensis* (Condé, 1961); Uganda
- 7. Tergite I-VI with seta *P1a'* . . . . . *B. chiangmaiensis* Nakamura & Likhitrakarn, 2009; Thailand
- Tergite I-VI without seta *P1a'* . . . . . 8
- 8. Tergite VII with 4 pairs of *A*-setae . . . . . *B. tuxeni* (Nosek & Hüther, 1974); Brazil
- Tergite VII with 3 pairs of *A*-setae . . . . . 9
- 9. Foretarsal sensillum *b* short, not reaching base of seta  $\gamma 2$  . . . . . *B. becki* (Tuxen, 1976); Brazil
- Foretarsal sensillum *b* long, surpassing base of *f* . . . . . *B. celisi* (Condé, 1955); Congo

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