

Christovizetes Krivolutsky (Acari: Oribatida: Microzetidae), a newly recorded genus from caves in China, with description of a new species

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Original research

ABSTRACT

A new species of oribatid mites of the genus *Christovizetes* (Acari: Oribatida: Microzetidae), *Christovizetes longisaetosus* **sp. nov.** is described based on adult specimens collected from caves in Yunnan Province, Southwestern China. This genus is reported from China for the first time. The new species could be distinguished from other three known species of the genus by the following combination of characteristics: (1) distinctly longer notogastral setae *lm*, *lp*, *h*₁₋₃, (2) notogastral setae *lp* located anterior to lyrifissure *im*, (3) each lamellar cusp with four teeth, among which two inner teeth much longer and thinner than two outers, (4) aggenital setae smooth. A key to the four species of this genus is given.

Keywords oribatid mites; morphology; taxonomy; first record; key

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Introduction

The genus *Christovizetes* of the family Microzetidae was established by Krivolutsky (1975) with *Christovizetes ovatus* Krivolutsky, 1975 found in Tajikistan as the type species. Then, Mahunka (1995) reported the second species of the genus, *C. prasadi*, from Thailand, and Akrami and Behmanesh (2011) described the third congener, *C. iranensis*, from Iran. According to above three references, the main generic characters of this genus are as follows: tectum wide and long, projecting from under the lamellae and with dense small setae; lamellae with numerous teeth on their external edge, located marginally and connected by a narrow translamella, with long lamellar setae.

During the study of oribatid specimens collected from caves in Southwestern China, the authors found a new species of *Christovizetes*, which is also a newly recorded genus from China.

In 1932, Willmann described *Belba lengersdorfi* from the stalactite cave, which is the first record of cave oribatid mites (Willmann 1932). Since then, more and more oribatid mites have been found in caves in Europe, Asia, and North America (Alexander 1995, Wauthy and Ducarme 2006, Nakamura *et al.* 2010). By 2021, 272 species in 89 genera representing 33 families of Oribatida have been reported from caves all over the world.

Up to now, there is only one reference about oribatid mites inhabiting caves in China, in which the authors (Yang *et al.* 2021) listed 20 families of Oribatida collected from four

Received 08 October 2022

Accepted 30 January 2023

Published 06 February 2023

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Academic editor

Pfingstl, Tobias

<https://doi.org/10.24349/yuya-dvki>

ISSN 0044-586X (print)

ISSN 2107-7207 (electronic)



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How to cite this article Fu L. *et al.* (2023), *Christovizetes* Krivolutsky (Acari: Oribatida: Microzetidae), a newly recorded genus from caves in China, with description of a new species. *Acarologia* 63(1): 180-187. <https://doi.org/10.24349/yuya-dvki>

caves in Guizhou Province, southwestern China, without detailed information of collection and description for the taxa.

In present paper, the new species was described and a key to the all known species of *Christovizetes* was provided.

Material and methods

Soil samples with bat guano, humus, rat droppings, decaying wood, separately were collected from caves. The distance between the sampling site and the entrance of the cave was measured with laser range finder. The mites were extracted with Berlese-Tullgren funnels and kept into 80% ethyl alcohol. Observations, figures, measurements and descriptions were based on adult specimens mounted in temporary cavity slides. Drawings were made with a camera lucida connected with a Leica transmission light microscope “Leica DM 2500”, and digitally inked in Photoshop (Adobe Photoshop CC 2018). The body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate. Notogastral and body width refers to the maximum width in dorsal view. Lengths of body setae were measured in lateral view. All body measurements are presented in micrometers. Formulas for leg setation are given in parentheses according to the sequence trochanter-femur-genu-tibia-tarsus (famulus included). Formulas for leg solenidia are given in square brackets according to the sequence genu-tibia-tarsus.

Morphological terminology used in this paper follows that of F. Grandjean: see Travé and Vachon (1975) for references, Norton (1977) for leg setal nomenclature, and Norton and Behan-Pelletier (2009) for overview.

All specimens are kept in alcohol and deposited in IZAS — the National Animal Collection Resource Center of China, Institute of Zoology, Chinese Academy of Sciences, Beijing (Zhang 2018).

The following abbreviations are used: *lam* = lamella; *tu* = tutorium; *ro*, *le*, *in*, *bs*, *ex* = rostral, lamellar, interlamellar, bothridial and exobothridial setae, respectively; *c*, *la*, *lm*, *lp*, *h*, *p* = notogastral setae; *ia*, *im*, *ip*, *ih*, *ips* = notogastral lyrifissures; *gla* = opisthonotal gland opening; *h*, *m*, *a* = subcapitular setae; *v*, *l*, *d*, *cm*, *acm*, *ul*, *sul*, *vt*, *lt* = palp setae; ω = palp and leg solenidium; *cha*, *chb* = cheliceral setae; *Tg* = Trägårdh's organ; Pd I, Pd II = pedotecta I, II, respectively; *1a*, *1b*, *1c*, *2a*, *3a*, *3b*, *3c*, *4a*, *4b*, *4c* = epimeral setae; *dis* = discidium; *cp* = circumpedial carina; *g*, *ag*, *an*, *ad* = genital, aggenital, anal and adanal setae, respectively; *iad* = adanal lyrifissure; *Tr*, *Fe*, *Ge*, *Ti*, *Ta* = leg trochanter, femur, genu, tibia, tarsus, respectively; *p.a.* = leg porose area; ω , σ , ϕ = leg solenidia; ε = leg famulus; *v*, *ev*, *bv*, *l*, *d*, *ft*, *tc*, *it*, *p*, *u*, *a*, *s*, *p**v*, *p**l* = leg setae.

Family Microzetidae

Genus *Christovizetes* Krivolutsky, 1975

Christovizetes longisaetosus sp. nov.

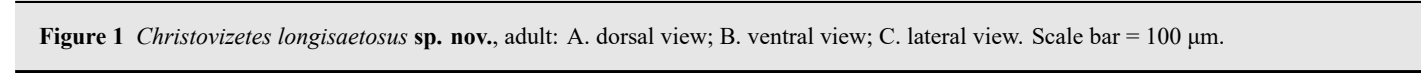
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(Figs. 1–3)

Material examined

Holotype: Male (in alcohol, IZAS-FL-21-412), China, Yunnan Province, Maguan County, Xinfu Zhai Village, Xinfu Zhai Cave, 23°10'33.51"N, 104°15'35.7"E, 1361m a.s.l., bat guano, 452m from the cave entrance, 14.X.2021, coll. Liu Fu.

Paratypes: (four males and one female in alcohol, IZAS-FL-21-412), with same data as the holotype.



The specific name “*longisaetosus*” is a combination derived from the Latin words “*longus*” meaning long and “*saeta*” meaning seta, which refers the long notogastral setae of the new species. The name is given as Latin adjective.

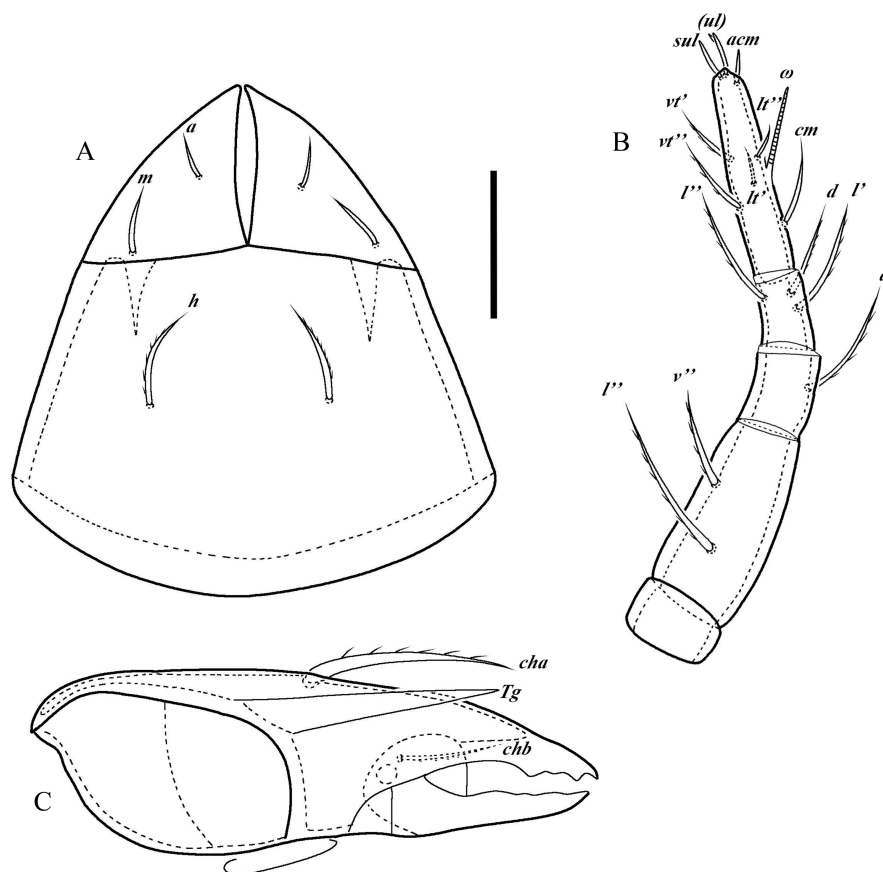


Figure 2 *Christovizetes longisaetosus* sp. nov., adult: A. subcapitulum, ventral view; B. palp, left, antiaxial view; C. chelicera, left, paraxial view. Scale bar = 20 μ m.

Diagnosis

The new species is characterized by the combination of following characteristics: body size 263–300 $\times$ 175–187; each lamellar cusp bifurcated as four long and strong teeth, two inner teeth longer and thinner distinctly than two outers; interlamellar setae inserted in interlamellar region, adjacent to lamellae; notogastral setae *lm*, *lp*, *h*₁₋₃ long (23–25), smooth, *lp* located anterior to lyrifissure *im*; anterodistal and lateral margin of pteromorph dentate; aggenital setae smooth.

Description

Measurements — Body length: 263–300 (holotype: 300; five paratypes: 263–280); body width: 175–187 (holotype: 187; five paratypes: 175–180).

Integument — Body color light brownish. General body surface smooth.

Prodorsum — (Figs. 1A, C) — Rostrum conical, rostral setae (85–88) thin, long, and simple, flagellate distally. Lamellae very wide, connected by translamella and not covering prodorsum basally and medially, each lamellar cusp with four long and strong teeth, two outer teeth distinctly shorter and thicker than the two inner ones, first third of outer lamellar margin (anterior to *le* insertion) dentate, with five to eight small tooth-like projections, lamellar surface covered by longitudinal rugae, lamellar setae (110–113) thick, long and simple, flagellate distally, inserted on lamellar surface in median concavity of cusps. Interlamellar setae (25–27) slightly thick, spine-like, inserted in interlamellar region adjacent to lamellae. Bothridial setae

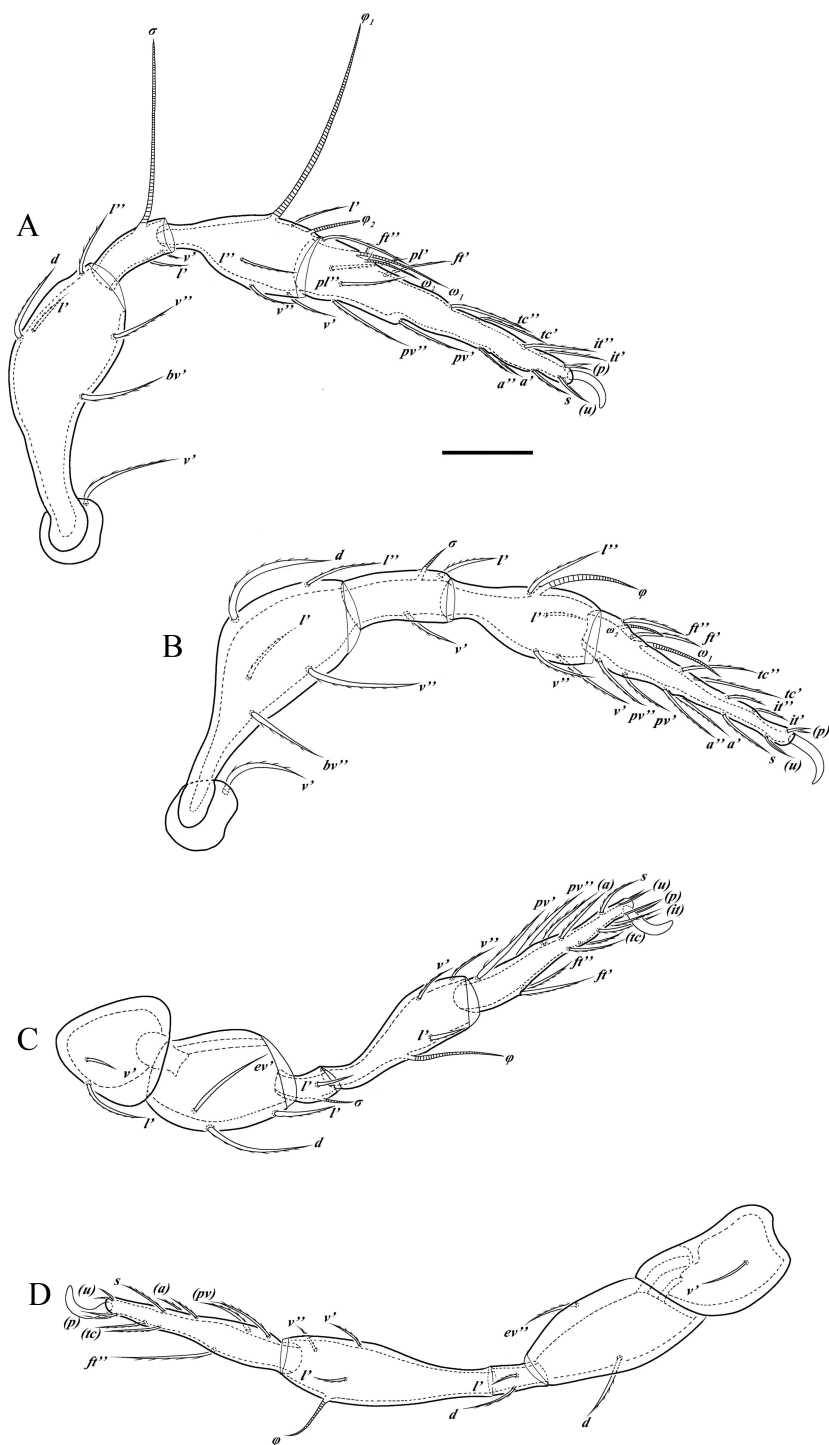


Figure 3 *Christovizetes longisaetosus* sp. nov., adult: A. leg I, right, antiaxial view; B. leg II, right, antiaxial view; C. leg III, right, antiaxial view; D. leg IV, left, antiaxial view. Scale bar 20 = μ m.

(127–130) setiform, densely ciliate. Exobothridial setae (35–37) thick and barbed. Tutoria large, wide, projecting from under lamellae, anteriorly and laterally covered with dense bristle-like setae.

Notogaster — (Figs. 1A, C) — Notogaster wider than long (175–187 $\times$ 135–145), some-

what semicircular. Dorsosejugal suture well defined, slightly convex medially. Pteromorph some triangular-shaped, with fine wrinkles, anterodistal and lateral margins dentated. Nine pairs of notogastral setae thin, smooth; p_1 and p_2 (6) shorter than other setae obviously, lm , lp , h_{1-3} (23–25) the longest. Setae la (12–15) located posterior-lateral to c (12–15), and lp anterior to lyrifissure im . Only lyrifissures im distinct, ia , ip , ih and ips not visible. Opisthonotal gland openings (gla) located posteriorly to im .

Gnathosoma — (Fig. 2) — Subcapitulum slightly longer than wide (68–70 × 60–63). Subcapitular setae (h , 13; m , 11; a , 8) setiform, h barbed, m and a smooth. Pedipalp (49–53) with setation 0-2-1-3-9 (+ ω). Chelicera (57–60) with two setae, cha (13) and chb (12) thin, setiform.

Epimeral and lateral podosomal regions (Fig. 1B) — Epimeral setal formula: 3-1-3-3. All setae simple, barbed, $3b$, $4c$, and $1b$ (15) slightly longer than others (11). Pedotecta I and II with rugae. Discidium triangular. Circumpedial carinae thick, long, almost reaching anterior margin of PdI .

Anogenital region (Fig. 1B) — Six pairs of genital setae simple, g_1 (13) slightly barbed, distinctly longer than other minute smooth setae (g_2 – g_6 , 3), g_4 in a parallel line in respect to the others. One pair of aggenital setae (7–9) smooth. Two pairs of anal (4) and three pairs of adanal (4) setae thin, smooth, ad_3 inserted posterior level of an_1 . Adanal lyrifissure (iad) parallel and close to anal plate, located between ad_2 and ad_3 .

Legs — (Fig. 3) — All legs monodactylous. Claw of each leg smooth. Formulas of leg setation and solenidia: I (1-5-2-4-18) [1-2-2], II (1-5-2-4-15) [1-1-2], III (2-3-1-3-15) [1-1-0], IV (1-2-2-3-12) [0-1-0]; homology of setae and solenidia indicated in Table 1.

Remarks

On the basis of the diagnosis with tutoria large, wide, projecting from under the lamellae and covering with dense setae, lateral margin of lamella bearing small teeth, each lamella bifurcated at distal part, and lamellar setae long, the new species clearly belongs to the genus *Christovizetes*. However, there are some distinct morphological differences between the new species and the known species.

Christovizetes longisaetosus **sp. nov.** is morphologically most similar to *C. prasadi* Mahunka, 1995 from Thailand in having long rostral setae, well-developed translamella, slightly convex dorsosejugal suture, and the genital setae disposition, but differs from the latter by: the two inner teeth of lamellar cusp longer and thinner distinctly than the two outers (versus the two outers almost same shape as the two inners); interlamellar setae located in interlamellar region (versus on lamellar surface); notogastral setae lm , lp , h_{1-3} similar in length as the interlamellar setae (versus those setae about 1/2 length of the interlamellar setae); setae lp anterior to lyrifissure im (versus posterior to im); aggenital setae smooth (versus barbed obviously); genital setae g_1 , as twice long as ag , distinctly longer than other minute genital setae (g_2 – g_6), as half long as ag (versus g_1 slightly longer than other genital setae which are not minute).

Christovizetes longisaetosus **sp. nov.** differs from *C. iranensis* Akrami & Behmanesh, 2011 from Iran by: the inner two teeth of lamellar cusp longer than the outer two (versus the

Table 1 Leg setation and solenidia of adult *Christovizetes longisaetosus* **sp. nov.**

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
I	v'	d , (l), bv'' , v''	l' , v' , σ	(l), (v), ϕ_1 , ϕ_2	(ft), (tc), (it), (p), (u), (a), s , (pv), (pl), ε , ω_1 , ω_2
II	v'	d , (l), bv'' , v''	l' , v' , σ	(l), (v), ϕ	(ft), (tc), (it), (p), (u), (a), s , (pv), ω_1 , ω_2
III	l' , v'	d , l' , ev'	l' , σ	l' , (v), ϕ	(ft), (tc), (it), (p), (u), (a), s , (pv)
IV	v'	d , ev'	d , l'	l' , (v), ϕ	ft'' , (tc), (p), (u), (a), s , (pv)

Note. Roman letters refer to normal setae, Greek letters to solenidia (except ε = famulus). Single prime (') marks setae on the anterior and double prime (') setae on the posterior side of a given leg article.

inner two slightly shorter than the outer two); setae *lp* anterior to lyrifissure *im* (versus posterior to *im*); genital setae *g₁*, as twice long as *ag*, distinctly longer than other minute genital setae (*g₂*–*g₆*), as half long as *ag* (versus setae *g₁* slightly longer than other genital setae); genital setae *g₄* in a parallel line in respect to the others (versus *g₁₋₃* parallel, *g₄₋₆* parallel); aggenital setae smooth (versus strongly barbed); translamella well-developed (versus weakly-developed); dorsosejugal suture slightly convex (versus distinctly convex); small pteromorphae (versus large). *Christovizetes longisaetosus* **sp. nov.** differs from *C. ovatus* Krivolutsky, 1975 from Tajikistan by: lamellar cusp divided into two branches, each branch bifurcated with two long teeth, and length of inner two teeth about 1/2 length of inner branch (versus lamellar cusp divided into two branches, but the outside branch without bifurcation, the inner one bifurcated with two small teeth, and length of teeth about 1/5 length of inner branch); notogastral setae *c* and *la* inserted on the base of the pteromorphae (versus on the median part of the notogaster); rostral setae long (versus short); pteromorphae dentate anterodistally and laterally (versus smooth).

Key to known species of *Christovizetes*

1. Outside branch of lamellar cusp without bifurcation, rostral setae distinctly short, almost same length as interlamellar setae, margin of pteromorphae smooth *C. ovatus* Krivolutsky, 1975
— Outside branch of lamellar cusp divided distally into two teeth; rostral setae distinctly longer than interlamellar setae, margin of pteromorphae dentate 2
2. Notogastral setae *lp* located anterior to lyrifissure *im*; genital setae *g₁* much longer than other minute genital setae; aggenital setae smooth *C. longisaetosus* **sp. nov.**
— Notogastral setae *lp* posterior to lyrifissure *im*; genital setae *g₁* slightly longer than other genital setae; aggenital setae barbed 3
3. Two inner teeth of lamellar cusp almost same shape as the two outsiders, interlamellar setae on the lamellar surface, notogastral setae *lp* located anterior to opisthonotal gland opening *gla* ...
..... *C. prasadi* Mahunka, 1995
— Two inner teeth of lamellar cusp obviously shorter and thicker than the two outsiders, interlamellar setae located in interlamellar region adjacent to lamellae, notogastral setae *lp* located posterior to opisthonotal gland opening *gla* *C. iranensis* Akrami & Behmanesh, 2011

Acknowledgement

The authors thanks Shu-Jing Xu and Cheng-Lin Liu for their help in article preparing, Ze-Gang Feng for his help in specimen collecting. This work was supported by the National Natural Science Foundation of China (no. 32070421), the National Science & Technology Fundamental Resources Investigation Program of China (Grant No. 2019FY101800), and the Second Tibetan Plateau Scientific Expedition and Research (STEP) Program (grant no. 2019QZKK05010600).

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