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Lithobius (*Monotarsobius*) *aterrimus* sp.n., a new centipede species from China (Chilopoda: Lithobiomorpha: Lithobiidae)

Lithobius (*Monotarsobius*) *aterrimus* sp.n., новый вид костянок из Китая (Chilopoda: Lithobiomorpha: Lithobiidae)

Sujian Pei[1], Huiqin Ma[1,2,*], Haipeng Liu[1], Kuijing Liang[1], Yanmin Lu[1,2]
Сучжань Пеи[1,2], Юикинь Ма[1], Хаипен Лю[1], Куичжин Лиан[1], Янминь Лу[1,2]

[1] Institute of Myriapodology, School of Life Sciences, Hengshui University, Hengshui, Hebei 053000, China.
[2] Hebei Key Laboratory of Wetland Ecology and Conservation, Hengshui, Hebei 053000, China.
* Author for correspondence: Ma Huiqin (E-mail: mahuiqin008@126.com)

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КЛЮЧЕВЫЕ СЛОВА: Myriapoda, таксономия, новый вид, ключ, карта, Китай.

ABSTRACT. A new lithobiid species, *Lithobius* (*Monotarsobius*) *aterrimus* sp.n., is described from several provinces of mainland China. Morphologically, the new species seems to be extremely close to *Lithobius* (*Monotarsobius*) *femoratus* Pei, Ma, Liu, Lu et Liang, 2021 from Hebei Province, China, but it can easily be distinguished by its moderately wide central longitudinal groove on the dorsal side of the tibia of male legs 15, and the apex is widened and raised to form an obvious protuberance, 8–10 ocelli on each side, the presence of DaC spine on legs 13, 14 and 15, and a bidentate apical claw of the third article of the female gonopods. Based on adult specimens, a key to all 14 species of the subgenus *Monotarsobius* known to occur in China is presented, with a map showing the distribution of the new species.

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РЕЗЮМЕ. Из нескольких провинций материкового Китая описан новый вид костянок: *Lithobius* (*Monotarsobius*) *aterrimus* sp.n. Морфологически новый вид, вероятно, ближе всего к *Lithobius* (*Monotarsobius*) *femoratus* Pei, Ma, Liu, Lu et Liang 2021 из провинции Хебей (Китай), но легко отличается умеренно широкой центральной продольной бороздкой на верхней стороне голени 15 самца, а вершина расширена и приподнята, формируя отчетливый выступ, 8–10 глазками на каждой стороне, наличием шипа DaC на ногах 13, 14 и 15, а также двузубым вершинным коготком на третьем членике гонопода самки. Представлены ключ для всех 14 видов подрода *Monotarsobius*, известных их Китая, и карта с распространением нового вида.

Introduction

Verhoeff [1905] originally proposed *Monotarsobius* Verhoeff, 1905 as a subgenus of *Lithobius* Leach, 1814 in the family Lithobiidae. It presently accommodates a group of about 115 species or subspecies mostly known from Eurasia, but some introduced elsewhere. They occur over a wide range of epigeic habitats, from low altitudes to 4200 m a.s.l., also living in caves [Zapparoli, Edgecombe, 2011]. *Monotarsobius* is characterised by the following combination of characters: Forcipular coxosternal teeth 2+2; porodonts setiform. Tergites without posterior triangular projections. Tarsal articulation of legs 1–13 very faint or indistinct. Secondary sexual modifications sometimes present on male legs 14 and 15. Female gonopods with a uni-, bi- or tridentate claw and usually 2+2 spurs [Zapparoli, Edgecombe, 2011].

Altogether, among the ca 100 species or subspecies of Lithobiomorpha currently known to occur in China, 13 species belong to *Monotarsobius*, including only two reported so far from the Hebei Province [Takakuwa, 1940, 1941; Wang, 1955, 1956, 1957, 1959, 1963; Wang, Mauriès, 1996; Eason, 1997; Ma *et al*., 2009, 2014; Pei *et al*., 2011, 2020a, b, 2021a, b; Chao *et al*., 2018, 2020; Qiao *et al*., 2019]. Below, a new species recently discovered in the Hebei, Liaoning, Jilin and Gansu provinces of mainland China is described and illustrated. Based on adult specimens, a key to all species of *Monotarsobius* reported from China is presented, with Map showing the distribution of the new species.

Materials and methods

Specimens were collected under leaf litter or stones and preserved in 75% ethanol. Illustrations and measurements were produced using a ZEISS SteREO Discovery.V20 mi-

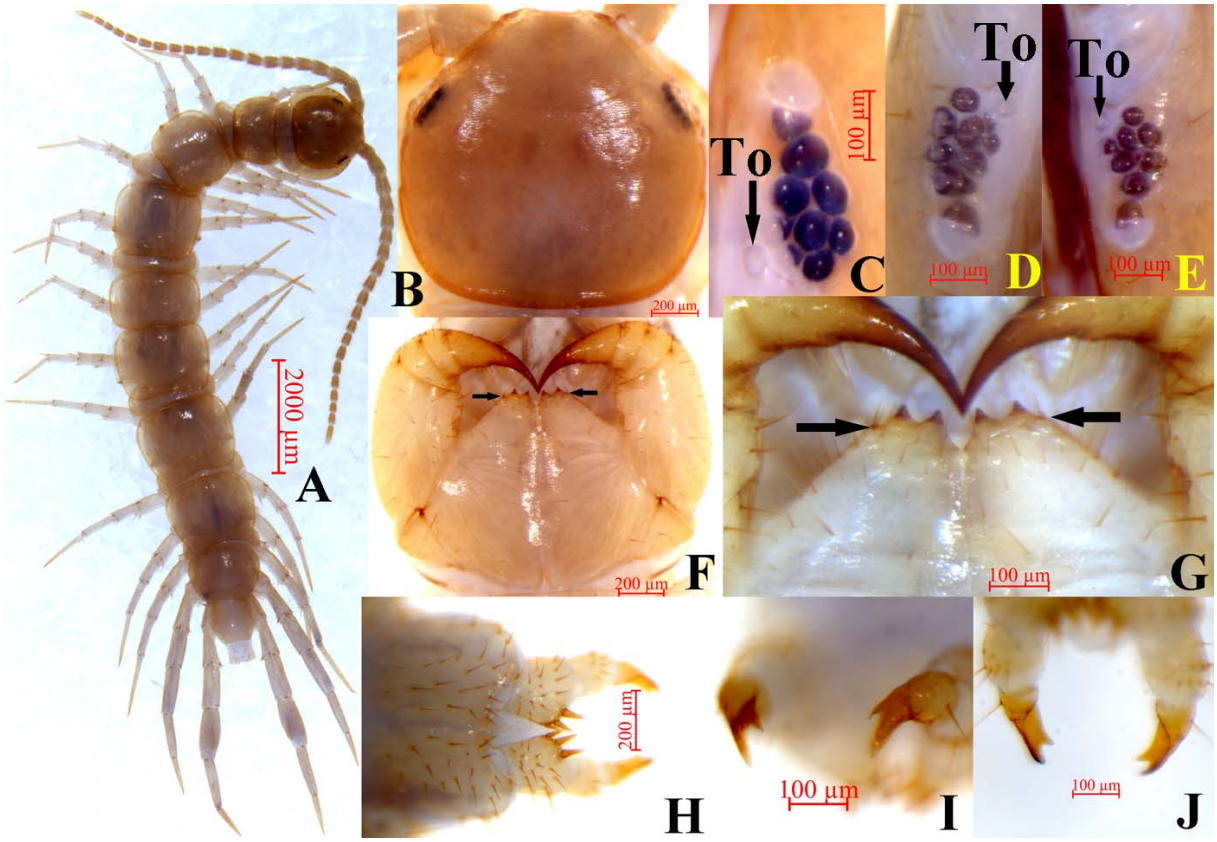


Fig. 1A–E. *Lithobius* (*Monotarsobius*) *aterrimus* sp.n., ♂ holotype (A, B, C, F, G), ♀ paratype (D, E, H, I, J). A — habitus, dorsal view; B — cephalic plate, dorsal view; C, D, E — ocelli and Tömösvary's organ (To), lateral view; F — cephalic plate, ventral view; G — forcipular coxosternite, ventral view; H — posterior segments and gonopods, ventral view; I, J — apical claw of gonopods, dorsal and ventral views, respectively.

Рис. 1A–E. *Lithobius* (*Monotarsobius*) *aterrimus* sp.n., голотип ♂ (A, B, C, F, G), (A, B, C, F, G), паратип ♀ (D, E, H, I, J). A — общий вид, сверху; B — головная пластинка, сверху; C, D, E — глазки и орган Темешвари (To), сбоку; F — головная платинка, снизу; G — коксостернит ногочелюсти, снизу; H — задние сегменты и гоноподы, снизу; I, J — вершинный коготь гонопода, соответственно сверху и снизу.

croscope equipped with an Abbe drawing tube, an ocular micrometre and an Axiocam 512 colour camera. The description is based on specimens fixed in 75% ethanol. Body length is measured from the anterior margin of the cephalic plate to the posterior end of the postpedal tergite. Type specimens and other material are mostly deposited in the Institute of Myriapodology, School of Life Sciences, Hengshui University, Hengshui, China (IMHUSLS), with a few paratypes to be shared with the collection of the Zoological Museum, State University of Moscow (ZMUM), Russia, as indicated below. The terminology of the external anatomy follows Bonato *et al*. [2010]. Measurements are shown in millimetres (mm). The following abbreviations are used in the text and Table: a — anterior, C — coxa, F — femur, m — median, P — prefemur, p — posterior, S, SS — sternite, sternites, T, TT — tergite, tergites, Ti — tibia, Tr — trochanter.

Taxonomy

Family Lithobiidae Newport 1844
Genus *Lithobius* Leach, 1814
Subgenus *Monotarsobius* Chamberlin, 1919

Lithobius (*Monotarsobius*) *aterrimus* **sp.n.**
Figs 1A–J, 2A–G, Table.

TYPE MATERIAL: HOLOTYPE ♂ (Lmon02-01) (Fig. 1-1A), China, Hebei Province, Hengshui City, Taocheng County, North outer ring road, 37.775748ºN, 115.68575ºE, ca 20 m a.s.l., 28 May 2017, S. Pei, H. Ma leg. PARATYPES: 9 ♀♀, 6 ♂♂ (Lmon02-1), same data as holotype.

OTHER MATERIAL: 39 ♀♀, 43 ♂♂ (Lmon02-02), Beiling Park, Huanggu County, Shenyang City, Liaoning Province, 41.854767ºN, 123.433799ºE, ca 50 m a.s.l., 24 August 2011, C. Zhang, H. Ma leg.; 26 ♀♀, 14 ♂♂ (Lmon02-03), Five-women Moutain, Huanren Manchu Autonomous County, Benxi City, Liaoning Province, 41.332282ºN, 125.421546ºE, ca 610 m a.s.l., 17 August 2016, Y. Lu, H. Liu, S. Pei, H. Ma leg.; 1 ♀, 5 ♂♂ (Lmon02-04), Tongsheng Street Tong Village, Ji'an City, Jilin Province, 41.139957ºN, 126.210766ºE, 180 m a.s.l., 20 August 2016, Y. Lu, H. Liu, S. Pei, H. Ma leg.; 54 ♀♀, 41 ♂♂ (Lmon02-05), Beishan Park, Kuandian Manchu Autonomous County, Dandong City, Liaoning Province, 40.747807ºN, 124.793645ºE, ca 305 m a.s.l., 16 August 2016, Y. Lu, H. Liu, S. Pei, H. Ma leg.; 8 ♀♀, 7 ♂♂ (Lmon02-06), Xiaoniangnianggou, Kuandian Manchu Autonomous County, Dandong City, Liaoning Province, 40.759748ºN, 124. 776434ºE, ca 700 m a.s.l., 15 August 2016, Y. Lu, H. Liu, S. Pei, H. Ma leg.; 51 ♀♀, 55 ♂♂ (Lmon02-07), Baisahn Passenger Station, Hunjiang County, Baishan City, Jilin

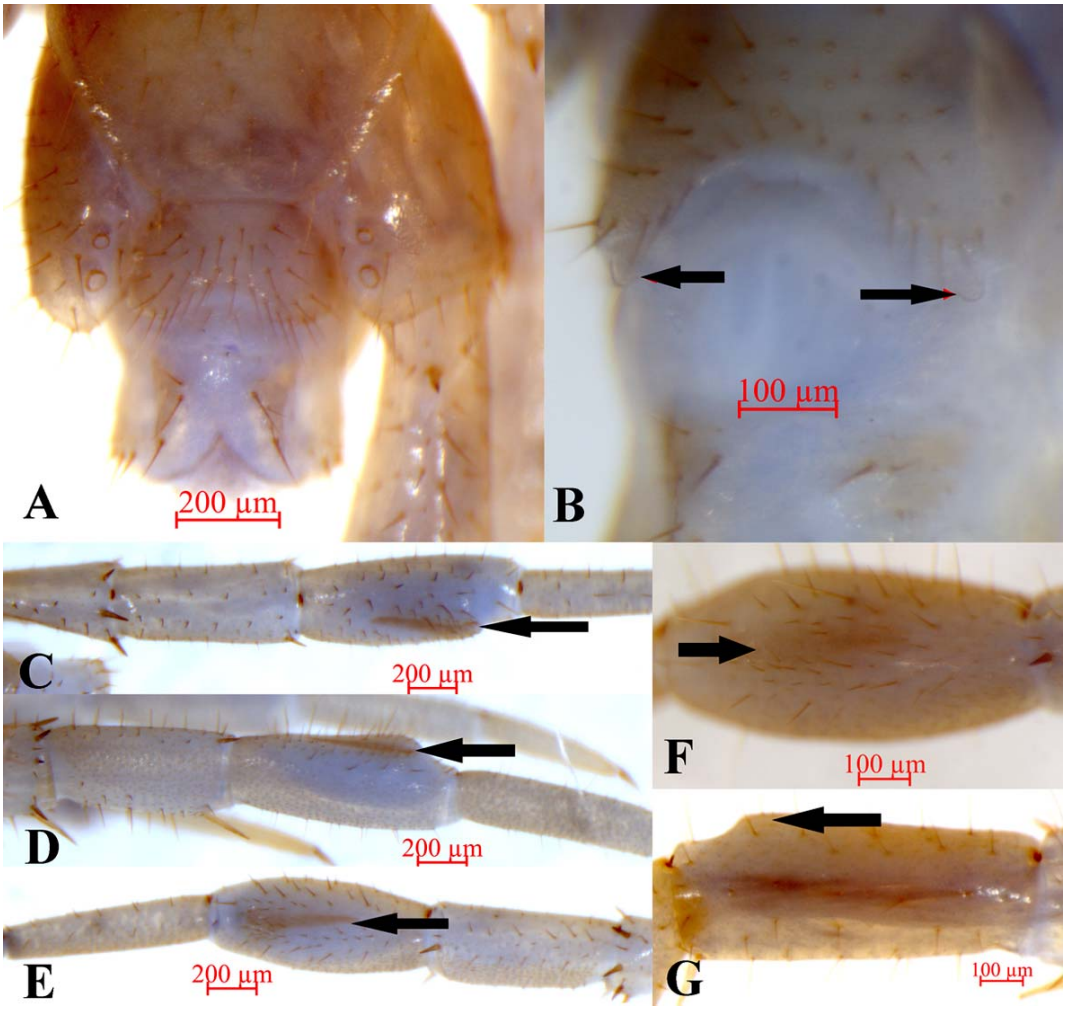


Fig. 2A–G. *Lithobius* (*Monotarsobius*) *aterrimus* sp.n., ♂ paratype (A, B, F,G), ♂ holotype (C, D, E). A, B — posterior segments and gonopods, ventral view; C, D — tibia of legs 15, left and right subdorsal views, respectively; E, F — tibia of legs 15, dorsal views, respectively; G — tibia of legs 15, lateral view.

Рис. 2A–G. *Lithobius* (*Monotarsobius*) *aterrimus* sp.n., паратип ♂ (A, B, F, G), голотип ♂ (C, D, E). A, B — задние сегменты и гоноподы, снизу; C, D — голень 15, соответственно слева и справа почти сверху; E, F — голень 15, сверху; G — голень 15, сбоку.

Province, 41. 958447ºN, 126.466409ºE, ca 480 m a.s.l., 22 August 2016, S. Pei, H. Ma leg; 16 ♀♀, 49 ♂♂ (Lmon02-08), Dingxi Park, Anding County, Dingxi City, Gansu Province, 35.616584ºN, 104.60536ºE, ca 1970 m a.s.l., 24 August 2018, S. Pei, H. Ma leg.

DIAGNOSIS. In accordance with the grouping of species proposed in the subgenus *Monotarsobius* [Zapparoli, Edgecombe, 2011], the new species differs from other consubgeners in having the antennae composed of 17–22, commonly 20+20 articles, ocelli 8–10, usually 9 on each side, arranged in three irregular rows, with the posterior ocellus the largest, Tömösváry's organ slightly larger than the adjacent ocelli; commonly 2+2 coxosternal teeth, porodonts long, slender and transparent, lying posterolateral to the lateralmost tooth; coxal pore formula 2–4, arranged in one row; legs 14 and 15 thicker than the anterior pairs in both sexes, with a longitudinal groove on the dorsal side of the tibia of male legs 15. Female gonopods with 3+3 or 2+2 moderately small coniform spurs, apical claw of the third article bidentate.

NAME. To emphasise that the dorsal side of the tibia of male legs 15 is with a moderately wide, central, longitudinal groove, and the apex is widened and raised to form an obvious protuberance.

DESCRIPTION. Holotype 14.1 mm long, cephalic plate: 1.4 mm long, 1.5 mm wide. Body: 9.5–14.7 mm long, cephalic plate 0.9–1.3 mm long, 1.0–1.3 mm wide.

Coloration: Antennae pale grey-brown to brown, distal article with yellowish hue; tergites pale yellow-brown with brownish hue; cephalic plate pale yellow-brown; pleural region pale grey with bluish hue; sternites pale brown with greyish hue; distal part of forcipules darker yellow-brown, with basal and proximal parts of forcipules and forcipular coxosternite, as well as SS 14 and 15 pale yellow-brown with greyish hue; all legs pale grey with yellowish hue;, tarsus-I yellow, a little thickened, tarsus-II yellow and even more strongly thickened.

Antennae with 17–22 articles, commonly 20+20 (Fig. 1A). Antennal article I longer than width at base, remaining articles significantly longer than wide; from article II on, each article gradually shortened, distalmost articles still being significantly, 3.1–3.7 times as long as wide; abundant

setae on antennal surface, less so in basal articles, gradually and increasingly setose to approximately article VI, then more or less constant.

Cephalic plate smooth, obviously convex, equal to or slightly wider than long; tiny setae emerging from pores scattered very sparsely over the whole surface; frontal marginal ridge with a shallow anteromedian furrow; short to long setae very sparsely scattered along marginal ridge of cephalic plate; lateral marginal ridge discontinuous, posterior margin continuous, straight, wider than lateral marginal ridge (Fig. 1B).

Ocelli eight to ten, commonly nine oval ocelli on each side, from small to large, arranged in three irregular rows, posterior ocellus the largest. Ventral ocelli smaller than dorsal ones, domed, translucent and usually dark (Fig. 1C, D, E).

Tömösváry's organ located close to ocelli at anterolateral margin of cephalic plate, surrounding sclerotised area always narrow, slightly larger than adjoining ocelli (Fig. 1C, D, E, To).

Coxosternite subtrapezoidal (Fig. 1F), anterior margin narrow, lateral margins slightly longer than medial margins; median diastema moderately deep, V-shaped; anterior margin with 2+2 acute triangular teeth; porodonts feebly thicker, posterolateral, separated from lateral tooth, lying posteriolateral to lateralmost tooth, with a marked bulge at base (Fig. 1F, G); long scattered setae on ventral side of coxosternite, longer setae near dental margin.

All tergites smooth, without wrinkles, dorsum slightly convex; tiny setae emerging from pores scattered sparsely over entire surface; T1 narrower posterolaterally than anterolaterally, generally inverted trapezoidal; cephalic plate wider than T 1 and T 3, T1 narrower than T 3. Lateral marginal ridges of all tergites continuous. Posterior marginal ridges of TT 1, 3 and 5 continuous, posterior marginal ridges of TT 10, 12 and 14 discontinuous. Posterior margin of TT 1, 3 and 5 feebly concave, posterior margin of TT 8, 10, 12 and 14 moderately concave. Posterior angles of tergites rounded, without triangular projections. Short to long minuscule setae scattered sparsely over surface.

Sternites: Posterior side of sternites narrower than anterior one, generally inverted trapezoidal, smooth; setae emerging from very sparsely scattered pores on surface and at lateral margin. 2–3 pairs of approximately symmetrically arranged long setae in middle part of anterior portion.

Legs: Relatively robust, tarsi ill-defined on legs 1–13, tarsal articulations on dorsal side indistinct, being visible only as a shallow ventral suture; well-defined on legs 14 and 15. From short to long setae sparsely scattered over surface of coxa, trochanter, prefemur, femur, and tibia of all legs, more setae on tarsal surface; setae on dorsal and ventral surfaces slightly longer; some notably thickened setae arranged in one row on ventral surface of tarsi 1–13, no setae arranged in one row on ventral surface of tarsi 14 and 15. All legs with moderately long and curved claws; legs 1–13 with anterior and posterior accessory spurs, anterior accessory spurs moderately long and slender, forming a moderately small angle to claw; posterior accessory spurs slightly more robust, forming a comparatively large angle to claw, only posterior accessory spurs present in legs 14 and 15. Legs 14 and 15 thicker than anterior pairs in both sexes, male legs 15 thicker and stronger than female ones, especially in tibia. Tarsus-II, 3.6–4.5 times longer than width; tarsus-II, 66.6%–85.9% length of tarsus-I of legs 15 in female, tarsus-II, 3.8–5.7 times longer than width, tarsus-II, 64.6–86.4% length of tarsus-I of legs 15 in male. Leg plectrotaxy as in Table.

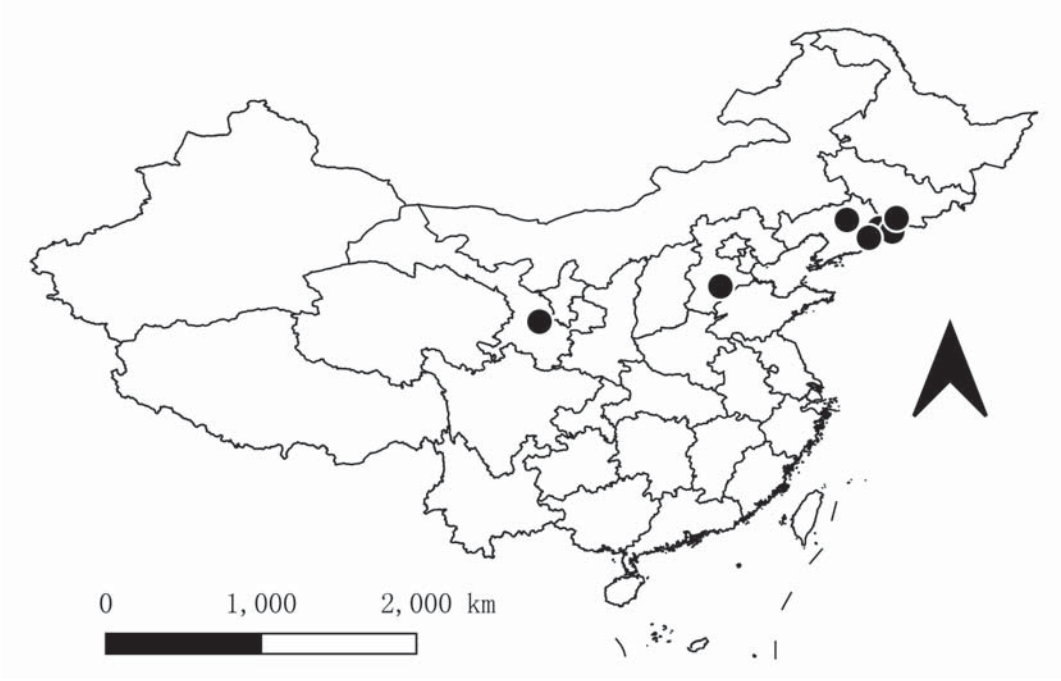
Coxal pores: Round, 2–4 in a row, 3(4)-4-4-3 in female, 3(2)-4(3)-4(3)-3(2) in male; commonly round, coxal pore field set inside a relatively shallow groove, coxal pore-field fringe with a slight prominence and moderately long setae sparsely scattered over surface.

Female: S 15 anterior margin broader than posterior one, posterior angles generally rounded, posterior marginal ridges slightly concave. Posterior side of sternites narrower than anterior one, moderately long setae sparsely scattered over S 15 surface, surface of lateral sternal margin of genital segment well-chitinised, posterior margin of genital sternite deeply concave between condyles of gonopods, except for a small, median, rhomboid-shaped bulge. Short to long setae very sparsely scattered over ventral surface of genital segment, slightly more setae in posterior part, especially at posterior edge. Gonopods: first article fairly broad, bearing 15–18 moderately long setae arranged in three irregular rows; with 3+3 (Fig. 1H) or 2+2 small coniform spurs, inner spur slightly smaller than outer one; second article with seven or eight long setae in ventral part, approximately

Table. Leg plectrotaxy of *Lithobius* (*Monotarsobius*) *aterrimus* sp.n.
Таблица. Плектротаксия *Lithobius* (*Monotarsobius*) *aterrimus* sp.n.

legs	ventral					dorsal				
	C	Tr	P	F	Ti	C	Tr	P	F	Ti
1			p	am(p)	m			mp	a(p)	a
2			p	amp	m			mp	ap	a
3			(m)p	amp	m			mp	ap	a(p)
4			mp	amp	(a)m			amp	ap	ap
5–12			mp	amp	am			amp	ap	ap
13		m	amp	amp	am	a		amp	(a)p	(a)p
14		m	amp	amp	m	a		amp	p	p
15		m	amp	am		a		amp	p	

NB: Letters in brackets indicate variable spines.



Map. Distribution of *Lithobius* (*Monotarsobius*) *aterrimus* sp.n. in China.
Карта. Распространение *Lithobius* (*Monotarsobius*) *aterrimus* sp.n. в Китае.

evenly scattered over ventral surface; third article with three or four long setae in ventral part, arranged in one irregular row, with a bidentate apical claw, ventral part short and acute, dorsal part long and blunt (Fig. 1I, J).

Male: S 15 posterior margin narrower than anterior one, slightly concave posteromedially, generally inverted trapezoidal, covered with sparse long setae; sternite of genital segment evidently smaller than in female, usually sclerotised; posterior margin deeply concave between gonopods, without medial bulge. Short to long setae evenly scattered over ventral surface of genital segment. Gonopods short, each appearing as a small ball-like bulge with 0–2 long setae, slightly sclerotised apically (Fig. 2A, B). With a moderately wide central longitudinal groove on dorsal side of tibia of male legs 15, and apex widened and raised to form an obvious protuberance, setation density at groove edge higher than that in other positions (Fig. 2C-G).

HABITAT. Under the leaf litter of a mixed pine and poplar forest.

COMMENTS. Morphologically, the new species seems to be extremely close to *Lithobius* (*Monotarsobius*) *femoratus* Pei, Ma, Liu, Lu et Liang 2021 [Pei *et al*., 2021b], from the Hebei Province. Females are similar to *Lithobius* (*Monotarsobius*) *fugax* Stuxberg, 1876, from Siberia and Mongolia, in the structure of the gonopods [Stuxberg, 1876; Loksa, 1965; Zalesskaja, 1978], whereas males to *Lithobius* (*Monotarsobius*) *curtipes* C.L. Koch, 1847, from Europe and Siberia, in the secondary sexual modifications of tibia 15 [Koch, 1847; Loksa, 1962; Zalesskaja, 1978]. The new species shares with them the antennae being composed of 17–22 articles, the posterior ocellus the largest, DaC spine on legs 14 and 15; 2+2 prosternal teeth, and the female gonopods with 3+3 or 2+2 moderately small coniform spurs. However, the new species can easily be distinguished from *L.* (*M.*) *femoratus* by the following characters: a central longitudinal groove present on dorsal side of tibia of male legs 15, *vs.* no other special features in *L.* (*M.*) *femoratus*; 8–10 ocelli on each side, *vs.* six or seven ocelli on each side in *L.* (*M.*) *femoratus*; DaC spine on legs 13, 14 and 15, *vs*. DaC spine on legs 14 and 15 in *L.* (*M.*) *femoratus.* The new species clearly differs from *L.* (*M.*) *fugax* by the following characters: a central longitudinal groove present on dorsal side of tibia of male legs 15, *vs*. no other special features except the dorsal side being slightly flattened in *L.* (*M.*) *fugax*; Tömösváry's organ larger than adjacent ocelli, *vs.* smaller than adjacent ocelli in *L.* (*M.*) *fugax*; dorsal plectrotaxy: 221 in legs 2 and 10311 in legs 14, *vs*. 122 in legs 2 and 10310 in legs 14 in *L.* (*M.*) *fugax*.

In addition, the new species can easily be distinguished from *L.* (*M.*) *curtipes* by the following characters: a central longitudinal groove present on a convex dorsal side of tibia of male legs 15, *vs.* no obvious longitudinal groove, but a protuberance extending backwards in *L.* (*M.*) *curtipes*; dorsal plectrotaxy: 221 in legs 2 and 00322 in legs 12, *vs*. 122 in legs 2, 0(1)0311 in legs 12 in *L.* (*M.*) *curtipes*; apical claw of female gonopods bidentate, *vs.* apical claw of female gonopods tridentate in *L.* (*M.*) *curtipes*.

To assist the identification of the species of *Monotarsobius* known to occur in China, the following key is offered. This key emphasises characters that can be examined without high-magnification microscopy; moreover, these characters are specific to the taxa occurring in China and are valid only for adult specimens.

KEY TO THE CHINESE SPECIES OF SUBGENUS *MONOTARSOBIUS*

1 Coxal pores only 1111 .....
L. (*M.*) *monoforaminis* Ma, Pei, Wu, Lin et Gai, 2012
– Coxal pores at least 1222 2
2 Coxal pores 5555 ..... *L.* (*M.*) *ramulosus* Takakuwa, 1940
– Coxal pores at most 4444 3
3 Tömösváry's organ larger than or equal to the largest ocellus …. ..... *L.* (*M.*) *holstii* (Pocock, 1895)

– Tömösváry's organ smaller than the largest ocellus 4
4 Tömösváry's organ smaller than adjoining ocelli 5
– Tömösváry's organ larger than or equal to adjoining ocelli 6
5 Dorsal plectrotaxy: 121 in legs 2 and 10210 in legs 14 ... . *L.* (*M.*) *zhangi* Ma, Pei, Hou et Zhu, 2014
– Dorsal plectrotaxy: 122 in legs 2 and 10200 in legs 14 ... *L.* (*M.*) *songi* Pei, Ma, Shi, Wu et Zhou, 2011
6 DaC spine present on legs 14 and 15 7
– DaC spine absent on legs 14 and 15 9
7 Dorsal plectrotaxy: 00100 in legs 14 and 15 .. *L.* (*M.*) *obtusus* (Takakuwa, 1941)
– Dorsal plectrotaxy: 00300 in legs 14 and 15 8
8 Posterior and posterosuperior ocelli larger than seriate ocelli, ventral plectrotaxy: 01320 in legs 15 .... *L.* (*M.*) *meifengensis* Chao, Lee et Chang, 2018
– Posterior ocellus larger than posterosuperior and seriate ocelli, ventral plectrotaxy: 01210 in legs 15 .... *L.* (*M.*) *qingquanensis* Chao, Lee et Chang, 2020
9 Dorsal plectrotaxy: 211 in legs 1; ventral plectrotaxy: 01332 in legs 13 ..... *L.* (*M.*) *crassipes* L. Koch, 1862
– Dorsal plectrotaxy: 111 in legs 1; ventral plectrotaxy: 00232 in legs 13 10
10 Coxal pores 1222–2222, ventral plectrotaxy: 11 in legs 1; dorsal plectrotaxy: 00311 in legs 13 .... *L.* (*M.*) *ferganensis* (Trotzina, 1894)
– Coxal pores 3–5, ventral plectrotaxy: 121 in legs 1; dorsal plectrotaxy: 00322 in legs 13 .... *L.* (*M.*) *femoratus* Pei, Ma, Liu, Lu et Liang, 2021
11 Six ocelli on each side, posterior two ocelli the largest ..... *L.* (*M.*) *subspinipes* Ma, Pei, Zhu, Zhang et Liu, 2009
– Eight to ten ocelli on each side, posterior ocellus the largest 12
12 Dorsal plectrotaxy: 222 in legs 2; ventral plectrotaxy: 01321 in legs 15 .... *L.* (*M.*) *tetrasulcus* Pei, Liu, Liang, Ma et Lu, 2021
– Dorsal plectrotaxy: 221 in legs 2; ventral plectrotaxy: 01320 in legs 15 ..... *L.* (*M.*) *aterrimus* **sp.n.**

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