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A new species of *Uroballus* Simon, 1902 (Araneae: Salticidae) from Hong Kong, a jumping spider that appears to mimic lichen moth caterpillars

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ABSTRACT

A new salticid spider species *Uroballus carlei* n. sp. (♂) from Hong Kong is diagnosed, described and illustrated. The species is unusual for the jumping spiders in its striking resemblance to lichen moth larvae. A brief discussion of the putative caterpillar-mimicry in some *Uroballus* species is provided as well.

KEYWORDS: Arachnida, Aranei, description, mimicry, Oriental Region.

РЕЗЮМЕ

Диагностирован, описан и иллюстрирован новый вид пауков-сальтицид *Uroballus carlei* n. sp. (♂) из Гонконга. Внешним видом этот паук сильно напоминает личинок лишайниц, что необычно для пауков-скакунчиков. Также дается краткое обсуждение предполагаемой мимикрии некоторых видов *Uroballus* с гусеницами.

КЛЮЧЕВЫЕ СЛОВА: Arachnida, Aranei, пауки-скакунчики, описание, мимикрия, Ориентальная область.

INTRODUCTION

Uroballus Simon, 1902 is a poorly known Oriental genus belonging to the group Simaethinae (*sensu* Simon 1903) or the subtribe Simaethina in the tribe Viciriini (*sensu* Maddison 2015). The genus contains five valid species (WSC 2019): *Uroballus henicurus* Simon, 1902 (♂) and *U. octovittatus* Simon, 1902 (♂♀) from Sri Lanka (no exact localities), *U. kinabalu* Logunov, 2018 (♀) from North Borneo (Mt. Kinabalu), *U. koponeni* Logunov, 2014 (♀) from Borneo (Sarawak), and *U. peckhami* Żabka, 1985 (♀) from northern Vietnam (Hanoi); the type species is *U. octovittatus*. To date, all these species are known from the original descriptions and from the type localities only.

The genus *Uroballus* is characterized by the following combination of characters: the extremely long dorsal spinnerets, the key character of the original generic diagnosis by Simon (1902: 400, 1903: figs 981–993M; see also Logunov 2014: figs 1–7); the flat and broadened carapace (Logunov 2014: figs 6, 7) and minute PMEs positioned about half way between the ALEs and PLEs (Logunov 2014: fig.

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6; 2018: fig. 7; but see Prószyński 1987: 107); the ocular quadrangle wider behind than in front; the fissidentate pattern of the cheliceral dentition (Fig. 5; Prószyński 1987: 107; Logunov 2014: fig. 8; 2018: fig. 8); the very weak leg spination, practically limited to Tb and Mt of the first legs; the simple male palps with a singular tibial apophysis (pointed or blunt) and a relatively short embolus directed apicad or retro-laterad; the simple, two-chambered spermathecae having short insemination ducts (Żabka 1985: fig. 638; Logunov 2014: fig. 10; 2018: fig. 10).

The aims of the present paper are: (1) to describe a new, caterpillar-like *Uroballus* species from Hong Kong; and (2) to discuss briefly the putative caterpillar-mimicry in some *Uroballus* species.

MATERIAL AND METHODS

The holotype of the new species has been deposited in the Manchester Museum of the University of Manchester, UK (MMUE; curator D.V. Logunov). Digital photographs of live specimens were made by the second author with a Canon MP-E 65mm Lens and a Sigma 150 mm f/2.8 Lens mounted on a Canon 80D Camera. Digital photographs of preserved specimens were made by the first author at the World Museum of Liverpool (UK) with a Canon 6D Mark II Camera with a Canon MP-E 65mm Lens with Helicon Remote ver. 3.9.7W to control the StackShot 3X Macro Rail and camera settings, and Helicon Focus 6.8.0 as processing software.

Abbreviations used in the text and figures are as follows: *Eyes*: ALE – anterior lateral eye, AME – anterior median eye, PLE – posterior lateral eye, PME – posterior median eye. *Leg segments*: Fm – femur, Mt – metatarsus, Pt – patella, Tb – tibia, Tr – tarsus. *Position of leg spines*: ap – apical, pr – prolateral, v – ventral. For the leg spination, the system by Ono (1988) is adopted. The sequence of leg segments in measurement data is as follows: femur + patella + tibia + metatarsus + tarsus (total). All measurements are in millimeters.

TAXONOMY

Family Salticidae Blackwall, 1841

Genus *Uroballus* Simon, 1902

Uroballus carlei n. sp.

(Figs 1–15)

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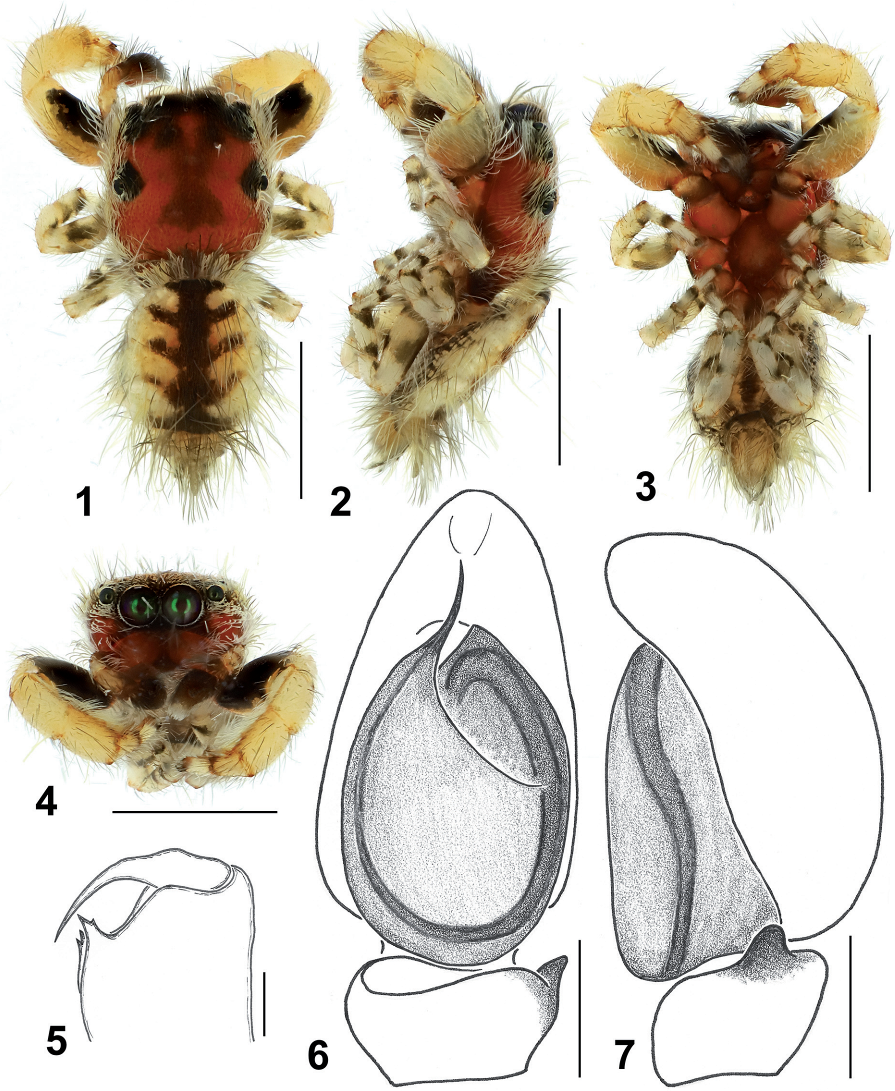
Etymology: The species is dedicated to Eric Carle (b. 1929), the American illustrator and author of more than 70 books for children and adults. His most renowned books include ‘The Very Hungry Caterpillar’, which chronicles the growth and metamorphosis of a caterpillar, and ‘The Very Busy Spider’. Indeed, these and other books by Eric Carle provide the first conscious contact of young readers with the natural world, being innovative tools for early-age environmental and biodiversity education.

Diagnosis: Of the five *Uroballus* species described to date (WSC 2019), two are known from the males, of which only the male of *U. octovittatus* has been illustrated (Prószyński 1987: 107). *U. carlei* n. sp. can be easily distinguished from the latter species by the wide serrate longitudinal stripe on the dorsum (five narrow transverse bands in *U. octovittatus*), the embolic tip directed apicad (laterad in *U. octovittatus*), and the short, wide and blunt tibial apophysis (comparatively long and pointed in *U. octovittatus*).

Description: Male (holotype). *Measurements*. Carapace 1.25 long, 1.03 wide and 0.49 high at PLE. Ocular area 0.71 long, 0.80 wide anteriorly and 0.97 wide posteriorly. Diameter of AME 0.25. Clypeus height 0.03 (almost unmarked), chelicera length 0.29. Abdomen 1.28 long (without anal tubercle), 0.88 wide. Length of leg segments: I: 0.69+0.40+0.20+0.31+0.21 (1.81); II: 0.49+0.30+0.26+0.21+0.19 (1.45); III: 0.47+0.23+0.19+0.21+0.21 (1.31); IV: 0.65+0.29+0.29+0.27+0.21 (1.71). *Leg formula*: I, IV, II, III. *Leg spination*. Leg I: Tb v 0-2; Mt v 2-2ap. Legs II–IV: Fm d 1ap, other segments spineless. *Coloration* (in alcohol, Figs 1–4). Carapace yellowish russet, with surface shagreen, densely covered with recumbent brownish/white scales and long protruded brownish/white hairs and bristles; a wide transverse brown stripe along eyes of the first row (Fig. 1); brown areas around PLEs and a triangle brownish spot in the centre of the eye field; carapace sides (in their rear halves) and thorax rear margin brown. Sternum, endites and labium light brown (Fig. 3). Chelicerae brownish orange (Fig. 4), promargin with two small teeth, retromargin with a tall fissidentate tooth (Fig. 5). Abdomen oval and flat: dorsum light yellow, with a wide longitudinal brown serrate stripe and densely covered with long whitish and brownish erected hairs/bristles that are especially dense at the rear third of dorsum (Fig. 1); sides and venter light yellow, with longitudinal dotted greyish lines and a median longitudinal greyish stripe on venter. Book-lung covers yellow. Anal tubercle long, yellowish grey. Spinnerets: dorsal pair long and thin, yellowish grey; ventral pair shorter, sausage-shaped, light yellow. Leg I light yellow with Fm black anteriorly (Fig. 1). Legs II–IV light yellow, with brown patches and (semi)rings at segment joints. Palps: all segments yellow, but cymbium brown, with a bunch of whitish hairs at its tip. Palpal structure as in Figs 6, 7: tibia short, with a very short and wide tibial apophysis having a blunt tip; bulbus oval, with a visibly pointed tegular shoulder; embolus short and thin, directed apicad at 12 o'clock.

Female is formally unknown, but Wong (2016: 279: sub. *Uroballus* sp.) provided photographs of a live, probably an immature female of *U. carlei* n. sp. Based on these images, it is obvious that the female has almost identical body coloration to that of the male and only differs in having both palpi and legs I entirely yellow.

Remarks: Although the female of *U. carlei* n. sp. and its copulatory organs are not formally described yet, its general appearance was picture by Wong (2016: 279: sub. *Uroballus* sp.). Based on these photographs, it is safe to conclude that the hairy female of *U. koponeni* from Malaysia cannot be that of *U. carlei* n. sp.



Figs 1–7: Somatic characters and copulatory organs of *Uroballus carlei* sp. n. (holotype ♂): (1) body, dorsal view; (2) ditto, lateral view; (3) ditto, ventral view; (4) carapace, front view; (5) left chelicera, ventral view; (6) palp, ventral view; (7) ditto, retrolateral view. Scale bars for Figs 1–4 = 1 mm, for Figs 5–7 = 0.1 mm.

The female of the new species differs from it in having the wide brown serrate longitudinal stripe on the dorsum (eight narrow brownish transverse bands in *U. koponeni* (see figs 1, 2 in Logunov 2014) and the markedly shorter spinnerets [cf. figures in Wong (2016: 279: sub. *Uroballus* sp.) and in Logunov (2014: figs 1–7)].

Holotype: ♂ (MMUE, G7625.1) **China**: Hong Kong, Chai Wan, Shek O Country Park [22.256624°N, 114.240100°E], c. 165 m a.s.l., 9.xi.2018, S. Obenauer.

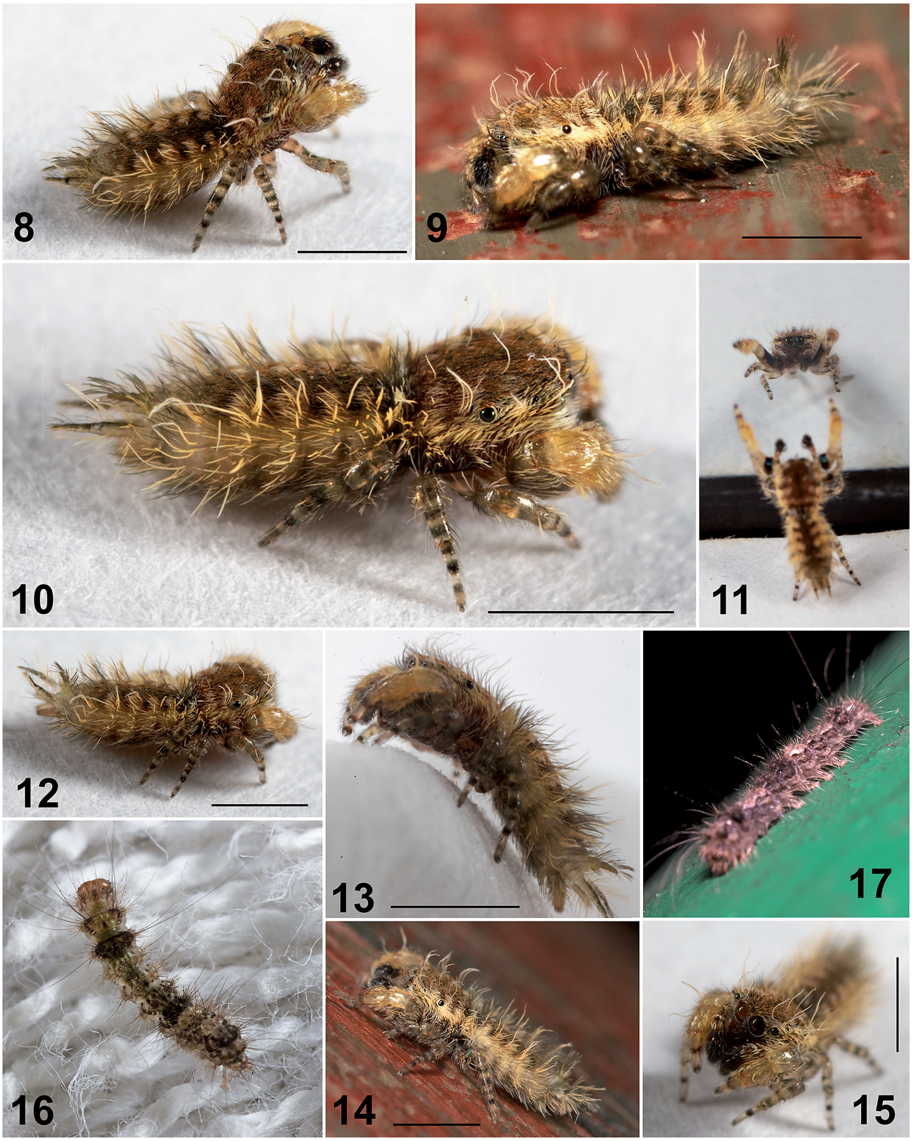
Habitat: The studied male was collected from a painted metal railing (Figs 9, 14), just at the edge of Shek O Country Park. However, we tend to believe that this species might actually occur in tree canopies, as some other *Uroballus* species described to date, e.g., *U. kinabalu* from North Borneo (Logunov 2018).

Lab observations: The studied specimen was kept by one of us (SO) alive in the lab for several days. It was noted that the male moved rather slowly and often stopped; it could also jump from time to time. The male spent most of its time in the lab at rest, motionless. While moving, the male usually erected its anal tubercle (Figs 12, 14). It did not construct any retreat, but sometimes was observed resting in between two layers of tissue paper (near the opening), which provided enough space in between them to fit its body. While trying to escape, the male once fell down and hung on a dragline several cm long, then climbed back up. The male recognized its mirror image and displayed towards it (Fig. 11). When the male was given a small Psocoptera, it followed it at first but then ignored it. A bit later, when it was within one cm of the psocid, it again approached and caught it, but then let it go after some 20 seconds.

DISCUSSION

A striking resemblance of live specimens of *U. carlei* n. sp. to a small-sized, hairy caterpillar (Figs 8–15) is unique within the Salticidae and the entire order Araneae. Such resemblance was first mentioned by Wong (2016: 279), the author of the photographic guide to the spiders of Hong Kong. He published the first original photographs of the female of this species under the name *Uroballus* sp. and also noted that it had "*some longer and harder hairs erected to mimic caterpillar*". Interestingly, while in the lab, the studied male moved rather slowly, often stopped and rarely jumped, thus to some extent mimicking the movements of a caterpillar. The only other spider species known to us that also seems to be a caterpillar-mimic is another *Uroballus* species, *U. koponeni* from Malaysia. The body and spinnerets are densely covered with long protruding hairs in a similar manner to *U. carlei* n. sp. (cf. figs 1–5 in Logunov 2014). Unfortunately, *U. koponeni* was described from a series of dead museum specimens, and the behaviour of live specimens was not observed.

Based on the recent account of mimicry and other adaptive resemblances published by Quicke (2017), the similarity of *U. carlei* n. sp. and *U. koponeni* to caterpillars could be characterized as a dual-purpose aggressive mimicry, being "*simultaneously protective and aggressive to different dupes*" (Quicke 2017: 306; see also Nelson 2014). Indeed, many colourful (aposematic) and/or hairy caterpillars are distasteful, toxic and/or possess urticating hairs, making them unprofitable prey to such predators as birds (examples are in Ruxton *et al.* 2004; Quicke 2017; and references therein). The *Uroballus* species seem to resemble an early stage of lichen moth caterpillars (Erebidae: Arctiinae, Lithosiini; e.g., Figs 16, 17), a common component of Oriental tropical forests. In Hong Kong, there are some 60 species of lithosiine moths, which constitute a rather depauperate fauna, but there are hundreds of species in Malaysia (Roger Kendrick pers. comm.).



Figs 8–17: General appearance of live male of *Uroballus carlei* n. sp. (holotype ♂; 8–15) and the caterpillars of *Brunia antica* (Walker, 1854) (16, 17). Scale bars = 1 mm.

As the lithosiine larvae retain the toxic components of lichens, most of them are aposematic and conspicuous in habit, which is especially true of taxa with diurnally active caterpillars (Anderson *et al.* 2017; Wagner 2009; and references therein). As observed by the second author (SO), the commonest and rather abundant diurnal lithosiine species that occurs together with *U. carlei* n. sp. is the Yellow-Underwing Lichen Moth, *Brunia antica* (Walker, 1854). Although the similarity of *U. carlei* n. sp. to the caterpillars of *B. antica* (cf. Figs 16, 17 and 8–15) is not particularly accurate, it is not essential for a defensive mimicry to be effective, as was shown, for instance, for the ant-mimicry system of Salticidae and other spider groups (Pekár 2004 and references therein). The main prerequisite for a model-mimic system to be effective is the presence and abundance of the model species occurring in the same habitat (Quicke 2017) and the lichen moth larvae of *B. antica* (and apparently of some other species) seem to suit this condition. Thus, it might be expected that external similarity of *Uroballus* species to young hairy lithosiine caterpillars would be of a selective advantage that increases their chance of survival.

Additionally, a resemblance to an innocuous caterpillar might be used as a predatory ploy to deceive potential prey, such as small-sized Diptera or Hemiptera, thereby aiding the spider in stalking and capturing them; essentially a wolf in sheep's clothing. The same Biblical allegory was recently employed by Perger & Rubio (2018) to elucidate a possible adaptive advantage of the fly-resembling jumping spider *Scoturius dipterioides* Perger & Rubio, 2018 from Bolivia.

Finally, even aposematic and distasteful caterpillars are prone to attack by specialized parasitoids (Wagner 2009). Hence the very caterpillar likeness of *Uroballus* species could perhaps be treated as a visual lure (i.e., aggressive allurement), aiding the spider to attract some of its prey (alluring mimicry *sensu* Quicke 2017). For instance, the brightly-coloured bodies of many orb-web spiders (*Argiope*, *Gasteracantha*, *Leucauge*, etc.), both diurnal and nocturnal, have been shown to attract generalist pollinators thus increase prey capture (Craig & Ebert 1994; Hauber 2002; Tso *et al*. 2007; but see Gawryszewski & Motta 2012). Even in some vagrant spider species (e.g., the pantropical *Heteropoda venatoria* (Linnaeus, 1767)), a contrasting white stripe of the forehead was shown to act as a visual lure attracting moths (Zhang *et al.* 2015).

The putative caterpillar mimicry of *Uroballus* species requires further field observations and experimental study. It is our hope that this paper will encourage naturalists to search for more specimens of *U. carlei* n. sp. and to study the biology of this and other *Uroballus* species that seem to mimic lichen moth caterpillars.

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