A new *Larca* (Arachnida: Pseudoscorpiones: Larcidae) from Crete

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Summary

Larca bosselaersi sp. n., a new troglobitic pseudoscorpion from Crete, is described and compared with related species. The genus is new for Greece.

Introduction

The cave-dwelling pseudoscorpion fauna of Crete is rich and varied. Recently new troglobitic relicts have been described, some very specialised and morphologically altered (Henderickx, 1997, 2000). There is also the scattered presence of representatives of unexpected genera, more or less adapted to cave life, that probably colonised the island during periods when Crete was near or attached to the mainland (Henderickx, 1998). Deeleman-Reinhold (1989) argues that during the isolation of Crete in the Quaternary era species evolved by splitting off from ancestral forms and adapted to live in the shallow cave systems. It is likely that an indigenous fauna exists in the porous underground system of Crete and that some caves are only gateways to this mostly unknown ecosystem. Evidence for this view is provided by the discovery of a colony of the troglobitic *Neobisium (Ommatoblothrus) schawalleri* Henderickx, 2000 in the Arkalospiliara cave, Maratos, Crete. This species was previously known only from the Doxa cave, Maratos, which is separated from the Arkalospiliara cave by a distance of approximately 4 km.

With the intention to examine further the Cretan troglobitic fauna, the first author organised three expeditions in 2000. A large number of caves, in the mountainous as well as the coastal area, were examined. On 21 December 2000 the Milatos cave (Crete, province of Lassithi, 35°18.606′N, 25°34.683′E, elevation 200 m) was visited. This cave is known for its biological interest and has been the subject of intensive biospeleological investigations. It contains an important colony of bats, and a new genus of dysderid spiders was described from this cave (Deeleman-Reinhold, 1989). The Milatos cave still provides surprises: within it in December 2000 the first author found two specimens of an undescribed pseudoscorpion. The specimens turned out to belong to *Larca* Chamberlin, 1930 (Larcidae (Harvey, 1992)), a genus and family that had not previously been reported from Crete or Greece. Both authors found 12 more specimens at the same location in May 2001. The new species is described in this paper.

Material and methods

The male paratype T2 was dehydrated in acetone, critical-point dried in carbon dioxide, and sputter-coated with gold before observation with a Philips XL-20 SEM. The right pedipalp and right chelicera were separated from the body. After SEM observation, the gold coating was removed with bromine vapour, and the specimen was rehydrated in a vacuum and preserved in 70% ethanol.

The male paratype T7 and female paratype T11 were gradually dehydrated in alcohol and via xylol embedded in Pertex slides for light microscopy. The chelicerae, pedipalps, and legs I and IV were removed. The hand of the pedipalp was partially separated from the tibia, only the connection with muscles being retained to allow the hand to rotate by 45° and display the position of the trichobothria. The specimens were then partially cleared in potassium hydroxide (KOH), dehydrated and embedded in Pertex.
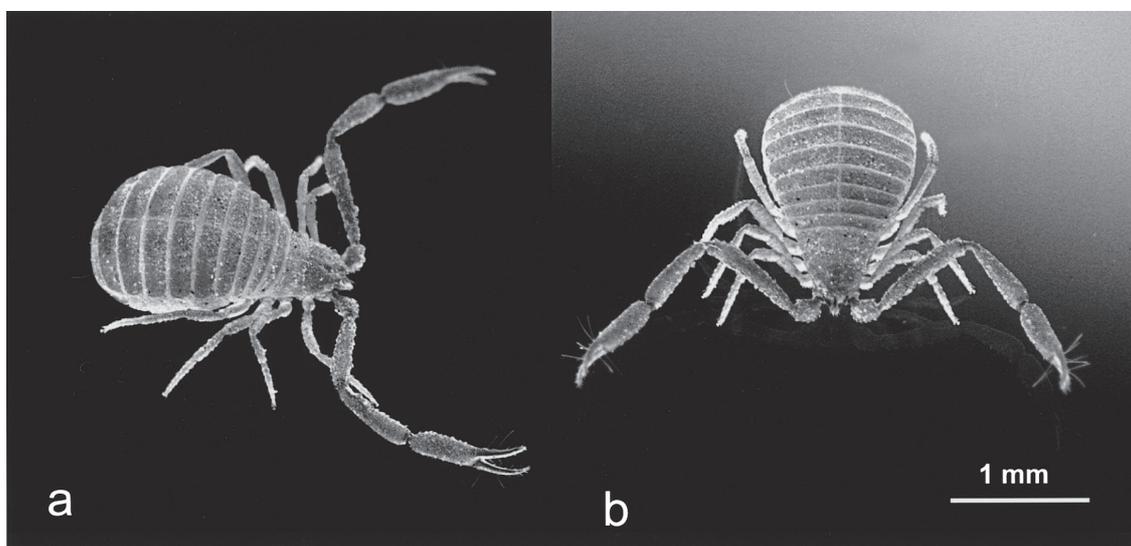

Fig. 1: *Larca bosselaersi* sp. n., male paratype T1. **a** Dorsal lateral view; **b** Dorsal frontal view.

All measurements are in mm, except for ratios of the length/width of articles.

Larca bosselaersi sp. n. (Figs. 1–6)

Type material: Female holotype, Crete, Milatos, Milatos cave, 24 May 2001, leg. Henderickx & Vets, deposited in Western Australian Museum (Mark Harvey), Perth.

Paratypes: 12, labelled T1–T12, same locality as holotype. T1 (Fig.1), T4, T5, T6, T7 (Fig. 2a), T8: males, 24 May 2001, leg. Henderickx & Vets; T2, T3: males, 21 December 2000, leg. Henderickx; T9, T10, T11, T12: females, 24 May 2001, leg. Henderickx & Vets. Paratypes T4 and T9 deposited in Muséum national d'Histoire naturelle, Paris; paratypes T5 and T10 in Muséum d'Histoire naturelle de Genève; paratype T6 in Western Australian Museum (Mark Harvey), Perth; the other paratypes in the collection of the authors.

Etymology: The species is named after the Belgian arachnologist Dr Jan Bosselaers, to honour his work in the Mediterranean region.

Diagnosis: The chaetotaxy is the main character separating the new species from other *Larca* species. Only *Larca bosselaersi* sp. n., *L. lata* (Hansen, 1884) and *L. hispanica* Beyer, 1939 have 4 setae on the posterior margin of the carapace, but the cheliceral hand of the new species bears 4 setae compared with 5 in *L. lata* and 6 in *L. hispanica* (see also Discussion).

Female holotype: Total length (excluding chelicerae) 2.67. Opisthosoma, chelicerae and legs brownish yellow, poorly pigmented. A pair of muscle spots or sigilla on tergites 4–10 and on sternites 5–10. Pedipalps and carapace darker, reddish brown. Carapace (Fig. 2b) without epistome, 0.64 × 0.71, granulated, with 32 setae, 4+4 on anterior, 4 on posterior margin. Two pairs of small eyes, both with lenses. Tergal chaetotaxy of abdomen: 6, 7, 8, 10, 13, 11, 13, 13, 9, 8; two long tactile setae on tergite X. Sternal chaetotaxy: anterior margin of genital region with 10 setae, posterior margin with 13 setae; sternal formula from IV to X: 6, 10, 10, 10, 10, 8, 8. Coxal chaetotaxy: pedipalp: 12+12; coxa I: 8+6; coxa II: 6+6; coxa III: 6+5; coxa IV: 8+10.

Chelicera: hand with 4 setae; movable finger (Fig. 3b) 0.13 × 0.05, with 1 distal seta; galea (length 0.07)
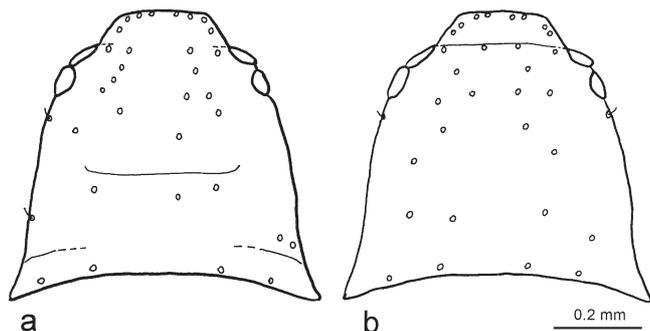

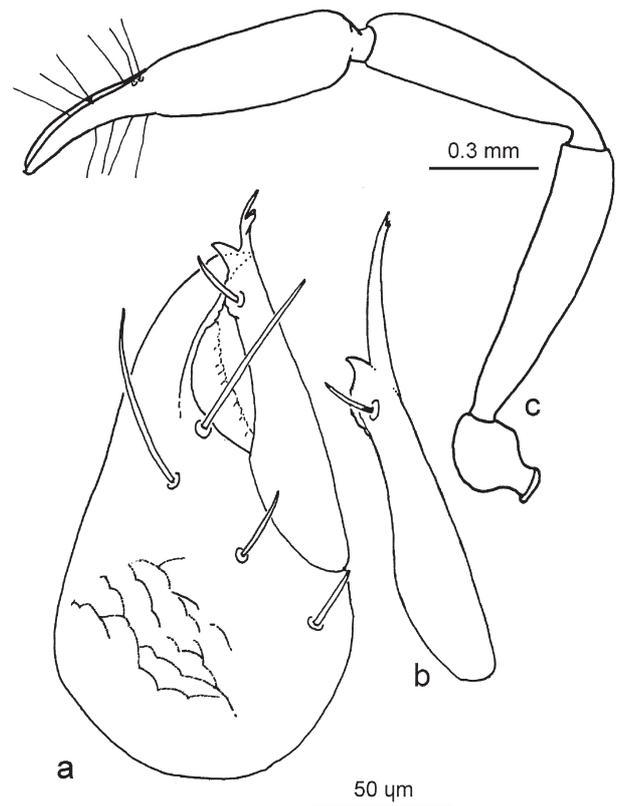Fig. 2: *Larca bosselaersi* sp. n., carapace, dorsal view. **a** Male paratype T7; **b** Female holotype.

Fig. 3: *Larca bosselaersi* sp. n. **a** Male paratype T2, right chelicera, dorsal view; **b** Female holotype, right movable cheliceral finger with galea, dorsal view; **c** Holotype female, right pedipalp, dorsal view.

slender, distally triple pointed; cheliceral hand+fixed finger 0.20 × 0.12. Cheliceral preparations of female paratype T11 show 16 lamellae on serrula exterior, 8 lamellae on serrula interior, and flagellum with 4 lanceolate, rudimentary dentate blades.

Pedipalp (Fig. 3c): slender, coarsely granulated (average tubercle diameter 0.007); hand subcylindrical, elongated; trochanter 0.32 × 0.20, ratio 1.6; femur 0.86 × 0.18, ratio 4.78; tibia 0.75 × 0.20, ratio 3.75; femur 1.15 × length of tibia; chela length 1.07, hand with stem 0.66 × 0.24, ratio 2.75. Fixed finger (length 0.41) with 31 teeth (distal triangular and pointed, proximal flattened); surface granulated dorsally, smooth in dental area; with 4 external and 4 internal trichobothria. Movable finger (length 0.46) with 32 teeth (shape as fixed finger); surface smooth; with two external trichobothria.

Leg I: trochanter 0.18 × 0.12, ratio 1.50; femur 0.29 × 0.10, ratio 2.90; patella 0.23 × 0.11, ratio 2.09; tibia 0.27 × 0.08, ratio 3.37; metatarsus 0.19 × 0.07, ratio 2.71; telotarsus 0.16 × 0.06, ratio 2.66. Leg IV: trochanter 0.28 × 0.13, ratio 2.15; femur 0.18 × 0.13, ratio 1.38; patella 0.46 × 0.15, ratio 3.07; tibia 0.46 × 0.10, ratio 4.60; metatarsus 0.24 × 0.07, ratio 3.43; telotarsus 0.21 × 0.06, ratio 3.50.

Female, variation of pedipalp: Trochanter length 0.31 (T9)–0.32 (holotype), width 0.18 (T9)–0.20 (holotype); femur length 0.86 (holotype)–0.87 (T11), width 0.18 (all females); tibia length 0.70 (T11)–0.77 (T9), width 0.20 (all); chela length 1.01 (T11)–1.10 (holotype).
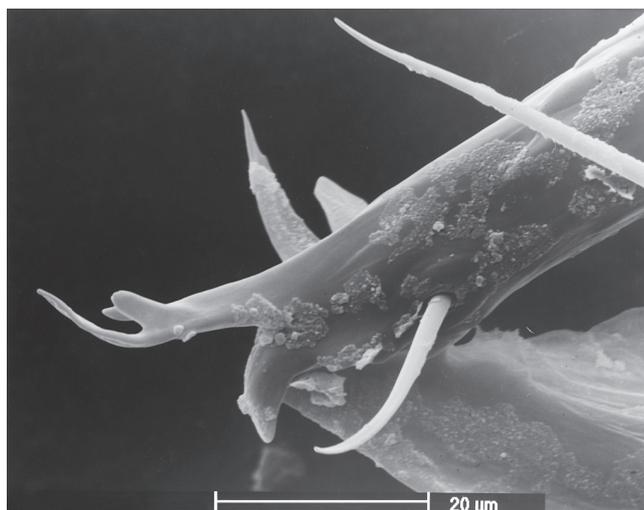
Fig. 4: *Larca bosselaersi* sp. n., male paratype T2. Right galea, dorsal view.

Male paratype T2: Total length (excluding chelicerae) 1.90. Colour as holotype. Carapace 0.56 × 0.66.

Chelicera (Fig. 3a): movable finger 0.12 × 0.03; galea (Fig. 4) length 0.02, slender but much shorter than in female, distally triple pointed; cheliceral hand+fixed finger 0.17 × 0.09.

Pedipalp (Figs. 5, 6): trochanter 0.22 × 0.15, ratio 1.47; femur 0.79 × 0.15, ratio 5.27; tibia 0.67 × 0.16, ratio 4.19; femur 1.18 × length of tibia; chela length 0.96, hand with stem 0.61 × 0.19, ratio 3.21. Fixed finger length 0.35, with 28 teeth; movable finger length 0.43, with 27 teeth; fixed finger 0.81 × length of movable finger.

Leg I: trochanter 0.15 × 0.10, ratio 1.50; femur 0.26 × 0.09, ratio 2.89; patella 0.20 × 0.10, ratio 2.00; tibia 0.24 × 0.08, ratio 3.00; metatarsus 0.18 × 0.06, ratio 3.00; telotarsus 0.16 × 0.05, ratio 3.20. Leg IV: trochanter 0.24 × 0.11, ratio 2.18; femur 0.15 × 0.11, ratio 1.36; patella 0.40 × 0.13, ratio 3.08; tibia 0.39 × 0.09, ratio 4.33; metatarsus 0.22 × 0.07, ratio 3.14; telotarsus 0.20 × 0.06, ratio 3.33.

Sexual dimorphism: The galea of the examined specimens is much longer in females than in males. The pedipalps of the males are more slender.

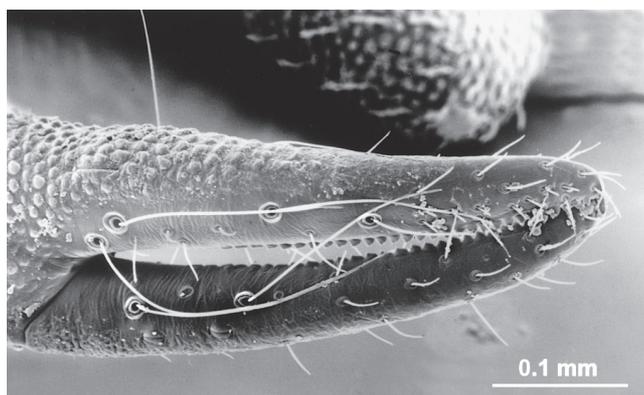*Distribution*: Known only from the type locality.

Discussion

Larca was originally defined by Chamberlin (1930). Currently 8 species are known, including the new species. The genus has a wide distribution, including scattered cavernicolous populations.

The new species and all except one of the other *Larca* spp. have 2 trichobothria on the pedipalpal movable finger (the exception is *L. notha* Hoff, 1961, with 3 trichobothria). Gardini (1983) made a further separation based on the number of setae on the posterior margin of the carapace. *Larca bosselaersi* sp. n. fits in the group with 4 setae (with *L. lata* (Hansen, 1884) and *L. hispanica* Beier, 1939). The number of setae on the cheliceral hand of *L. bosselaersi* (4) differs from that in the widespread epigeic *L. lata* (5 setae) and *L. hispanica* (6 setae). The Nearctic species *L. chamberlini* Benedict & Malcolm and *L. laceyi* Muchmore, 1981 also have 4 setae on the cheliceral hand, but they have 8 (*L. chamberlini*) and 6 (*L. laceyi*) setae on the posterior margin of the carapace.

The European *L. italica* Gardini, 1983 is also cavernicolous. The cheliceral hand of this species has 5 setae (4 in *L. bosselaersi* sp. n.) and the posterior margin of the carapace has 6–8 setae (4 in *L. bosselaersi* sp. n.). No epigeic or cavernicolous *Larca* species was previously known from Crete or Greece. The cave (*locus typicus*) may have served as a refugium because of the constant relative humidity, temperature and food supply, after a possible epigeic ancestor became extinct. Similar cases have been reported from other genera. The genus *Lasiochernes* is also known only from a single cave on Crete (*Lasiochernes cretonatus* Henderickx, 1998). However, transportation by bats, mammals or birds, in recent or ancient times, must be considered as an alternative explanation for the scattered occurrence of some troglobites.

The new *Larca* was first found under a piece of ancient terracotta, next to a pile of bat guano. This suggests that it feeds on smaller guano-dwellers (e.g. Collembola, Psocoptera). The habitat in the cave is

Fig. 5: *Larca bosselaersi* sp. n., male paratype T2. Right chelal fingers, external lateral view.
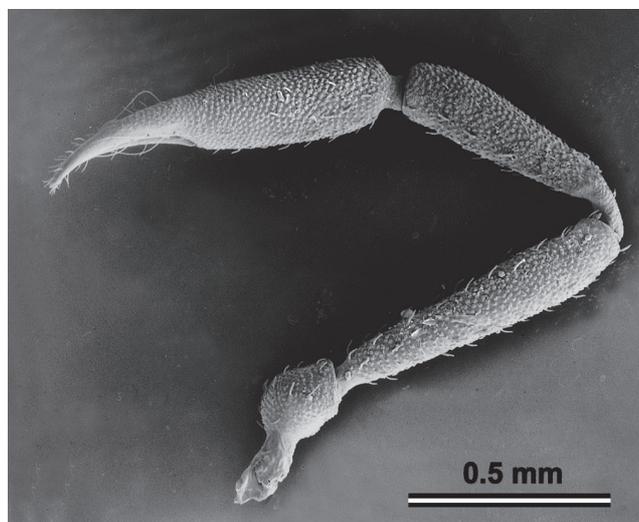

Fig. 6: *Larca bosselaersi* sp. n., male paratype T2. Right pedipalp, dorsal view.

unusual. All specimens were found in two small chambers at the back of the cave. These chambers are in the upper part of the cave and therefore less humid. The soil is dusty. The description of the biotope of the Italian *Larca italica* provided by Gardini (1983) is similar. *Larca* species in general seem to prefer the dry and upper parts of their habitats.

Acknowledgements

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Possible role of brain monoamines in the dispersal behaviour of spiderlings of *Hogna carolinensis* (Walckenaer) (Araneae, Lycosidae)

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Summary

Experiments were conducted to identify neurochemical parameters (changes in brain monoamines) associated with the dispersal of spiderlings of *Hogna carolinensis* (Lycosidae). Brain weights did not differ over the five-day period immediately after emergence from the egg sac, during which the spiderlings remained attached to the abdomen of the maternal parent. All spiderlings dispersed from their mothers on day 6 after emergence (under rearing conditions at 23°C, 70% relative humidity, and a 14L:10D photoperiod regime). Mean brain concentrations of serotonin (5-HT) ranged from 56.61–62.23 nm/mg for spiderlings from days one to five after emergence, the time during which they remained with their mother, and increased to 81.34 nm/mg on day 6 (following dispersal), and 81.13 nm/mg for adults. There was no significant difference in 5-HT levels between the brains of adult males and females, or between 6-day old spiderlings and adults. Levels of 5-HT increased significantly on day 6 after emergence as compared with concentrations recorded on day 5. There were no significant differences between mean brain concentrations of octopamine (OA) for days 1–5. However, on day 6, there was a significant increase in OA levels as compared with day 5. In contrast, dopamine (DA) concentrations did not change significantly at any developmental stage. The possible role of 5-HT and OA in the onset of dispersal behaviour in lycosid spiderlings is discussed.

Introduction

Biogenic amines (monoamines) are important neurotransmitters, neuromodulators, and neurohormones in the central nervous systems (CNS) of vertebrates and invertebrates. In numerous taxa they have been shown to play a role in the mediation of arousal and locomotor activity, short-term and chronic physiological stress, and aggressive and social dominance relationships (Bicker & Menzel, 1989; Haney *et al.*, 1990; Corbet, 1991; Orchard *et al.*, 1993; Punzo, 2001).

In arthropods, monoamines have been shown to play a role in the regulation of a variety of physiological responses as well as behaviour. Most of the research has been conducted on insects. For example, octopamine (OA) turnover rates increased significantly in crickets after fighting with conspecifics (Adamo *et al.*, 1995). Significant increases in foraging and nest defence activities were associated with higher concentrations of OA, dopamine (DA), and serotonin (5-hydroxytryptamine, 5-HT) in the brain (supraoesophageal ganglion, SEG) of worker honeybees (Harris & Woodring, 1992). An increase in brain levels of 5-HT has been implicated in the onset of flight behaviour (dispersal) in boll weevils (Guerra *et al.*, 1991).

The role of monoamines in the regulation of physiological parameters and behaviour in arachnids has received far less attention. Changes in monoamine concentrations in the SEG were associated with ontogenetic shifts in aggressive behaviour in solifugids (Punzo, 1998). The increased aggression exhibited by later nymphal instars was accompanied by significant changes in brain 5-HT and DA levels (Punzo, 1993,