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Wilson R. Lourenço, Jürgen Velten. Possible estimation of litter size in palaeoburmesebuthid scorpions from Early Cretaceous Burmite (Chelicerata: Scorpiones). *Faunitaxys*, 2024, 12 (49), pp.1-4. 10.57800/faunitaxys-12(49) . hal-04719088

HAL Id: hal-04719088

<https://hal.science/hal-04719088v1>

Submitted on 2 Oct 2024

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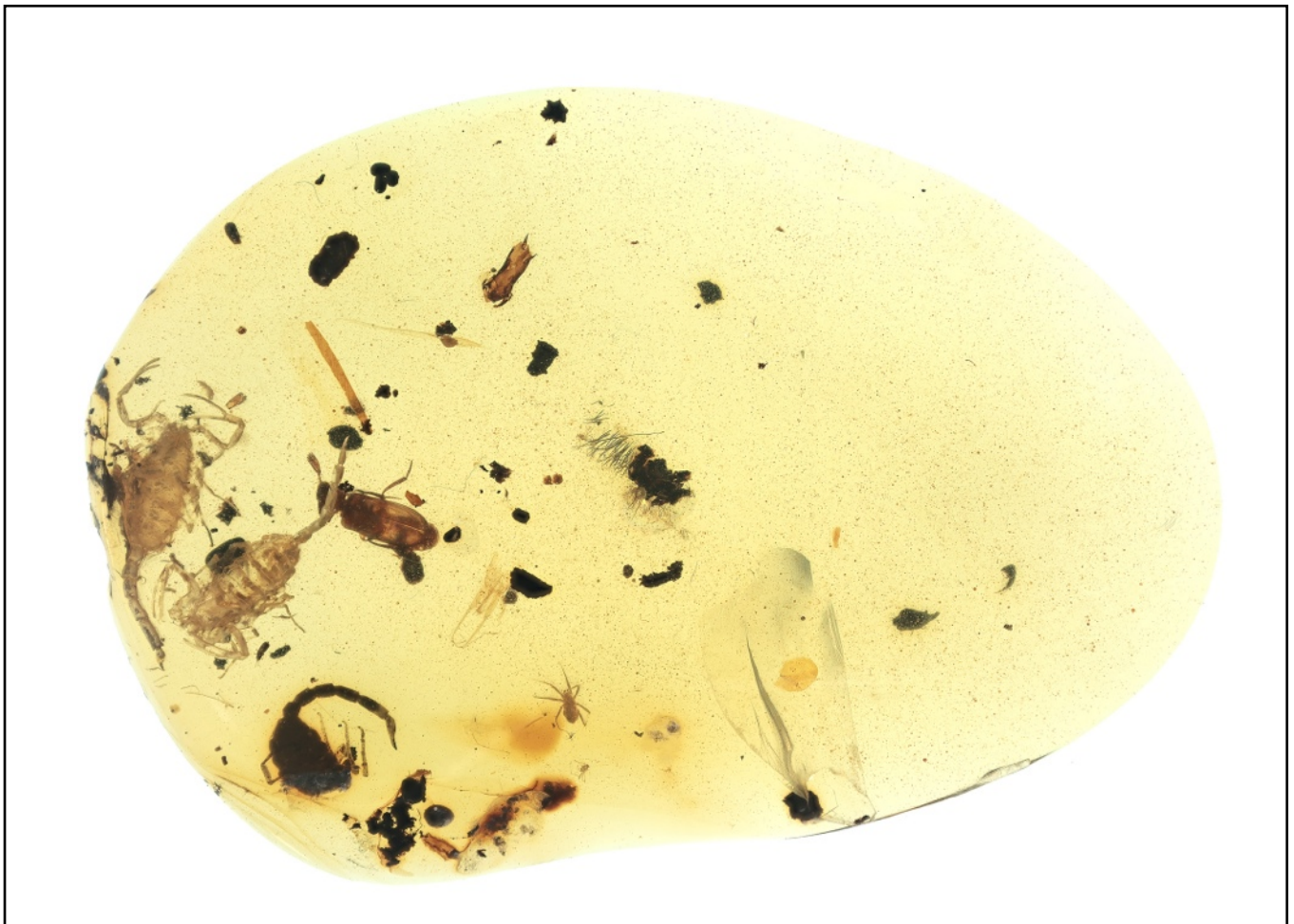
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Faunitaxys

*Revue de Faunistique, Taxonomie et Systématique
morphologique et moléculaire*



Volume 12
Numéro 49

Septembre 2024

ISSN (Print) : 2269 - 6016
ISSN (Online) : 2970 - 4960
Dépôt légal : Septembre 2024

Faunitaxys

*Revue de Faunistique, Taxonomie et Systématique
morphologique et moléculaire*

ZooBank : <https://zoobank.org/79A36B2E-F645-4F9A-AE2B-ED32CE6771CC>

Directeur de la publication, rédacteur, conception graphique et PAO:

Lionel Delaunay

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Imprimée sur les presses de SPEED COPIE, 6, rue Tréfilerie, F- 42100 Saint-Etienne

Imprimé le 30 09 2024

Possible estimation of litter size in palaeoburmesebuthid scorpions from Early Cretaceous Burmite (Chelicerata: Scorpiones)

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Keywords:

Scorpiones;
Palaeoburmesebuthidae;
fossil;
litter size;
Burmite.

Abstract. – In previous studies concerning litter size in extant buthoid species of scorpions it was suggested that a number of factors could directly be associated with litter size variation. Litter size should be directly proportional to the size of adult females but inversely proportional to the size of the embryos and pro-juveniles. The large body size of pro-juveniles at birth should be directly associated with a more complete embryonic development, leading to post-embryonic developments comprising smaller numbers of instars but with higher values for the morphometric growths. For fossil scorpions and in particular those from Early Cretaceous nothing could be presumed until now. An original observation of pro-juvenile aggregation for *Betaburmesebuthus* suggests that for micro-buthoid fossil scorpions litter size was extremely reduced but composed of large embryos and pro-juveniles.

Lourenço W. R. & Velten J., 2024. – Possible estimation of litter size in palaeoburmesebuthid scorpions from Early Cretaceous Burmite (Chelicerata: Scorpiones). *Faunitaxys*, 12(49): 1 – 4.

DOI: [https://doi.org/10.57800/faunitaxys-12\(49\)](https://doi.org/10.57800/faunitaxys-12(49))

ZooBank: <https://zoobank.org/5F279A52-DBD0-48CC-8BF4-F32BCF868CD6>

Received: 26/09/2024 – Revised: 27/09/2024 – Accepted: 28/09/2024

Introduction

As already emphasized in previous publications (Lourenço, 2002, 2007, 2018), scorpions are unusual among terrestrial arthropods in several characteristics of their life-history. These particular traits of their reproductive biology lead to approximative interpretations by some early authors (Polis & Sissom, 1990). Nevertheless, some precise studies on scorpion embryology were carried out since the end of the 19th century (Laurie, 1890, 1891, 1896a,b) and these were followed by other publications such as those of Pavlovsky (1924, 1925) and Pflugfelder (1930). Since the middle of the 1970s a new interest on the reproductive biology of scorpions took place, in particular concerning their post-embryonic developments. Very few studies however, were dedicated to litter size in scorpions and only a few isolated publications provided some additional information such as Francke (1981). According to this author, litter size was directly proportional to the size of females and inversely proportional to the size of the pro-juveniles. The size of females and the size of pro-juveniles were found to account for 81% of the variation in litter size among the species studied. Subsequent syntheses proposed by Polis & Sissom (1990) and Lourenço (2002) mainly resumed the known data about litter size in scorpions, without further discussions about the factors that could be responsible for its variability. In a more specific study, Lourenço (2007) focused on micro-buthoid scorpions, in the sensu previously defined by Lourenço (2000). This included in particular the families Buthidae C. L. Koch, 1837 and Microcharmidae Lourenço, 1996. In fact, most of the buthid and microcharmidae species defined as having small-sizes also present

largely reduced litter-sizes generally inferior to 10 (Fig. 1-2) but more frequently with numbers lower than 7 pro-juveniles (Lourenço, 2007).

Results

The specimens investigated are preserved in a very clear round to oval-shaped piece of yellow amber that measures 28 x 20 mm and is about 3 mm thick. Two of the three observed scorpions are totally complete and most of the structures and characters are globally visible. The third scorpion was cut and only part of the mesosoma and metasoma are observable (Fig. 3-6). This is the second known piece of Burmite with several scorpions trapped together. The first recorded case was one concerning *Palaeoburmesebuthus ohlhoffi* Lourenço, 2015. The scorpions were however, very poorly preserved juveniles (Lourenço & Velten, 2019). The observation of a few bothria (not the hairs) allows defining the family and genus as Palaeoburmesebuthidae Lourenço, 2015 and *Betaburmesebuthus* Lourenço, 2015. In account of the size and number of teeth of the pectines, the species clearly shows affinities with *Betaburmesebuthus kobberti* Lourenço, 2015. The two well visible specimens represent one male with large pectines and 21-21 teeth and one female with smaller pectines and 18-17 teeth. Their global size reaches 6.51 mm. Their definition as pro-juveniles (or instar I) is clearly possible by the observation of a number of characters:

- (i) buccal apparatus not opened,
- (ii) chelicerae without the presence of serrulas,
- (iii) aculeus not sharpened and not functional,
- (iv) extremity of tarsi without claws or ungues but with the presence of blunts, cup-shaped tips.

Reviewer: Eric Ythier (BYG Taxa, France) - ZooBank: <http://zoobank.org/06FD0852-A88E-49E5-B8E6-E1494B86C4E1>



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Fig. 1. *Microtityus rickyi*, Kjellesvig-Waering, 1966. Female with pro-juveniles.



Fig. 2. *Tityus (Caribetityus) elii* Armas & Marciano Fondeur, 1992. Female with pro-juveniles.

The only known specimen (holotype) of *B. kobberti* is a male juvenile with a total length of 10.41 mm. It is possible to suppose that one or two more molts should yet be necessary to reach adult stage. Taking in account that theoretical morphometric growth value (constant) defined by Dyar (1890) and Przibram & Megusar (1912) for the development of arthropods is 1:26, it is possible to expect a final global size for this species equal to 13.11 mm (one extra molt) or 16.53 mm (two extra molts). Moreover, among micro-buthoids, females are normally slightly bigger. Nevertheless, final sizes could yet be more important if morphometric growth values are higher. For some extant micro-buthoids the observed growth values vary from 1:28 to 1:33 (Lourenço, 2002).

For the studied pro-juveniles, which measure 6.51 mm, if their development is based on a morphometric growth value of 1:26, one can expect successive values equal to 8.20, 10.33, 13.02 and 16.40 mm, what presumes a total of four molts to reach adult stage. If the morphometric growth values are higher this could even suggest a total development with a lower number of molts. These hypothetical results appear to be in accordance with those observed for extant micro-buthoid scorpions (Lourenço, 2002, 2007, 2018).

Acknowledgements

We are most grateful to Dr. Ben Smeele (Amsterdam, Netherlands) for his full support to this study and to Alexander Beigel (Aachen, Germany) for the preparation of several of the photos which illustrated this article.

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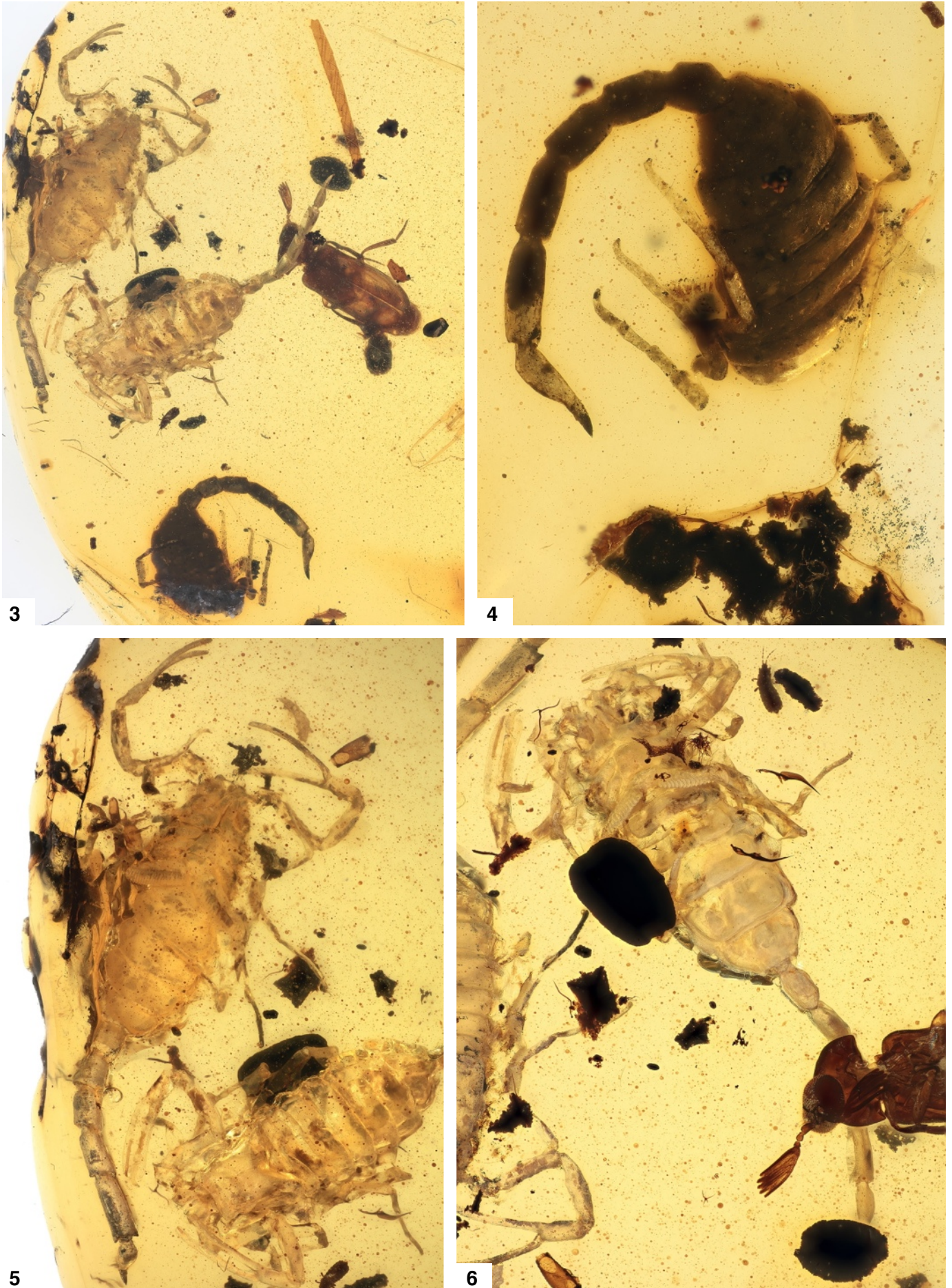


Fig. 3. *Betaburmesebuthus kobberti* Lourenço.

3. Pro-juveniles 1 to 3 and syninclusions. 4. Pro-juvenile 3 showing metasoma with not sharp and non-functional aculeus. 5. Male pro-juvenile, ventral aspect showing large pectines. 6. Female pro-juvenile, ventral aspect showing reduced pectines.

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- Authors contribution**¹
- Publisher Correspondence.* – WL
Writing the article. – WL
Article proofreading. – WL
Bibliographic work. – WL
Material study. – WL & JV
Author of the figures. – WL (Fig. 1-2)
- ¹ WL = Wilson R. Lourenço – JV = Jürgen Velten

Résumé

Lourenço W. R. & Velten J., 2024. – Possible estimation de la taille des portées chez les scorpions Palaeoburmesebuthidae de l'ambre birman du Crétacé inférieur (Chelicerata : Scorpiones). *Faunitaxys*, 12(49): 1–4.

Dans des études précédentes concernant la taille des portées chez les buthoid actuels, un certain nombre de facteurs ont pu être reliés à la variation de cette taille. La taille des portées semblerait directement proportionnelle à la taille des femelles adultes mais inversement proportionnelle à la taille des embryons et des pro-juvéniles. La taille plus importante des pro-juvéniles à la naissance semble directement associée à un développement embryonnaire davantage complet, conduisant à un développement post-embryonnaire plus court avec un nombre de stades plus réduit mais avec des taux de croissance plus élevés. Pour les scorpions fossiles et en particulier ceux trouvés dans l'ambre crétacé de Birmanie, aucune connaissance sur ce sujet n'est disponible. Une observation originale concernant une agrégation de pro-juvéniles appartenant au genre *Betaburmesebuthus* semble suggérer que chez les micro-buthoid fossiles la taille des portées était très réduite mais composée de gros embryons et pro-juvéniles.

Mots-clés. – Scorpiones, fossile, ambre Birman, Palaeoburmesebuthidae, taille des portées.

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Possible estimation of litter size in palaeoburmesebuthid scorpions from Early Cretaceous Burmite (Chelicerata: Scorpiones).

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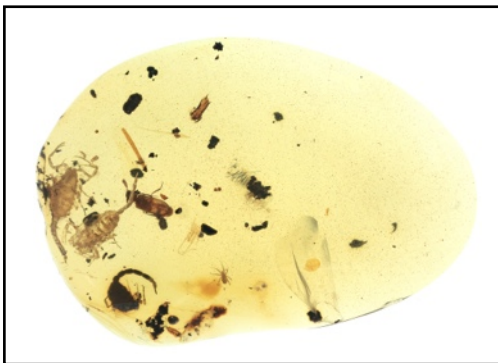


Illustration de la couverture :

Illustration de la Couverture: *Betaburmesebuthus kobberti* Lourenço; pro-juveniles in the stone - piece of amber (AB).

Crédits:

Wilson R. Lourenço : Fig. 1-2.

Alexander Beigel : Fig. 3-6 & couverture.