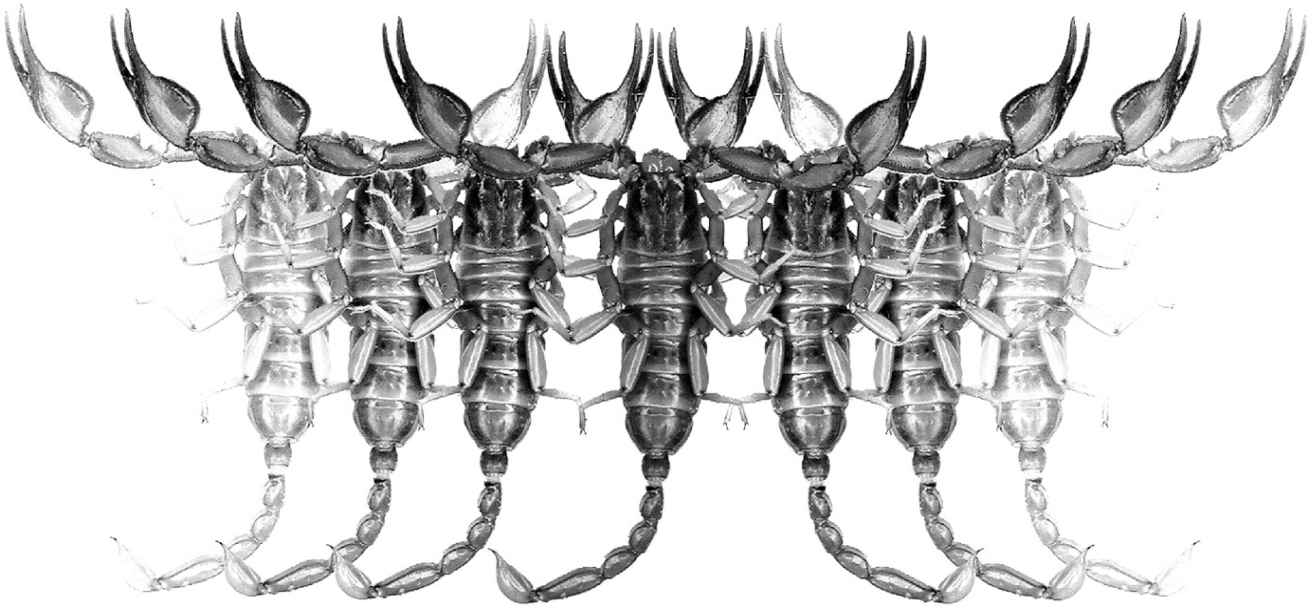
Euscorpius

Occasional Publications in Scorpiology



First report of regeneration in the genus *Mesobuthus* (Scorpiones: Buthidae)

Rıdvan Kurt, Ersen Aydın Yağmur & Gülhanım Çelik

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Derivatio Nominis

The name ***Euscorpius*** Thorell, 1876 refers to the most common genus of scorpions in the Mediterranean region and southern Europe (family Euscorpiidae).

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Euscorpius — Occasional Publications in Scorpiology. 2023, No. 372

First report of regeneration in the genus *Mesobuthus* (Scorpiones: Buthidae)

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Summary

A new example of scorpion leg regeneration is reported in an adult male *Mesobuthus mesopotamicus* (Penther, 1912). A claw (pretarsus) was observed to regenerate at the distal end of the tibia of the left leg II. The regeneration case is described and illustrated.

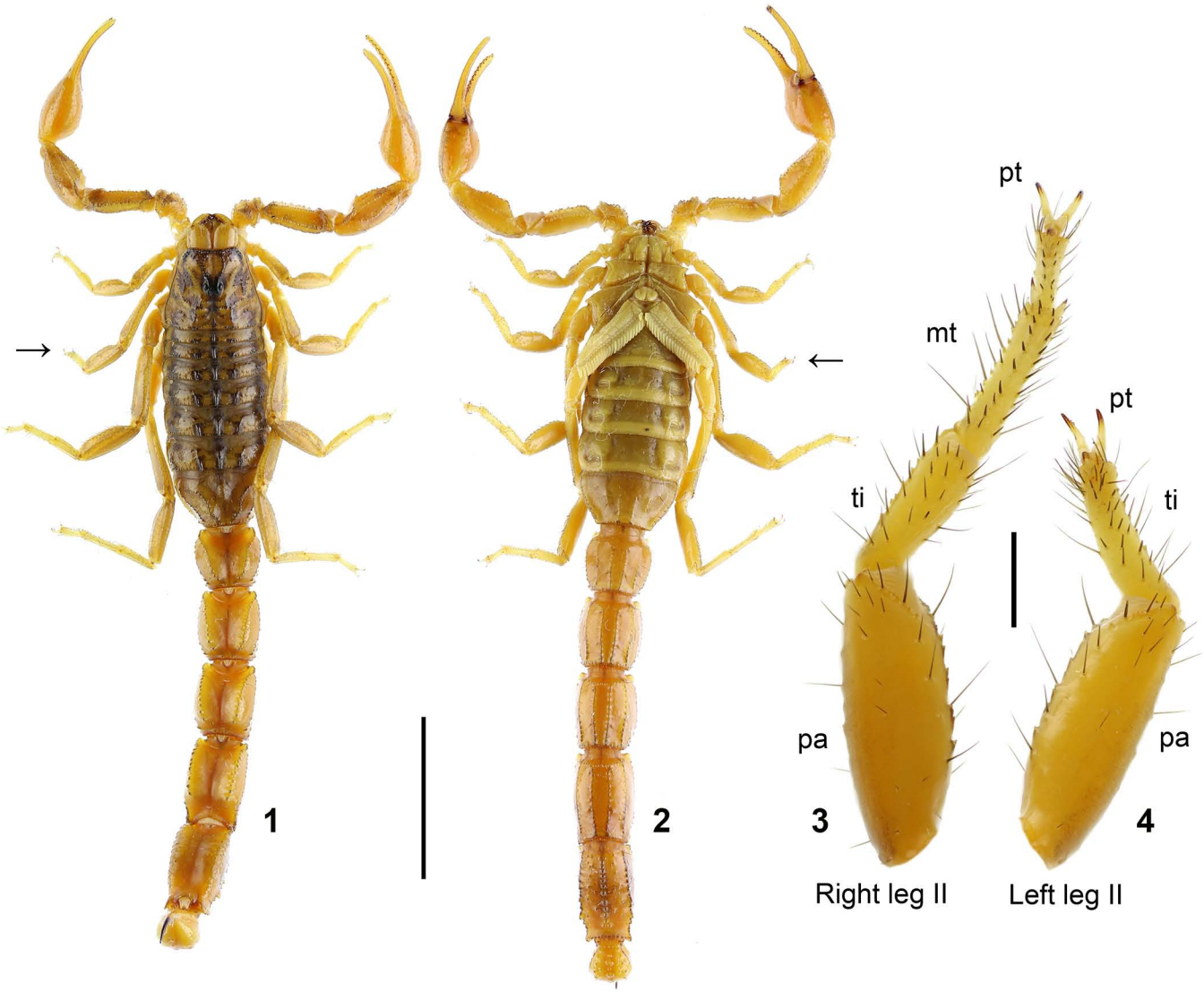
Introduction

Many abnormalities in body parts have been reported in scorpions. Some of these anomalies occur during embryonic development and result in teratologic disorders such as deformations, duplications, division or fusion, or absence of scorpion body parts (Armas, 1976; Ayrey, 2011; Berland, 1913; Mattoni, 2005; Shulov & Amitai, 1955; Teruel, 2003; Teruel & Baldazo-Monsivaiz, 2015; Yağmur et al., 2021). Another reason for malformations is the regeneration of lost or severed body parts (Watz & Dunlop, 2022). Regeneration has been reported in many arthropod orders (Maruzo et al., 2005; Maruzo & Bortolin, 2013) and recorded in Arachnida by Wood (1926) for the first time. Scorpions may lose body parts due to attacks by predators, or problems arising during molting (Watz & Dunlop, 2022). Vachon (1953) reported for the first time that scorpions can regenerate their lost body parts and pointed out that they always carry a complete pretarsus even if several leg segments are missing. Rosin and Shulov (1963) described leg and aculeus regeneration in the nymphs of *Nebo hierichonticus.* Leg regeneration was reported by Vachon (1957) for a newborn *Euscorpius* sp. [reported as *E. carpathicus*], and by Rosin (1964) for *Leiurus hebraeus* [reported as *L. quinquestriatus*], *Scorpio maurus* and *Nebo hierichonticus*. Rosin (1964) observed that juveniles of scorpions potentially can regenerate their legs until last ecdysis. Besides Rosin (1964) observed that juveniles which lost various segments of legs, regenerated only pretarsus and even if scorpion lost more than pretarsus, the distal part of the preceding segment regenerated a new pretarsus. At the same time, Rosin (1964) did not observe any case that generated additional segments. According to observations of Rosin (1964), the regenerated leg is initially smaller than normal legs, but may reach full size in later stages. Very recently, Watz & Dunlop (2022) reported a new leg regeneration case in *Olivierus caucasicus*, as well as a pedipalp regeneration for the first time in *Opisthacanthus asper*. At the same time, Stemme (2023) in his experiments with *Euscorpius italicus*, did not observe any regenerative capability on pectines amputated before the second molt and observed up to six molting stages.

Mesobuthus mesopotamicus was described by Penther (1912) from Mosul (Iraq) as *Buthus eupeus mesopotamicus*. Vachon (1958) transferred this taxon to the genus *Mesobuthus*. Although Kovařík et al. (2011) synonymized this taxon with *Mesobuthus eupeus phillipsii* and identified Southeastern Anatolia populations (including Şırnak population) as *M. e. phillipsii*. Finally, Kovařík et al. (2022) assigned these records to *Mesobuthus mesopotamicus*, which was restored and validated at species level.

Material and Methods

An adult male *Mesobuthus mesopotamicus* (Penther, 1912) specimen that has regeneration at the left leg II was collected around Kasrik town of Şırnak Province, Turkey on 15 May 2021 by first author. Terminology for leg follows Watz & Dunlop (2022). The collected scorpion specimen was preserved in 96% alcohol and deposited in AZMM (Alaşehir Zoological Museum, Manisa Celal Bayar University, Alaşehir, Manisa, Türkiye, AZMM/Sco-2021:22). Photographs were taken as described by Yağmur (2021).



Figures 1–4: *Mesobuthus mesopotamicus* (Penther, 1912). **Figures 1–2**. Dorsal (1) and ventral (2) views. **Figures 3–4**. Normal right leg II (3), Left leg II with regeneration (4). Scale bar: 10 mm (1–2), 1 mm (3–4). Abbreviations: mt=metatarsus, pa=patella, pt=pretarsus, ti=tibia.

Results and Discussion

The examined specimen (Figs. 1–2) that was collected has a regeneration at the left leg II whereas right leg II and other legs are normal (Figs. 3–4). Both legs have a normally developed patella. The specimen has a truncation on the left leg II. The tibia of left leg II is slightly elongated; it is slightly longer and thinner than tibia of right leg II. Rosin (1964) suggested that the regenerated leg may reach full size in later stages, but legs cannot generate additional segments. Our observation supports this suggestion. Although the overall size of the left leg II is shorter than the right leg II, it has elongated to compensate for this deficiency. The cut site of tibia is immediately followed by the pretarsus. The claw is of a normal size. Our specimen carries the pretarsus on the distal tip of tibia whereas a *Scorpio maurus* specimen studied by Rosin (1964) carried the pretarsus on the distal tip of patella. However, the pretarsus was fully formed in all other cases of Rosin (1964), as in our case.

The ventral surface of left leg II has denser stumpy setae than the right leg and their morphology resembles spinules present on the ventral surface of the metatarsus on right leg. Besides, there are denser setae at the distal end of the tibia around claws than right leg. Probably left leg II has the ability to walk due to these changes. The dorsal surface of the tibia of leg II has denser macrosetae than the right leg and its appearance is more like metatarsus than tibia of right leg. Probably the regenerated segment has been modified to serve both as the tibia and the metatarsus. Rosin (1964) reported that the segment that carries the regenerated pretarsus often bears excessive setae, which agrees with our observation.

Watz & Dunlop (2022) listed as regenerations the anomaly reports by Graham (2006) (malformed dentition on the movable finger), Jahanifard et al. (2008) (pedipalp, chela and vesicle anomalies) and Karataş & Kürtüllü (2006) (duplicated pedipalp segments). Watz & Dunlop (2022) suggested that the cases reported as leg anomalies by Armas (1977) and Ayrey & Myers (2020) also were regenerations. The leg anomaly case described by Ayrey & Myers (2020) is a very similar case to the one we report herein. The cheliceral anomaly recently reported by Yağmur et al. (2021) could also represent a regeneration. According to Rosin (1964) and Maruzzo & Bortolin (2013), scorpions can regenerate only the pretarsus. At the same time, Vachon (1957) reported that in one case a juvenile scorpion regenerated pretarsus and it differentiated into a tarsus and pretarsus during the second molt after amputation. Our observation is consistent with suggestion of Rosin (1964) and Maruzzo & Bortolin (2013).

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