

New insights on the taxonomy of the genus *Birulatus* Vachon, 1974, and description of a new remarkable species from Jordan (Scorpiones, Buthidae)

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Abstract. – New insights are proposed on the taxonomy of the enigmatic genus *Birulatus* Vachon, 1974. For the first time, one male of the type species *Birulatus haasi* Vachon, 1974, is diagnosed and illustrated, confirming the patterns of some characters such as the trichobothriotaxy. One new species, *Birulatus jordanensis* n. sp., is also described based on two female specimens collected from a mostly arid and rocky site located nearby an intermediate region (within the Irano-Turanian biogeographic zone) located between the East Mediterranean Mountains and the Jordan Valley. The species of the genus *Birulatus* remain rarely collected and their total number is now raised to four.

Résumé. – **Nouvel apport à la taxonomie du genre *Birulatus* Vachon, 1974, et description d'une remarquable nouvelle espèce pour la Jordanie (Scorpiones, Buthidae).** De nouvelles données sont proposées sur la taxonomie du très énigmatique genre *Birulatus* Vachon, 1974. Pour la première fois, le mâle de l'espèce-type *Birulatus haasi* Vachon, 1974, est diagnostiqué et illustré, confirmant ainsi la validité de certains caractères, tel celui de la trichobothriotaxie. Une nouvelle espèce, *Birulatus jordanensis* n. sp., est également décrite sur la base de deux spécimens femelles collectés dans une région particulièrement aride et rocheuse, située dans la zone intermédiaire de la Jordanie, entre les montagnes de l'Est méditerranéen et la vallée du Jourdain ; zone située dans la région biogéographique Irano-Touranienne. Les espèces du genre *Birulatus* demeurent rarement collectées et leur nombre total est désormais de quatre.

Keywords. – Scorpion, taxonomy, Jordan, myrmecophylous behaviour.

In previous publications (LOURENÇO, 1999, 2002; STATHI & LOURENÇO, 2003), the circumstances surrounding the description of the enigmatic genus *Birulatus* Vachon, 1974, have already been discussed. In fact, VACHON (1974) described several genera and subgenera in a short addendum at the end of his comprehensive monograph on trichobothrial patterns in scorpions. Among these was the new genus *Birulatus*, based on a single female specimen collected in the South of Tafila (= At Tafila), near to Schauback (= Ash Shawbak) in Jordan (30°31'1.27"N 35°33'19.54"E). The diagnosis proposed for the new genus and the description of the type species *Birulatus haasi* Vachon, 1974, were extremely limited. Several important characters were neither described nor commented on. In a redescription of the type specimen of *B. haasi* (LOURENÇO, 1999), some further precisions were proposed for the diagnosis of the genus and species. The subsequent study of a second specimen from Israel with the use of scanning electron microscopy (LOURENÇO, 2002), confirmed that some characters were not precisely defined such as those associated to the trichobothrial pattern which could be either

A-Beta orthobothriotaxic, as described by VACHON (1974, 1975), or minor-neobothriotaxic as observed for the Israeli specimen described as a new species *Birulatus israelensis* Lourenço, 2002. The study of a third specimen from Syria (STATHI & LOURENÇO, 2003), lead again to the description of another new species, *Birulatus astartiae* Stathi & Lourenço, 2003, presenting also an orthobothriotaxic pattern. Presently, the genus *Birulatus* is represented by three species, and only females were diagnosed until now.

In a recent biological study (ZVIK, 2017), a myrmecophylous behaviour was observed for the populations of *Birulatus israelensis* from north of Israel. The author of this study refers to the collecting of 31 specimens, but no precision is proposed for a possible sex ratio of the species.

In this contribution, new insights are proposed for the taxonomy of the genus *Birulatus*. A male of *B. haasi* is described and illustrated for the first time. Moreover, a new species, *Birulatus jordanensis* n. sp., is described from the intermediate region of Jordan, between the East Mediterranean Mountains and the Jordan Valley. The total number of species of *Birulatus* is now raised to four, but they remain globally rarely collected. Comments are added about the biotopes of *B. haasi* and that of the new species including the confirmation of the myrmecophylous behaviour for *B. haasi*.

MATERIAL AND METHODS

Illustrations and measurements were produced using a Wild M5 stereomicroscope with a drawing tube and an ocular micrometre. Map was made using GIS ArcMap Ver. 10.8. Measurements follow STAHNKE (1970) and are given in mm. Trichobothrial notations follow VACHON (1974, 1975), morphological terminology mostly follows VACHON (1952) and HJELLE (1990), and chelicerae dentition follows VACHON (1963). The specimens studied herein are deposited in the Muséum national d'Histoire naturelle, Paris (MNHN), and in the collections of the University of Jordan, Amman, Jordan.

TAXONOMY

Family **Buthidae** C. L. Koch, 1837

Genus *Birulatus* Vachon, 1974

Birulatus haasi Vachon, 1974 (fig. 1-8, 19)



Fig. 1-2. – *Birulatus haasi* Vachon. – **1**, Habitus of alive male from ‘Ayn al Baydā’, Aţ Tařila Governorate (total length: 17.8 mm). – **2**, Same male, ventral aspect, showing coxapophysis, sternum, genital operculum and pectines.

Birulatus haasi Vachon, 1974: 949; VACHON & KINZELBACH, 1987: 100; AMR *et al.*, 1988: 374; EL-HENNAWY, 1988: 101; EL-HENNAWY, 1992: 111; AMR & EL-ORAN, 1994: 188; LOURENÇO, 1999: 110; STATHI & LOURENÇO, 2003: 106; AMR *et al.*, 2015: 32.

Material examined. – 1 adult ♂, Jordan, region of ‘Ayn al Bayḍā’ (Aṭ Ṭaḥla Governorate), 30°46’15.18”N 35°36’7.52”E, 2.V.2020, *Al-Saraireh et al. leg.* The specimen will be deposited in the collections of MNHN.

Diagnosis of the male. – Scorpion of small size, with a total length of 17.80 mm. General morphology globally similar to that of the female, without any marked sexual dimorphism. Coloration globally yellow, paler than that of females; only the carapace shows some reddish zones. Entire body covered with strong pearly granulations, better marked than those of females. Lateral eyes absent with only the presence of maculae; lens absent. Telson similar in morphology to that of females, but with very long hairs (setae) not observed in females. Chelicerae with a single ventral tooth on the fixed finger, as for females. Sternum small and triangular. Genital

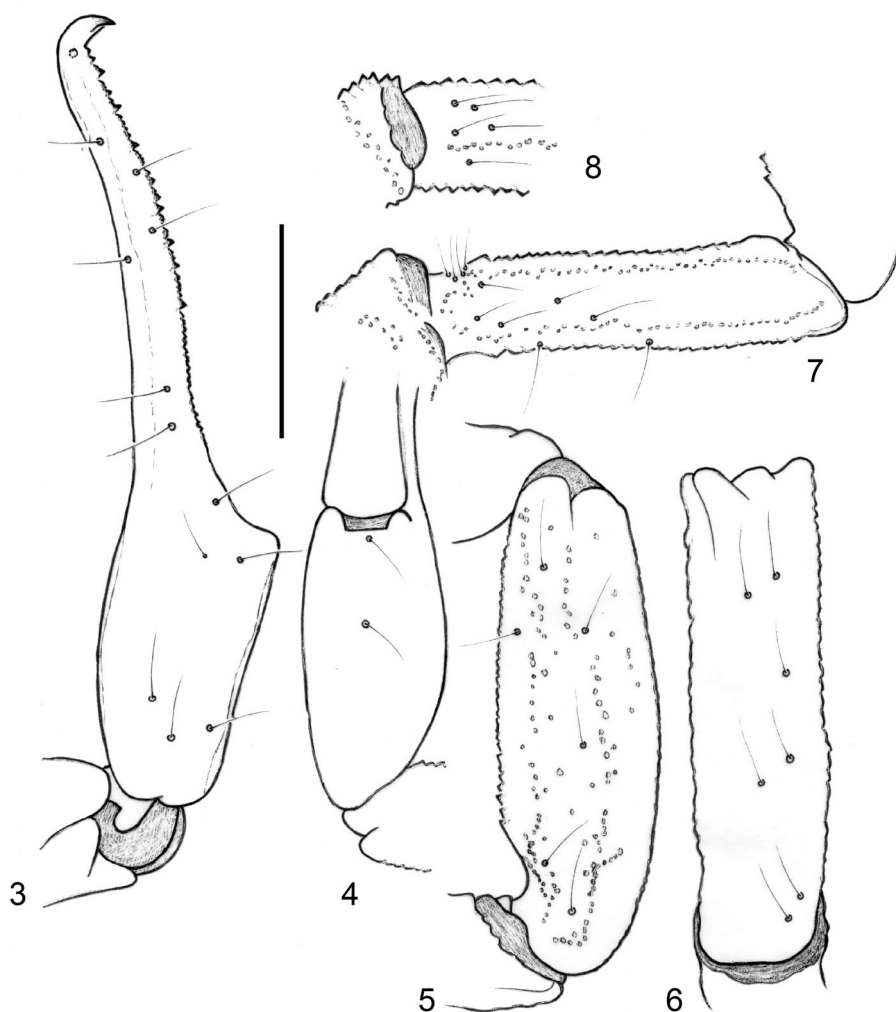


Fig. 3-8. – *Birulatus haasi* Vachon, ♂, trichobothrial pattern. – 3-4, Chela: 3, dorso-external aspect; 4, ventral aspect. – 5-6, Patella: 5, dorsal aspect; 6, external aspect. – 7-8, Femur: 7, dorsal aspect; 8, internal aspect. Scale bar = 1 mm.

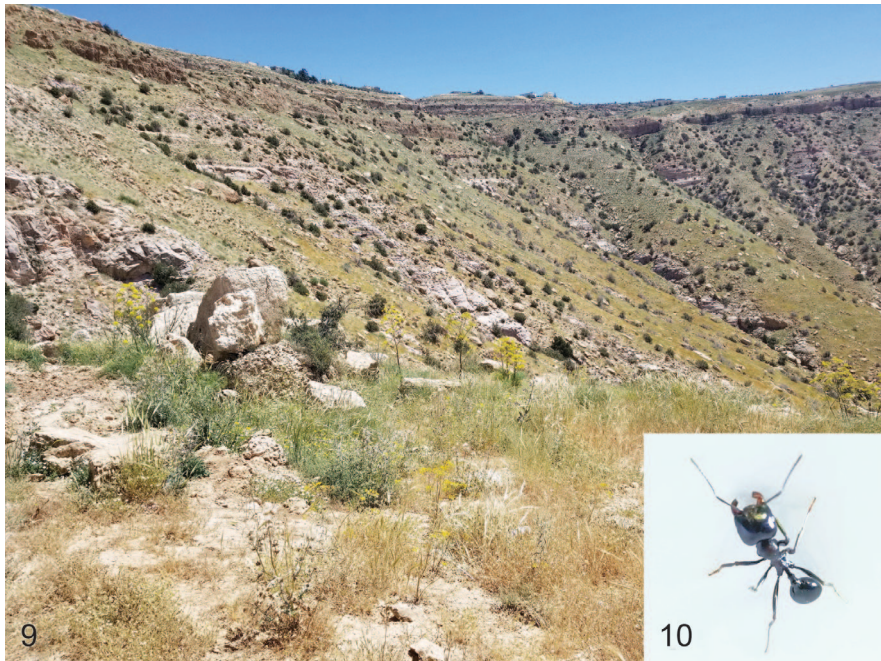


Fig. 9-10. – 9, Natural habitat of *Birulatus haasi* Vachon in the region of 'Ayn al Baydā' (Aṭ Ṭafla Governorate). – 10, Ant of the genus *Messor* from 'Ayn al Baydā' region (Aṭ Ṭafla Governorate).

operculum formed by two semi-triangular plates but clearly smaller in size than that of females. Pectines more enlarged than those of females, with distinct fulcra and with 8-9 teeth. Fixed and movable fingers of chela with seven partially oblique rows of granules and without external accessory granules. Tibial spurs moderately developed on legs III and IV. Trichobothrial pattern confirmed as type A, orthobothriotaxic, with a β (beta) configuration for dorsal trichobothria of femur, as suggested by VACHON (1974, 1975), Trichobothrium Esb on chela-hand almost vestigial.

Morphometric values (mm). – Total length including the telson, 17.80. Carapace: length 2.80; anterior width 1.67; posterior width 3.00. Mesosoma length: 4.67. Metasomal segments. I: length 1.40, width 1.27; II: length 1.53, width 1.00; III: length 1.60, width 0.93; IV: length 1.73, width 0.80; V: length, 2.07, width 0.74, depth 0.67. Telson length 2.00; vesicle: width 0.54, depth 0.47. Pedipalps: femur length 2.07, width 0.60; patella length 2.40, width 0.74; chela length 3.80, width 0.67, depth 0.67. Movable finger length 2.53.

Ecological notes. – Two other specimens were collected in the same site, one female and one juvenile. This area corresponds to the arid Mediterranean region of Jordan (fig. 9) with many rocks and scattered vegetation. All the specimens were found under a rock living along with an ant colony of the genus *Messor* Forel, 1890 (fig. 10). According to BOROWIEC & SALATA (2020), the species *Messor semirufus* (André, 1883) is common in this region. This observation confirms the myrmecophilous behaviour of *Birulatus* species, as already observed for *Birulatus israelensis* by ZVIK (2017). Other scorpion species collected from this area includes *Leiurus hebraeus* (Birula, 1908) and *Scorpio kruglovi* Birula, 1910. The area is undisturbed due to its rocky nature and strong inclination to the west that does not allow any form of agriculture or urbanization.

***Birulatus jordanensis* n. sp.** (fig. 11-18, 20, 22-23)

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HOLOTYPE: ♀, Jordan, within the Irano-Turanian biogeographic realm of Jordan, located within the intermediate region between the east Mediterranean mountains and the Jordan Valley

(31°59'21.0"N 35°36'44.7"E). Collected at night with the use of ultra-violet light. A zone with rocky nature and scarce vegetation, VIII.2020, *Abu Affah et al. leg.* (will be deposited in MNHN).

PARATYPE: 1 ♀, same data as for the holotype (will be deposited in the collections of the University of Jordan, Amman, Jordan).

Diagnosis. – Small scorpions, total length of female holotype 17.87 mm. Tergites with three distinct median carinae. Entire body as well as the femur and patella of the pedipalps covered with strong pearly granulation. Lateral eyes absent; in fact, these are represented by one to three maculae, but lens absent. Moderately elongated spiracles. Telson long, without subaculear tooth; ventral aspect depressed. Chelicerae with two very small ventral teeth on the movable finger, one vestigial; basal teeth on fixed finger fused in one. Sternum small but distinctly triangular. Pectines small with weakly distinct fulcrum; holotype and paratype with respectively 8-7 and 8-9 teeth. Genital operculum formed by two semi-triangular plates, relatively large. Metasomal segments I to IV with weakly marked carinae. Fixed and movable fingers of pedipalps chelae with eight rows of granules, partially oblique, without external accessory granules. Trichobothrial pattern, type A- β (beta) with a minorante trichobothriotaxy; absence of d_2 and of one internal on femur; d_5 on femur placed in a strongly distal position. Tibial spurs moderate to weak on legs III and IV.



Fig. 11-12. – *Birulatus jordanensis* n. sp., ♀ holotype, habitus; photos under white light and ultra-violet light.

Description of the female holotype. – *Coloration.* Generally pale yellow to reddish yellow; granulation and carinae of prosoma, mesosoma, femur and patella of pedipalps without any pigmentation. Prosoma: carapace yellow; median eyes surrounded by black pigment; region of lateral eyes with the presence of maculae. Mesosoma: yellow to slightly reddish yellow, tergite VII paler than the others. Metasomal segments yellow to pale yellow; telson yellow to pale yellow; aculeus yellowish at the base and dark red at the extremity. Venter yellow; some sternites darker than coxapophysis, genital operculum and pectines. Chelicerae pale yellow; teeth of fingers dark red. Pedipalps: femur and patella pale yellow (paler than body); chela yellow; rows of granules in the fingers slightly reddish. Legs pale yellow.

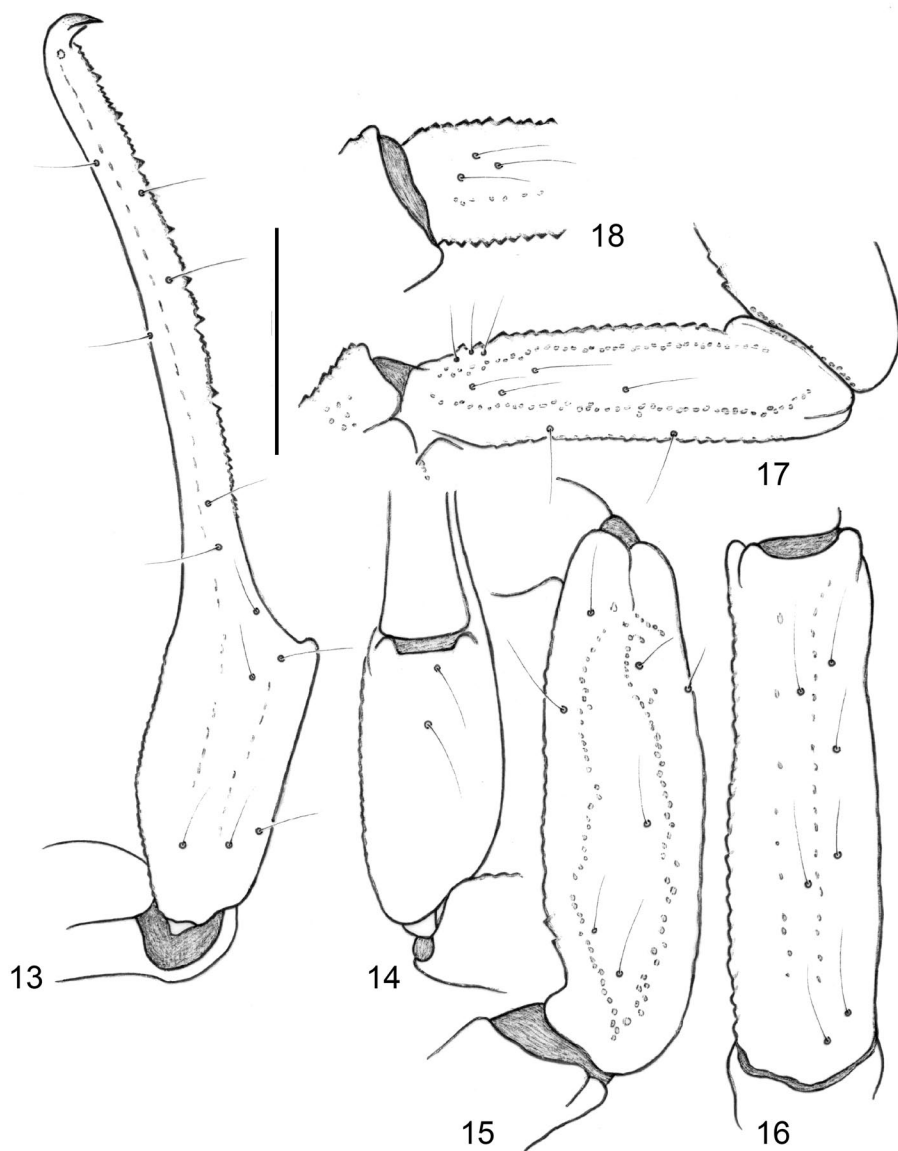


Fig. 13-18. *Birulatus jordanensis* n. sp., ♀ holotype, trichobothrial pattern. – 13-14, Chela: 13, dorso-external aspect; 14, ventral aspect. – 15-16, Patella: 15, dorsal aspect; 16, external aspect. – 17-18, Femur: 17, dorsal aspect; 18, internal aspect. Scale bar = 1 mm.

Morphology. Carapace strongly granular; anterior margin of carapace not emarginated, with the presence of numerous spinoid granules present. Carapace carinae moderately developed; central median, posterior median, anterior median and central lateral carinae moderate; posterior median carinae terminating distally in a small spinoid process that extends slightly beyond the posterior margin of the carapace. Two furrows present; one anterior, moderate, and one posterior, strongly marked. Median ocular tubercle slightly anterior to the centre of the carapace; median eyes small, separated by almost two ocular diameters. Lateral eyes absent; only the presence of maculae is observed, but no lens. Sternum triangular with a large base. Mesosomal tergites I-VI tricarinated. Lateral carinae on I-VI strong in all tergites, granulated; each carina terminating distally with a spinoid process that extends slightly beyond the

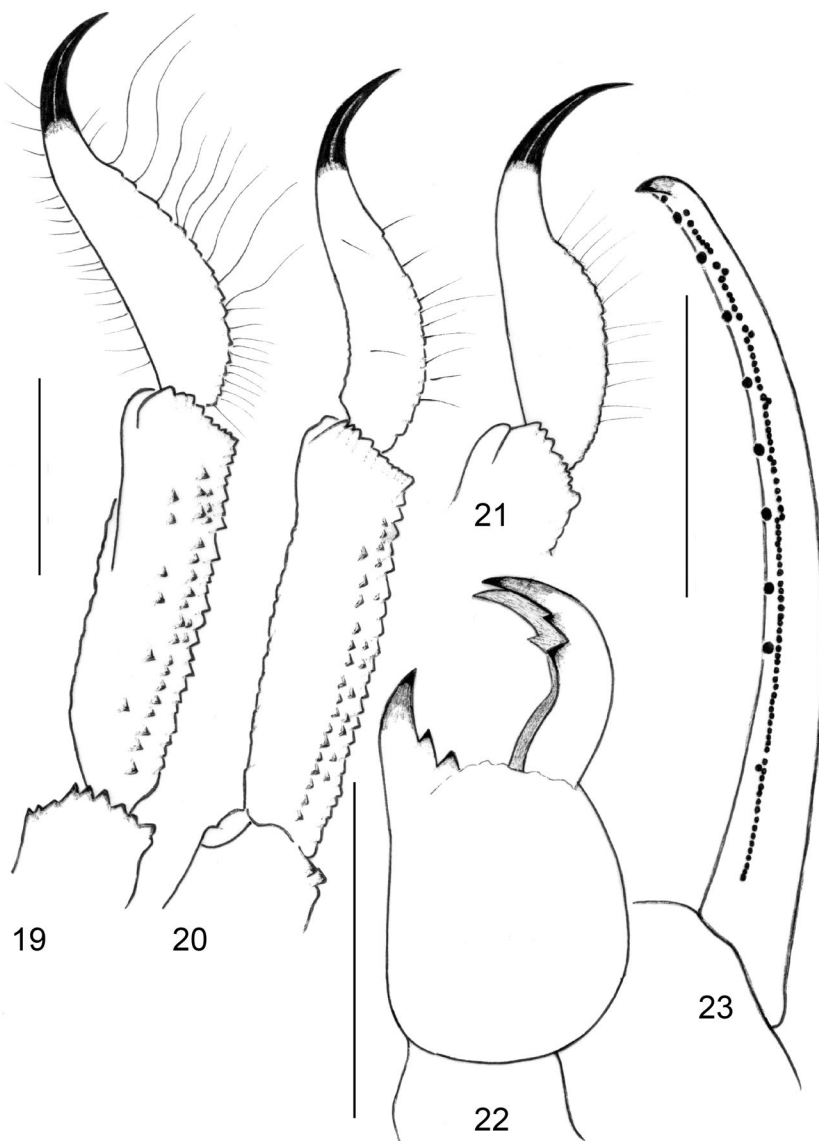


Fig. 19-23. – *Birulatus* spp. – 19-21, Metasomal segment V and telson, lateral aspect: 19, *B. haasi* Vachon, ♂; 20, *B. jordanensis* n. sp., ♀ holotype; 21, *B. israelensis* Lourenço, ♀ holotype. – 22-23, *B. jordanensis* n. sp., ♀ holotype: 22, chelicera, dorsal aspect; 23, cutting edge of movable finger with granulations. Scale bars = 1 mm; for 22 = 0.5 mm.

posterior margin of tergite. Median carina strong, crenulate; terminating distally on each segment with a spinoid process that extends slightly beyond the posterior margin of the tergite. Tergite VII pentacarinat, with lateral pairs of carinae moderate; median carina present on proximal half, moderate. Intercarinal spaces strongly granular. Ventral aspect with a large genital operculum, divided longitudinally in two semi-triangular plates. Pectines short; pectinal tooth count 8-7; basal middle lamellae of each pecten not dilated; fulcra moderate. Sternites strongly granular with small elongated spiracles; two longitudinal furrows on each sternite; VII without furrows. Metasomal segments I to IV with dorsal, latero-ventral and ventral carinae weakly marked. Segment V with latero-ventral carinae marked by spinoid lobes and strong spinoid granules on the ventral surface. Tegument moderately granular. Telson very elongated and thin, depressed dorsally and weakly granulated; aculeus short and weakly curved. Subaculear tooth absent. Chelicerae with two reduced basal teeth on the movable finger, one vestigial and fused basal teeth on fixed finger (VACHON, 1963); ventral aspect of both finger and manus with long but not very dense setae. Pedipalps: femur pentacarinat, moderately crenulated; patella with carinae moderately crenulated; chela with only vestigial carinae; all faces weakly to moderately granular. Fixed and movable fingers of chela with eight partially oblique rows of granules and without external accessory granules. Trichobothriotaxy: Minorante-neobothriotaxy (see diagnosis) type A- β (VACHON, 1974, 1975). Legs: tarsi with very few fine setae ventrally. Tibial and pedal spurs present, moderate on legs III and IV.

Morphometric values (mm). – Total length including the telson, 17.87. Carapace: length 2.67; anterior width 1.60; posterior width 2.93. Mesosoma length: 5.27. Metasomal segments. I: length 1.33, width 1.20; II: length 1.53, width 1.00; III: length 1.53, width 0.93; IV: length 1.67, width 0.80; V: length, 2.00, width 0.73, depth 0.53. Telson length 1.87; vesicle: width 0.47, depth 0.40. Pedipalps: femur length 2.07, width 0.60; patella length 2.33, width 0.73; chela length 4.00, width 0.67, depth 0.73. Movable finger length 2.73.

Etymology. – The specific name refers to Jordan, the country where the new species was found.

Relationships. – *Birulatus jordanensis* n. sp. seems to have some closer affinities with *B. israelensis*, described from Israel, both by the geographic proximity and by the absence of certain trichobothria. The new species can however be distinguished from *B. israelensis* by a number of features: (i) smaller number of teeth on pectines, (ii) ventral aspect of telson depressed, (iii) fixed and movable fingers of pedipalps chelae with 8 rows of granules, (iv) posterior furrow on carapace deeper, (v) a distinct trichobothrial pattern with a minorante



Fig. 24. – Natural habitat of *Birulatus jordanensis* n. sp.

trichobothriotaxy; absence of d_2 and one internal on femur; d_5 on femur is also placed in a markedly distal position.

Ecological notes. – The area from which the specimens were recovered is very dry and void of natural vegetation (fig. 24). It is rocky in nature with an important number of large ant colonies (genus *Messor*). Three other scorpion species were also observed in the site: *Leiurus hebraeus* (Birula, 1908), *Scorpio kruglovi* Birula, 1910, and an unidentified species of *Compsobuthus* Vachon, 1949.

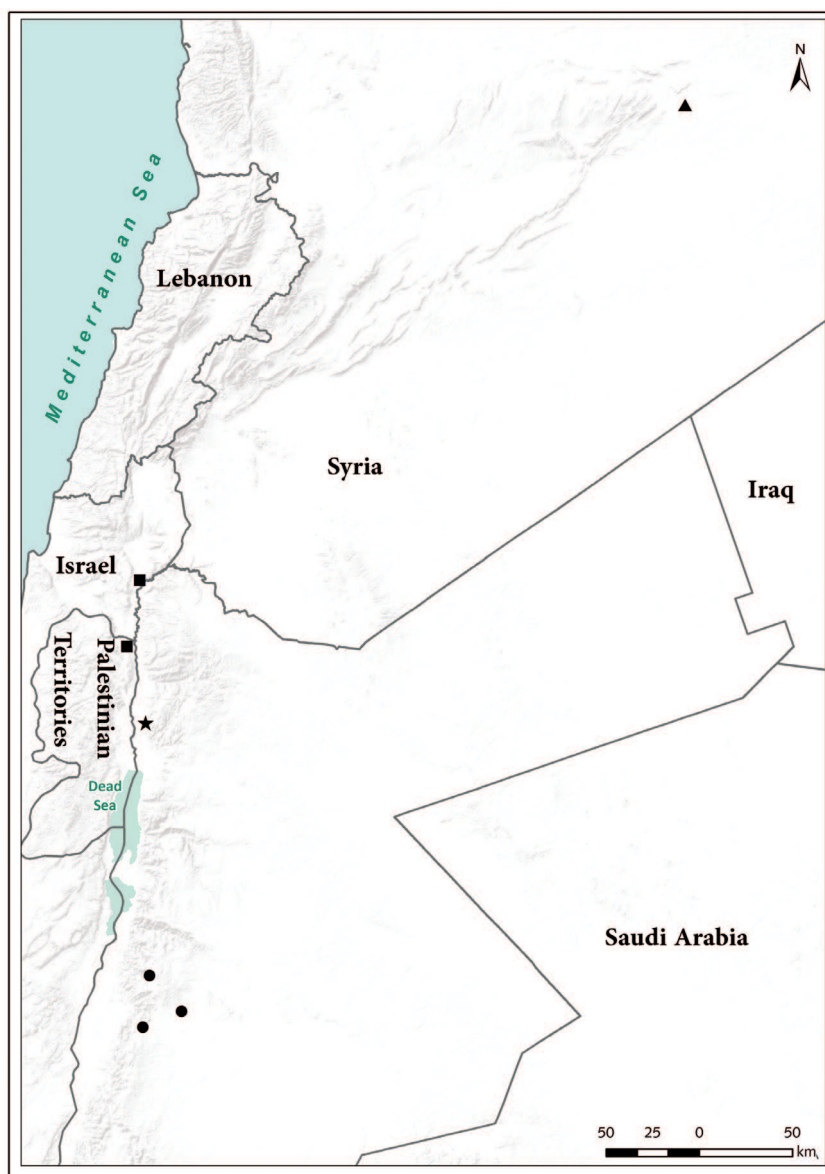


Fig. 25. – Map of Middle East, including Jordan, Israel and Syria, with the known distribution of the *Birulatus* species: *B. haasi* Vachon (circle); *B. israelensis* Lourenço (square); *B. astartiae* Stathi & Lourenço (triangle); *B. jordanensis* n. sp. (star).

Geographic distribution. – The current known distribution of the genus *Birulatus* is limited to a small portion of the Middle East, mainly Jordan, Israel and Syria and each known species probably corresponds to small patchy populations (fig. 25).

Final remarks. – This contribution to the knowledge of the Jordan scorpion fauna represents a potential process of cooperation between Jordanian scientists and the arachnological section of the Muséum national d'Histoire naturelle in Paris. Other studies should follow in a short period.

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