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Checklist and review of the scorpion fauna of Iraq (Arachnida: Scorpiones)

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Abstract. The knowledge of the scorpion fauna of Iraq and its geographical distribution is limited. Our review reveals the presence in this country of 19 species belonging to 13 genera and five families: Buthidae, Euscorpiidae, Hemiscorpiidae, Iuridae and Scorpionidae. Buthidae is, with nine genera and 15 species, the richest and the most diverse family in Iraq. Synonymies of several scorpion species were reviewed. Due to erroneous identifications and locality data, we exclude 18 species of scorpion from the list of the Iraqi fauna. The geographical distribution of Iraqi scorpions is discussed. *Compsobuthus iraqensis* Al-Azawii, 2018, **syn. nov.** is synonymized with *C. matthiesseni* (Birula, 1905).

Keywords: Buthidae, distribution, diversity, Euscorpiidae, Hemiscorpiidae, Iuridae, Scorpionidae

Zusammenfassung. Checkliste und Übersicht der Skorpione im Irak (Arachnida: Scorpiones). Die Kenntnisse über die Skorpionfauna im Irak und deren geografische Verbreitung sind begrenzt. Die Checkliste umfasst 19 Arten aus 13 Gattungen und fünf Familien: Buthidae, Euscorpiidae, Hemiscorpiidae, Iuridae und Scorpionidae. Die Buthidae sind mit neun Gattungen und 15 Arten die artenreichste und diverseste Familie im Irak. Aufgrund von Fehlbestimmungen und falschen Ortsangaben werden 18 Skorpionarten für den Irak gestrichen. Die geografische Verbreitung der Skorpionarten innerhalb des Landes wird diskutiert. *Compsobuthus iraqensis* Al-Azawii, 2018, **syn. nov.** wird mit *C. matthiesseni* (Birula, 1905) synonymisiert.

الملخص: قائمة تدقيق ومراجعة لحيوان العقرب (Arachnida: Scorpiones) في العراق. إن المعرفة بالعقارب العراقية وتوزيعها جغرافياً لاتزال محدودة، وقد أظهرت مراجعتنا وجود 19 نوعاً من العقارب في هذا البلد، تعود الى 13 جنس وخمسة عوائل وهي: Buthidae، Euscorpiidae، Hemiscorpiidae، Iuridae والعائلة Scorpionidae. العائلة بوثيدي Buthidae هي الاكثر تنوعاً من حيث عدد الانواع، إذ تضم 15 نوعاً تعود الى تسعة أجناس. تم مراجعة الاسماء المترادفة Synonymies للعديد من الأنواع العراقية، فضلاً عن توزيعها الجغرافي. ونظراً للتشخيص والبيانات المحلية الخاطئة، فقد تم استبعاد 18 نوعاً من قائمة العقارب العراقية، فالنوع *Compsobuthus iraqensis* Al-Azawii, 2018, **syn. nov.** هو مرادف للنوع (Birula, 1905) *C. matthiesseni*.

The scorpion fauna of Iraq is one of the least known in the Middle East. The fauna and geographical distribution of scorpions in Iraq have not been comprehensively investigated. Based on available data from the literature, it appears that several independent researchers collected specimens from various provinces of Iraq. The records of some of the identified scorpion species and their distribution are dubious and unclear, which requires further verifications. In addition, their taxonomy may need to be adjusted based on current systematic revisions. For instance, taxonomy of members of the genera *Androctonus*, *Compsobuthus*, *Mesobuthus* and *Orthochirus* still presents the main challenge despite the efforts of many researchers. The aim of this work is to review the literature on the research history of the Iraqi scorpions and provide an updated checklist for the scorpion fauna of Iraq and their geographical distribution.

Materials and methods

For this study, we reviewed publications by Simon (1880), Kraepelin (1899), Penther (1912), Birula (1910, 1918), Corkhill (1930), Kennedy (1937), Whittick (1955), Pringle (1960), L. Khalaf (1962), K. Khalaf (1963), Vachon (1966), Kovařík (1992, 2004), Lourenço & Pézier (2002), Lourenço & Qi (2007), Sissom & Fet (1998), Fet et al. (2009), Yağmur et al. (2013), Al-Azawi (2017), Al-Khazali & Yağmur (2019), Kovařík et al. (2019b), Tahir et al. (2014) and Kachel (2020). The records given in these papers were reviewed and compared with current scorpion systematics. In addition, the administrative provinces to which the records found in those publications belong were determined.

Abbreviations of specimen repositories

AZMM: Alaşehir Zoological Museum, Celal Bayar University, Manisa, Turkey. BMNH: Natural History Museum, London, UK. FKCP: František Kovařík Collection, Praha, Czech Republic. MHNG: Museum d'Histoire Naturelle, Geneva, Switzerland. MNHN: Muséum National d´Histoire Naturelle, Paris, France. ZISP: Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia. ZMB: Museum für Naturkunde Berlin, Germany. ZMH: Zoologisches Institut und Zoologisches Museum, Universität Hamburg, Germany.

Geography of Iraq

The geographical distribution of scorpions in Iraq has been neglected as previous studies focused only on the systematics. Iraq, covering about 437000 km^2, can be divided into 18 provinces (Fig. 1). For the purpose of understanding the preferred environmental conditions and geographical distribution of each scorpion species, the 18 Iraqi provinces are grouped into four geographical regions based on their temperature, climate diversity and geographical topology (Mohammed et al. 2017): **MR** (Mountainous Region; Duhok, Erbil and Sulaymaniyah), **UR** (Undulated Region: Mosul or Ninevah, Kirkuk and Diyala), **DR** (Desert Region: Al Anbar, Baghdad, Salah ad Din, Karbala, Najaf and Al-Muthana) and **AR** (Alluvial

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Region: Wasit, Al-Qādisiyyah, Maysan, Dhi Qar, Babil and Basra).

The Desert region (DR) with environmentally extremely harsh conditions in the west and southwest covers the largest area of Iraq. The Mountainous and highlands region (MR) with moderate temperature in the north-east and in the north is characterized by the presence of many trees, especially oaks, but also by numerous cliffs and rocks. The transitional region located between desert and mountains is undulated and hilly (UR) extending from the northern to the eastern parts of Iraq. The Alluvial region (AR) in the central and southern part of the country is characterised by scattered lakes and marshes (Malinowski 2002, Bachmann et al. 2011).

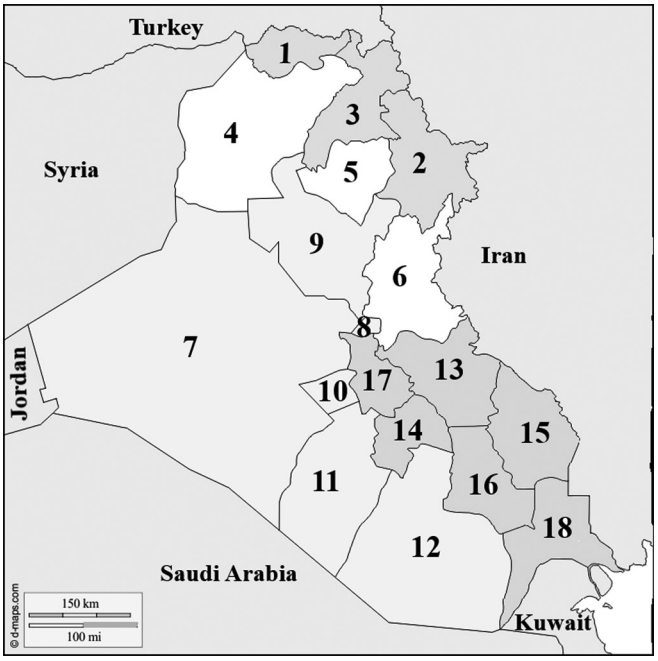

Fig. 1: Iraq map showing the approximate grouping of 18 provinces into the four major geographical regions: MR (**1** – Duhok, **2** – Sulaymaniyah, **3** – Erbil), UR (**4** – Mosul, **5** – Kirkuk, **6** – Diyala), DR (**7** – Al Anbar, **8** – Baghdad, **9** – Salah ad Din, **10** – Karbala, **11** – Najaf, **12** – Al-Muthana), AR (**13** – Wasit, **14** – Al-Qādisiyyah, **15** – Maysan, **16** – Dhi Qar, **17** – Babil, **18** – Basra), modified after Mohammed et al. (2017)

History of research on Iraqi scorpion fauna

Pioneering research (1861–1955)

Peters (1861) was the first to describe a scorpion species, *Hemiscorpius lepturus*, from what is now the territory of Iraq (Mendeli near Baghdad). Simon (1880) described *Buthus saulcyi* from Mosul Province. Kraepelin (1899), summarizing records of the known Iraqi scorpions, additionally listed *Buthus crassicauda* (Mesopotamia), *B. saulcyi* (Mosul) and *Hemiscorpius lepturus* (Baghdad). Later, Birula (1910) described the subspecies *Scorpio maurus kruglovi* from Mosul.

The earliest detailed report on the scorpions of Iraq was published by Penther (1912). When Penther carried on his fieldwork and published his paper, Iraq still did not exist as a country. Therefore, some records refer to localities within the present borders of Turkey and Syria. Penther listed six species from modern Iraq from the provinces Salah ad Din, Mosul, Baghdad and Babil.

Four studies published between 1918 and 1955 reported information on the scorpions of Iraq. Birula (1918) gave an *Orthochirus mesopotamicus* record from Baksai (now Wasit Province, Iraq). Corkhill (1930) reported *Buthus australis* and *Hemiscorpius lepturus* from Baghdad. After that, Kennedy (1937) reported another two species from Baghdad identified as *Buthus crassicauda* and *B. eupeus*. The work by Whittick (1955) was a critical and detailed study focused on the diversity of Iraqi scorpions. He listed eight species from the provinces Baghdad, Duhok, Ninevah, Diyala, Dhi Qar, Erbil and Al Anbar.

Modern research (1960–1998)

Pringle (1960) published a comprehensive study on the scorpion fauna of Iraq based on the previous locality records of Whittick (1955), with some new observations. In his work, he reported nine different species from the provinces Baghdad, Duhok, Karbala, Diyala, Mosul, Babil, Wasit, Basra, Kirkuk, Dhi Qar and Sulaymaniyah.

A study by Leila Khalaf (1962), under the supervision of Professor Kamal Khalaf, is considered the first scientific work by Iraq's researchers conducted on scorpion samples present in Iraq in natural history institutes. Khalaf listed eight species from Baghdad, Salah ad Din, Maysan, Duhok, Erbil and Diyala provinces.

The following study by K. Khalaf (1963) did not report any new localities but listed only the 14 previously mentioned species. Vachon (1966) compiled the comprehensive list of scorpion species of the Middle East countries, including 15 species from Iraq.

Levy et al. (1973) mentioned a female of *Buthacus yotvatensis* in the BMNH collection from Hinadi (Baghdad Province), but the record is questionable since the authors did not investigate this material. Kovařík (1992) and Sissom & Fet (1998) reported three further species from Iraq.

Research after the Catalog of the Scorpions of the World (2000–2020)

After publication of the world scorpion catalogue (Fet et al. 2000), several studies contributed to the scorpion fauna of Iraq. Fet & Kovařík (2003) recorded *Euscorpius* (*Polytrichobothrius*) *italicus* from an oasis in Najaf Province (clearly introduced by humans). Kovařík (2003) described *Compsobuthus jakesi* from Najaf Province. Kovařík (2004) corrected the *Orthochirus innesi* record and described this population as a new species from Najaf Province – *O. iraqus* and synonymized *Buthus pietschmanni* with *Buthacus macrocentrus* (Kovařík 2005). *Odontobuthus bidentatus* was described from Khanaqin (Dyala Province) (Lourenço & Pézier 2002) and *Hottentotta mesopotamicus* from Zakho (Dohuk Province) (Lourenço & Qi 2007).

Fet et al. (2009) described *Calchas birulai* from Turkey and reported this species also from Iraq at Geli Ali Beg waterfall (Erbil Province). Yağmur et al. (2013) described *Calchas anlasi* from Çukurca (Hakkari, Turkey) and suggested that the Erbil population of *C. birulai* belongs to this species. Tahir et al. (2014) recorded *Razianus zarudnyi* from Bazair (Baghdad Province).

Al-Azawi (2017) collected samples from nine provinces in the middle and south of Iraq. The scorpion species recorded were: *Androctonus crassicauda* from Abo Ghraib (Baghdad), Al Dora (Baghdad), Al-Kadhymia (Baghdad), Al-Sink (Baghdad Province), Al-Topchi (Baghdad), Batawin (Baghdad),

Al-Tagi (Baghdad) and Karbala Province; *Mesobuthus eupeus* from Al-Khalis, Baqubah (Diyala Province), Baladiyat, Abo Ghraib and Zafaraninyah (Baghdad Province); *Orthochirus scrobiculosus* from Abo Ghraib (Baghdad Province); *Hottentotta zagrosensis* from Al-Topchi, Al-Sink (Baghdad Province) and Al-Kales, Baquba (Diyala Province); *H. judaicus* from Al-Ahoiesh (Diyala Province); *Bothriurus nendai* from Abo Ghraib, Al-Nairiyaha, Baghdad Province (Baghdad Province); *Scorpio maurus* from Mishkab region (Najaf Province). Al-Azawii (2018) described *Compsobuthus iraqensis* from Tikrit (Salahuddin Province).

Al-Khazali & Yağmur (2019) reported six scorpion species from Dhi Qar Province: *Androctonus bicolor*, *Buthacus macrocentrus*, *Compsobuthus matthiesseni*, *Mesobuthus phillipsii*, *Orthochirus iraqus* and *Androctonus crassicauda*.

Kovařík et al. (2019b) reviewed *Orthochirus scrobiculosus mesopotamicus*, confirmed its validity and elevated it to species level as *O. mesopotamicus*. In addition, they described *Orthochirus fomichevi* from Sulaymaniyah and Dohuk Provinces.

Most recently, Kachel (2020) recorded *Androctonus crassicauda*, *Hottentotta saulcyi* and *Scorpio maurus* in Zakho (Duhok Province).

Comments on taxonomy

In this section, we review and confirm the names, taxonomic status, and verify the presence of all scorpion species in Iraq based on the recently updated scorpion classification.

Family Buthidae

***Androctonus crassicauda* (Olivier, 1807)**

Androctonus crassicauda has been reported from Iraq in several studies under different names as *Buthus crassicauda* by Kraepelin (1899) and Kennedy (1937); *Prionurus crassicauda* by Penther (1912); and *Buthus* (*Prionurus*) *crassicauda* by Whittick (1955). The majority of studies have reported it under the currently accepted name, *Androctonus crassicauda*: Pringle (1960), Khalaf (1962), Khalaf (1963), Vachon (1966), Al-Azawi (2017), Al-Khazali & Yağmur (2019) and Kachel (2020).

***Buthacus macrocentrus* (Ehrenberg, 1828)**

Buthus pietschmanni is an enigmatic scorpion species described by Penther (1912) that was later synonymized with *Buthacus macrocentrus* (Ehrenberg, 1828) by Kovařík (2005). On the other hand, Whittick (1955), Pringle (1960), Khalaf (1962) and Khalaf (1963) reported only the existence of *Buthacus leptochelys* and did not include anything about *Buthus pietschmanni*. Vachon (1966) mentioned both *Buthus pietschmanni* and *Buthacus leptochelys*. In our opinion, all *Buthacus leptochelys* records from Iraq belong to *B. macrocentrus* and, as we already mentioned, *Buthus pietschmanni* is a synonym of *Buthacus macrocentrus* (Kovařík 2005). Levy et al. (1973) listed a doubtful *Buthacus yotvatensis* record from Hinadi (Baghdad Province); presumably this record also belongs to *B. macrocentrus*. Therefore, we exclude both *Buthacus leptochelys* and *B. yotvatensis* from scorpion species list of Iraq and accept all their localities for *B. macrocentrus*.

***Buthus* sp.**

Kovařík (1992) reported *Buthus occitanus* (Amoreux, 1789) in Iraq. However, in the last two decades, several studies demonstrated that all populations of *Buthus* in the Middle East and Northern Africa do not belong to *Buthus occitanus* (which is restricted only to NE Spain and SW France; Sousa et al. 2017). Therefore, *B. occitanus* is excluded from the scorpion list of Iraq.

There is also an undescribed *Buthus* in Iraq, so far documented by only a single male (Sousa et al. 2017, F. Kovařík personal communication). We thus refer to this species as *Buthus* sp. pending its proper description.

***Compsobuthus matthiesseni* (Birula, 1905)**

Whittick (1955) recorded *Buthus acutecarinatus* var. *judaicus* from Iraq. Khalaf (1962) and Khalaf (1963) reported it as *Compsobuthus acutecarinatus* while Pringle (1960) gave a record of *C. matthiesseni*. Vachon (1966) listed all three names: *Compsobuthus acutecarinatus*, *C. judaicus* and *C. matthiesseni*. *Compsobuthus matthiesseni* was described as a subspecies of *C. acutecarinatus* (Simon, 1882), and Vachon & Kinzelbach (1987) elevated it to species level. Sissom & Fet (1998) redescribed *C. matthiesseni* and confirmed its species level. Therefore, we accept all previous records of *Compsobuthus acutecarinatus* as *C. matthiesseni.* Furthermore, Fet & Lowe (2000) did not list *C. acutecarinatus* in Iraq. Lourenço et al. (2010) redescribed *C. acutecarinatus* and restricted its distribution to Yemen and Oman. Therefore, we exclude *Compsobuthus acutecarinatus* and *C. judaicus* from the scorpion list of Iraq.

Al-Azawii (2018) described *Compsobuthus iraqensis* from Iraq, but did not compare it with the two *Compsobuthus* species already known from Iraq (*C. jakesi* and *C. matthiesseni*), while comparing it with *Compsobuthus persicus* occurring only in Iran. In addition, the author did not mention the existence of *C. matthiesseni* in Iraq; the species is widely distributed there (Sissom & Fet 1998). The description of *C. iraqensis* having long and slender pedipalps and chelae, the fifth segment of the metasoma very long and narrow, and colouration of all body generally yellow to pale yellow, matches that of *C. matthiesseni*. According to Sissom & Fet (1998), in *C. matthiesseni*, the posterior median carinae terminate distally in a small spinoid process that extends slightly beyond the posterior margin of the carapace, and the central median and posterior median carinae are slightly separated by a small space, and linearly arranged. These characters match the published image of the carapace of *C. iraqensis* (Al-Azawii 2018). Based on this evidence we synonymize *Compsobuthus iraqensis* Al-Azawii, 2018 = *C. matthiesseni* (Birula, 1905), **syn. nov.**

***Hottentotta mesopotamicus* Lourenço & Qi, 2007 and *Hottentotta saulcyi* (Simon, 1880)**

Whittick (1955) reported *Buthotus scaber* (now *Hottentotta scaber*), but Pringle (1960) did not confirm this record. Instead, he reported a yellow *Buthotus* sp. that was less hirsute than *Hottentotta saulcyi.* Subsequently, Lourenço & Qi (2007) described *Hottentotta mesopotamicus* from Zakho in northern Iraq. The characteristics of *H. mesopotamicus* were, to a certain extent, identical to the *Buthotus* sp. reported by Pringle (1960). Because *H. mesopotamicus* is uniformly yellow in coloration and less hirsute than *Hottentotta saulcyi*, we accept that Pringle (1960) recorded *Hottentotta mesopotamicus* from Khanaqin (Dyala Province). Furthermore, *H. scaber* is only known from Yemen and is therefore excluded from the list of scorpions in Iraq.

***Hottentotta schach* (Birula, 1905), *H. zagrosensis* Kovařík, 1997 and *H. judaicus* (Simon, 1872)**

Vachon (1966) listed *Buthotus schach* (now *Hottentotta schach*) for Iraq referring to Birula (1905). Recently, however, *H. schach* has been revised by Kovařík et al. (2019a) who demonstrated that the original records of Birula (1905) are only from Iran. Therefore, *H. schach* is excluded from the scorpion fauna of Iraq.

Al-Azawi (2017) reported *Hottentotta zagrosensis* and *H. judaicus* from Iraq, but it is clear from the figures given in this paper that both species belong to the genus *Androctonus*. Therefore, these two species are excluded from the list of scorpions in Iraq.

***Bothriurus nendai* Ojanguren Affilastro & Garcia-Mauro, 2010**

Al-Azawi (2017) also recorded *Bothriurus nendai* Ojanguren Affilastro & Garcia-Mauro, 2010 from the family Bothriuridae, which is present only in South America, southern Africa and Australia (Kovařík & Ojanguren Affilastro 2013). Al-Azawi's (2017) record of *Bothriurus nendai* is surely erroneous, because this species occurs only in Argentina and no species from the family Bothriuridae occur in the Palearctic region. Moreover, it is clear from the figure of *B. nendai*, that the depicted animal in fact belongs to a species of the genus *Androctonus* from family Buthidae. Thin chela on the figure strongly resemble *Androctonus bicolor*.

***Leiurus* sp.**

Sissom (1994) reported *Leiurus quinquestriatus* (Ehrenberg, 1828) from Iraq without mentioning the exact locality. Vachon & Kinzelbach (1987) did not clarify this record. Recently, Lowe et al. (2014) revised *Leiurus* populations from the Middle East and reported that the genus *Leiurus* does not occur in Iraq. However, there was a sting by *Leiurus* reported from Balad town (Saladin) by Shalita & Wells (2007). They stated the species was *Leiurus quinquestriatus* and the figure in their paper is clearly a *Leiurus*. However, *Leiurus quinquestriatus* is restricted to North Africa (Lowe et al. 2014). Therefore, this *Leiurus* population cannot be *Leiurus quinquestriatus.* Very recently, Lourenço (2020) described *Leiurus kuwaiti* from Al-Abraq, Kuwait, very close to the border of Iraq. Previous records may belong to this new species. Therefore, *Leiurus quinquestriatus* is excluded from the list of scorpion fauna in Iraq but we do not know whether the reported species could be assigned to *Leiurus kuwaiti.* Therefore, we list it here as *Leiurus* sp.

***Mesobuthus phillipsii* (Pocock, 1889)**

Penther (1912) also described *Buthus eupeus mesopotamicus*, which was synonymized with *Mesobuthus eupeus phillipsii* (Pocock, 1889) by Kovařík et al. (2011). Soon after, *M. e. phillipsii* was elevated to species level as *M. phillipsii* by Mirshamsi et al. (2011). *Mesobuthus eupeus* was reported under different generic names in previous studies. Whittick (1955) reported it under *Buthus* while Pringle (1960), Khalaf (1963), Vachon (1966) and Al-Azawi (2017) reported it under *Mesobuthus* from various areas. There is a high probability that all previous records could belong to *M. phillipsii* because it has been listed for a long time as a subspecies of *Mesobuthus eupeus*. We treat all *M. eupeus* records as referring to *M. phillipsii* and exclude *M. eupeus* from the list of Iraqi scorpions. From the zoogeographical point of view, *Mesobuthus eupeus* occurs on the north to the Zagros-Taurus mountain range, thus does not reach Iraq in its distribution (Mirshamsi 2013). Al-Khazali & Yağmur (2019) recently reported only *M. phillipsii*.

***Olivierus caucasicus* (Nordmann, 1840)**

The genus *Olivierus* was described by Farzanpay (1987) (with the type species *Buthus caucasicus*) and was synonymized with *Mesobuthus* by Gantenbein et al. (2003); Kovařík (2019), however, reestablished the genus *Olivierus*. Although Zhang et al. (2020) did not accept it, we follow and accept the results of Kovařík (2019). The genus *Olivierus* is not found south of the Zagros-Taurus mountain range. Therefore, Penther's *Olivierus caucasicus* record is very doubtful, and *O. caucasicus* has not been confirmed in Iraq again. We speculate that this record may belong to *Mesobuthus*, and *Olivierus caucasicus* should thus be excluded from the list of Iraqi scorpions.

***Odontobuthus bidentatus* Lourenço & Pézier, 2002**

Pringle (1960) recorded *Odontobuthus doriae*, which was also listed by Khalaf (1963). Lourenço & Pézier (2002) described *O. bidentatus* from the west of the Zagros Mountains. *Odontobuthus doriae* is endemic to the central plateau region of Iran, but does not occur in Iraq leading us to exclude it from the list of scorpions in Iraq.

***Orthochirus mesopotamicus* (Birula, 1918) and *Orthochirus iraqus* Kovařík, 2004**

Penther (1912) recorded *Butheolus scrobiculosus* var. *persa* Birula, 1900, later reported as *Orthochirus scrobiculosus* in studies by Whittick (1955), Pringle (1960), Khalaf (1962) and Khalaf (1963). Vachon (1966), however, mentioned both *Orthochirus persa* (as a valid species, without any justification) and *O. scrobiculosus* (Grube, 1873). The latter is a name traditionally used for many *Orthochirus* populations from the Middle East and Central Asia. However, *O. scrobiculosus* was described from western Turkmenistan, and many of the known populations were misidentified. Kovařík (1992) reported *O. innesi* (Simon, 1910) from Iraq; later he corrected this and described it as a new species – *O. iraqus* Kovařík, 2004. Recently, Kovařík et al. (2019b) reviewed the *Orthochirus* fauna of Iraq; they elevated *O. scrobiculosus mesopotamicus* Birula, 1918 to species level and described a new species, *O. fomichevi*. In addition, they confirmed *O. iraqus* in Iraq. Each *Orthochirus* species in Iraq has a limited range, e.g. *O. fomichevi* is found in the north of the country and the foothills of Zagros Mountains, *O. iraqus* is found in the central and western plains, while *O. mesopotamicus* is found in southern humid and plain regions of Iraq. Therefore, we consider that all the previous records of *Orthochirus* in Iraq belong to the three above-mentioned species, while *Orthochirus innesi, O. scrobiculosus* and *O. persa* are excluded from the list of Iraqi scorpions. We reviewed again the record of *O. iraqus* by Al-Khazali & Yağmur (2019) from Dhi Qar Province and correct it to *O. mesopotamicus* herein.

***Razianus zarudnyi* (Birula, 1903)**

Razianus zarudnyi was described by Birula (1903) as *Hemibuthus zarudnyi* from Baluchistan, Persia (now Sistan and Baluchistan Provinces, Iran). Farzanpay (1987) erected the genus *Razianus* and transferred this species to the new genus. *Ra-*

zianus zarudnyi has been reported only from Iran for long time (Birula 1903, Vachon 1966, Farzanpay 1987, Navidpour et al. 2008a, 2008b, 2008c, 2008d, 2010, 2012, 2013, Pirali-Kheirabadi et al. 2009, Karataş et al. 2012). Recently Tahir et al. (2014) confirmed it from Iran and recorded from Iraq.

Family Scorpionidae

***Scorpio kruglovi* Birula, 1910**

Penther (1912) recorded *Scorpio maurus* var. *testaceus* from Iraq, a subspecies that was already synonymized by Birula (1910) with *S. maurus maurus*, which only occurs in northern Africa. In addition, Birula (1910) also described another subspecies, *S. maurus kruglovi* from Mosul and Deir-Zor, upper Euphrates (now Deir ez-Zor). Although Fet (2000) mentioned this locality as being in Iraq, it is now within the territory of Syria. This subspecies was recently elevated to species level as *Scorpio kruglovi* by Talal et al. (2015). Therefore, all records from Iraq seem to belong to *S. kruglovi*. Pringle (1960) reported *Scorpio maurus fuscus* from Sarsing (Dohuk Province), which is close to the type locality of *S. kruglovi*. Besides, Whittick (1955) already reported *S. maurus kruglovi* from Dohuk. Therefore, we accept the record of Pringle (1960) belongs to *S. kruglovi*, and *S. fuscus* is excluded from the list of scorpions from Iraq. Due to the known localities of *Scorpio* all being close to the type locality of *Scorpio kruglovi*, and this species was already recorded from Iraq, we accept all records as *S. kruglovi*.

Systematic list of the scorpions of Iraq

Data on the distribution of each scorpion species in Iraq are presented according to 18 administrative provinces.

Family Buthidae

In Iraq, the family Buthidae includes nine genera and 15 species (Tab. 1). The members of genera *Androctonus, Buthacus*, *Buthus*, *Hottentotta, Leiurus*, *Mesobuthus* and *Odontobuthus* are medically important species. Because they have effective neurotoxic venom they are dangerous for human health (Ward et al. 2018).

***Androctonus bicolor* (Ehrenberg, 1828)**

Type locality and repository. Egypt; ZMH.

Distribution in Iraq. Dhi Qar Province (Al-Khazali & Yağmur 2019).

General distribution. Algeria, Egypt, Eritrea, Iraq, Israel, Jordan, Lebanon?, Libya, Morocco, Syria, Tunisia and Yemen (Al-Khazali & Yağmur 2019, Fet & Lowe 2000).

***Androctonus crassicauda* (Olivier, 1807)**

Type locality and repository. Iran, Esfahan Province, Kashan; type lost.

Distribution in Iraq. *A. crassicauda* is one of the most widely distributed species in most provinces of Iraq. Basra, Babil, Dhi Qar, Maysan, Al-Qādisiyyah, Wasit, Najaf, Salah ad-Din, Karbala, Al Anbar, Baghdad, Diyala, Mosul, Erbil & Duhok Provinces (Whittick 1955, Pringle 1960, Khalaf 1962, Al-Ramahi & Al-Hasnawi 2012, Al-Azawi 2017, Al-Khazali & Yağmur 2019, Kachel 2020).

General distribution. Armenia, Azerbaijan, Bahrain, Egypt (Sinai), Iran, Iraq, Israel, Jordan, Kuwait, Oman, Saudi Arabia, Syria, Turkey, United Arab Emirates and Yemen (Fet & Lowe 2000, Hendrixson 2006).

***Buthacus macrocentrus* (Ehrenberg, 1828)**

Type locality and repository. Egypt, Sinai; ZMB.

Distribution in Iraq. Mosul, Erbil, Najaf and Dhi Qar Provinces (Whittick 1955, Khalaf 1962, Khalaf 1963, Kovařík 2005, Mohammed et al. 2017, Al-Khazali & Yağmur 2019).

General distribution. Bahrain, Iran, Iraq, Israel, Jordan, Oman, Qatar, Saudi Arabia, Syria, Turkey, and United Arab Emirates (Crucitti & Vignoli 2002, Fet & Lowe 2000, Kovařík 2005, Lourenço 2006).

***Buthus* sp.**

Distribution in Iraq. Baghdad Province (Kovařík 1992).

Note. Yet undescribed species (see above).

***Compsobuthus jakesi* Kovařík, 2003**

Type locality and repository. Iraq, Najaf Province, Ash-Shabakah; FKCP.

Distribution in Iraq. Najaf Province (Kovařík 2003).

General distribution. Iran, Iraq (Kovařík 2003).

***Compsobuthus matthiesseni* (Birula, 1905)**

Type locality and repository. Iran, Qum Province (= Qom); ZISP.

Distribution in Iraq. Baghdad, Diyala, Kirkuk, Erbil, Salahuddin and Dhi Qar Provinces (Pringle 1960, Sissom & Fet 1998, Kovařík 2003, Al-Azawii 2018, Al-Khazali & Yağmur 2019).

General distribution. Iran, Iraq, Turkey, Syria (Birula 1905, Pringle 1960, Sissom & Fet 1998, Kovařík 1996, 2003).

***Hottentotta mesopotamicus* Lourenço & Qi, 2007**

Type locality and repository. Iraq, Duhok Province, Zakho; MNHN.

Distribution in Iraq. Duhok and Diyala Provinces (Whittick 1955, Pringle 1960, Vachon 1966, Lourenço & Qi 2007).

General distribution. Iraq (Lourenço & Qi 2007).

***Hottentotta saulcyi* (Simon, 1880)**

Type locality and repository. Iraq, Mosul; MNHN, ZMH.

Distribution in Iraq. Duhok, Mosul, Kirkuk, Sulaymaniyah, Diyala, Salah ad-Din and Baghdad Provinces (Pringle 1960, Khalaf 1962, Kovařík 2007, Ismael et al. 2018, Kachel 2020).

General distribution. Afghanistan, Iraq, Iran, Turkey (Birula 1918, Crucitti & Vignoli 2002, Kovařík 2007, Simon 1880).

***Leiurus* sp.**

Distribution in Iraq. Salah ad-Din (Sissom, 1994, Shalita & Wells 2007).

Note. An unidentified species (see above).

***Mesobuthus phillipsii* (Pocock, 1889)**

Type locality and repository. Iran, Bushehr Province, Bushehr; BMNH.

Distribution in Iraq. Mosul, Salah ad-Din, Baghdad, Dhi Qar, Diyala, Babil and Basra Provinces (Penther 1912, Whittick 1955, Pringle 1960, Khalaf 1962, Vachon 1966, Morad & Al-Abbad 2016, Al-Azawi 2017, Al-Khazali & Yağmur 2019).

General distribution. Iran, Iraq, Turkey, Syria (Pocock 1889, Penther 1912, Kovařík et al. 2011).

***Odontobuthus bidentatus* Lourenço & Pézier, 2002**
Type locality and repository. Iraq, Baghdad, Khanaqin-Dyala; MHNG.
Distribution in Iraq. Mosul, Baghdad and Diyala Provinces (Pringle 1960, Khalaf 1963, Lourenço & Pézier 2002).
General distribution. Iran, Iraq (Lourenço & Pézier 2002).

***Orthochirus fomichevi* Kovařík, Yağmur, Fet & Hussen, 2019**
Type locality and repository. Iraq, Sulaymaniyah Province, Chaqzhi Khwaroo; FKCP.
Distribution in Iraq. Sulaymaniyah and Dohuk Provinces (Kovařík et al. 2019b).
General distribution. Iraq, Turkey (Kovařík et al. 2019b).

***Orthochirus mesopotamicus* (Birula, 1918)**
Type locality and repository. Iran, Khoozestan Province, Karun River, Kut-e-Gazaie; ZISP.
Distribution in Iraq. Wasit, Basra & Dhi Qar Provinces (Kovařík et al. 2019b, Al-Khazali & Yağmur 2019).
General distribution. Iran, Iraq (Kovařík et al. 2019b).

***Orthochirus iraqus* Kovařík, 2004**
Type locality and repository. Iraq, Najaf Province, Ash-Shabakah (Shabachah, Shabicha); FKCP.
Distribution in Iraq. Baghdad & Najaf Provinces (Kovařík 2004, Kovařík et al. 2019b).
General distribution. Iraq (Kovařík 2004, Kovařík et al. 2019b).

***Razianus zarudnyi* (Birula, 1903)**
Type locality and repository. Iran, Sistan and Baluchistan Province; ZISP.
Distribution in Iraq. Baghdad Province (Tahir et al. 2014).
General distribution. Iran, Iraq (Tahir et al. 2014).

Family Euscorpiidae
Euscorpius is the single genus of this family that has been reported in Iraq. *Euscorpius italicus* is distributed in separated regions. The reported population of this species in Iraq is assumed to be from a foreign source. Members of the family Euscorpiidae are not medically important species (Ward et al. 2018).

***Euscorpius italicus* (Herbst, 1800)**
Type locality and repository. Italy; type(s) lost.
Distribution in Iraq. Najaf Province (Fet & Kovařík 2003).
General distribution. Albania, Algeria, Croatia, Georgia, Greece, France, Hungary, Iraq, Italy, Monaco, Montenegro, Morocco, North Macedonia, Romania, Russia, San Marino, Slovenia, Switzerland, Tunisia, Turkey, Yemen (Fet & Sissom 2000, Fet & Kovařík 2003, Yağmur 2012).

Family Hemiscorpiidae
This family includes 16 species belonging to a single genus *Hemiscorpius,* which are distributed in the Middle East. The knowledge available on the venom components of one member of this family, *Hemiscorpius lepturus*, shows their medical significance (Monod & Lourenço 2005). Therefore, handling other species of Hemiscorpiidae should be done extremely carefully due to unknown venom composition.

***Hemiscorpius lepturus* Peters, 1861**
Type locality and repository. Iraq (Mendeli near Baghdad); ZMB.
Distribution in Iraq. Baghdad and Diyala Provinces (Monod & Lourenço 2005).
General distribution. Iran, Iraq (Peters 1861, Farzanpay 1987, Monod & Lourenço 2005).

Family Iuridae
The distribution of the family Iuridae is almost only limited to Greece and Turkey, with a single record in Iraq (Erbil); it requires further verification in Syria. Stings by the species of this family does not cause any harm to human health and such cases are also very rare. They have strong pedipalps for capturing prey.

***Calchas anlasi* Yağmur, Soleglad, Fet & Kovařík, 2013**
Type locality and repository. Turkey, Hakkari Province, Çukurca District; AZMM.
Distribution in Iraq. Erbil Province (Yağmur et al. 2013).
General distribution. Iraq, Turkey (Yağmur et al. 2013).

Family Scorpionidae
The family Scorpionidae includes only one genus in Middle East and North Africa which is *Scorpio*. The species *S. fuscus* (Ehrenberg, 1829), *S. kruglovi* Birula, 1910, *S. palmatus* (Ehrenberg, 1828), *S. propinquus* (Simon, 1872) and the subspecies *S. maurus arabicus* (Pocock, 1900) and *S. maurus towsendi* (Pocock, 1900) are known in the Middle East and Iran. Among these valid species only *S. kruglovi* Birula, 1910 was reported from Iraq. Members of the family Scorpionidae are not medically important species (Ward et al. 2018).

***Scorpio kruglovi* Birula, 1910**
Type locality and repository. Deir-Zor, upper Euphrates, now Syria; ZISP.
Distribution in Iraq. Mosul, Erbil, Duhok, Baghdad and Najaf Provinces (Penther 1912, Pringle 1960, Khalaf 1962, Sherwan 2015, Al-Azawi 2017, Mohammad et al. 2017, Kachel 2020).
General distribution. Iran, Iraq, Jordan, Kuwait, Qatar, Saudi Arabia, Syria (Fet 2000).

Discussion
Based on our revision, the Iraqi scorpion fauna consists of 19 species from 13 genera and five families: Buthidae, Euscorpiidae, Hemiscorpiidae, Iuridae and Scorpionidae. The majority of the species (15) belong to Buthidae, and the other families are represented by one species each. However, the Iraqi scorpion fauna is one of the least studied in the region, when compared to some neighbouring countries. Currently, 41 species and three subspecies from four families of scorpion are known from Turkey (Dupre 2016), 21 species in three families are known in Syria (Khalil & Yağmur 2010), 28 species are reported from Saudi Arabia (Al-Asmari et al. 2013) and 68 species in three families from Iran (Cokendolpher et al. 2019).

Identification of scorpion species based on morphological characters only, which are often inadequately described and illustrated, are the main taxonomic problem behind the continuous changes in scorpion classification (Sissom & Fet

Tab. 1: Distribution of the 18 accepted scorpion species in different provinces and regions of Iraq. Province numbers 1–18 are shown in Fig. 1. MR = Mountainous and highlands region, UR = Undulated and hilly, DR = Desert region, AR = Alluvial region

	Provinces/Geographical regions in Iraq																	
	MR			**UR**			**DR**						**AR**					
Family/species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Buthidae																		
Androctonus bicolor																■		
Androctonus crassicauda	■		■	■		■	■	■	■	■	■		■	■	■	■	■	
Buthacus macrocentrus			■	■							■					■		
Buthus sp. (undescribed)								■										
Compsobuthus jakesi											■							
Compsobuthus matthiesseni			■		■	■		■	■							■		
Hottentotta mesopotamicus	■					■												
Hottentotta saulcyi	■	■		■	■	■		■	■									
Leiurus sp. (unidentified)									■									
Mesobuthus phillipsii				■		■		■	■							■	■	■
Odontobuthus bidentatus				■		■		■										
Orthochirus fomichevi	■	■																
Orthochirus mesopotamicus													■					■
Orthochirus iraqus								■			■					■		
Razianus zarudnyi								■										
Euscorpiidae																		
Euscorpius italicus											■							
Hemiscorpiidae																		
Hemiscorpius lepturus						■		■										
Iuridae																		
Calchas anlasi			■															
Scorpionidae																		
Scorpio kruglovi	■		■	■				■			■							
Species number per province	**5**	**2**	**5**	**6**	**2**	**7**	**1**	**8**	**4**	**1**	**6**	**0**	**2**	**1**	**1**	**6**	**2**	**2**

1998). More detailed studies in the future will give us more accurate information about the true identity of some species. For example, *Orthochirus innesi* in Iraq was recorded by Kovařík (1992). Later this record was corrected by the same author (Kovařík 2005) to a new species, *O. iraqus*. In addition, several species have been recorded under different names or reported without verified confirmation for their existence in Iraq. Here, we excluded 18 species from the scorpion fauna of Iraq. To avoid such issues, a combination of morphology (chaetotaxy) and modern methods (molecular analyses) should be used for scorpion species identification (Dehghani & Kassiri 2018). It is also necessary that existing species should be properly redescribed, as Kovařík et al. (2019b) did for *Orthochirus mesopotamicus* and *Orthochirus iraqus*.

The geographical distribution of scorpion species in the four regions of Iraq is shown in Tab. 1. Three (*Androctonus crassicauda, Buthacus macrocentrus* and *Compsobuthus matthiesseni*) of the nineteen species are recorded in all four geographical regions. Buthidae – the most common and diverse family in Iraq – includes nine genera, *Androctonus*, *Buthacus*, *Buthus*, *Compsobuthus*, *Hottentotta*, *Leiurus*, *Odontobuthus, Orthochirus and Razianus*. The genera with the highest number of species recorded are *Hottentotta* and *Orthochirus* (three species each) (Tab. 1). Fourteen of the 19 species are recorded in DR which accounts for 74% of all scorpion diversity in Iraq. Recording of the large number of species in DR indicates that these species prefer desert habitats.

It is clear from the data presented in this review that seven of the 19 known species (*A. bicolor*, *Buthus* sp., *C. jakesi*, *Leiurus* sp., *R. zarudnyi, E. italicus* and *C. anlasi*) have been reported from only one locality (Tab. 1) and most of them are identified from a very small number or even a single specimen. The data related to the single restricted geographical distribution of scorpion species in Iraq might be due to the inadequate number of scientific field studies rather than to restricted ecological conditions. Therefore, further investigation is required for confirmation of their presence and geographical distribution in Iraq, especially in western and southwestern regions.

On the other hand, twelve species (*A. crassicauda, B. macrocentrus, C. matthiesseni, H. mesopotamicus, H. saulcyi, M. phillipsii, O. bidentatus, O. fomichevi, O. mesopotamicus, O. iraqus, H. lepturus* and *S. kruglovi*) have wider geographical distribution in two or more regions and provinces throughout the country and appear to be adapted to different habitats (Mirshamsi 2013). *Androctonus crassicauda* is widespread in Iran, Syria, Turkey, Jordan and Saudi Arabia, and is the most frequently reported species in Iraq (Ozkan et al. 2006, Navidpour et al. 2012). It has been recorded from 15 provinces out of 18 in Iraq. *Compsobuthus matthiesseni*, *H. saulcyi*, *M. phillipsii, O. fomichevi* and *S. kruglovi* may be noted as other species which are widespread in Iraq.

Lack of detailed epidemiological and biochemical studies on the scorpions of Iraq are the main reasons behind unknown dangerously venomous and medical important species. Based on international studies, *H. lepturus*, *A. crassicauda*, *A. bicolor* and *H. saulcyi* are considered venomous and medically important scorpion species from Iraq (Keegan 1980). Beside *H. lepturus* from the family Hemiscorpiidae, reportedly the

most dangerous and medically important scorpion species in Iraq, all other hazardous scorpion species belong to the family Buthidae. *Hemiscorpius lepturus* is generally found in the Baghdad and Diyala provinces in Iraq. It is also found in Yemen and Pakistan (Rein 2020). *Hemiscorpius lepturus* is known to cause 95% of patient deaths by scorpion stings in Iran (Radmanesh 1990). Therefore, educating health staff and communities with the necessary knowledge on the morphology and ecology of the known scorpion species in Iraq might lead to significant reduction in the rate of scorpion stings. In addition, this work might lead to future studies on the bioactive molecules within their venom for better understanding their modes of action and developing species-specific anti venom.

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