Additions to the distribution of Sudanese scorpions

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Abstract

Six species of scorpion (Arachnida: Scorpiones) are documented from eighteen localities in seven different states within the Republic of the Sudan. Combining this new data with historical records in the Sudan Natural History Museum and the published literature enables the first provisional distribution maps for Sudanese scorpions. New state records could be added for three medically significant species: Androctonus amoreuxi (Audouin, 1826) from Khartoum, North Kordofan and North Darfur, Leiurus quinquestriatus (Ehrenberg, 1829) from Kassala, River Nile, White Nile and North Darfur, and Parabuthus abyssinicus (Pocock, 1901) from Kassala. Among the less venomous species, we offer new state records for Buthacus leptochelys (Ehrenberg, 1829) in White Nile State, for Compsobuthus werneri (Birula, 1908) in North Kordofan, White Nile and Kassala States and for Orthochirus olivaceus (Karsch, 1881) in River Nile, Northern and Kassala States. Further information about the taxonomy, distribution and toxicity of Sudanese scorpions is presented.

Key Words

distribution, East Africa, identification, public health, Scorpiiones

Introduction

Scorpions are a familiar group of arachnids found in warmer regions of the world, including throughout Africa. The Republic of Sudan covers a huge area of eastern Africa and is of particular biogeographical interest for hosting a range of environments (Fig. 1), including deserts in the north and west, coastal regions in the east, the Nile valley, and subtropical savannahs to the south. Despite this size and diversity of habitats, Sudan’s scorpion fauna remains rather poorly known. Notable early accounts include Hirst (1911a, b), Werner (1911), King (1925) and Borelli (1929). These, and other, records from the published literature were summarised by Dunlop et al. (2018), who listed a total of seventeen species. A further species was added by Kovařík et al. (2020) and a synonym was recognised by Kovařík and Lowe (2022). Here, we aim to expand this baseline data through novel records based on newly collected scorpions belonging to six different species (Fig. 2). We also include an updated summary (Table 1) of species and the states they occur in, as well as the first distribution maps for Sudanese scorpions (Fig. 3), again focussing on the six species for which we have recent and accurate locality data. Four Sudanese scorpion species are thought to be medically significant (see Discussion) and several clinical studies (e.g. Ali and Ali 2015) have reported scorpion stings in this country. Our data may thus be relevant for future public health initiatives, and problems with scorpion envenomation in Sudan are briefly reviewed.
Material and methods

Literature data for Sudanese scorpions was taken from Dunlop et al. (2018), and references therein. We also drew on historical collections held in the Sudan Natural History Museum of the Faculty of Science, University of Khartoum, Khartoum (SNHMK). This material was assembled by several people, mostly from the 1920s through to the 1960s. Unfortunately, the historical data is often associated only with abbreviations for the name of the collector. While some can be inferred based on the literature, for example “D.J.L. (1953)” is almost certainly David J. Lewis who worked in Khartoum in the 1950s, other historical collectors could not be identified unequivocally at this stage and are listed below in the verbatim form from the labels, i.e.: W.C. (1927), R.G.A. (1928), A.E. (1953), M.M.I. (1938), R.C. (1951), A.K.A. (1942), N.M.G. (1947), H.J.M. (1951), and A.M.E. (1952/1960). From the 1990s there is also museum material from J. Nasr Eldin Taj.

Another limiting factor here is that the historical museum data only covers five of Sudan’s eighteen states, namely Khartoum, River Nile, Northern, North Kordofan and North Darfur. To supplement this, new scorpion material was collected by the first (MS) and fourth authors (AM) from a total of eighteen localities across seven states: Northern State (Dongola, Wadi Halfa, Wadi El-Ga’ab, Merawi, Bayood Desert, El-Madeqeen), River Nile State (Atbara, El-Mosawarat, El-Manaseer, Mugrat Island), Kassala (Khashm El-Gerba, Kassala), Khartoum State (Khartoum, Omdorman), North Kordofan State (El-Obied), White Nile State (Kosti, Ab-Dareesh) and Sennar State (Dinder National Park). Scorpions were detected in the field using ultraviolet detection torches at night, or by searching under surface debris and rocks during the day. Typical habitats/collecting sites for several species are shown in Fig. 1, habitus images of those species for which we have new distribution data in Fig. 2 and the geographical maps were created using ArcMap (version 10.4.1) and are shown in Fig. 3.

Voucher specimens were preserved in 80% ethanol and deposited either in the Sudan Natural History Museum (SNHMK) and/or the Museum für Naturkunde Berlin (MfN) under its traditional acronym ZMB (for ‘Zoolögisches Museum Berlin’). Scorpions were initially identified to genus level using available keys, with species identifications mostly confirmed by FK drawing on extensive comparative studies of scorpions from northern and eastern Africa (e.g. Kovarik et al. 2016, 2020).

Results

Of the seventeen scorpion species currently known from the Republic of the Sudan (Dunlop et al. 2018; Kovarik et al. 2020), fifteen belong to the family Buthidae. These are *Androctonus amoreuxi* (Audouin, 1826), *A. australis* (Linnaeus, 1758), *Buthacus leptochelys* (Ehrenberg, 1829), *Buthus brignolii* Lourenço, 2003, *B. duprei* Rossi & Tropea, 2016a, *B. karoraensis* Rossi & Tropea, 2016b,
Table 1. The seventeen species of scorpion currently known from the Republic of Sudan, cross referenced to the eighteen states, listed approximately from north to south: Northern (NS), River Nile (RNS), Red Sea (RSS), Khartoum (KHS), Gezira (GS), North Darfur (NDS), West Darfur (WDS), Central Darfur (CDS), South Darfur (SDS), East Darfur (EDS), North Kordofan (NKS), West Kordofan (WKS), South Kordofan (SKS), White Nile (WNS), Sennar (SS), Al Quadarif (AQS), and Blue Nile (BNS).

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SCORPIONIDAE

| Pnd. sudanicus         | ✓  |     |     |     |    |     |     |     |     |     |     |     |     |     |    |     |     |
| Scorpio sudanensis     | ✓  |     |     |     |    |     |     |     |     |     |     |     |     |     |    |     |     |

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Compsobuthus werneri (Birula, 1908), C. seichertii Kovářík, 2003, Hottentota minax (L. Koch, 1875), H. niloticus (Birula, 1928), Leiurus quinquestriatus (Ehrenberg, 1828), Nanobuthus andersoni Pocock, 1895, O. olivaceus (Karsch, 1881), Parabuthus hunteri Pocock, 1895 and P. abyssinicus Pocock, 1901. Two more belong to the family Scorpionidae: Pandinurus sudanicus (Hirst, 1911a) and Scorpio sudanensis Lourenço and Cloudsley-Thompson, 2009. Note that Orthochirus aristidis (Simon, 1882) was recently synonymised with O. olivaceus (Karsch, 1881) by Kovářík and Lowe (2022), thus the former name has now been removed from the Sudanese species list. In focus in the present study, material assignable to six of these buthid species was collected during the present study and includes several novel state and/or locality records. These are detailed below and summarised in Table 1 and the distribution maps.

Family Buthidae C.L. Koch, 1837
Genus Androctonus Ehrenberg, 1828

Androctonus amoreuxi (Audouin, 1826)


Remarks. Androctonus amoreuxi is found in the arid north of Sudan, usually in sandy areas. Like L. quinquestriatus (see below), it is highly venomous and aggressive (Soliman et al. 2013). Limited work has been done on the distribution of Androctonus amoreuxi and the related species A. australis in Africa. They have almost the same general morphology and coloration. However, A. australis has wider metasomal segments associated with spinoid granule rows and a dorsal depression in addition to strongly developed dorsal carinae on metasomal segments I to IV and three well developed lateral lobes in an anal arc (Seiter and Turiel 2013).

Androctonus amoreuxi was previously documented by Hemprich and Ehrenberg (1828) and Birula (1908) from two localities in Northern State:
Dongola and Wadi Halfa. The present discovery in Merwi, Gureir and El Madeeqeen – Sa’ad finiti (also Northern State) represent new locality records, while its occurrence in west Omdurman (Khartoum State), Abu Zabad (North Kordofan State) and Abu Sufyan (North Darfur State) represent three new state and locality records.

Genus Buthacus Birula, 1908

Buthacus leptochelys (Ehrenberg, 1829)

Figure 2b


Remarks. This species, which may in future need to be divided into several species, was first described by Hemprich and Ehrenberg (1828) and Ehrenberg (1829) as Androctonus (Leiurus) leptochelys. The status of the genus Buthacus was confusing, but has recently been subject to several revisions (e.g. Kovařík 2018; Cain et al. 2021). Buthacus leptochelys was previously recorded in Dongola (Northern State), Duroor and Port Sudan (Red Sea State). Here, it is recorded for the first time in White Nile State, specifically from the locality of Ab-Dareesh and from further localities near Dongola.

Genus Compsobuthus Vachon, 1949

Compsobuthus werneri (Birula, 1908)

Figure 2c


Remarks. Compsobuthus is one of the most widely distributed genera of the family Buthidae with records from the Republic of Sudan, Ethiopia and Somaliland as the south-eastern limits of distribution for this genus (Kovařík et al. 2016a). Despite its small body size, Compsobuthus werneri is a fairly toxic species, usually found under stones or embedded in sand or underground. It was previously documented from several localities in the Republic of Sudan (see Dunlop et al. 2018) and its range is here expanded to include four new localities representing three new states (North Kordofan, White Nile and Kassala).

Genus Leiurus Ehrenberg, 1828

Leiurus quinquestriatus (Ehrenberg, 1829)

Figure 2d

Material examined. 1♀; SNHMK 2.316, The Republic of Sudan, River Nile State, Shendi (16°40’15.6”N, 33°26’59.6”E, 363 m a.s.l), leg. J.W. C., 26.12.1927, det. J.W. C. 1♂ 1♀; ZMB 49463, ZMB 49462, Northern State, Ambucol (21°18’15.6”N, 30°53’13.9”E, 182 m a.s.l), 26.10.2012, leg. A. Mohammad, det. A. Mohammad. 1♂ 1♀; ZMB 50601, Northern State, Bayood Desert, (19°32’42.9”N, 30°30’47.9”E, 224 m a.s.l), 03.09.2012, leg. A. Mohammad, det. A. Mohammad. 1♂; ZMB 49466, Northern State, Merawi (18°30’06.7”N, 31°48’15.3”E, 279 m a.s.l), 25.08.2005, leg. A. Mohamed, det. A. Mohammad. Northern State, 1♂ 1♀; SNHMK 2.548, El Madeeqeen – Sa’ad finiti, (20°20’18.96”N, 30°33’38.23”E, 789 m a.s.l), 15.03.2021, leg. H. Marzoug, det. M. Siyam. 1♂; ZMB 49467, White Nile State, Ab-Dareesh (14°59’31.9”N, 32°26’49.8”E, 384 m a.s.l), 11.05.2012, leg. A. Mohammad, det. A. Mohammad. 2♀; SNHMK 2.346, North Darfur State, Kuma District, Hajar Elsari (13°57’04.0”N, 26°01’39.0”E, 745 m a.s.l), 30.07.2012, leg. (unknown), det. M. Siyam.1♀; SNHMK 2. 302, Northern State, Kerma (19°38’27.0”N, 30°35’01.0”E, 223 m a.s.l), 09.10.2016, leg. O. Abubakr, det. M. Siyam. 1♂ 1♀; ZMB 49461, ZMB 49460, Northern State, Wadi El-Ga’ab, (19°27’47.5”N, 30°15’23.3”E, 219 m a.s.l), 15.09.2019, leg. I, Al-Khidir, det. M. Siyam.1♀; SNHMK 2.303, River Nile State, El-Mosawrat (16°16’08”N,
33°16'36"E, 424 m a.s.l), leg. I. Al-Khidir, 06.12.2018., det. M. Siyam, 2♀; SNHMK 2.360, River Nile State, Mur- 
grat Island (19°30'00.0"N, 33°15'00.0"E, 317 m a.s.l), leg. O. Khalil, 03.02.2018. det. M. Siyam, 1♀; ZMB 49465, River Nile State, El-Manaseer, Birti (16°16'08.0"N, 33°16'36.0"E, 424 m a.s.l) leg. M. Bakhit, 07.08.2019. det. M. Bakhit. 2 (juv); ZMB 49422, Kassala State, Khashm El-Gerba - Muraba’a village – Berno Wadi (14°16'45.8"N, 35°52'36.1"E, 502 m a.s.l), leg. M. Siyam and O. Khalil, 14–19.02.2019, det. M. Siyam and F. Kovařík.

**Description.** Male / female total body length (9–13 cm). General coloration yellow to brownish yellow, depend- ing on region. Prosoma yellowish brown, with brownish granulated carinae. Mesosoma brown, tergites granulated

**Figure 2.** Habitus photographs of several Sudanese scorpion species, all in the family Buthidae, for which we can offer new distribution data here. a. *Androctonus amoreuxi* (Audouin, 1826); b. *Buthacus leptochelys* (Ehrenberg, 1829); c. *Compsobuthus werneri* (Birula, 1908); d. *Leiurus quinquestriatus* (Ehrenberg, 1829); e. *Orthochirus olivaceus* (Karsch, 1881); f. *Parabuthus abyssinicus* (Pocock, 1901). Of these, *A. amoreuxi, L. quinquestriatus* and *P. abyssinicus* have a potent venom and are regarded as medically significant.
all over (I–VI darker than VII). Metasoma yellow, except segment V which is dark brown; tip of telson black. Legs pale yellow. Pedipalps long and yellow; manus normal. Pectines with 28 teeth in females and 36–37 teeth in males.

Remarks. *Leiurus quinquestriatus* is a widely distributed species both in Sudan and northern Africa through into the Middle East. It is typically found in poor savanna areas or mountains, usually under stones or shrubs. This species is highly toxic and aggressive and is known to cause fatalities, especially among children (Ali and Ali 2015). Our present material documented above represents four new state records (Kassala, River Nile, White Nile and North Darfour State) and thirteen new locality records for this species.

Genus *Orthochirus* Karsch, 1892

*Orthochirus olivaceus* (Karsch, 1881)

Figure 2e


**Description.** Male/female total body length (7–9 cm). General coloration brown. Prosome brown; lighter in front. Mesosoma dark brown, with slightly granulated tergites except VII with lighter coloration and thick granulation. Metasoma thick and strongly granulated, segments I–III dark yellow while segments IV and V dark brown. Telson reddish brown, aculeus tip black. Legs yellowish brown. Pedialps long, yellowish brownish, manus normal. Pectines with 33 teeth in females and 40 teeth in males.

Remarks. *Parabuthus* is a poorly documented genus in the horn of Africa, and the Republic of Sudan represents the northern limits of its distribution (Kovařík et al. 2016b). *Parabuthus abyssinicus* was, for many years, treated as a synonym of *P. liosoma* Ehrenberg 1828 before being revalidated by Kovařík et al. (2016b) as part of a species complex. *P. abyssinicus* is a highly venomous and aggressive species (e.g. Cilli and Corazzi 1946), usually found in sandy areas or under stones or wood. King (1925) documented it, as *P. liosoma*, in Khartoum (Khartoum State) and Erkowit (Red Sea State). The new specimens of *P. abyssinicus* now added a new locality record (Toker) from Red Sea State and new state record (Kassala State) in with two new localities (Kassala and Khashm Elgerba).

**Discussion.**

Four of the scorpion species found in Sudan have highly potent venom and are thus regarded as medically significant: *Androctonus amoreuxi*, *A. australis*, *Leiurus quinquestriatus* and *Parabuthus abyssinicus*. For accounts of these species’ toxicity, also in neighbouring countries, see Cilli and Corazzi (1946), Adi-Bessalem et al. (2008), Goyffon et al. (2012), Soliman et al. (2013) and Ali and Ali (2015). The two *Androctonus* species, colloquially known as ‘fat-tailed scorpions’, were previously known only in Sudan from Northern State in the north of the country (Dunlop et al. 2018). In the present study the range of at least *Androctonus amoreuxi* can be expanded to the south (Table 1, Fig. 3) to include the three adjacent states of North Darfur, North Kordofan and Khartoum. *Leiurus quinquestriatus*, the ‘deathstalker’ or ‘Omdurman scorpion’, has a wider distribution (Fig. 3). It has been recorded in Sudan from seven states, even down as far as Blue Nile State in the south of the country; whereby four state records (Kassala, River Nile, White Nile and North Darfur) could be added in the present study. Both King (1925) and Abushama (1961) noted that this species is quite common in north–central Sudan, and...
we might expect further records from other parts of the country. *Parabuthus abyssinicus* is restricted to eastern Sudan and a new state record (Kassala) was added here (Fig. 3).

While there are several published clinical case studies about scorpion stings from Sudan, the authors were, unfortunately, often unable to identify the species involved. For example, Elmadhoun and Hussain (2011)
offered hospital data (including fatalities in children) for the Atbara region in River Nile State, although none of the potentially dangerous species noted above had been previously recorded here. Our data shows that *Leiurus quinquesstriatus* occurs in River Nile State too (Fig. 3), and thus may have been the scorpion responsible for some or all of the hospitalisations. A similar problem affects the otherwise useful summary of Ali and Ali (2015). Their fig. 4 shows a concentration of reported scorpion stings along the Nile valley, but this may just reflect higher population densities. The respondents to their survey were also not in a position to provide useful data about which scorpion(s) were responsible, beyond reporting them as being black (perhaps *Hottentotta* or *Orthochirus*) or more commonly yellow, which could, of course, refer to several possible species. Thus, it is essential to provide basic diagnostic characters (combining colour, size, habitus, etc.) for the different scorpion species and make these available to clinicians, and the general public, so that they can both recognise and avoid the most venomous taxa. This will hopefully lead to better data on the distribution and habitats of the most dangerous scorpions.

The highest diversity of scorpions in general (according to Table 1) is in Khartoum and Northern States (both have 7 species), Red Sea States (6 species), River Nile and Kassala states (5 species); see also Fig. 3. We suspect that this may be more due to the proximity to population centres like Khartoum where previous zoologists were active (e.g. King 1925) and/or historical collecting activity which focussed on sites like Dongola and Wadi Halfa in the north near the Egyptian border (Hemprich and Ehrenberg 1828) and the Suakin and Port Sudan regions near the Red Sea. Significant gaps exist in the Darfur region (Fig. 3) making up the west of Sudan, for which we could newly record *Androctonus amoreuxii* (see above) as one of only three scorpion species known from North Darfur. The five Darfur states have proved difficult to sample due to ongoing political instability and the rarity of historical field trips. As shown in Table 1, the states of East, Central, South and West Darfur have no recorded scorpions to date despite the semi-arid climate here being suitable for several species. This large, but neglected, region may offer new species or records for scorpions and other arachnids in Sudan. Fieldwork here is likely to be very productive.

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