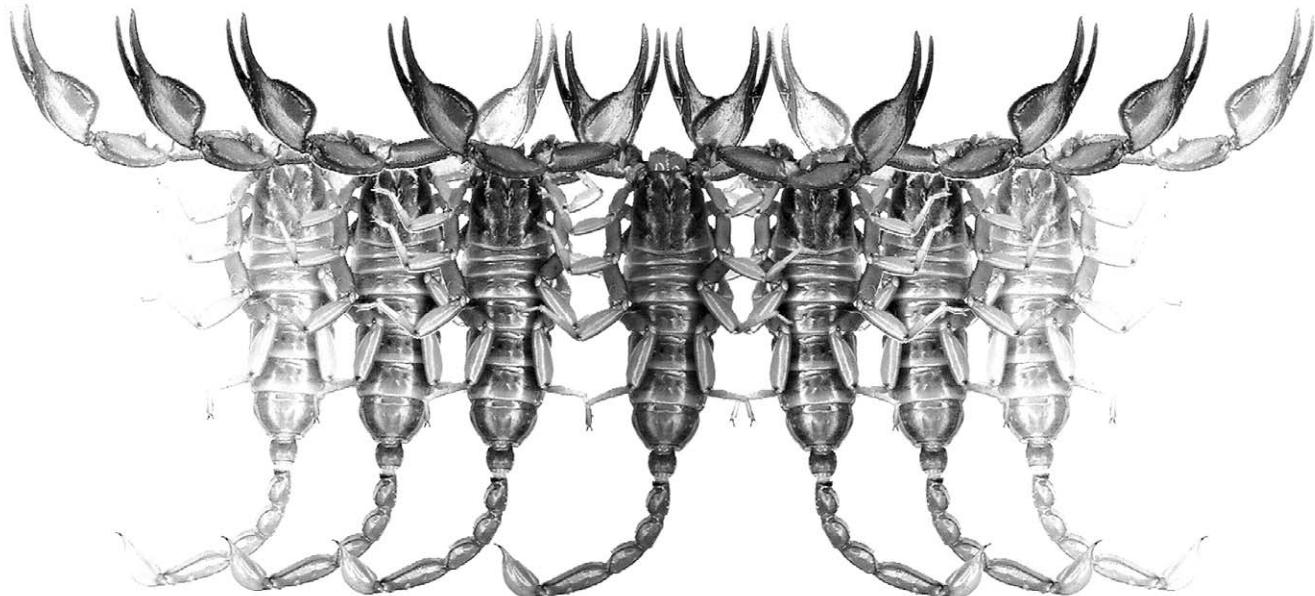


# *Euscorpius*

Occasional Publications in Scorpiology



**Scorpions of the Horn of Africa (Arachnida, Scorpiones). Part XVII. Revision of *Neobuthus*, with Description of Seven New Species from Ethiopia, Kenya and Somaliland (Buthidae)**

František Kovařík, Graeme Lowe, Ahmed Ibrahim Awale,  
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# *Euscorpius*

## Occasional Publications in Scorpiology

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<http://zoobank.org/urn:lsid:zoobank.org:pub:8A32B7DD-1A3F-45B0-A808-2BD7E5752A24>

# Scorpions of the Horn of Africa (Arachnida, Scorpiones).

## Part XVII. Revision of *Neobuthus*, with description of seven new species from Ethiopia, Kenya and Somaliland (Buthidae)

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<http://zoobank.org/urn:lsid:zoobank.org:pub:8A32B7DD-1A3F-45B0-A808-2BD7E5752A24>

### Summary

New information about the taxonomy and distribution of the genus *Neobuthus* Hirst, 1911 is presented, based on material recently collected mainly from Somaliland, but also Djibouti and Kenya. Emended diagnoses are proposed for *N. berberensis* Hirst, 1911 and *N. ferrugineus* (Kraepelin, 1898) sensu stricto. New species described are: *N. amoudensis* sp. n. from Ethiopia and Somaliland; *N. erigavoensis* sp. n., *N. factorio* sp. n., *N. gubanensis* sp. n., *N. maidensis* sp. n., and *N. montanus* sp. n. from Somaliland; and *N. kloppersi* sp. n. from Kenya. This doubles the number of species in *Neobuthus*, unearthing a rich diversification of this genus of diminutive benthids in the Horn of Africa. Included is a key and distribution map. In *N. gubanensis* sp. n., we report a second known case of anomalous pectine development with tarsal-like structures that implicate homeotic mutation, providing further evidence of pectine-leg homology in scorpions.

### Introduction

The genus *Neobuthus* Hirst, 1911 includes several small benthid scorpions distributed in northeastern Africa (Horn of Africa). In recent reviews (Kovařík & Lowe, 2012; Lowe & Kovařík, 2016), we redefined the genus, clarified its distinctness from the genus *Butholus*, and studied *N. berberensis* Hirst, 1911 (type species) and other species from Eritrea and Ethiopia. However, *Neobuthus* remained a rather poorly known taxon because only limited materials were available at the time. We had insufficient specimens from Somaliland and Djibouti, and in our previous paper we provisionally listed isolated specimens acquired in 2010–2011 from several localities as *N. ferrugineus* (Kraepelin, 1898) (fig. 161 in Lowe & Kovařík, 2016). In subsequent years of 2017–2018, the first author (F.K.) had the opportunity to participate in three more expeditions to Somaliland that permitted the collection from 9 localities of another 145 *Neobuthus* specimens representing 6 new species. We also acquired several important specimens from nor-

thern Kenya and Djibouti representing another new species and *N. ferrugineus* sensu stricto. Our opportunity to analyze an extensive series of new materials has provided us with a more comprehensive picture of the scope of the genus which we present here. Our work elevates to thirteen the number of verified species in *Neobuthus*, and reveals the rich speciation and adaptive radiation of one genus of small scorpions that comprises an important element of endemic biodiversity in the Horn of Africa (Lowe & Kovařík, 2016).

### Methods, Material & Abbreviations

Nomenclature and measurements follow Vachon (1963), Stahnke (1971), Sissom (1990), Kovařík (2009), and Kovařík & Ojanguren Affilastro (2013), except for trichobothriotaxy (Vachon, 1974, 1975), and morphology of sternum (Soleglad & Fet, 2003), and hemispermatophore (Kovařík et al., 2018).

We intentionally use here the name Somaliland (Hargeisa) for the northern territory (Republic of So-

maliland) corresponding to the former British colony (British Somaliland), which we distinguish from Somalia (Mogadisho). Somaliland has its own currency, a functional government with representation in several countries.

Specimens used for this study were collected and imported with permissions from Amoud, Erigavo and Hargeisa Universities and Ministry of the Environment of the Republic of Somaliland.

Specimens studied herein are preserved in 80% ethanol.

*Depositories:* BMNH (The Natural History Museum, London, United Kingdom); FKCP (František Kovařík, private collection, Prague, Czech Republic); GLPC (Graeme Lowe, private collection, Philadelphia, USA); MNHN (Muséum National d'Histoire Naturelle, Paris, France); MRAC (Musée Royal de l'Afrique Centrale, Tervuren, Belgium), RTOC (Rolando Teruel, private collection, Cuba), ZMHB (Museum für Naturkunde der Humboldt-Universität, Berlin, Germany), and ZMUH (Centrum für Naturkunde (CeNak), Center of Natural History Universität Hamburg, Zoological Museum, Hamburg, Germany).

## Systematics

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

#### *Neobuthus* Hirst, 1911 (Figs. 1–438, Tables 1–5)

*Neobuthus* Hirst, 1911: 462; Kovařík & Lowe, 2012: 1–25, figs. 1–6, 9–74, 86, 89, 92, 95–96, 100–101 (including complete generic synonymy prior to 2012); Kovařík et al., 2013: 4, 14; Lowe & Kovařík, 2016: 1–46, figs. 1–165, tables 1–5.

**DIAGNOSIS.** Small buthid scorpions, total length 15–25 mm (males), 22–32 mm (females); carapace strongly trapezoidal, surface granular with only anterior median carinae developed; ventral aspect of cheliceral fixed finger usually with single denticle, but this may be reduced or atrophied (*N. ferrugineus*); tergites with three carinae, of which the lateral pair may be less conspicuous; sternites III–VI with finely micro-denticulate posterior margins, lacking larger non-contiguous denticles; pectines with fulcra, hirsute; metasomal segments I–III with 8–10 carinae, segment V with enlarged lobate dentition on posterior ventrolateral carinae; telson rather bulbous, vesicle steeply inclined posteriorly, aculeus shorter than vesicle; macrosetae on vesicle normal to surface (♂) or oriented in anterior direction (♀); pedipalps short with stout segments, movable finger of pedipalp with 4–6 subrows of primary denticles flanked by mid-row internal and proximal external accessory denticles, 3 denticles just proximal to terminal denticle;

movable finger without dense terminal brush of setae on ventral surface; strongly spatulate microsetae not present on termini of fixed and movable fingers; pedipalp finger margins straight, without proximal scalloping or basal lobe and notch; trichobothrial pattern type A, orthobothriotoxic or neobothriotoxic minorante, dorsal trichobothria of femur arranged in β-configuration; trichobothrium  $d_2$  of pedipalp femur present or absent on dorsal surface,  $d_2$  of pedipalp patella present or absent,  $d_3$  of pedipalp patella situated internal to dorsomedian carina,  $V_2$  of chela manus strongly displaced internally relative to  $V_1$ , chela fixed finger with  $db$  located in proximal half, proximal to  $est$ ; tibial spurs present on legs III–IV; sexual dimorphism in setation, granulation and metasomal dentition: pedipalps, legs and metasoma with weaker granulation and long, filiform macrosetae in females, stronger granulation and shorter (often spiniform) macrosetae in males, ventrosubmedian and ventrolateral carinae on segments II–III strongly developed with enlarged dentition in females and regular dentition in males; capsule of hemispermatophore with 4 lobes in typical 3+1 configuration, basal lobe a broad, robust, hook-like process, flagellum well separated from lobes.

**HEMISPERMATOPHORE.** The hemispermatophores of all examined *Neobuthus* species exhibit similar morphology. The trunk is long and narrow, becoming broader in its basal half, and terminates apically in a short capsule region. The flagellum is well separated from the sperm hemiduct lobes and consists of a pars recta with laminate expansion on its anterior margin, and a narrow, cylindrical hyaline pars reflecta. The sperm hemiduct of the capsule region is 3-lobed, with large, apically rounded, spatulate posterior lobe attached by thickened suture or carina to concave surface of smaller acuminate median lobe. A small anterior lobe is well separated from the median lobe by a large gap. A robust, hook-like basal lobe with blunt apical profile projects from the convex surface at the base of the median lobe, attached along an oblique axis. The convex surface of the basal lobe is oriented anteriorly, and the concave surface posteriorly towards the flagellum. Intraspecific variation in lobe morphology was as great as interspecific variation, and we did not find systematic differences that could be useful in diagnosis at the species level. Sample sizes compared were (number of individuals, including previous studies): *N. amoudensis* sp. n. 10, *N. awashensis* 1, *N. cloudsleythompsoni* 1, *N. erigavoensis* sp. n. 4, *N. eritreaensis* 2, *N. factorio* sp. n. 3, *N. gubanensis* sp. n. 5, *N. kutcheri* 1, *N. maidensis* sp. n. 1, and *N. montanus* sp. n. 3. Left and right hemispermatophores in the same individuals did not differ significantly in their morphology. The consistent shape of the basal lobe within *Neobuthus* supports its use as a higher taxonomic character for differentiating between different buthid genera.



**Figure 1:** *Neobuthus amoudensis* sp. n., paratype female with newborns (first instar) before first ecdysis.

**TAXONOMIC REMARKS.** Key diagnostic characters for the genus *Neobuthus* originally proposed by Kovařík & Lowe (2012) were based on 3 species. These characters were subsequently confirmed by Lowe & Kovařík (2016) for 3 additional species. Here, we restudy two of the original species and describe 7 additional species. Our results further support the validity of the diagnostic characters. One key character was the presence of a single enlarged denticle on the ventral aspect of the cheliceral fixed finger. We confirmed that *N. amoudensis* sp. n., *N. erigavoensis* sp. n., *N. factorio* sp. n., *N. gubanensis* sp. n., and *N. montanus* sp. n. also comply with this character (Figs. 21, 118, 175, 257, and 393). In *N. ferrugineus* (Kraepelin, 1898), the denticle was smaller and difficult to visualize due to lack of darkening and concealment under microsetae (Fig. 210). However, UV microscopy of the profile of the ventral surface of the cheliceral fixed finger revealed a distinct tubercle (Fig. 212) that likely corresponds to a reduced ventral denticle. The difficulty of visualizing this under light microscopy explains why Kraepelin (1903) placed this species in *Nanobuthus* Pocock, 1895, which lacks ventral denticles as a diagnostic character (Pocock, 1895), and furthermore considered it a synonym of *N. andersoni* Pocock, 1895. Apparently, Prendini (2004, unpublished, cf. label in Figs. 182–183) concurred with this synonymy. We defer consideration of this issue until we can analyze the type or topotypes of *N. andersoni*, but if synonymy is upheld then *Neobuthus* would become a junior synonym of *Nanobuthus*.

Another key character is the 3+1-lobe configuration of the hemispermatophore capsule region with a strong, hook-like basal lobe. This was confirmed also in our newly described species (see above). The general lobe configuration is consistent with placement of *Neobuthus* in the ‘Buthus’ group (Fet et al., 2005) that was defined by trichobothrium  $d_3$  of the pedipalp patella being internal to the dorsomedian carina (Lowe et. al., 2018). Other key characters including sternite margin microdenticulation and various features of metasomal carination and setation were also validated.

**TERATOLOGY.** Among the samples examined, we detected two novel cases of anomalous structural development. In the first case, an adult paratype female of *Neobuthus gubanensis* sp. n. bore a malformed right pectine that was greatly abbreviated, with only 5 teeth (Figs. 432–434). The basal-most pectinal tooth had a much reduced sensillar area extending over only the distal third of the tooth, and the distal-most tooth had an unusual proximal annular constriction. Of particular interest was the presence of two hook-like processes on the anterior margin where marginal lamellae are normally positioned. These processes were curved with pointed tips composed of dark, hardened cuticle, resembling telotarsal unguis. Another area of dark, hardened

cuticle was expressed along the anterior edge of a single middle lamella exposed in a gap without marginal lamella. A similar case of development of tarsus-like structures in place of normal pectines was recently reported in an immature male of *Scorpiops luridus* Qi et al., 2005 (family Euscorpiidae) (Di et al., 2018). That case was interpreted as a homeotic mutation, yielding evidence that scorpion pectines are homologous to telopodites (= distal parts of primitive limbs). Our observation of a similar partial pectine-to-leg transformation in a phylogenetically distant buthid taxon supports the notion that this type of mutation, and inferred homology, is characteristic of Order Scorpiones, rather than being merely a phenomenon unique to Euscorpiidae.

In the second case, an adult male paratype of *N. montanus* sp. n. exhibited abnormal development of its genital opercula (Figs. 435–437). Normally, male opercula are slightly overlapped along the midline and freely articulate along their anterolateral attachment margins, allowing them to swing open for spermatophore extrusion. In this case, the sclerites were much more overlapped medially, and the right operculum was also posterolaterally attached and thus unable to articulate. Only a single genital papilla was detected by fluorescence behind this attached sclerite, instead of the normal pair of papillae. Interestingly, intact hemispermatophores were extracted from this male, even though it may have been difficult if not impossible for any spermatophore to be extruded via this mostly occluded genital opening.

**SUBORDINATE TAXA.** *N. amoudensis* sp. n., *N. awashensis* Kovařík & Lowe, 2012, *N. berberensis* Hirst, 1911 (type species), *N. cloudsleythompsoni* Lourenço, 2001, *N. erigavoensis* sp. n., *N. eritreaensis* Lowe & Kovařík, 2016, *N. factorio* sp. n., *N. ferrugineus* (Kraepelin, 1898), *N. gubanensis* sp. n., *N. kloppersi* sp. n., *N. kutcheri* Lowe & Kovařík, 2016, *N. maidensis* sp. n., *N. montanus* sp. n., and *N. sudanensis* Lourenço, 2005 (taxonomic position unclear).

#### *Neobuthus amoudensis* sp. n.

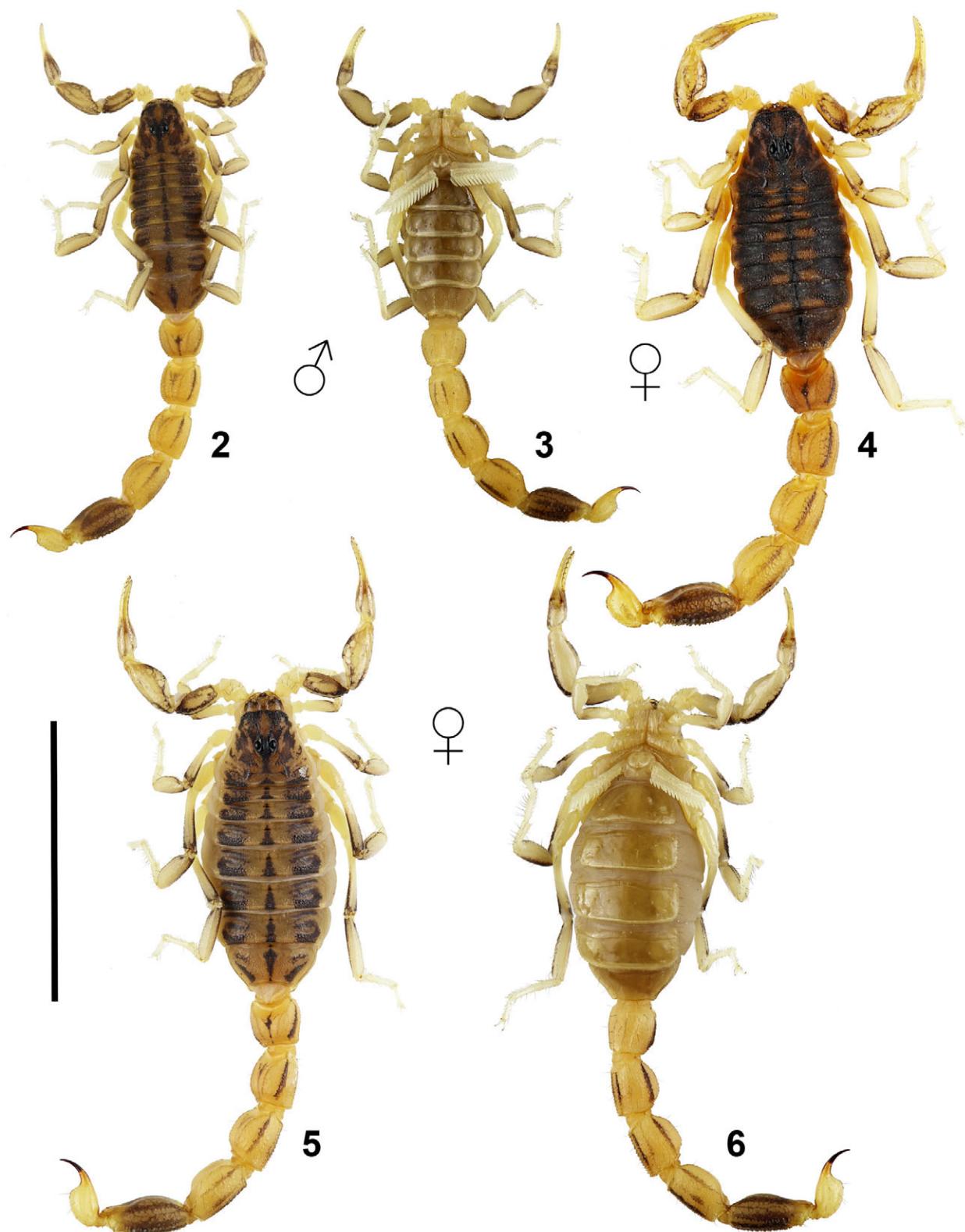
(Figs. 1–54, 402, 438, Tables 1 and 5)

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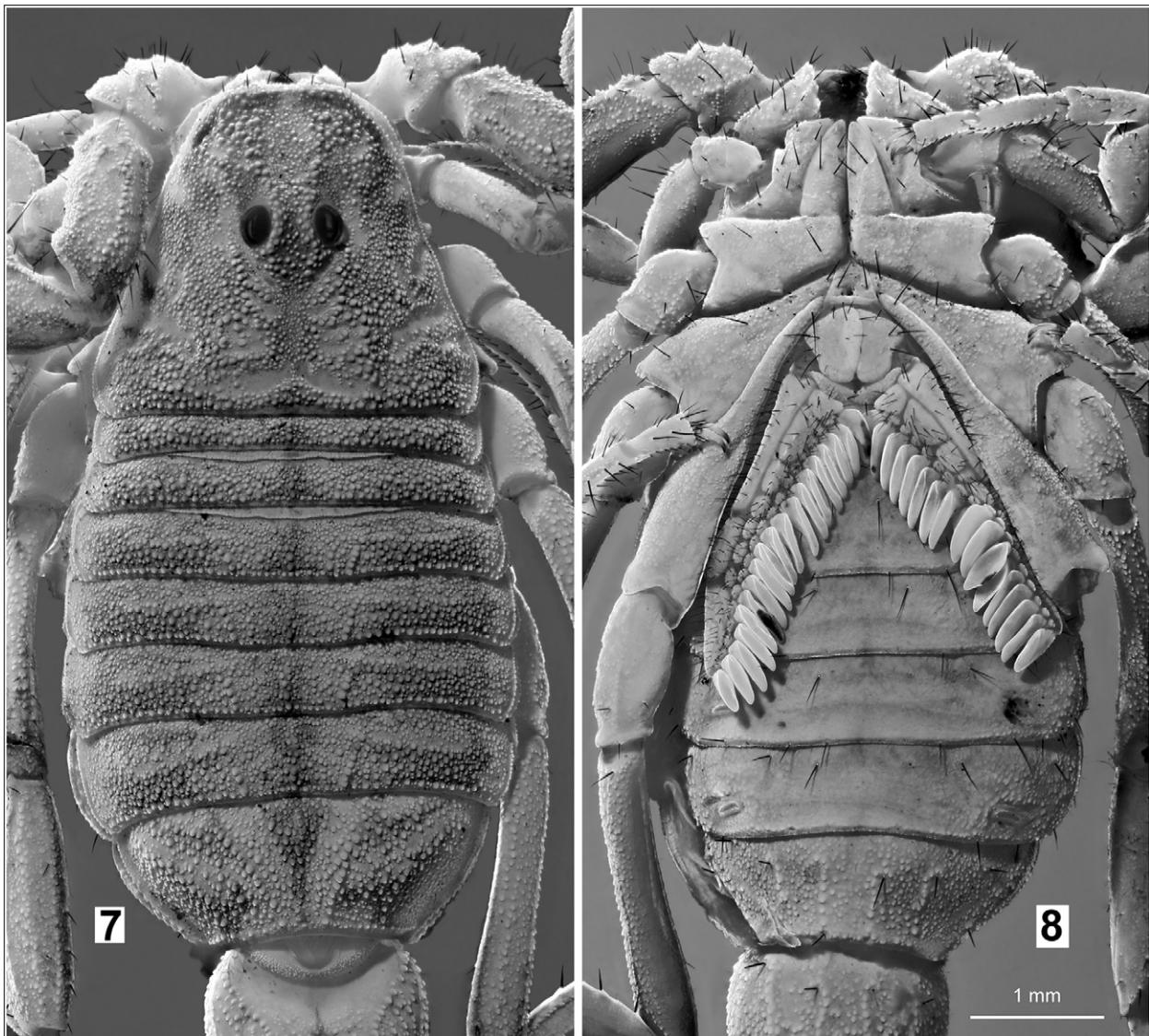
*Neobuthus ferrugineus*: Kovařík & Lowe, 2012: 3–7 (in part, male from Ethiopia).

**TYPE LOCALITY AND TYPE DEPOSITORY.** **Somaliland**, Borama, campus Amoud University, 09°56'49"N 43°13'23"E, 1394 m a.s.l.; FKCP.

**TYPE MATERIAL EXAMINED.** **Somaliland**, Borama, campus Amoud University, 09°56'49"N 43°13'23"E, 1394 m



**Figures 2–6:** *Neobuthus amoudensis* sp. n. from type locality **Figures 2–3.** Holotype male, dorsal (2) and ventral (3) views. **Figures 4–6.** Two differently colored paratype females, dorsal (4–5) and ventral (6) views. Scale bar: 10 mm.



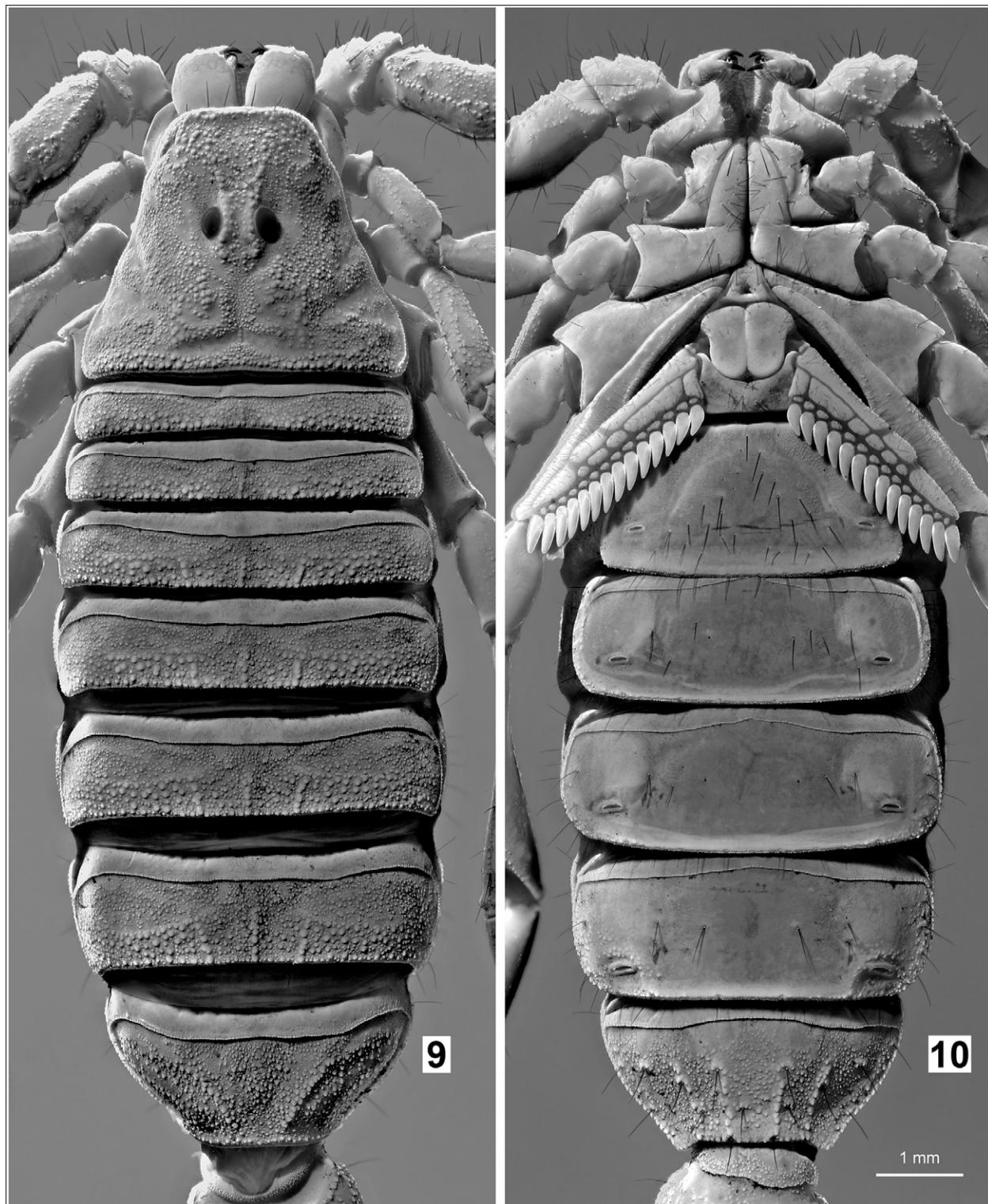
**Figures 7–8:** *Neobuthus amoudensis* sp. n., male paratype from type locality, carapace and tergites (7), coxosternal area and sternites (8). UV fluorescence. Scale bar: 1 mm.

a.s.l., 1♂ (holotype) 2♂ (Nos. 1200, 1201) 5♀4juvs. (paratypes), 4-5.II.2017 (Locality No. 17SA), 9-13. IX. 2017, 10♂ (Nos. 1306, 1307, 1310, 1311, 1312, 1313, 1314, 1315, 1316) 3♀9juvs. (paratypes), (Locality No. 17SR). **Ethiopia**, Dekhata valley, near Babile, Harar, 09°12'17.9"N 42°21'53.3"E, 975 m a.s.l., 17. VII.2011, 1♂ (paratype), leg. F. Kovařík. Most types including the holotype are in the collection of the first author (FKCP), three paratypes (2♂1♀) from 17SR are in the GLPC collection.

**ETYMOLOGY.** A patronym in honor of Amoud University of Republic of Somaliland.

**DIAGNOSIS.** Total length 18–20 mm (males), 23.5–25.7 mm (females); carapace with area between anterior

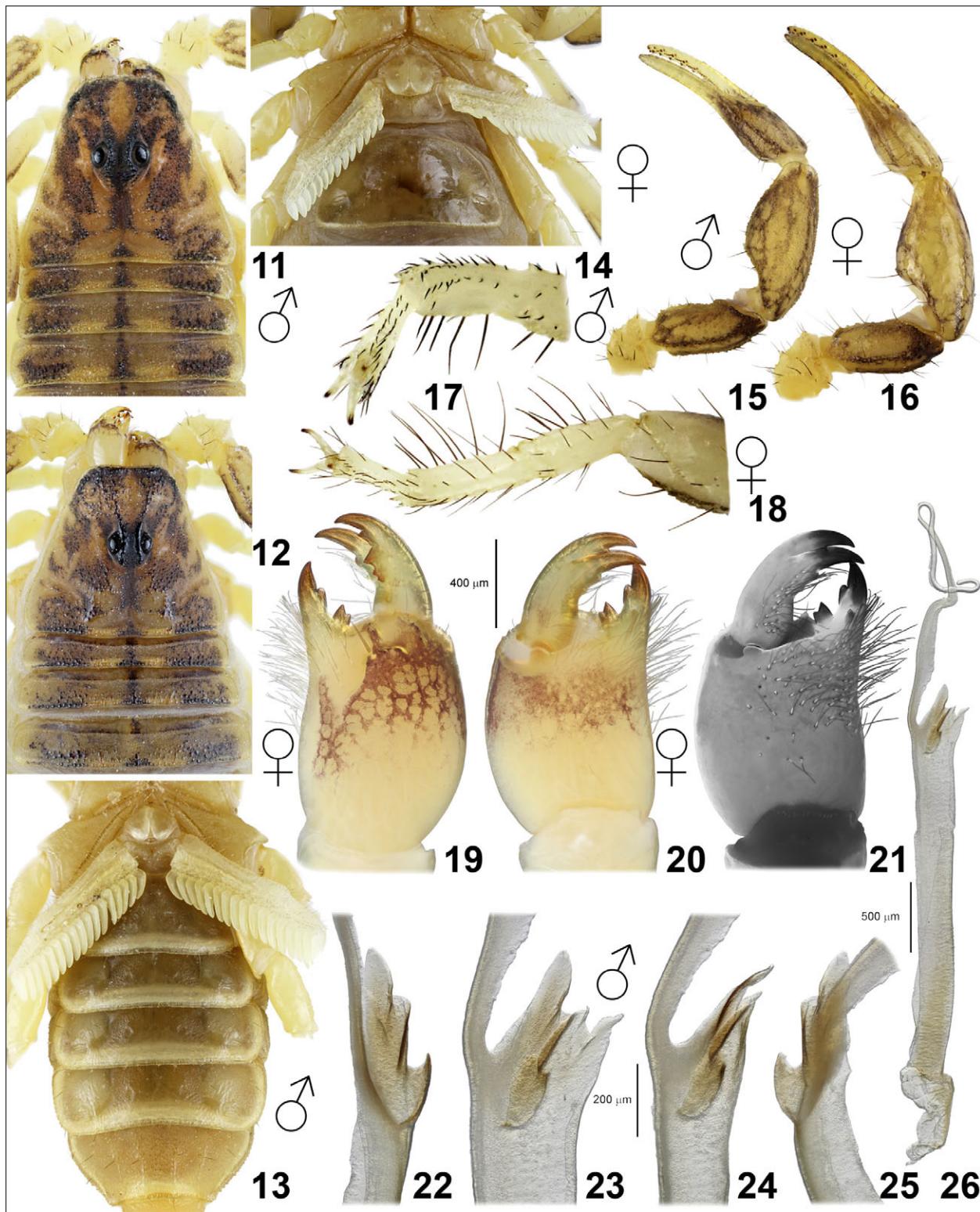
median carinae fuscous; tergites with fuscous variable pigmentation; pedipalp relatively slender, males with femur L/W 2.36–2.50, patella L/W 2.28–2.38, chela L/W 4.17–4.26; chela movable finger with 6 subrows of primary denticles, 4–5 external accessory denticles flanking proximal end of each subrow; trichobothria  $d_2$  usually present on femur and patella; dorsoexternal and ventroexternal carinae on pedipalp patella in female present, smooth; posterior margins of tergites usually lacking macrosetae; pedipalps, legs, metasoma and telson with moderately short, stout macrosetae in males, and long, fine setae in females; males with coxae sparsely granulated, sternites III–VI shagreened to smooth medially, sternite VII finely granulated with 4 weak, granulated carinae; females with sternites III–VI smooth, sternite VII with 4 weak granulated carinae;



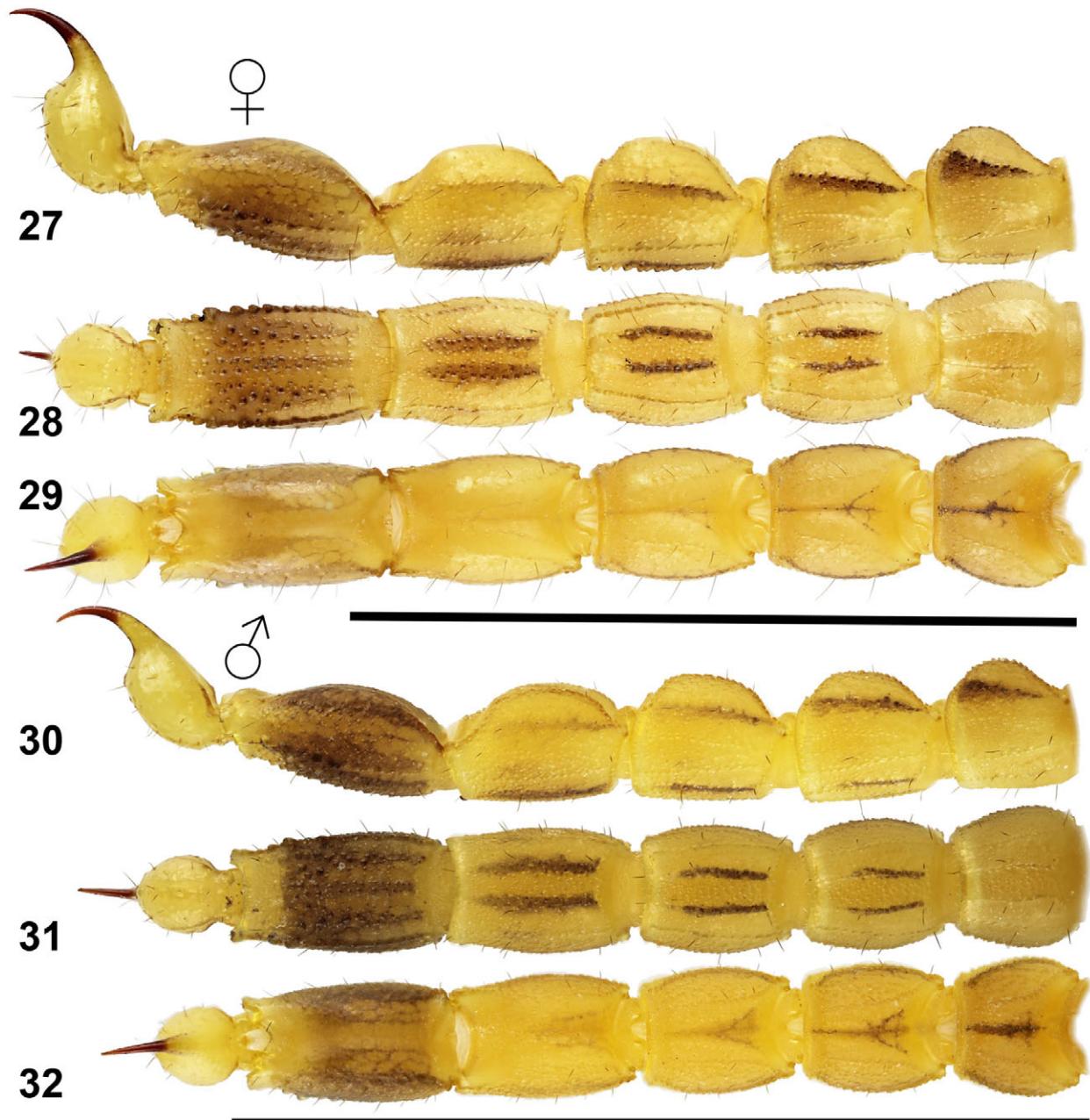
**Figures 9–10:** *Neobuthus amoudensis* sp. n., female paratype from type locality, carapace and tergites (9), coxosternal area and sternites (10). UV fluorescence. Scale bar: 1 mm.

metasoma I–III with median lateral carinae present in both sexes; lateral surface of metasoma V in males densely granulated, with granules separated; soles of

telotarsi with relatively sparse setation, leg III of adults with 12–16 ventral macrosetae on telotarsus; pectine teeth: 15–22 (males), 14–17 (females).



**Figures 11–26:** *Neobuthus amoudensis* sp. n. from type locality. **Figures 11, 13, 15, 17.** Male holotype, carapace and tergites I–III (11), coxosternal area and sternites (13), pedipalp dorsal (15) and leg III, retrolateral-ventral aspect (17). **Figures 12, 14, 16, 18–21.** Female paratype, carapace and tergites I–III (12), coxosternal area and sternite III (14), pedipalp dorsal (16) and leg III, retrolateral-ventral aspect (18), right chelicera, dorsal (19) and ventral (20) views, and ventral view under UV fluorescence (21). Scale bar: 400 µm. **Figures 22–26.** Male paratype (No. 1307), right hemispermatophore capsule region in posterior (22), convex compressed (23), convex (24) and anterior (25) views, hemispermatophore, convex compressed view (26). Scale bars: 200 µm, 500 µm.



**Figures 27–32:** *Neobuthus amoudensis* sp. n. from type locality, metasoma and telson. **Figures 27–29.** Female paratype, lateral (27), ventral (28), and dorsal (29) views. **Figures 30–32.** Male holotype, lateral (30), ventral (31), and dorsal (32) views. Scale bars: 10 mm.

**DESCRIPTION.** Total length of adult males 18–20 mm, of adult females 23.5–25.7 mm; measurements of carapace, telson, segments of metasoma and pedipalps given in Table 1; positions and distribution of trichobothria on pedipalps shown in Figs. 34–37, 39 and 41; trichobothrium  $d_2$  usually present on pedipalp femur and present on patella; base color pale yellow to light orange with variable fuscous pigmentation (Figs. 4 and 5) and

extensive patterns of dark maculation on pedipalps, metasoma and partially on legs; chelicerae yellow with dark reticulation on anterior manus, dentition reddish. **Sexual dimorphism:** strong, adult males substantially smaller, but without differences in shapes of pedipalps, metasoma and telson; pedipalp patella and femur granulate and matte in males, smooth and glossy in females; sternites smooth in females, partially granulated

in males; macrosetae on pedipalps, legs, metasoma and telson much longer and finer in females than males; other sex differences cited below.

**Pedipalp** (Figs. 15–16, 33–52). Pedipalp mostly sparsely hirsute; finely granulated in males and smooth in females; femur with five conspicuously granulose carinae, more strongly developed in males; patella with seven granulose carinae in males, and five smooth carinae in females; ventroexternal and dorsoexternal carinae on pedipalp patella in female are present and smooth; chela with carinae missing or weakly indicated.

**Carapace** (Figs. 7, 9, 11–12). Strongly trapezoidal (narrower anteriorly), wider than long (L/W 0.81–0.88); posterior median postocular area flat, anterior median preocular area gently sloped downwards towards anterior margin; lateral flanks steeply sloped; ocular tubercle broad, prominent, located slightly anterior to middle of carapace; anterior margin straight, finely microdenticulate, with coarser granules overlapping edge, bearing 6–8 macrosetae; anterior median carinae weak, coarsely granular, other carinae indistinct; dense granulation covering most of carapace.

**Chelicera** (Figs. 19–21). Fingers with typical buthid dentition (Vachon, 1963, Lowe & Kovařík, 2016); fixed finger with large distal denticle, 1 subdistal denticle and 2 basal denticles fused into bicusp, single denticle on ventral surface at level of bicusp; dorsal margin of movable finger with 5 denticles: 1 large distal denticle, medium-sized subdistal and medial, and 2 small, partially fused basal denticles; ventral margin with 2 denticles.

**Mesosoma** (Figs. 2–14). Tergites I–VI bear three carinae of which the lateral pair may be less conspicuous mainly on tergites I–IV; tergite VII bears five well-defined carinae (median, submedians and laterals); tergites I–VI densely granular, with coarser granules on posterior lateral areas; tergite VII densely granular; sternites III–VI smooth in females, smooth medially and granulate laterally in males; sternite VII with four well-defined carinae, densely, finely granulated in both sexes; sternum type 1, triangular in shape, smooth, with deep posteromedian invagination; genital opercula smooth; genital papillae present; pectines extending to around a quarter of sternite V in male and around end of sternite IV in female; pectine teeth 15–22 in males, 14–17 in females; combs with 3 marginal lamellae and 6–8 middle lamellae; marginal lamellae, middle lamellae and fulcra with dense cover of short dark reddish macrosetae; fulcra with 2–4 setae.

**Hemispermatophore** (Figs. 22–26). Typical of the genus.

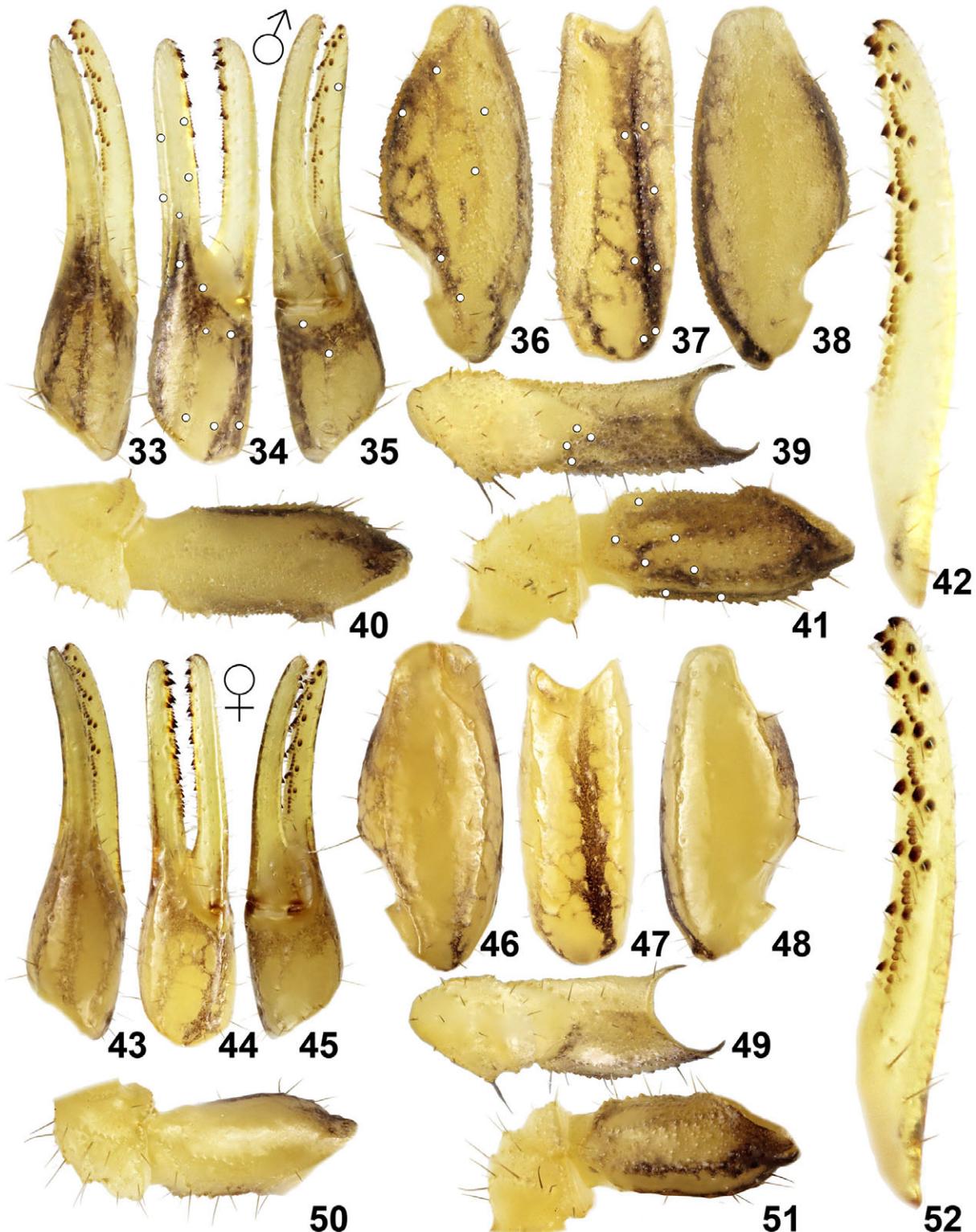
**Legs** (Figs. 17–18). Coxa, femora, patella and tibia of all legs bearing variable numbers of short to medium length, straight, dark-reddish macrosetae; tarsi with mix of short and longer, dark-reddish macrosetae; basitarsi I–III slightly compressed with flat retrolateral surfaces,

with bristle combs consisting of retrosuperior series of longer macrosetae, plus retroinferior and proinferior series of shorter macrosetae; telotarsi with two rows of short setae on ventral aspect, 12–16 macrosetae on telotarsus III; tibial spurs moderate on leg IV and almost reduced on leg III.

**Metasoma and telson** (Figs. 27–32). Metasoma and telson sparsely hirsute, macrosetae moderately short in male and longer in female, straight and reddish; metasomal segments I–III with 10 carinae, IV with 6–8 carinae, V with 2 carinae; segments I–III with moderate, granulate dorsolateral carinae, other carinae relatively well developed; segment IV with weakly indicated dorsolateral carinae; segment V with strong, granulate to dentate-lobate ventrolateral carinae; segments I–IV with dense granulation on all intercarinal surfaces except dorsal surfaces which are almost smooth, with only solitary granules; segment V densely granular on lateral and ventral surfaces, more coarsely so on ventral surface, granules not arranged along any traces of carinae; telson smooth, ventral surface sparsely, weakly granular; vesicle slightly elongated; aculeus stout, shorter than vesicle, tip of aculeus almost vertically directed.

**AFFINITIES.** The described features distinguish *N. amoudensis* sp. n. from all other species of the genus. According to the distribution (see Fig. 438) the type locality of *N. amoudensis* sp. n. is near to the localities of *N. gubanensis* sp. n. and *N. factorio* sp. n. From these two species *N. amoudensis* sp. n. can be unequivocally separated by the dorsoexternal carinae on the pedipalp patella which are present in females of *N. amoudensis* sp. n. (Fig. 46) and absent or only weakly indicated in females of *N. gubanensis* sp. n. and *N. factorio* sp. n. (Figs. 167 and 249).

**COMMENTS ON LOCALITY AND LIFE STRATEGY.** The type locality is a riverbed of an occasional river (Fig. 47 in Kovařík et al., 2018: 9, figs. 45–46 in Kovařík et al., 2017: 18, and fig. 145 in Kovařík et al., 2018: 19). The locality lies in the grounds of Amoud University Campus and is a study site for detailed research. The first author (F.K.) visited the locality 17SA on 4–5 February 2017 (winter dry season). At this locality, the authors recorded a daytime temperature of 24.7 °C (4 February, 16:08 h), and nighttime temperatures of 21.4 °C shortly after sunset, dropping to 19.3 °C (minimum temperature on 5 February at 19:20 h). The recorded humidity was 41% on 5 February at 19:20 h. The first author (F.K.) again visited the same locality on 9–13 September 2017 (summer minor dry season, 17SR) and recorded maximum daytime temperatures of 29.1 °C (10th September 2017) and 31.8 °C (12 September 2017), and a minimum nighttime temperature of 19.6 °C. The recorded humidity was between 31% (minimum at night) and 79% (maximum at day). All specimens were collected at

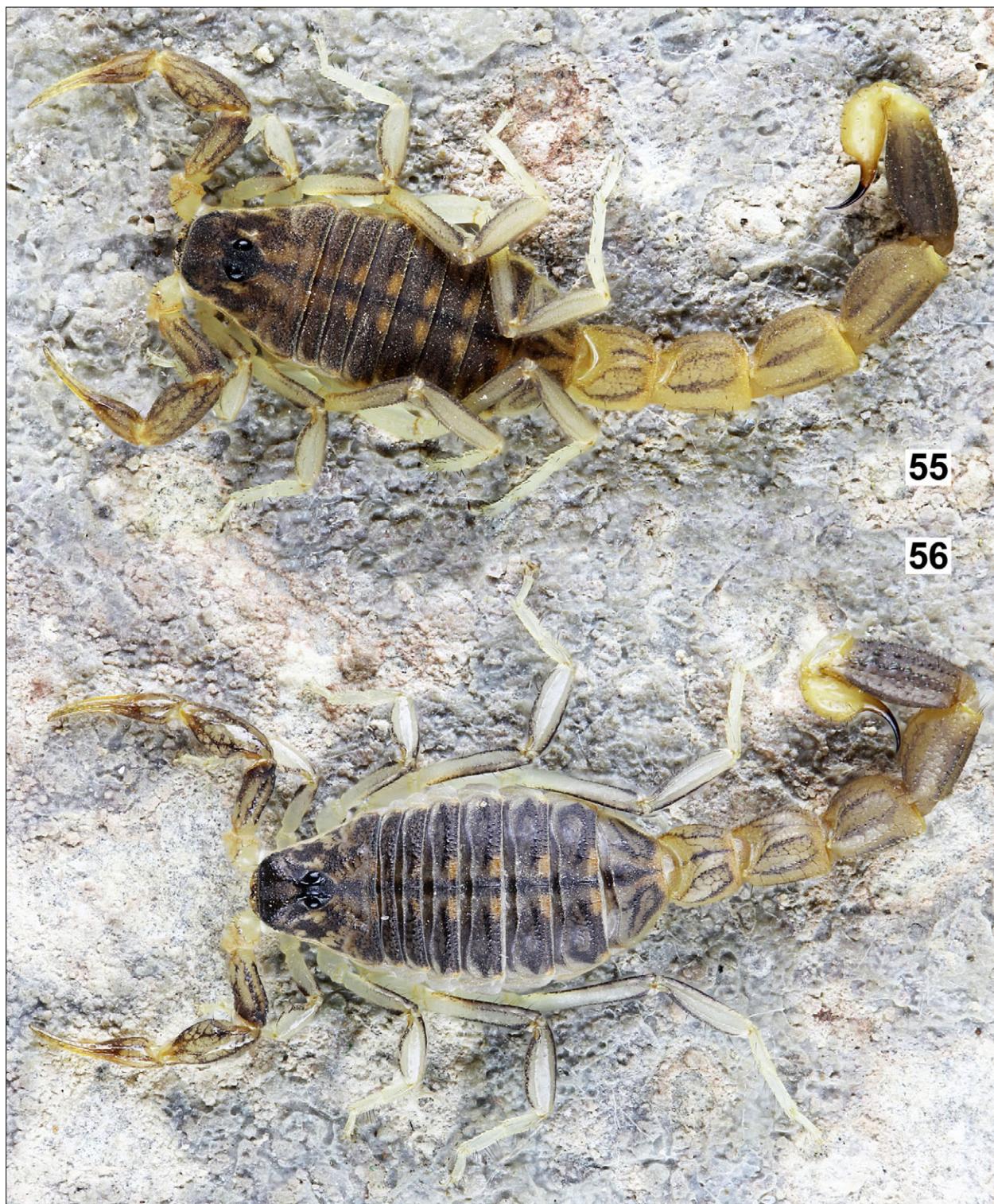


**Figures 33–52:** *Neobuthus amoudensis* sp. n. from type locality. **Figures 33–42.** Male holotype, pedipalp chela, dorsal (33), external (34), and ventral (35) views, pedipalp patella, dorsal (36), external (37) and ventral (38) views, pedipalp femur and trochanter internal (39), ventral (40), and dorsal (41) views, pedipalp movable finger dentate margin (42). **Figures 43–52.** Female paratype, pedipalp chela, dorsal (43), external (44), and ventral (45) views, pedipalp patella, dorsal (46), external (47) and ventral (48) views, pedipalp femur and trochanter internal (49), ventral (50), and dorsal (51) views, pedipalp movable finger dentate margin (52). The trichobothrial pattern is indicated in Figures 34–37, 39 and 41 (white circles).



**Figures 53–54:** *Neobuthus amoudensis* sp. n., paratypes from type locality, in vivo habitus. Male (53) and female (54).

night by ultraviolet (UV). At this locality, in addition to *N. amoudensis* sp. n., the first author also recorded *Barbaracurus somalicus* (Hirst, 1907), *Gint amoudensis* Kovařík et al., 2018 (type locality), *Parabuthus aby-*



**Figures 55–56:** *Neobuthus awashensis*, topotypes in vivo habitus. Male (55) and female (56).

*sinicus* Pocock, 1901 (Buthidae); *Pandinurus kmoniceki* Kovařík et al., 2017 (type locality) and *Pandinops pugillator* (Pocock, 1900) (Scorpionidae).

***Neobuthus awashensis* Kovařík & Lowe, 2012**  
(Figs. 55–56, 403, 418, 421, 438, Table 5)

*Neobuthus awashensis* Kovařík & Lowe, 2012: 7–16, figs. 5–6, 18–21, 34–38, 44–47, 67–74, 86, 89, 92, 95–96, 100–101; Kovařík et al., 2015: 30; Lowe & Kovařík, 2016: 2–4, figs. 1–6, 158, 161–165.

TYPE LOCALITY AND TYPE REPOSITORY. **Ethiopia**, Awash, Metahara env., 08°54'N 39°54'E, 960–1050 m a.s.l., FKCP.

TYPE MATERIAL EXAMINED. **Ethiopia**, Awash, Metahara env., 08°54'N 39°54'E, 960–1050 m a.s.l., 1♀ (paratype), 2008, leg. V. Trailin, 2♀1♂im. (allotype and paratypes), XI.2010, leg. T. Mazuch and P. Novák, 32♂ (holotype and paratypes) 18♀ (paratypes) 11♀ims, 5♂ims (paratypes), 19.-22.VII.2011, leg. F. Kovařík. Most types including holotype are in the collection of the first author (FKCP), other paratypes are in the GLPC, MRAC, RTOC, ZMHB, and ZMUH collections.

OTHER MATERIAL EXAMINED. **Ethiopia**, 11°43'22"N 40°56'52"E, 457 m a.s.l. (Locality No. **12EMA**), 20.XI.2012, 1♀1♂im., leg. F. Kovařík (UV detection), FKCP; 11°43'30"N 40°58'45"E, 404 m a.s.l. (Locality No. **12EM**), 20.XI.2012, 1♂, leg. F. Kovařík (UV detection), FKCP; Gewane, 10°09'38"N 40°39'45"E, 631 m a.s.l. (Locality No. **12EO**), 23.XI.2012, 1♂1♀, leg. F. Kovařík, (UV detection), FKCP; 09°08'10.4"N 40°09'45.5"E, 835 m a.s.l. (Locality No. **12ER**), 24.XI.2012, 12♂1♀1juv., leg. F. Kovařík (UV detection), FKCP, 26.-27.XI.2014, 8♂2♀2juvs, leg. F. Kovařík, FKCP; Awash, Metahara env., 08°54'N 39° 54'E, 960–1050 m a.s.l. (Locality No. **12EX**), 25.XI. 2012, 7♂6♀5juvs., 27.-30.XI.2014, 7♂1♀ (Figs. 55–56), topotypes, leg. F. Kovařík (UV detection).

DIAGNOSIS. Total length 18–22 mm (males), 22.5–30 mm (females); carapace with area between anterior median carinae fuscous; tergites with fuscous pigmentation unbroken across median area; pedipalp relatively slender, males with femur L/W 2.50–2.70, patella L/W 2.45–2.70, chela L/W 4.63–5.08; chela movable finger with 5–6 subrows of primary denticles, 3–5 external accessory denticles flanking proximal end of each subrow; trichobothria  $d_2$  usually absent from femur and patella; dorsoexternal and ventroexternal carinae on pedipalp patella in female well developed; posterior margins of tergites with 1–2 pairs of macrosetae; pedipalps, legs, metasoma and telson with short, stout macrosetae in males, and long, fine setae in fe-

males; males with coxae sparsely granulated, sternites III–VI lightly shagreened to smooth, sternite VII finely granulated with 4 weak, granulated carinae; females with sternites III–VI smooth, sternite VII sparsely shagreened with 4 weak carinae, median carinae granulated; metasoma I–III with median lateral carinae present in both sexes; lateral surface of metasoma V in males densely granulated, with granules separated; soles of telotarsi with relatively sparse setation, leg III of adults with 12–19 ventral macrosetae on telotarsus; pectine teeth: 17–21 (males), 15–18 (females).

***Neobuthus berberensis* Hirst, 1911**  
(Figs. 57–70, 404–405, 416–417, 438, Table 5)

*Neobuthus berberensis* Hirst, 1911: 462–464; ? Borelli, 1919: 361, 365; ? Borelli, 1931: 219; Fet & Lowe, 2000: 186; Lourenço, 2001: 178, 179, fig. 14; Lourenço, 2005: 27; Lourenço & Qi, 2006: 91; Kovařík & Lowe, 2012: 3, figs. 1–2, 9–17, 22–27, 39–40, 48, 72; Lowe & Kovařík, 2016: 2, 42, 43.

*Butheolus ferrugineus*: Kovařík, 2003: 137 (in part); Kovařík, 2004: 4 (in part); Kovařík & Mazuch, 2011: 5.

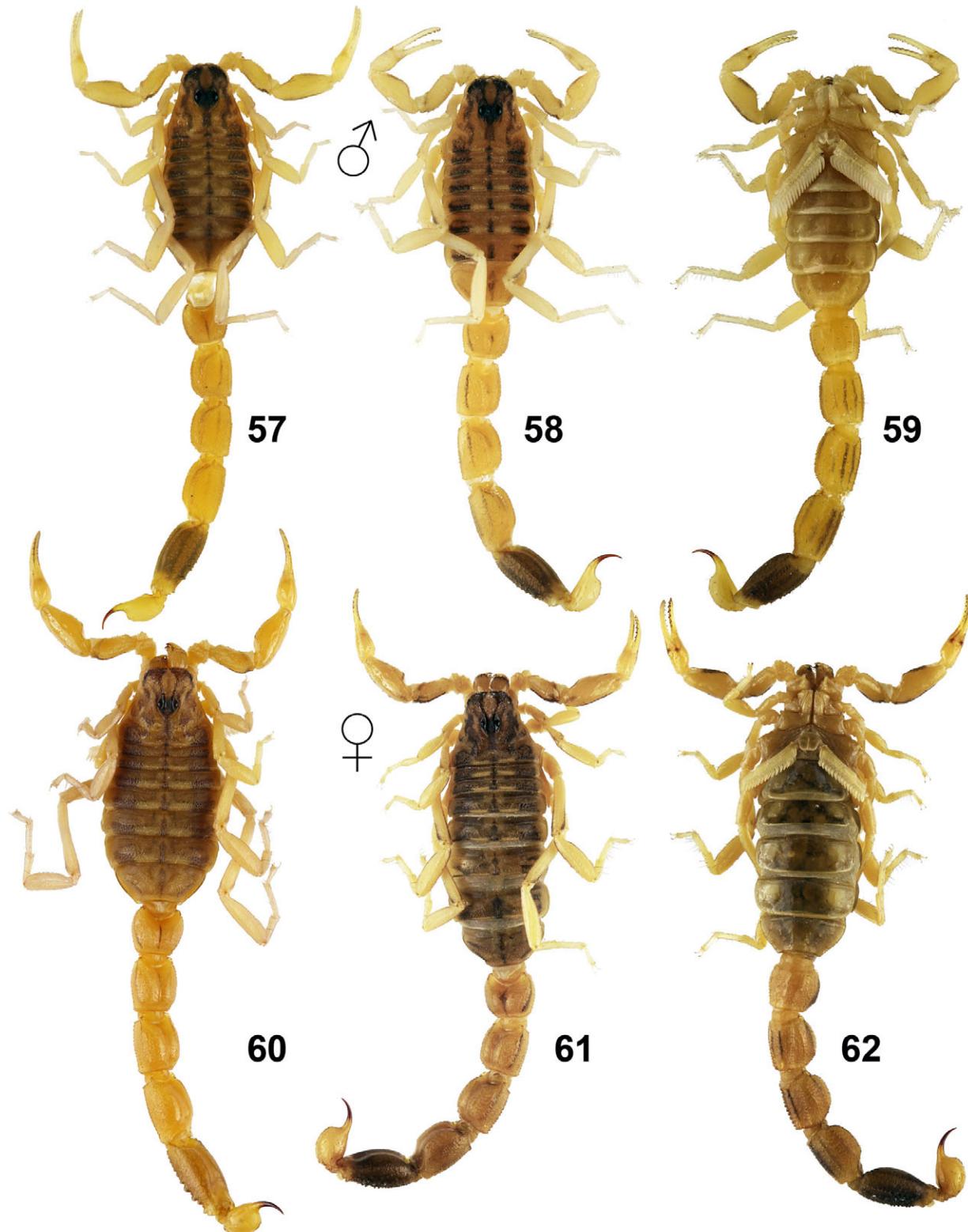
*Neobuthus ferrugineus*: Kovařík & Lowe, 2012: 3–7, figs. 28, 30–31, 33, 43, 52–59 (in part).

TYPE LOCALITY AND TYPE DEPOSITORY. **Somaliland**, Berbera; BMNH.

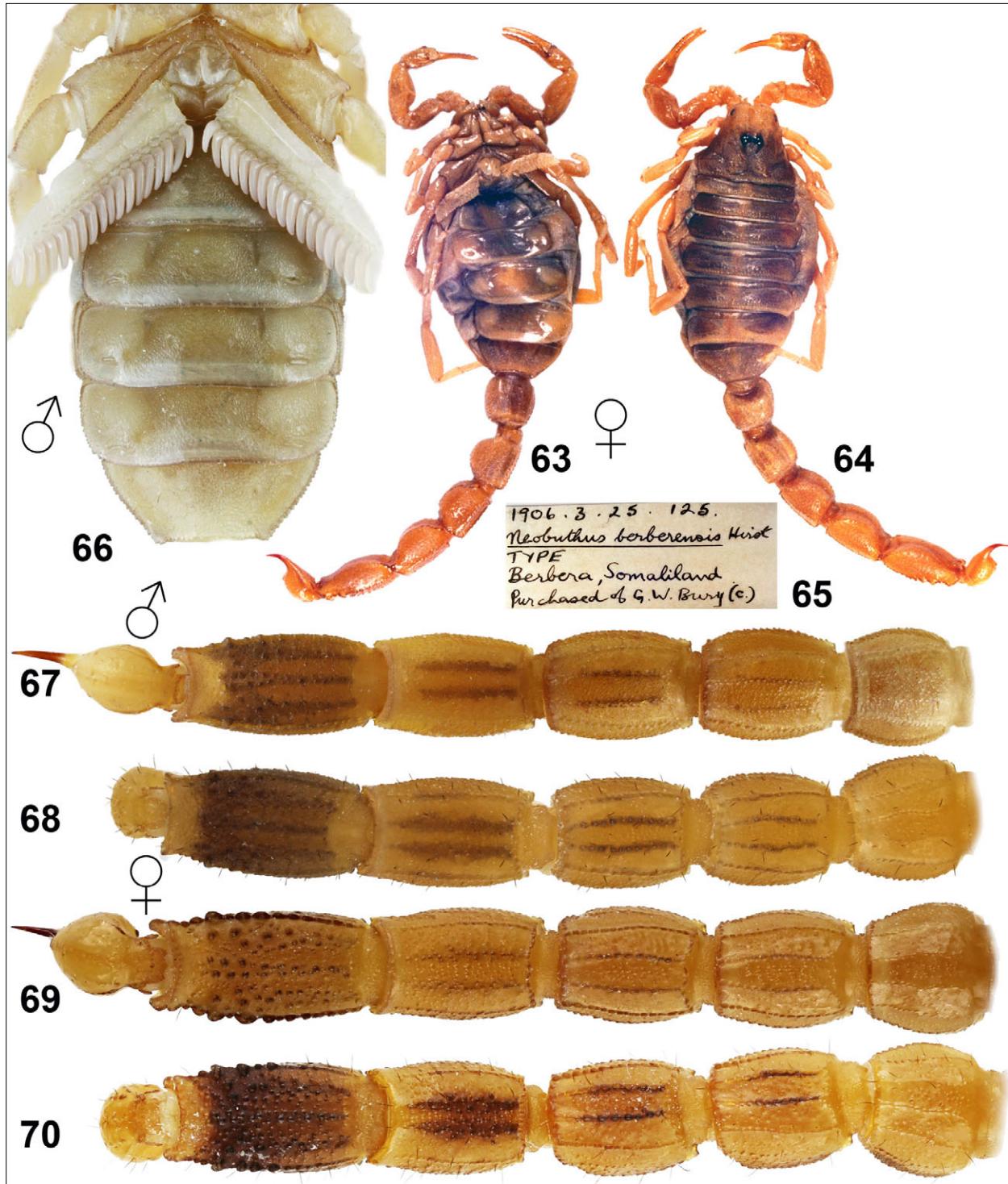
TYPE MATERIAL EXAMINED. **Somaliland**, Berbera, 1♀ (holotype, Figs. 63–65), purchased G. W. Bury; BMNH No. 1906.3.25.125.

OTHER MATERIAL EXAMINED. **Somaliland**, Berbera env., 10°22.8'N 45°02.2'E, 107 m a.s.l., sandy area, (figs. 9 and 13 in Kovařík & Lowe, 2012), 8.–10.VII.2011, 1♂1♂im.2♀1♀im.1juv. (topotypes, Figs. 57, 60, 66–70, 404, 416, 427), leg. F. Kovařík (UV detection), FKCP; near Berbera, 10°15'30.5"N 45°06'04.2"E, 376 m a.s.l., stony area (fig. 59 in Kovařík & Lowe, 2012: 12), 12.VII.2011, 1♂1♀1juv. (Figs. 58–59, 61–62, 405), leg. F. Kovařík (UV detection), FKCP.

EMENDED DIAGNOSIS. Total length 20–21 mm (males) and 27–32 mm (females); carapace densely granulated with only anterior median carinae developed, area between these carinae yellow to orange; tergites with fuscous variable pigmentation; pedipalps of female yellow without black spots; pedipalp relatively slender, males with femur L/W 2.30–2.50, patella L/W 2.40–2.55, chela L/W 4.53–4.70; chela movable finger with 5–6 subrows of primary denticles, 4–5 external accessory denticles flanking proximal end of each subrow; trichobothria  $d_2$  usually absent from pedipalp femur and patella; dorsoexternal and ventroexternal carinae on



**Figures 57–62:** *Neobuthus berberensis*. **Figure 57.** Male from Somaliland, Berbera env., 10°22.8'N 45°02.2'E, sandy area, dorsal view. **Figures 58–59.** Male from Somaliland, near Berbera, 10°15'30.5"N 45°06'04.2"E, 376 m a.s.l., stony area, dorsal (58) and ventral (59) views. **Figure 60.** Female from Somaliland, Berbera env., 10°22.8'N 45°02.2'E, sandy area, dorsal view. **Figures 61–62.** Female from Somaliland, near Berbera, 10°15'30.5"N 45°06'04.2"E, 376 m a.s.l., stony area, dorsal (61) and ventral (62) views.



**Figures 63–70:** *Neobuthus berberensis*. **Figures 63–65.** Female holotype, dorsal (63) and ventral (64) views and original label (65). **Figures 66–67.** Male from Somaliland, Berbera env., 10°22.8'N 45°02.2'E, sandy area, coxosternal area and sternites (66), and metasoma and telson ventral (67). **Figure 69.** Female from Somaliland, Berbera env., 10°22.8'N 45°02.2'E, sandy area, metasoma and telson ventral. **Figures 68 and 70.** Male (68) and female (70—) from Somaliland, Berbera env., 10°22.8'N 45°02.2'E, sandy area, metasoma and telson ventral.

pedipalp patella in female well developed; pedipalps including trochanter without dark setae (population from sandy area) or with several setae, posterior margins of tergites without (population from sandy area) or with 1–2 pairs of macrosetae (population from stony plain); metasomal macrosetae very short in male, stout and spiniform, and long and fine in females (population from stony plain); sternites III–VI without carinae, with dense, fine granulation in males, females with sternites III–VI smooth; sternite VII more strongly granulated without carinae in males, with four weak granulated carinae in females; metasoma I–III with median lateral and dorsal carinae present or at least weakly indicated in both sexes; metasoma I–III dorsally granulated in both sexes; soles of telotarsi with sparse setation, leg III of adults with 9–14 ventral macrosetae on telotarsus; pectine teeth: 17–20 (males), 13–16 (females).

***Neobuthus cloudsleythompsoni* Lourenço, 2001**  
(Figs. 406, 438, Table 5)

*Neobuthus cloudsleythompsoni* Lourenço, 2001: 179–182, figs. 15–21; Kovařík, 2003: 137–138; Fet et al., 2005: 12; Lourenço, 2005: 28; Kovařík & Lowe, 2012: 16; Lowe & Kovařík, 2016: 4–14, figs. 7–42, 94, 96, 148–150, 157, 161.

TYPE LOCALITY AND TYPE REPOSITORY. **Ethiopia**, lower valley of the Omo River, MNHN.

MATERIAL EXAMINED. **Ethiopia**, Southern Nationalities and Peoples Region Federal State (SNNPR), "lower valley of the Omo river", Chew Bahr, 04°50'38.5"N 36°44'11.4"E, 625 m a.s.l. (Locality No. **13EW**), 5.–6.VII.2013, 43♂6♀8♂im., leg. F. Kovařík, V. Socha, V. Trailin (UV detection), FKCP, GLPC.

DIAGNOSIS. Total length 18.5–19 mm (males), 23–25 mm (females); carapace with area between anterior median carinae yellow; tergites with 3 dark stripes, median stripe flanked on either side by broad, continuous longitudinal yellow bands; pedipalp relatively stout, males with femur L/W 2.05–2.38; patella L/W 2.31–2.57, chela L/W 4.40–5.50; chela movable finger with 4–6 subrows of primary denticles, 3–4 external accessory denticles flanking proximal end of each subrow; trichobothrium  $d_2$  of pedipalp femur usually absent,  $d_2$  of pedipalp patella present; dorsoexternal and ventroexternal carinae on pedipalp patella in female absent; posterior margins of tergites bare or with a pair of macrosetae; pedipalps, legs, metasoma and telson with very short, stout macrosetae in males, long, fine setae in females; males with coxae and sternites III–VI densely, finely granular, sternite VII densely, finely granular with 4 granulated carinae; females with sternites III–VI smooth, sternite VII sparsely shagreened

with 4 weak carinae, median carinae smooth or weakly granulated; metasoma I–III with median lateral carinae present in both sexes; lateral surface of metasoma V in males densely granulated, with granules close but separated; soles of telotarsi with sparse setation, leg III of adults with 13–20 ventral macrosetae on telotarsus; pectine teeth: 15–19 (males), 12–15 (females).

***Neobuthus erigavoensis* sp. n.**

(Figs. 71–123, 129–132, 407, 422, 426, 438, Tables 2 and 5)

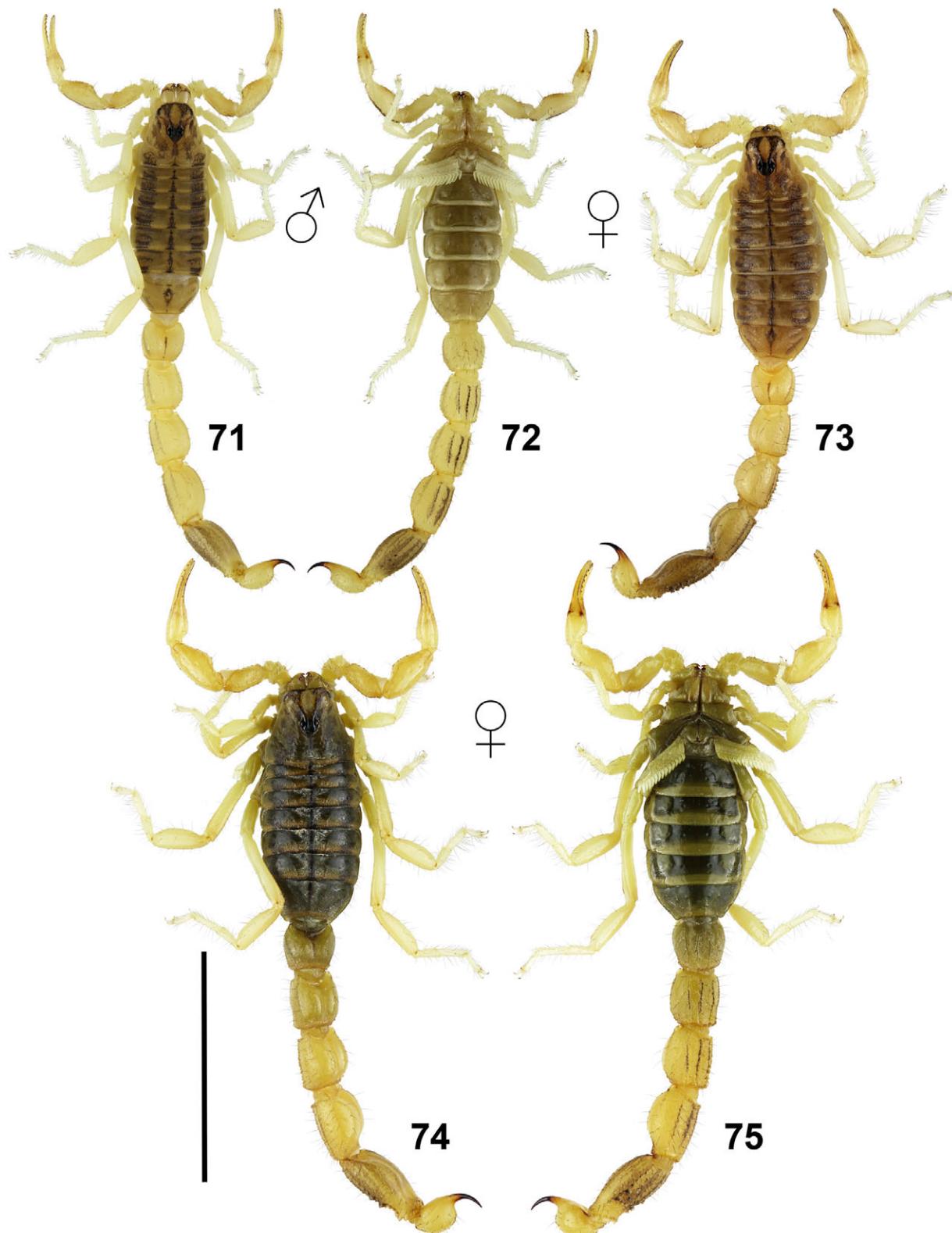
<http://zoobank.org/urn:lsid:zoobank.org:act:137A44D0-45F5-4B62-AEB2-0D29529640FF>

TYPE LOCALITY AND TYPE DEPOSITORY. **Somaliland**, Sanaag Region, Buq village near Erigavo, 10°37'25"N 47°10'53"E, 1723 m a.s.l.; FKCP.

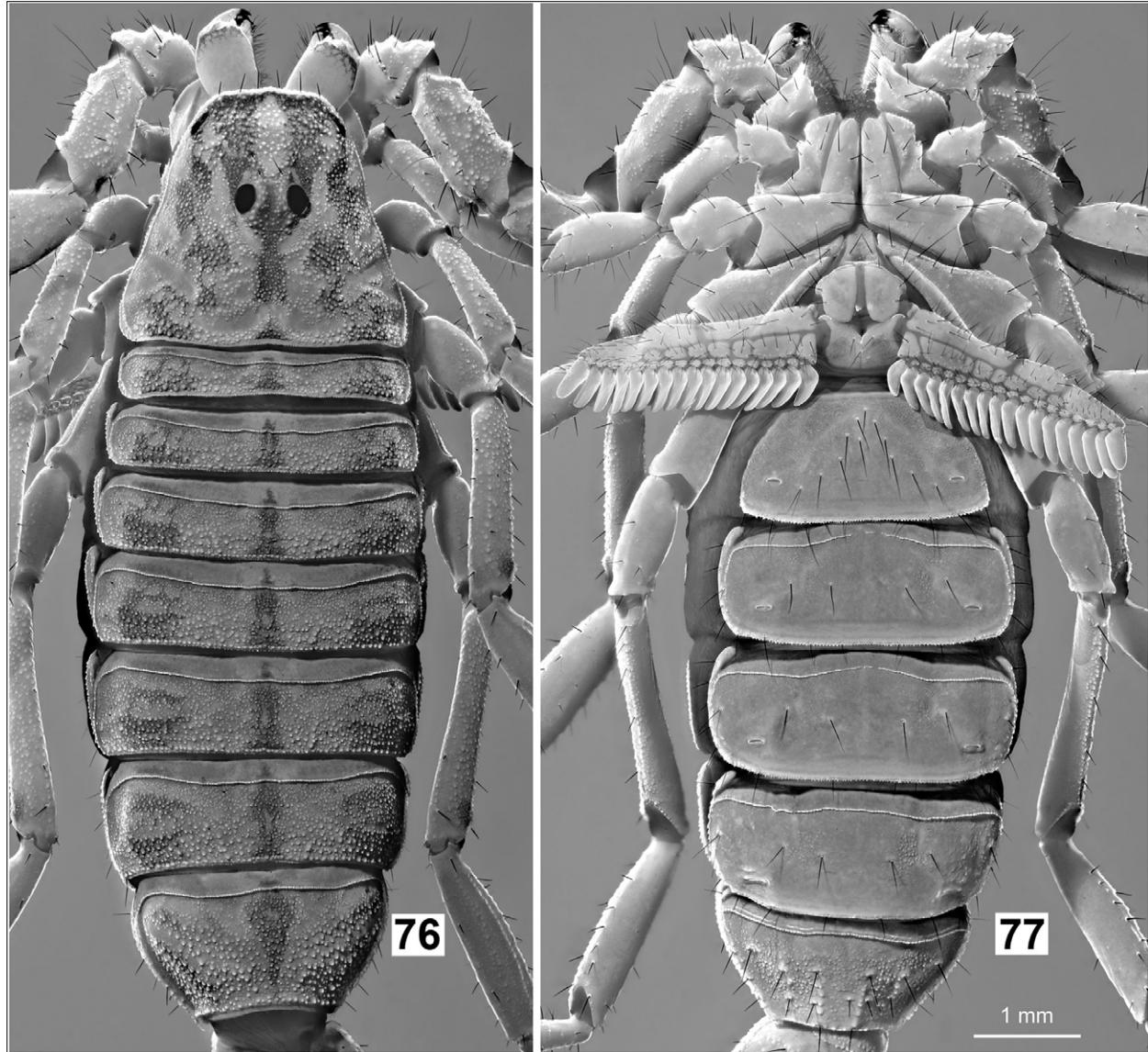
TYPE MATERIAL. **Somaliland**, Sanaag Region, Buq village near Erigavo, 10°37'25"N 47°10'53"E, 1723 m a.s.l. (Locality No. **18SH**, Figs. 131–132), 11♂10♀2♀ juvs. (holotype and paratypes), FKCP, 1♂1♀ (paratypes), GLPC (Nos. 1535, 1536, 1537, 1538), 27.VIII.2018, leg. F. Kovařík (UV detection); Sanaag Region, 5.5 km S-SW of Erigavo, 10°34'13"N 47°19'55"E, 1776 m a.s.l., 1♀ (paratype, Table 2), 25.I.2015, leg. T. Mazuch, FKCP.

ETYMOLOGY. Named after the occurrence around Eri-gavo city.

DIAGNOSIS. Total length 20–25 mm (males), 21–25.5 mm (females); carapace with area between anterior median carinae yellow; tergites with fuscous variable pigmentation; pedipalps of female yellow without black spots developed; pedipalp relatively slender, males with femur L/W 2.45–2.61, patella L/W 2.27–2.35, chela L/W 4.22–4.36; chela movable finger with 5–6 subrows of primary denticles, 4–5 external accessory denticles flanking proximal end of each subrow; trichobothria  $d_2$  usually present on femur and absent from patella; dorsoexternal and ventroexternal carinae on pedipalp patella in female absent; posterior margins of tergites without (male) or with 1–2 pairs of macrosetae (female); pedipalps, legs, metasoma and telson with moderately short, stout macrosetae in males, and long, fine setae in females; sternites III–VI shagreened to smooth medially in males, females with sternites III–VI smooth; sternite VII finely granulated with 4 weak, granulated carinae in both sexes; metasoma I–III with median lateral carinae present or at least indicated in both sexes; dorsal metasomal II–V carinae absent; lateral surface of metasoma V in males granulated, with granules separated; soles of telotarsi with relatively sparse setation, leg III of adults with 13–17 ventral macrosetae on telotarsus; pectine teeth: 15–18 (males), 12–16 (females).



**Figures 71–75:** *Neobuthus erigavoensis* sp. n. from type locality. **Figures 71–72.** Male holotype, dorsal (71) and ventral (72) views. **Figures 73–75.** Two differently colored paratype females, dorsal (73–74) and ventral (75) views. Scale bar: 10 mm.



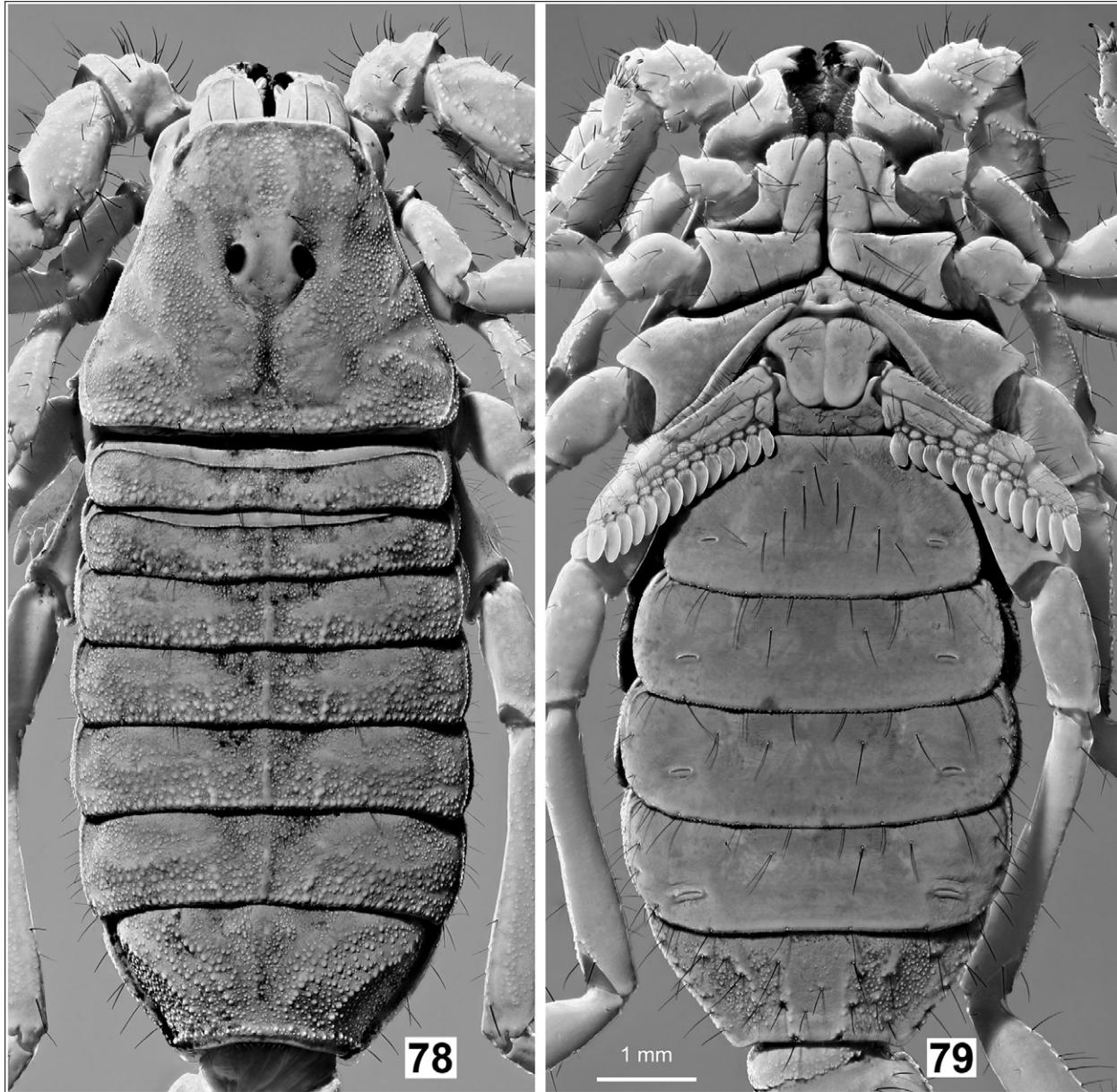
**Figures 76–77:** *Neobuthus erigavoensis* sp. n., male paratype from type locality, carapace and tergites (76), coxosternal area and sternites (77). UV fluorescence. Scale bar: 1 mm.

**DESCRIPTION.** Total length of adult males 20–25 mm, of adult females 21–25.5 mm; measurements of carapace, telson, segments of metasoma and pedipalps given in Table 2; positions and distribution of trichobothria on pedipalps shown in Figs. 97–100 and 103–104; trichobothrium  $d_2$  usually present on pedipalp femur, absent from patella; base color pale yellow with fuscous pigmentation reduced (Fig. 73 and 74), pedipalps and legs uniformly yellow with sole dark spot on external pedipalp patella; more extensive patterns of dark maculation present mainly on ventral metasoma; chelicerae yellow with dark reticulation on anterior manus, dentition reddish. **Sexual dimorphism:** strong, adult males clearly smaller, but without differences in shapes

of pedipalps, metasoma and telson; pedipalp patella and femur granulate and matte in males, smooth and glossy in females; sternites smooth in females, partly granulated in males; macrosetae on pedipalps, legs, metasoma and telson much longer and finer in females than males; other sex differences cited below.

**Pedipalp** (Figs. 96–115). Pedipalp mostly sparsely hirsute; finely granulated in males and smooth in females; femur with three conspicuously granulose carinae, more strongly developed in males; patella and chela with carinae obsolete or only weakly indicated, smooth.

**Carapace** (Figs. 76, 78, 80, 82). Strongly trapezoidal (narrower anteriorly), wider than long (L/W 0.82–0.93); posterior median postocular area flat, anterior median



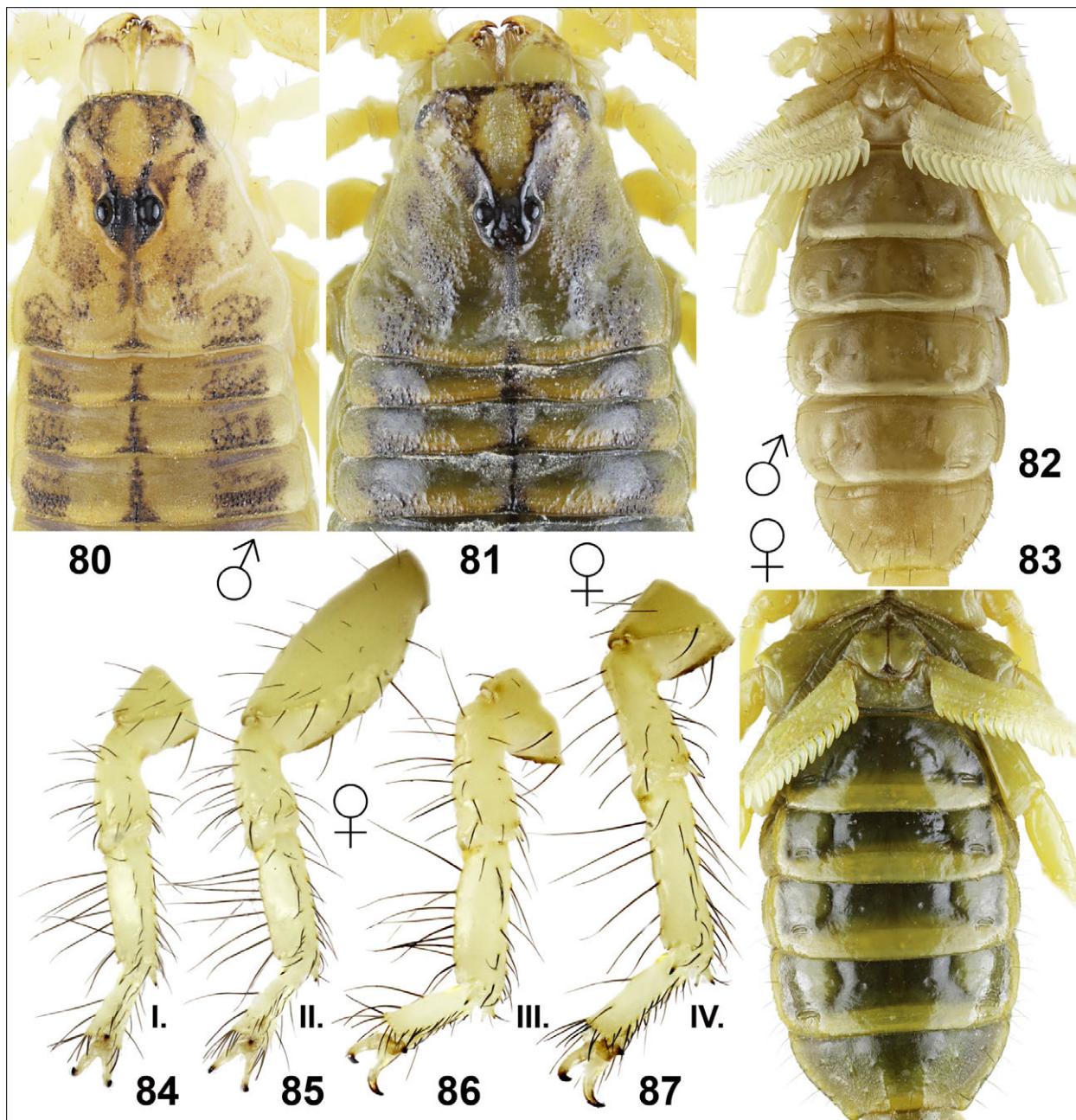
**Figures 78–79:** *Neobuthus erigavoensis* sp. n., female paratype from type locality, carapace and tergites (78), coxosternal area and sternites (79). UV fluorescence. Scale bar: 1 mm.

preocular area gently sloped downwards towards anterior margin; lateral flanks steeply sloped; ocular tubercle broad, prominent, located slightly anterior to middle of carapace; anterior margin straight, finely microdenticulate, with coarser granules overlapping edge, bearing 8 macrosetae; anterior median carinae weak, coarsely granular in males and smooth in females, other carinae indistinct; dense granulation covering most of carapace, more so in males.

**Chelicera** (Figs. 116–118). Fingers with typical buthid dentition (Vachon, 1963, Lowe & Kovařík, 2016); fixed finger with large distal denticle, 1 subdistal denticle and

2 basal denticles fused into bicusp, single denticle on ventral surface at level of bicusp; dorsal margin of movable finger with 5 denticles: 1 large distal denticle, medium-sized subdistal and medial, and 2 small, partially fused basal denticles; ventral margin with 2 denticles.

**Mesosoma** (Figs. 71–83). Tergites I–VI bear three carinae of which the lateral pair may be less conspicuous mainly on tergites I–IV; tergite VII bears five well-defined carinae (median, submedians and laterals); tergites I–VI granular in males, with coarser granules on posterior lateral areas; tergite VII densely granular; ster-



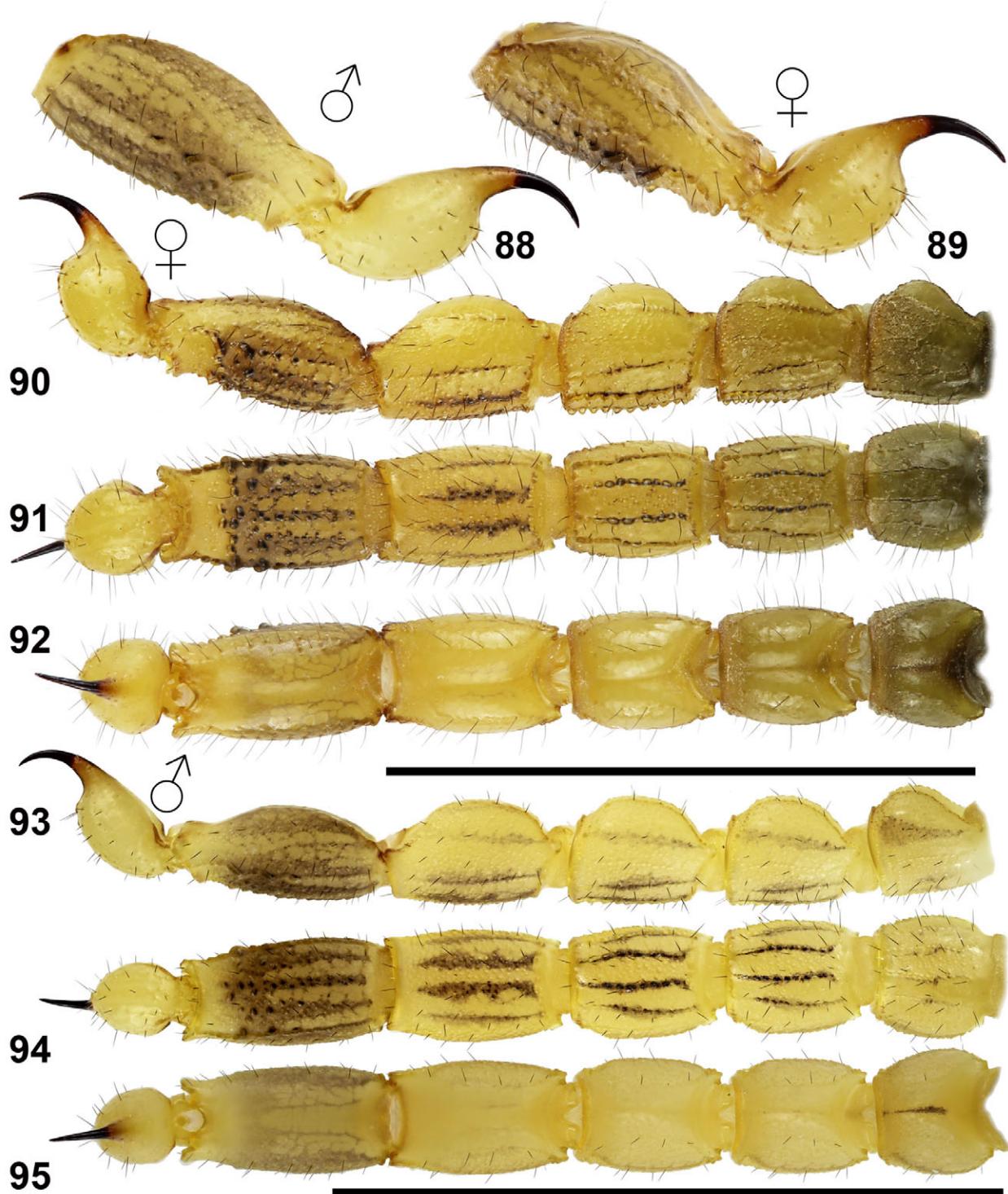
**Figures 80–87:** *Neobuthus erigavoensis* sp. n. from type locality. **Figures 80 and 82.** Male holotype, carapace and tergites I–III (80) and coxosternal area and sternites (82). **Figures 81, 83–87.** Female paratype, carapace and tergites I–III (81), coxosternal area and sternites (83), right legs I–IV, retro-lateral aspect (84–87).

nites III–VI smooth in females, smooth medially and granulate laterally in males; sternite VII finely granulated with four weak, granulated carinae in both sexes; sternum type 1, triangular in shape, smooth, with deep posteromedian invagination; genital opercula smooth; genital papillae present; pectines extending to around a three quarter of sternite IV in both sexes; pectine teeth 15–18 in males, 12–16 in females; combs with 3 marginal lamellae and 6–8 middle lamellae; marginal lamel-

lae, middle lamellae and fulera with dense cover of short dark reddish macrosetae; fulera with 2–4 setae.

**Hemispermatophore** (Figs. 119–123). Typical of the genus.

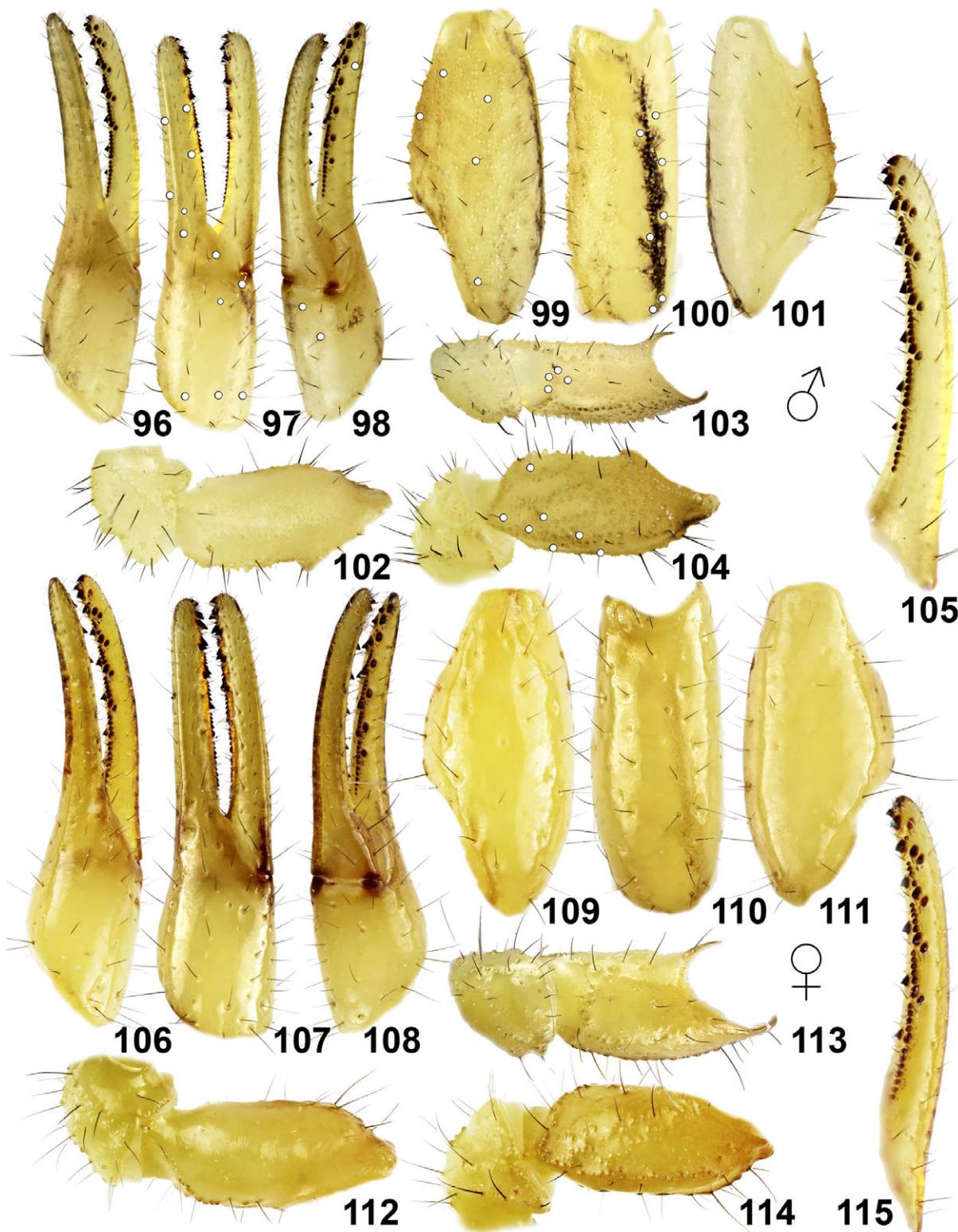
**Legs** (Figs. 84–87). Coxa, femora, patella and tibia of all legs bearing variable numbers of short to medium length, straight, dark-reddish macrosetae; tarsi with mix of short and longer, dark-reddish macrosetae; basitarsi I–III slightly compressed with flat retro-lateral surfaces,



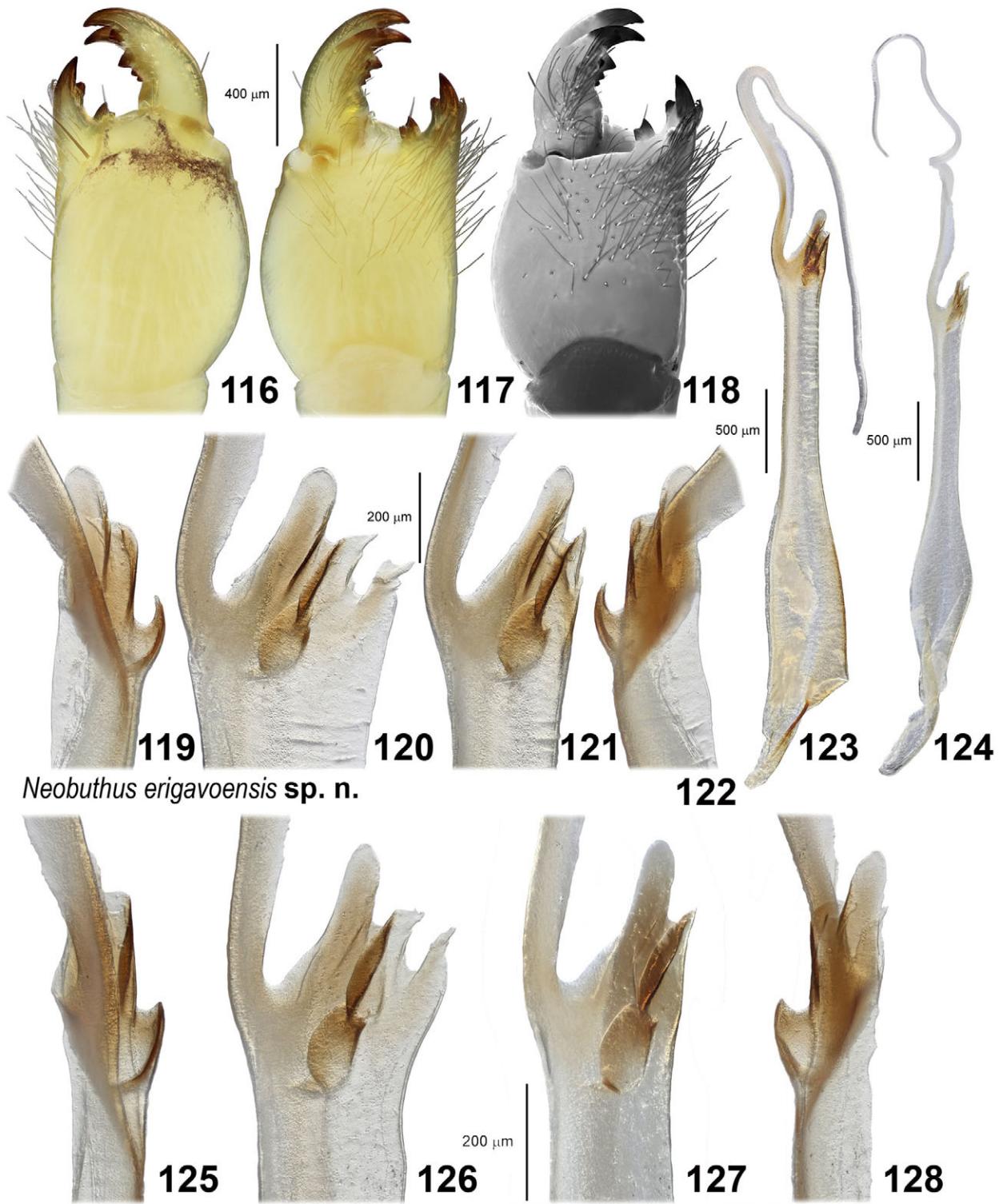
**Figures 88–95:** *Neobuthus erigavoensis* sp. n. from type locality. **Figures 88, 93–95.** Male holotype, metasoma V and telson lateral view (88), metasoma and telson lateral (93), ventral (94), and dorsal (95) views. **Figures 89–92.** Female paratype, metasoma V and telson lateral view (89), metasoma and telson lateral (90), ventral (91), and dorsal (92) views. Scale bars: 10 mm (90–92 and 93–95).

with bristle combs consisting of retrosuperior series of longer macrosetae, plus retroinferior and proinferior series of shorter macrosetae; telotarsi with two rows of

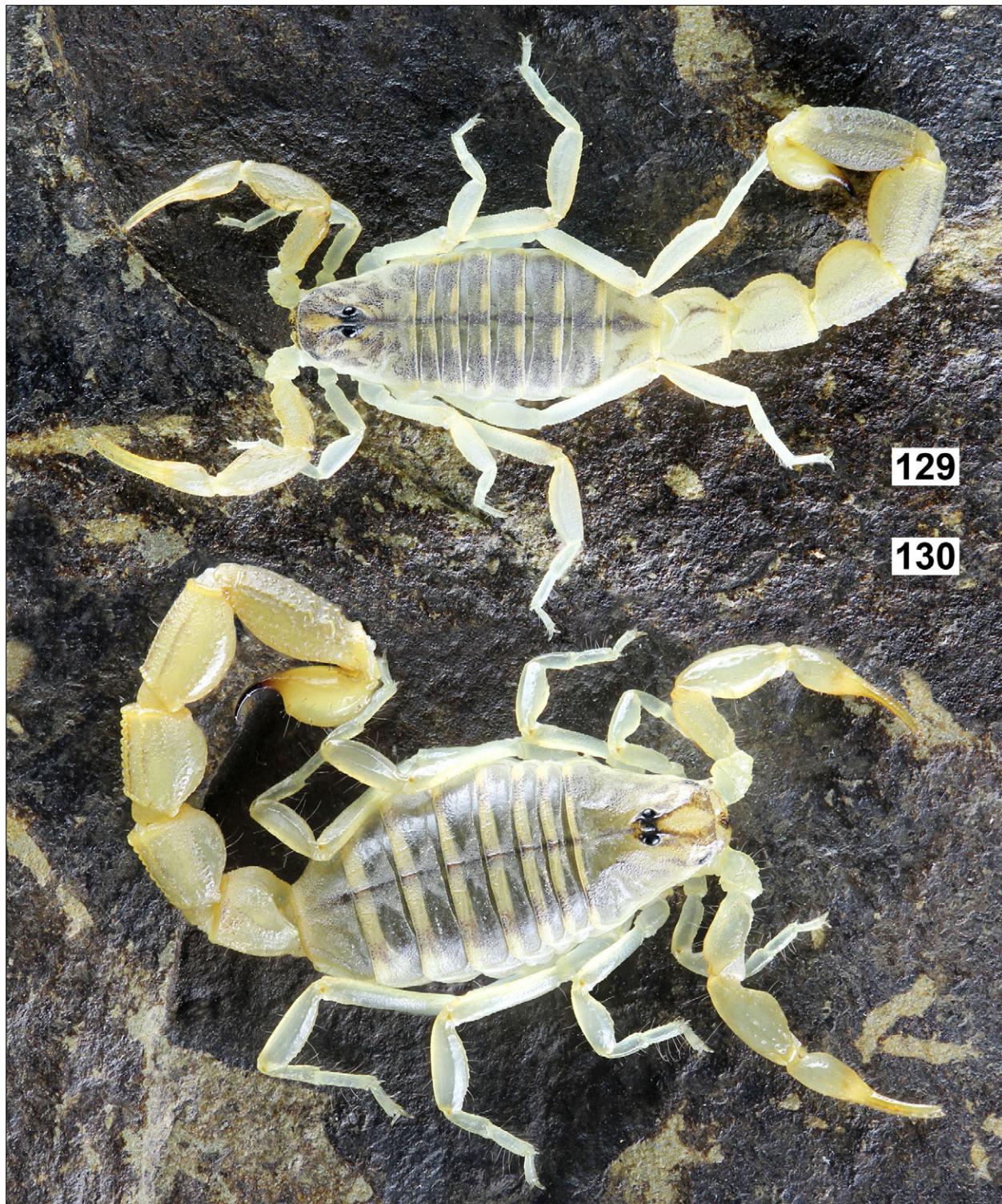
short setae on ventral aspect, 13–17 macrosetae on telotarsus III; moderate tibial spurs present on legs III and IV.



**Figures 96–115:** *Neobuthus erigavoensis* sp. n. from type locality. **Figures 96–105.** Male holotype, pedipalp chela, dorsal (96), external (97), and ventral (98) views, pedipalp patella, dorsal (99), external (100) and ventral (101) views, pedipalp femur and trochanter ventral (102), internal (103) and dorsal (104) views, pedipalp movable finger dentate margin (105). **Figures 106–115.** Female paratype, pedipalp chela, dorsal (106), external (107), and ventral (108) views, pedipalp patella, dorsal (109), external (110) and ventral (111) views, pedipalp femur and trochanter ventral (112), internal (113) and dorsal (114) views, pedipalp movable finger dentate margin (115). The trichobothrial pattern is indicated in Figures 97–100 and 103–104 (white circles).



**Figures 116–128:** Figures 116–123: *Neobuthus erigavoensis* sp. n. from type locality. **Figures 116–118.** Female paratype, right chelicera, dorsal (116) and ventral (117) views, and ventral view under UV fluorescence (118). Scale bar: 400 µm. Figures 119–123. Male paratype (No. 1536), left hemispermophore (mirror image), capsule region in posterior (119), convex compressed (120), convex (121) and anterior (122) views, hemispermophore, convex view (123). Scale bars: 200 µm, 500 µm. **Figures 124–128:** *Neobuthus factorio* sp. n. Male holotype (No. 1323) left hemispermophore, convex view (124) (mirror image). Male paratype (No. 1546) from type locality, right hemispermophore capsule region in posterior (125), convex compressed (126), convex (127) and anterior (128) views. Scale bars: 500 µm (124), 200 µm (125–128).



Figures 129–130: *Neobuthus erigavoensis* sp. n., paratypes from type locality, in vivo habitus. Male (129) and female (130).

**Metasoma and telson** (Figs. 88–95). Metasoma and telson sparsely hirsute, macrosetae moderately short in male and longer in female, straight and reddish; metasomal segments I–III with 6–10 carinae, IV with 4

carinae, V with 2 carinae; segments I–III with dorso-lateral carinae at least indicated and dorsal carinae present in males but absent in females, other carinae relatively well developed; segment IV with only ventral



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**Figures 131–132:** *Neobuthus erigavoensis* sp. n., type locality, Somaliland, Sanaag Region, Buq village near Erigavo, 10°37'25"N 47°10'53"E, 1723 m a.s.l.

carinae developed; segment V with strong, granulate to dentate-lobate ventrolateral carinae;. segments I–IV with dense granulation on intercarinal surfaces except dorsal surfaces which are smooth; segment V granular on lateral and ventral surfaces, more coarsely so on ventral

surface, granules not arranged along any traces of carinae; telson smooth, ventral surface sparsely, weakly granular; vesicle slightly elongated; aculeus stout, shorter than vesicle, tip of aculeus almost vertically directed.

AFFINITIES. The described features distinguish *N. erigavoensis* sp. n. from all other species of the genus. According to the distribution (see Fig. 438) the type locality of *N. erigavoensis* sp. n. is near to the type locality of *N. montanus* sp. n.. These two species have missing dorsal metasomal carinae in females, a unique character which differentiates them both from other *Neobuthus* species from Somaliland. The characters which unequivocally separate these two species are presented in the key below.

COMMENTS ON LOCALITY AND LIFE STRATEGY. The type locality **18SH** (Figs. 131–132) is in rocky semi-desert terrain. The first author visited the locality in the dry season and collected all specimens directly around the school (Fig. 132) at night with a UV light. The school is situated on the margin of Buq village. At this locality, the first author recorded a maximum daytime temperature of 27 °C, and a minimum nighttime temperature of 17 °C. The recorded humidity was between 37% (minimum at day) and 69% (maximum at night).

***Neobuthus eritreaensis* Lowe & Kovařík, 2016**  
(Figs. 408, 438, Table 5)

*Neobuthus eritreaensis* Lowe & Kovařík, 2016: 14–26, figs. 43–95, 97, 151–153, 159, 161, tables 2, 4–5.

TYPE LOCALITY AND TYPE REPOSITORY. **Eritrea**, near Massawa, 15°36'58.7"N 39°22'32.8"E, 74 m a.s.l.; FKCP.

TYPE MATERIAL. **Eritrea**, near Massawa, 15°36'58.7"N 39°22'32.8"E, 74 m a.s.l. (Locality No. **15EI**, fig. 97 in Lowe & Kovařík, 2016: 25), 1♂ (holotype) 4♀1♀im. (paratypes), FKCP, 1♂1♀ (paratypes), GLPC, 4.XI. 2015, leg. F. Kovařík (UV detection); near Massawa, 15°36'55" 39°24'22"E, 30 m a.s.l., (Locality No. **15EK**), 2♂1♀im. (paratypes), FKCP, 8.XI.2015, leg. F. Kovařík (UV detection).

EMENDED DIAGNOSIS. Total length 17–18 mm (males), 26–32 mm (females); carapace with area between anterior median carinae partially fuscous; tergites with 3 dark stripes, median stripe flanked on either side by broad longitudinal yellow bands that may be broken by fuscosity extending across anterior tergites; trichobothrium  $d_2$  of pedipalp femur usually absent,  $d_2$  of pedipalp patella present. pedipalp relatively slender, males with femur L/W 2.44–2.53, patella L/W 2.47–2.55, chela L/W 4.79–5.06; chela movable finger with 6 subrows of primary denticles, 3–4 external accessory denticles flanking proximal end of each subrow; dorsoexternal and ventroexternal carinae on pedipalp patella in female absent; posterior margins of tergites without or with 1–2 macrosetae; pedipalps, legs, metasoma and telson with

very short, stout macrosetae in males, long, fine setae in females; males with coxae and sternites III–VI densely, finely granular, sternite VII densely, finely granular without carinae or 2 vestigial median carinae; females with sternites III–VI smooth, sternite VII finely granular with 4 granulated carinae; metasoma I–III with median lateral carinae present in female, absent in male; lateral surfaces of metasoma I–IV densely granulated in both sexes; lateral surface of metasoma V in males densely granulated, with granules separated; tarsi with relatively sparse setation, leg III of adults with 13–20 ventral macrosetae on telotarsus; pectine teeth: 19–21 (males), 15–18 (females).

***Neobuthus factorio* sp. n.**

(Figs. 124–128, 133–181, 409, 438, Tables 1 and 5)  
<http://zoobank.org/urn:lsid:zoobank.org:act:F9A4F3BD-87D9-44CA-852F-9EAE0081F271>

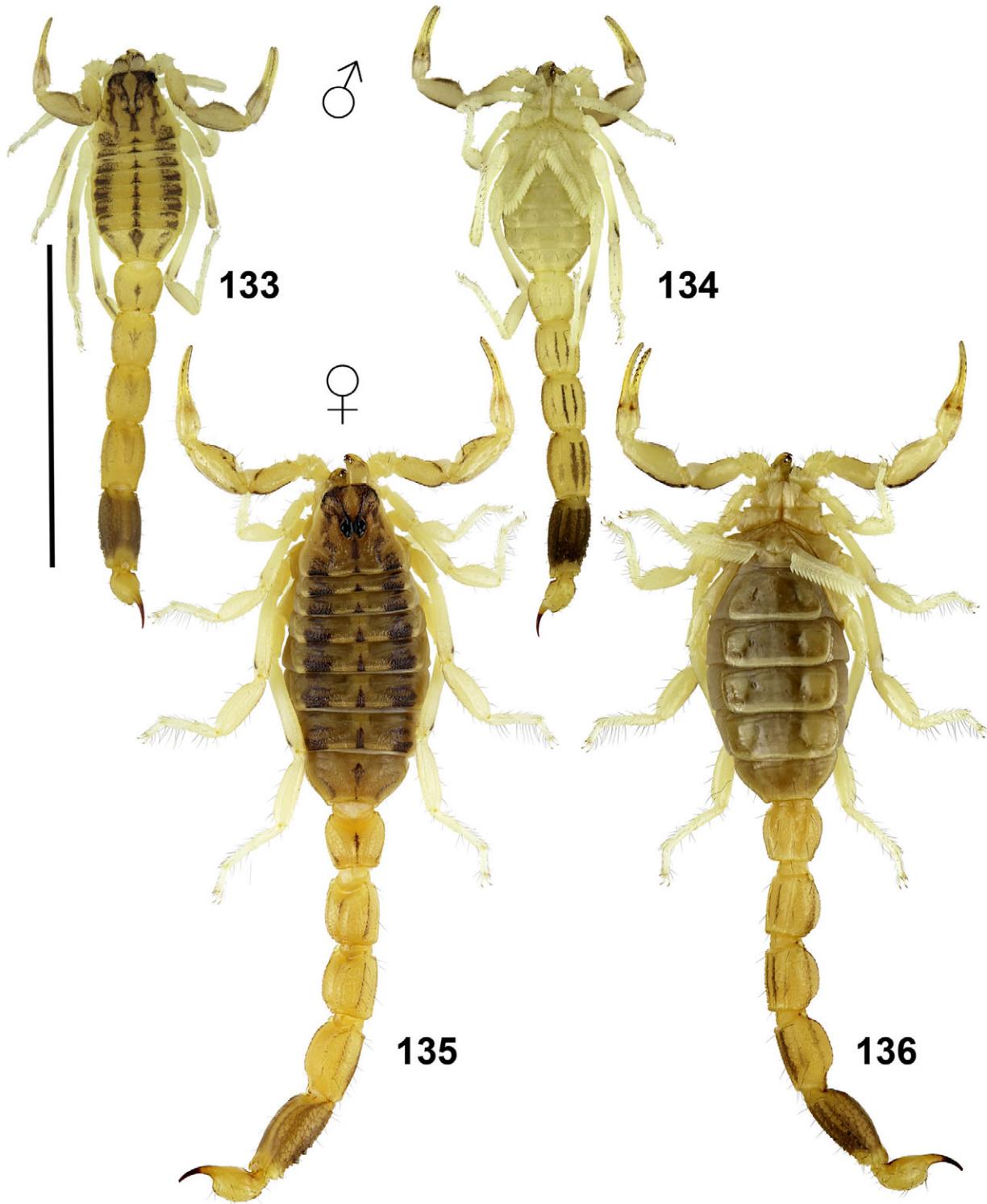
*Neobuthus ferrugineus*: Kovařík & Lowe, 2012: 3–7, figs. 29, 32, 41–42, 50–51, 62–66, 72 (in part).

TYPE LOCALITY AND TYPE REPOSITORY. **Somaliland**, Laas Gel, 50 km NE Hargeisa, 09°46'47"N 44°26'43"E, 1043 m a.s.l.; FKCP.

TYPE MATERIAL. **Somaliland**, Laas Gel, 50 km NE Hargeisa, 09°46'47"N 44°26'43"E, 1043 m a.s.l. (Locality No. **17SF**=**17SD**), 1♂ (holotype, No. 1323) 2♀1juv.♂ (paratypes), FKCP, 1♀ (paratypes) GLPC, 28.–30.VIII.2017, leg. F. Kovařík (UV detection); 15 km near Sheik, Goolis mts., 09°58.9"N 45°10.3"E, 1247 m a.s.l. (figs. 63–64 in Kovařík & Lowe, 2012: 13), 10.VII.2011, 1♂ (14O96-97 figs. 32, 42, 50–51, 62–64, 72 in Kovařík & Lowe, 2012: 3–7), leg. F. Kovařík, FKCP; near Sheik, 09°46.1"N 45°17.5"E, 1329 m a.s.l. (fig. 66 in Kovařík & Lowe, 2012: 14), 10.–11.VII.2011, 1♀ (14O98- 99 figs. 29, 41, 65–66, 72 in Kovařík & Lowe, 2012: 3–7), leg. F. Kovařík, FKCP; 15 km N of Sheik, Goolis Mts., 09°32'27.7"N 45°31'38.9"E, 1056 m a.s.l (Locality No. **17SB**), 2♀im. (No. 1203), 6.II. 2017, leg. F. Kovařík et D. Král, FKCP; Sheik, Goolis Mts., 09°56'38"N 45°10'59"E, 1418 m a.s.l (Locality No. **18SK** = **17SO**), 2♂ (Nos. 1545, 1546), 31.VIII. 2018, leg. F. Kovařík (UV detection), FKCP.

ETYMOLOGY. Named after a game made by the son of the first author.

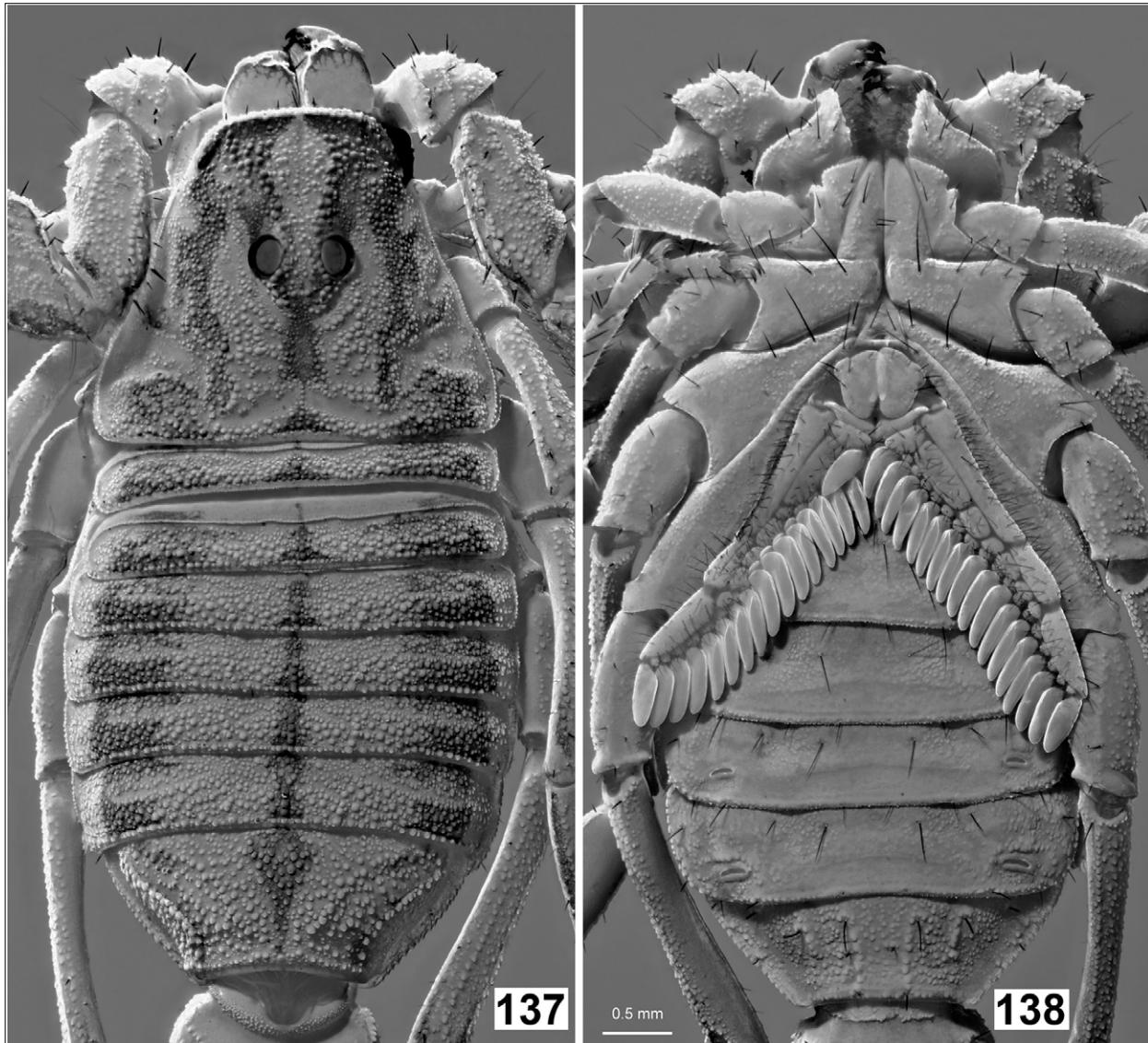
DIAGNOSIS. Total length 17–19 mm (males), 24–27 mm (females); carapace with area between anterior median carinae yellow to orange; tergites with 3 dark stripes, median stripe flanked on either side by broad longitudinal yellow bands that may be broken by fuscosity extending across anterior tergites; pedipalp relatively slender, males with femur L/W 2.42–2.70, patella L/W



**Figures 133–136:** *Neobuthus factorio* sp. n. from type locality. **Figures 133–134.** Male holotype, dorsal (133) and ventral (134) views. **Figures 135–136.** Female paratype, dorsal (135) and ventral (136) views. Scale bar: 10 mm.

2.18–2.28, chela L/W 4.25–4.48; chela movable finger with 5 subrows of primary denticles, 4 external accessory denticles flanking proximal end of each subrow; trichobothria  $d_2$  usually absent from femur and patella;

dorsoexternal carina on pedipalp patella in female weakly indicated, ventroexternal carina absent; smooth dorsal carinae on pedipalp chela present; posterior margins of tergites without or with 1–2 pairs of macrosetae;

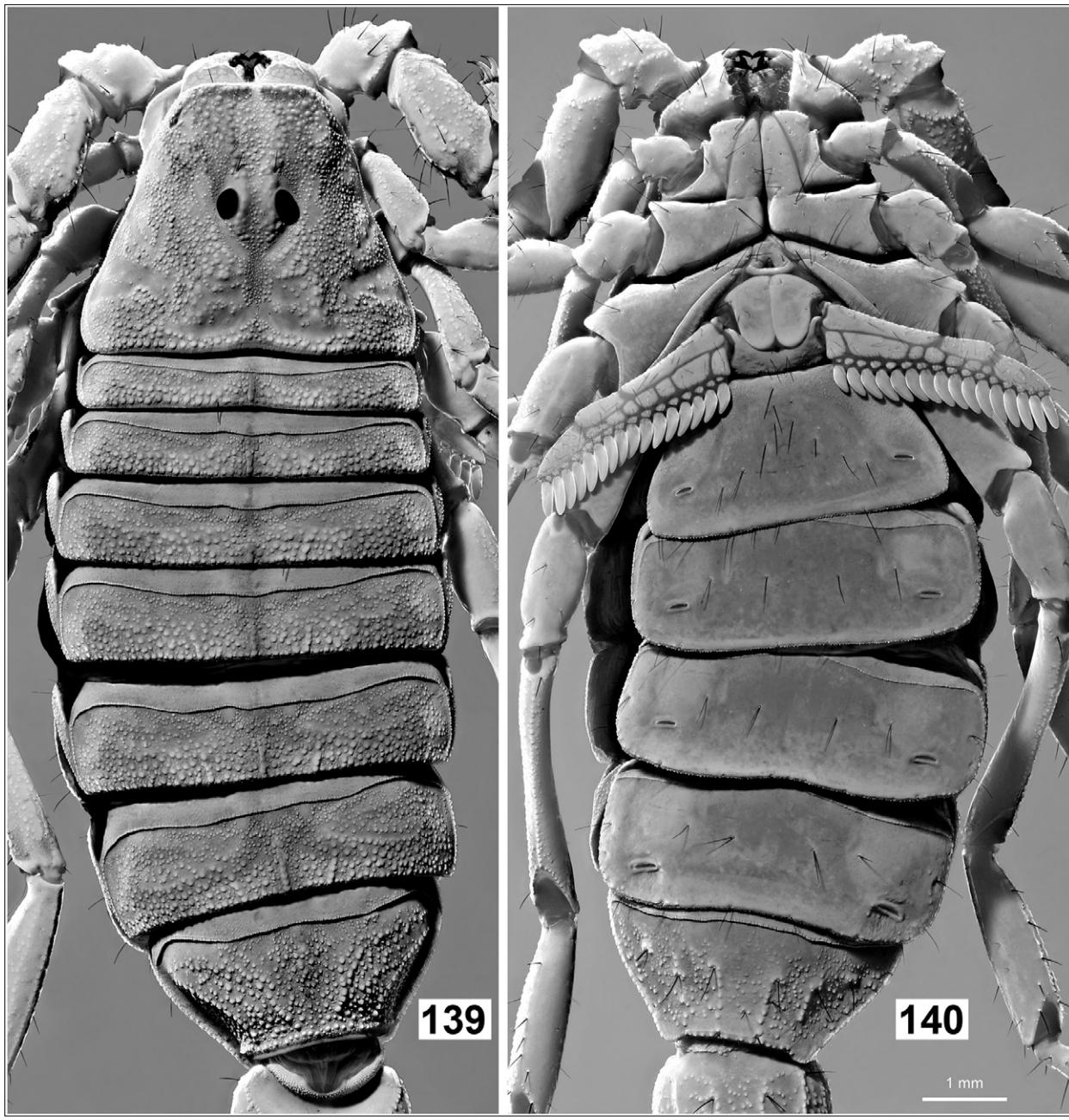


**Figures 137–138:** *Neobuthus factorio* sp. n., male paratype from type locality, carapace and tergites (137), coxosternal area and sternites (138). UV fluorescence. Scale bar: 1 mm.

pedipalps, legs, metasoma and telson with moderately short, not spiniform macrosetae in males, and long, fine setae in females; males with sternites III–VI shagreened to smooth medially, sternite VII shagreened with 4, granulated carinae; females with sternites III–VI smooth, sternite VII with 4 weak granulated carinae; metasoma I–III with median lateral and dorsal carinae present in both sexes; lateral surface of metasoma V granulated in both sexes, with granules separated; soles of telotarsi with relatively sparse setation, leg III of adults with 14–18 ventral macrosetae on telotarsus; pectine teeth: 16–19 (males), 14–18 (females).

**DESCRIPTION.** Total length of adult males 17–19 mm, of adult females 24–27 mm; measurements of carapace, telson, segments of metasoma and pedipalps given in

Table 1; positions and distribution of trichobothria of pedipalps shown in Figs. 156–159 and 162–163; trichobothrium  $d_2$  usually absent from femur and patella; base color pale yellow with variable fuscous pigmentation (Figs. 176–179) and patterns of dark maculation on metasoma, pedipalps and legs; chelicerae yellow with dark reticulation on anterior manus, dentition reddish. **Sexual dimorphism:** strong, adult males substantially smaller, but without differences in shapes of pedipalps, metasoma and telson; pedipalp patella and femur granulate and matte in males, smooth and glossy in females; sternites smooth in females and shagreened to smooth medially in males; macrosetae on pedipalps, legs, metasoma and telson much longer and finer in females than males; other sex differences cited below.

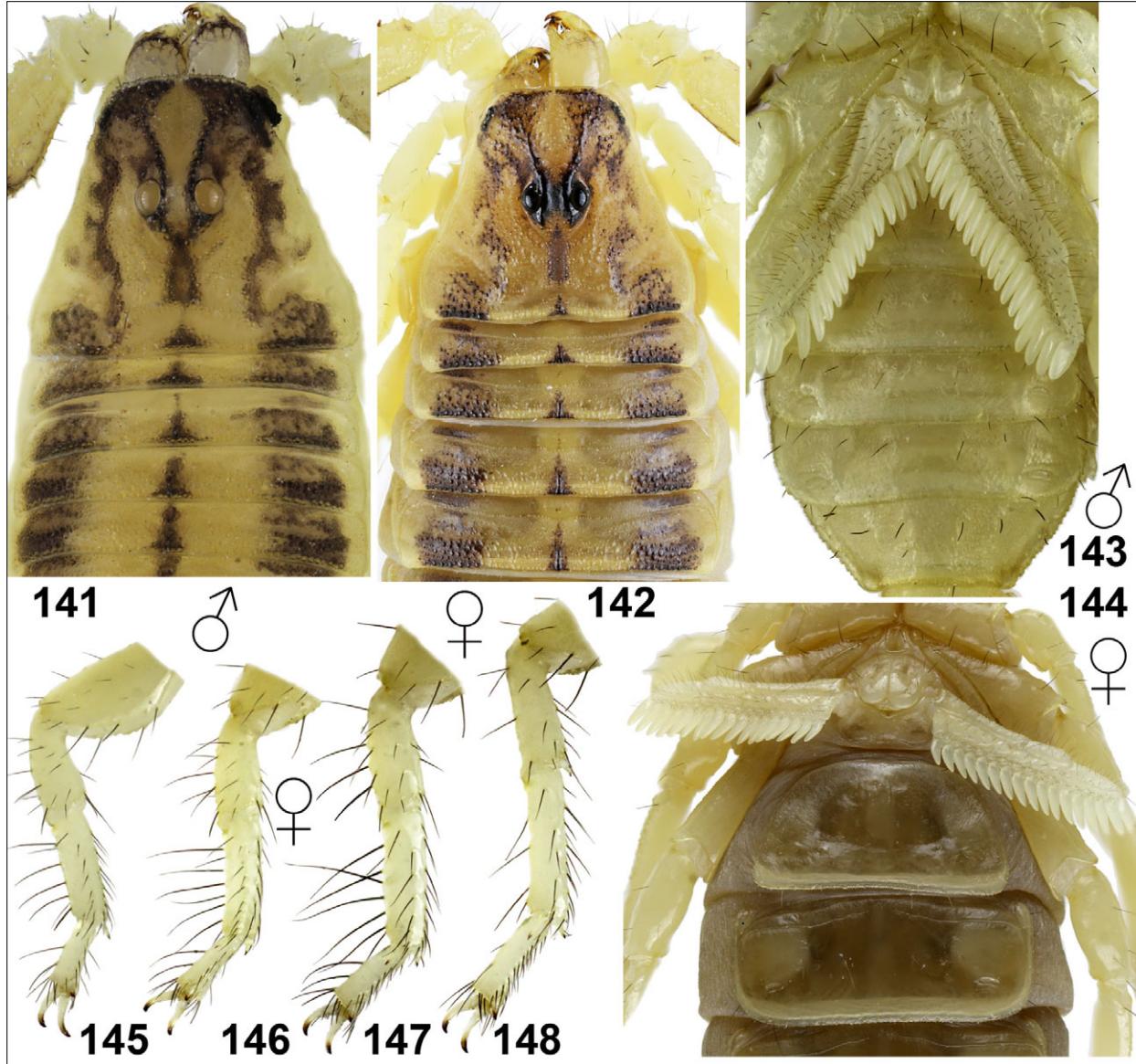


**Figures 139–140:** *Neobuthus factorio* sp. n., female paratype from type locality, carapace and tergites (139), coxosternal area and sternites (140). UV fluorescence. Scale bar: 1 mm.

**Pedipalp** (Figs. 155–175). Pedipalp mostly sparsely hirsute; finely granulated in males and smooth in females; femur with five conspicuously granulose carinae, more strongly developed in males; patella with seven granulose carinae, weakly developed in males and weakly indicated in females; chela with at least dorsal carinae present.

**Carapace** (Figs. 137, 139, 141–142). Strongly trapezoidal (narrower anteriorly), wider than long (L/ W

0.82–0.88); posterior median postocular area flat, anterior median preocular area gently sloped downwards towards anterior margin; lateral flanks steeply sloped; ocular tubercle broad, prominent, located slightly anterior to middle of carapace; anterior margin straight, finely microdenticulate, with coarser granules overlapping edge, bearing 8 macrosetae; anterior median carinae present, coarsely granular, other carinae indistinct; dense granulation covering most of carapace.

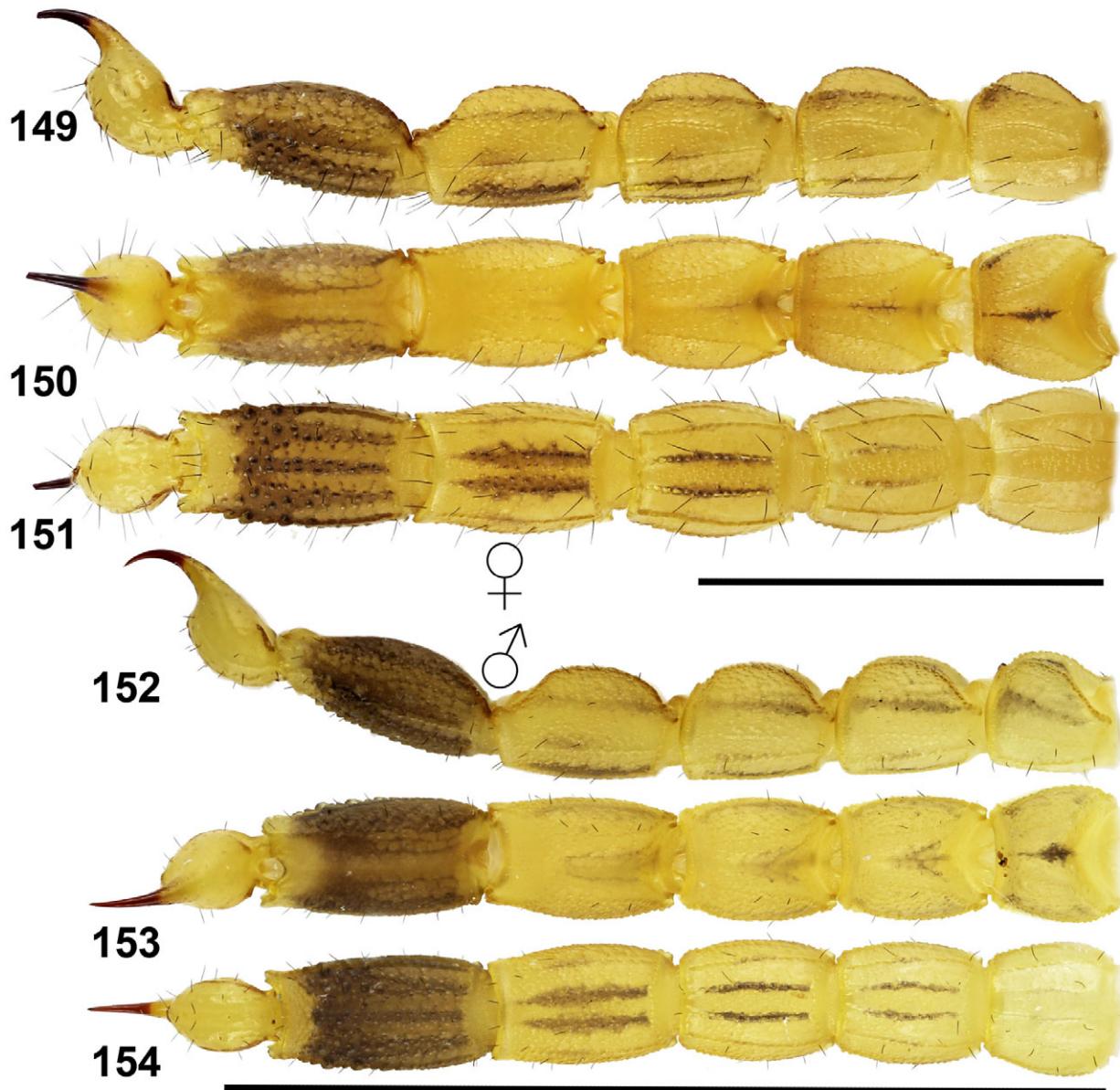


**Figures 141–148:** *Neobuthus factorio* sp. n. from type locality. **Figures 141 and 143.** Male holotype, carapace and tergites I–IV (141) and coxosternal area and sternites (143). **Figures 142, 144–148.** Female paratype, carapace and tergites I–IV (142), coxosternal area and sternites III–IV (144), right legs I–IV, retrolateral aspect (145–148).

**Chelicera** (Figs. 173–175). Fingers with typical buthid dentition (Vachon, 1963, Lowe & Kovařík, 2016); fixed finger with large distal denticle, 1 subdistal denticle and 2 basal denticles fused into bicusp, single denticle on ventral surface at level of bicusp; dorsal margin of movable finger with 5 denticles: 1 large distal denticle, medium-sized subdistal and medial, and 2 small, partially fused basal denticles; ventral margin with 2 denticles.

**Mesosoma** (Figs. 137–144). Tergites I–VI bear three carinae of which the lateral pair may be less conspicuous mainly on tergites I–IV; tergite VII bears five well-defined carinae (median, submedians and laterals); tergites

I–VI densely granular, with coarser granules on posterior lateral areas; tergite VII densely granular; sternites III–VI smooth in females, and shagreened to smooth medially and granulate laterally in males; sternite VII granulated in both sexes, more so in males, with four weak to well-defined carinae; sternum type 1, triangular in shape; smooth, with deep posteromedian invagination; genital opercula smooth; genital papillae present; pectines extending to around half of sternite V in male and around a quarter of sternite IV in female; pectine teeth 16–19 in males, 14–18 in females; combs with 3 marginal lamellae and 7–8 middle lamellae; marginal lamellae, middle lamellae and fulcra with



**Figures 149–154:** *Neobuthus factorio* sp. n. from type locality, metasoma and telson. **Figures 149–151.** Female paratype, lateral (149), dorsal (150), and ventral (151) views. **Figures 152–154.** Male holotype, lateral (152), dorsal (153), and ventral (154) views. Scale bars: 10 mm.

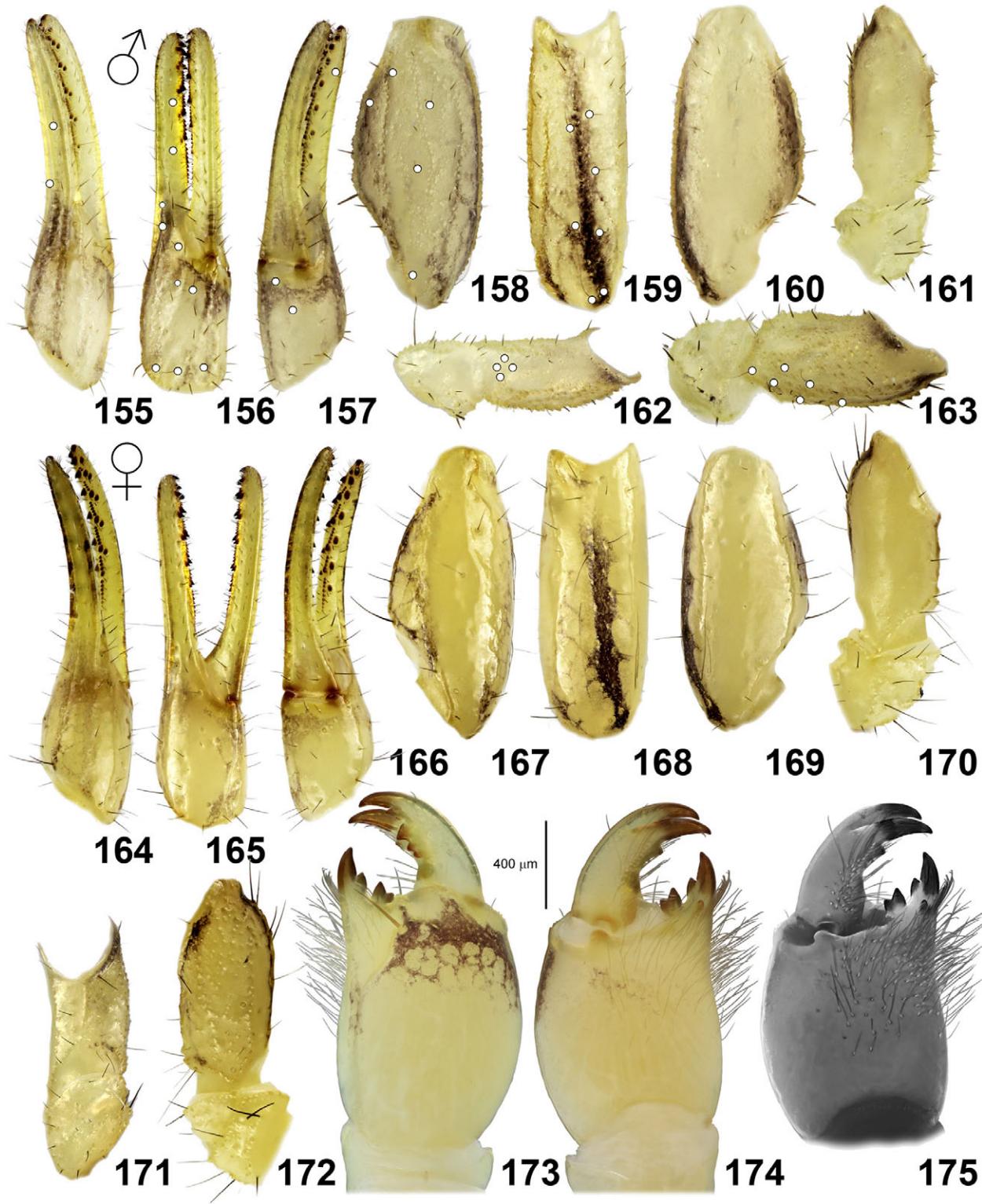
dense cover of short dark reddish macrosetae; fulcra with 2–4 setae.

**Hemispermatophore** (Figs. 173–175). Typical of the genus.

**Legs** (Figs. 145–148). Coxa, femora, patella and tibia of all legs bearing variable numbers of short to medium length, straight, dark-reddish macrosetae; tarsi with mix of short and longer, dark-reddish macrosetae; basitarsi I–III slightly compressed with flat retrolateral surfaces, with bristle combs consisting of retrosuperior series of longer macrosetae, plus retroinferior and proinferior series of shorter macrosetae; telotarsi with two rows of

short macrosetae on ventral aspect, 13–16 macrosetae on telotarsus III; tibial spurs moderate on leg IV and almost reduced on leg III.

**Metasoma and telson** (Figs. 149–154). Metasoma and telson sparsely hirsute, macrosetae moderately short in male and longer in female, straight and reddish; metasomal segments I–III with 10 carinae, IV with 8 carinae, V with 2 carinae; segments I–III with moderate, granulate dorsolateral carinae, other carinae relatively well developed; segment IV with weakly indicated dorsolateral carinae; segment V with strong, granulate to dentate-lobate ventrolateral carinae; segments I–IV with



**Figures 155–175:** *Neobuthus factorio* sp. n. from type locality. **Figures 155–163.** Male holotype, pedipalp chela, dorsal (155), external (156), and ventral (157) views, pedipalp patella, dorsal (158), external (159) and ventral (160) views, pedipalp femur and trochanter ventral (161), internal (162) and dorsal (163) views. **Figures 164–175.** Female paratype, pedipalp chela, dorsal (164), external (165), and ventral (166) views, pedipalp patella, dorsal (167), external (168) and ventral (169) views, pedipalp femur and trochanter ventral (170), internal (171) and dorsal (172) views. Right chelicera, dorsal (173) and ventral (174) views, and ventral view under UV fluorescence (175). Scale bar: 400 µm (173–175). The trichobothrial pattern is indicated in Figures 156–159 and 162–163 (white circles).

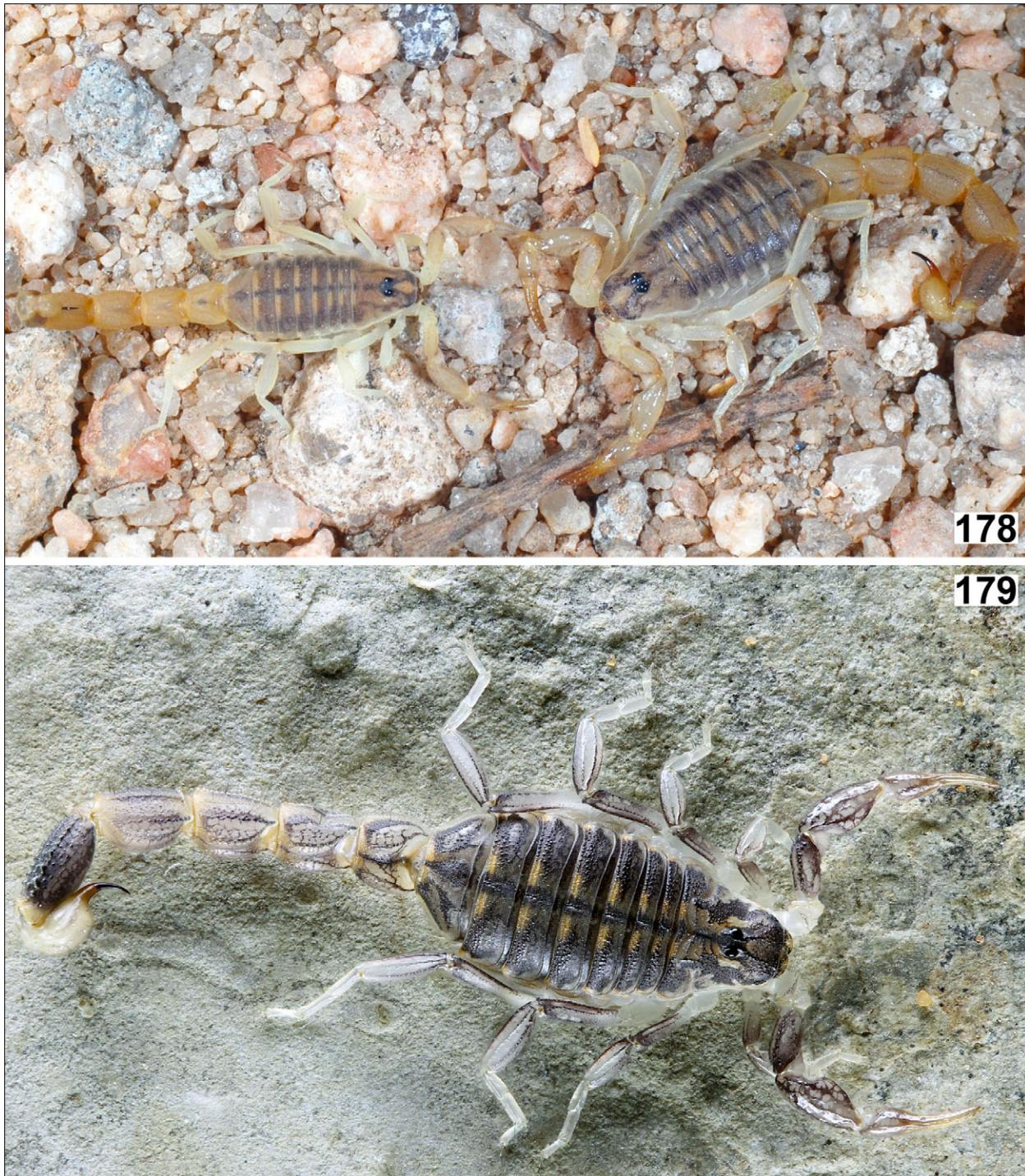


**Figures 176–177:** *Neobuthus factorio* sp. n. from type locality, in vivo habitus. Male (176) and female (177).

dense granulation on all intercarinal surfaces except dorsal surfaces which are sparsely granulated; segment V densely granular on lateral and ventral surfaces, more coarsely so on ventral surface, granules not arranged along any traces of carinae; telson tuberculate, ventral surface sparsely, weakly granular; vesicle slightly elongated;

gated; aculeus stout, shorter than vesicle, tip of aculeus almost vertically directed.

**AFFINITIES.** The described features distinguish *N. factorio* sp. n. from all other species of the genus. According to the distribution (see Fig. 438) the localities

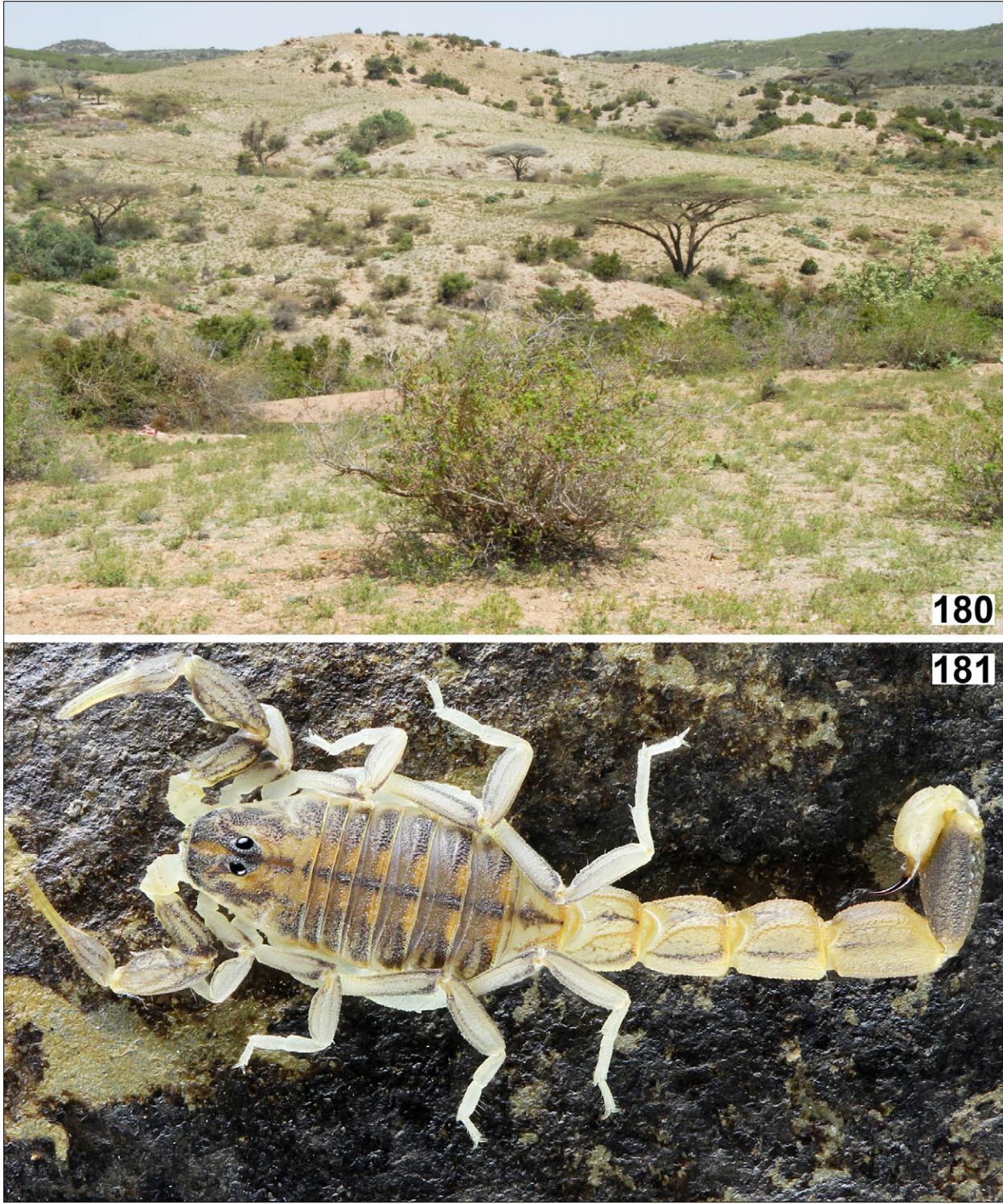


**Figures 178–179:** *Neobuthus factorio* sp. n. in vivo habitus. Male and female paratypes from type locality (178) and juvenile female paratype from locality 17SB (179).

of *N. factorio* sp. n. are near to the localities of *N. berberensis*. Males of *N. berberensis* have the metasoma without setae or with macrosetae very short, stout and spiniform (Figs. 67–68) while males of *N. factorio* sp. n. have metasoma with macrosetae moderately short, not very spiniform (Figs. 152–154). Females of *N. ber-*

*berensis* have dorsoexternal carinae on pedipalp patella well developed while females of *N. factorio* sp. n. have these carinae absent or weakly indicated.

COMMENTS ON LOCALITIES AND LIFE STRATEGY. The type locality, 17SF (fig. 48 in Kovařík et al., 2018: 10),



**Figures 180–181:** *Neobuthus factorio* sp. n., locality 18SK, Sheikh, Goolis Mts., 09°56'38"N 45°10'59"E, 1418 m a.s.l (180) and male paratype from the locality (181).

is in rocky semi-desert terrain with the riverbed of an occasional river in the center. *N. factorio* sp. n. was recorded at night during UV light collecting together with *Gint amoudensis* Kovařík et al., 2018 (type local-

ity), *Hottentotta polystictus* (Pocock, 1896), *Parabuthus heterurus* Pocock, 1897 (Buthidae), and *Pandinurus* sp. (Scorpionidae). At this locality, the first author recorded maximum daytime temperatures of 33.8 °C (28th August

		<i>N. amoudensis</i> sp. n.		<i>N. factorio</i> sp. n.	
Dimensions (mm)		♂ holotype	♀ paratype	♂ holotype	♀ paratype
Carapace	L/W	2.325 / 2.825	2.775 / 3.425	2.325 / 2.725	3.187 / 3.875
Mesosoma	L	5.650	7.550	4.125	6.550
Tergite VII	L/W	1.500 / 2.525	1.550 / 3.325	1.300 / 2.675	1.750 / 3.850
Metasoma+telson	L	11.924	15.376	12.188	17.050
Segment I	L/W/D	1.513 / 1.700 / 1.475	1.888 / 1.950 / 1.650	1.525 / 1.625 / 1.413	2.050 / 2.258 / 1.875
Segment II	L/W/D	1.700 / 1.550 / 1.500	2.275 / 1.825 / 1.775	1.775 / 1.475 / 1.400	2.525 / 2.025 / 1.938
Segment III	L/W/D	1.800 / 1.500 / 1.525	2.375 / 1.800 / 1.800	1.925 / 1.450 / 1.450	2.575 / 1.988 / 1.975
Segment IV	L/W/D	2.098 / 1.450 / 1.475	2.700 / 1.725 / 1.625	2.200 / 1.425 / 1.388	3.050 / 1.925 / 1.825
Segment V	L/W/D	2.600 / 1.400 / 1.263	3.263 / 1.625 / 1.475	2.350 / 1.375 / 1.200	3.775 / 1.800 / 1.525
Telson	L/W/D	2.213 / 0.900 / 0.850	2.875 / 1.100 / 1.088	2.413 / 0.900 / 0.855	3.075 / 1.275 / 1.225
Pedipalp	L	5.900	7.650	6.200	8.775
Femur	L/W	1.500 / 0.633	1.875 / 0.825	1.625 / 0.600	2.275 / 0.888
Patella	L/W	2.000 / 0.875	2.625 / 1.125	2.025 / 0.920	2.875 / 1.250
Chela	L	2.400	3.150	2.550	3.625
Manus	L/W/D	0.775 / 0.575 / 0.587	1.000 / 0.775 / 0.788	0.925 / 0.600 / 0.625	1.225 / 0.875 / 0.908
Movable finger	L	1.625	2.150	1.625	2.400
<b>Total</b>	<b>L</b>	<b>19.90</b>	<b>25.70</b>	<b>18.64</b>	<b>26.79</b>

**Table 1:** Comparative measurements of adults of *Neobuthus amoudensis* sp. n. and *N. factorio* sp. n. Abbreviations: length (L), width (W, in carapace it corresponds to posterior width), depth (D).

2017) and 34.7 °C (29th August 2017), and a minimum nighttime temperature of 22.8 °C (29th August 2017) and 23.2 °C (30th August 2017). The recorded humidity was between 26% and 54%.

***Neobuthus ferrugineus* (Kraepelin, 1898)**  
(Figs. 182–212, 410, 438, Table 1)

*Butheolus ferrugineus* Kraepelin, 1898: 43; Fet & Lowe, 2000: 88; Lourenço, 2001: 177, fig. 12; Kovařík, 2003: 137 (in part); Kovařík, 2004: 4 (in part); Lourenço, 2005: 27, fig. 31; Lourenço & Qi, 2006: 91–93.

*Neobuthus ferrugineus*: Kraepelin, 1903: 563–564; Vachon, 1980: 255; Kovařík & Lowe, 2012: 3–7, figs. 60–61, 72 (in part).

TYPE LOCALITY AND TYPE DEPOSITORY. **Djibouti**, Gulf of Aden, Tadjura Bay, ZMUH.

TYPE MATERIAL EXAMINED. **Djibouti**, Gulf of Aden, Tadjura Bay, 1♂ (holotype, Figs. 213–214), ZMUH.

ADDITIONAL MATERIAL EXAMINED. **Djibouti**, Barra Yer (Petit Barre), 11°18'33.56"N 42°42'39.17"E, 585 m a.s.l., I. 2017, 1♂ 2♀, FKCP, 1♂ 1♀, GLPC, leg. R. Štarha.

EMENDED DIAGNOSIS. Total length 19–21 mm (male), 25–27 mm (female); carapace with area between anterior median carinae orange to partially fuscous; tergites with 3 dark stripes, median stripe flanked on either side by

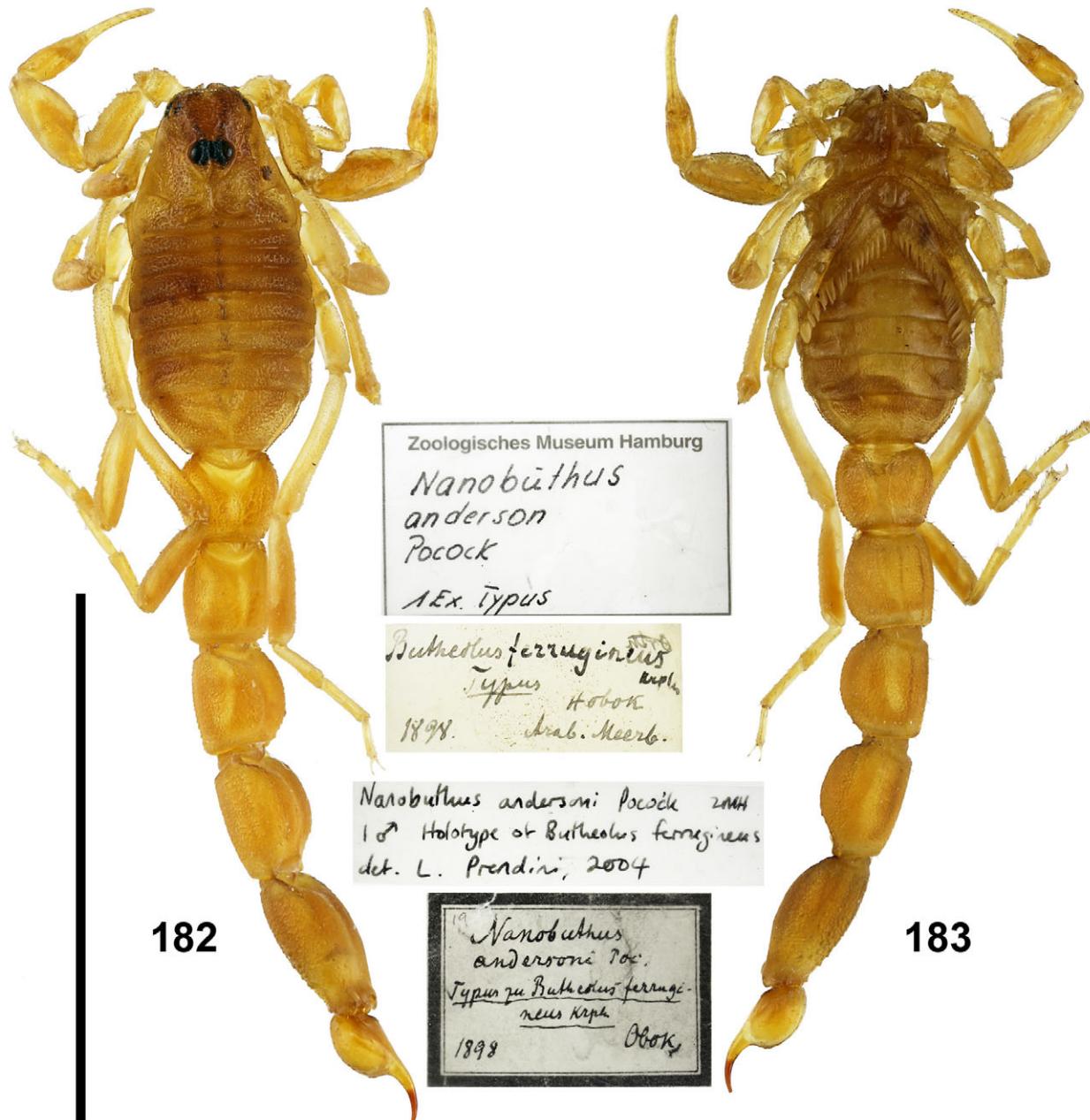
broad longitudinal yellow bands that may be broken by fuscosity extending across anterior tergites; pedipalp relatively slender, males with femur L/W 2.28–2.48, patella L/W 2.40–2.46, chela L/W 4.75–5.95; chela movable finger with 6 subrows of primary denticles, 3–4 external accessory denticles flanking proximal end of each subrow; dorsoexternal carina on pedipalp patella in female weakly indicated, ventroexternal carina absent; posterior margins of tergites without or with 1–2 pairs of macrosetae; pedipalps, legs, metasoma and telson with very short, stout macrosetae in males, and long, fine setae in females; males with sternite VII densely granular without carinae or 2 vestigial median carinae; females with sternites III–VI smooth, sternite VII finely granular with 4 vestigial carinae; metasoma I–III with median lateral carinae present in female, absent in male; lateral surfaces of metasoma I–IV densely granulated in male and smooth in female; lateral surface of metasoma V in males densely granulated, with granules separated; tarsi with relatively sparse setation, leg III of adults with 14–18 ventral macrosetae on telotarsus; pectine teeth: 18–21 (males), 16–18 (females).

***Neobuthus gubanensis* sp. n.**

(Figs. 213–262, 268–269, 411, 419, 423, 428, 431–434, 438, Tables 2, 5)

<http://zoobank.org/urn:lsid:zoobank.org:act:997D71E3-AC37-4677-BC81-1046C9CFE6A1>

TYPE LOCALITY AND TYPE REPOSITORY. **Somaliland**, Gerissa, N of Borama, 10°36'01"N 43°26'07"E, 245 m a.s.l.; FKCP.



Figures 182–183: *Neobuthus ferrugineus*, male holotype, dorsal (182) and ventral (183) views, including original labels.

TYPE MATERIAL. **Somaliland**, Gerissa, N of Borama, 10°36'01"N 43°26'07"E, 245 m a.s.l. (Locality No. 17ST, figs. 76–77 in Kovářík et al., 2018: 19), 11.–12.IX.2017, 1♂ (holotype) 35♂18♀6juvs. (paratypes), FKCP, 4♂2♀ (paratypes), GLPC (Nos. 1298, 1299, 1300, 1322, 1331), leg. F. Kovářík (UV detection).

ETYMOLOGY. Named after the Guban area (guban in Somali language means "burnt land"). It is the zone of hot and dry land along the sea between Djibouti and

Puntland (Somalia). Gerissa village belongs to the Guban area.

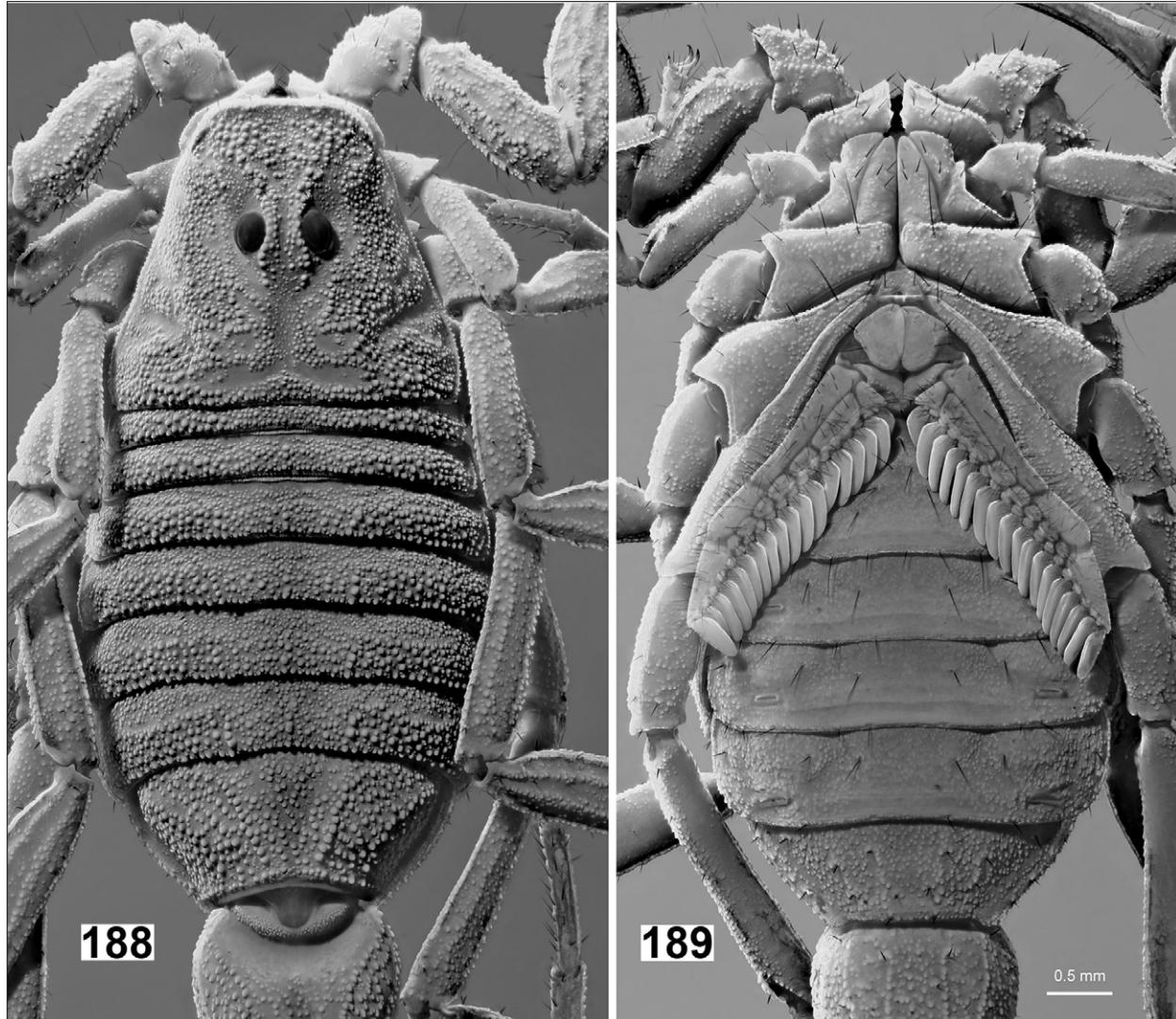
DIAGNOSIS. Total length 15–19 mm (males), 24–28 mm (females); carapace with area between anterior median carinae yellow to orange; tergites with 3 dark stripes, median stripe flanked on either side by broad longitudinal yellow bands that may be broken by fuscosity extending across anterior tergites; pedipalp relatively slender, males with femur L/W 2.38–2.50, pa-



**Figures 184–187:** *Neobuthus ferrugineus*, Djibouti, Barra Yer (Petit Barre), 11°18'33.56"N 42°42'39.17"E. **Figures 184–185.** Male, dorsal (184) and ventral (185) views. **Figures 186–187.** Female, dorsal (186) and ventral (187) views. Scale bar: 10 mm.

tella L/W 2.34–2.44, chela L/W 4.30–4.84; chela movable finger with 5 subrows of primary denticles, 4 external accessory denticles flanking proximal end of each subrow; trichobothria  $d_2$  present or absent on dorsal surface of femur and usually absent from patella; dorso-external and ventroexternal carinae on pedipalp patella

in female absent; posterior margins of tergites usually without or rarely with 1–2 pairs of macrosetae; pedipalps, legs, metasoma and telson with moderately short, not spiniform macrosetae in males, and long, fine setae in females; males with sternites III–VI with dense, fine granulation, sternite VII finely granulated with 4, gran-



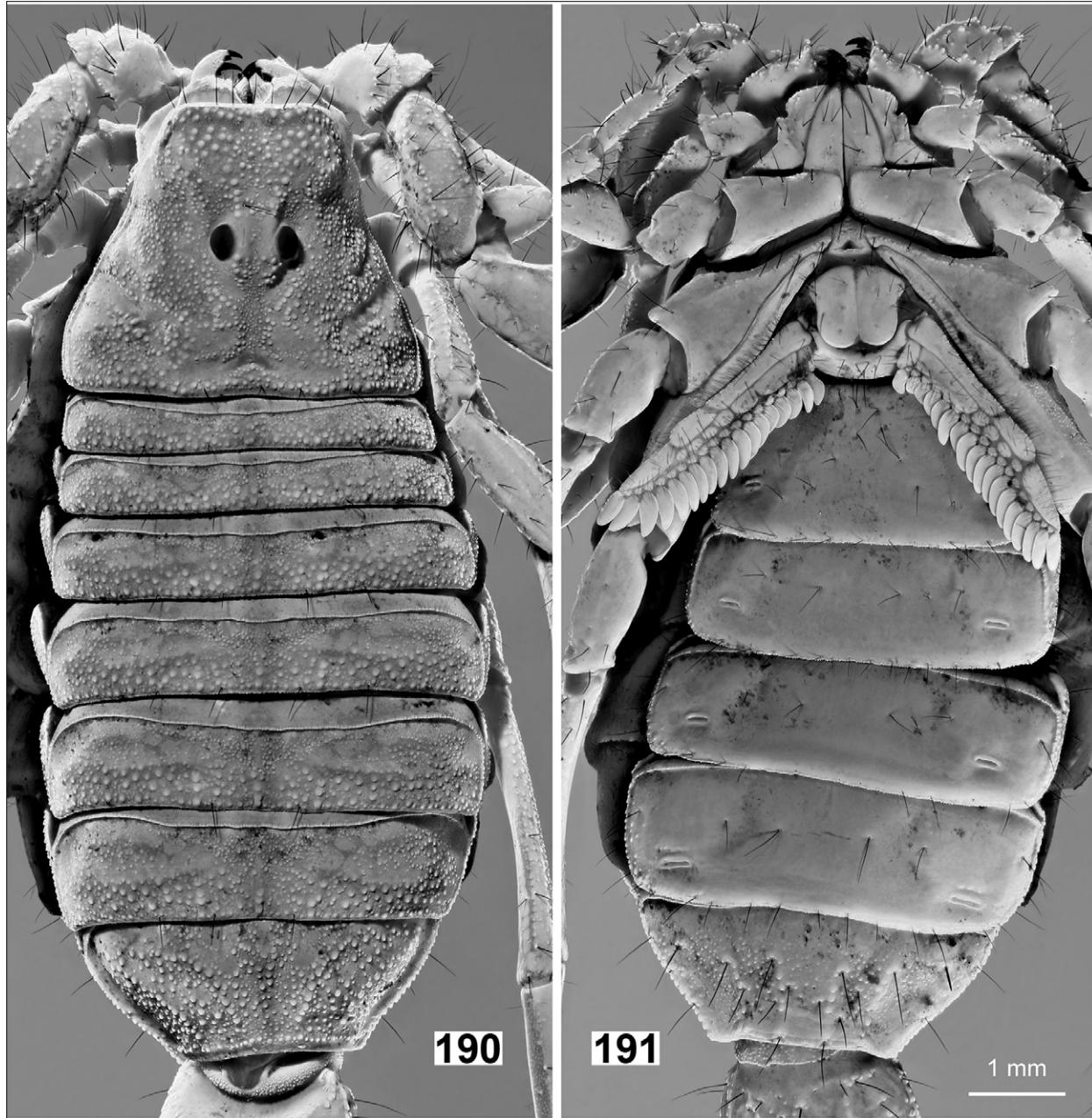
**Figures 188–189:** *Neobuthus ferrugineus*, Djibouti, Barra Yer (Petit Barre), 11°18'33.56"N 42°42'39.17"E. Male carapace and tergites (188), coxosternal area and sternites (189). UV fluorescence. Scale bar: 0.5 mm.

ulated carinae; females with sternites III–VI smooth, sternite VII with 4 weak granulated carinae; metasoma I–III with median lateral and dorsal carinae present in both sexes; lateral surface of metasoma V granulated in both sexes, with granules separated; soles of telotarsi with relatively sparse setation, leg III of adults with 12–16 ventral macrosetae on telotarsus; pectine teeth: 15–19 (males), 13–16 (females).

**DESCRIPTION.** Total length of adult males 15–19 mm, of adult females 24–28 mm; measurements of carapace, telson, segments of metasoma and pedipalps given in Table 1; positions and distribution of trichobothria of pedipalps shown in Figs. 237–240 and 243–244; trichobothrium  $d_2$  present or absent on pedipalp femur, usually absent from patella; base color pale yellow to light orange with variable fuscous pigmentation and ex-

tensive patterns of dark maculation on metasoma, partially on pedipalps and legs; chelicerae yellow with dark reticulation on anterior manus, dentition reddish. **Sexual dimorphism:** strong, adult males substantially smaller, but without differences in shapes of pedipalps, metasoma and telson; pedipalp patella and femur granulate and matte in males, smooth and glossy in females; sternites smooth in females and granulated in males; macrosetae on pedipalps, legs, metasoma and telson much longer and finer in females than males; other sex differences cited below.

**Pedipalp** (Figs. 236–254). Pedipalp mostly sparsely hirsute; finely granulated in males and smooth in females; femur with five conspicuously granulose carinae, more strongly developed in males; patella with seven granulose carinae, weakly developed in males and smooth to absent in females; dorsoexternal carinae on



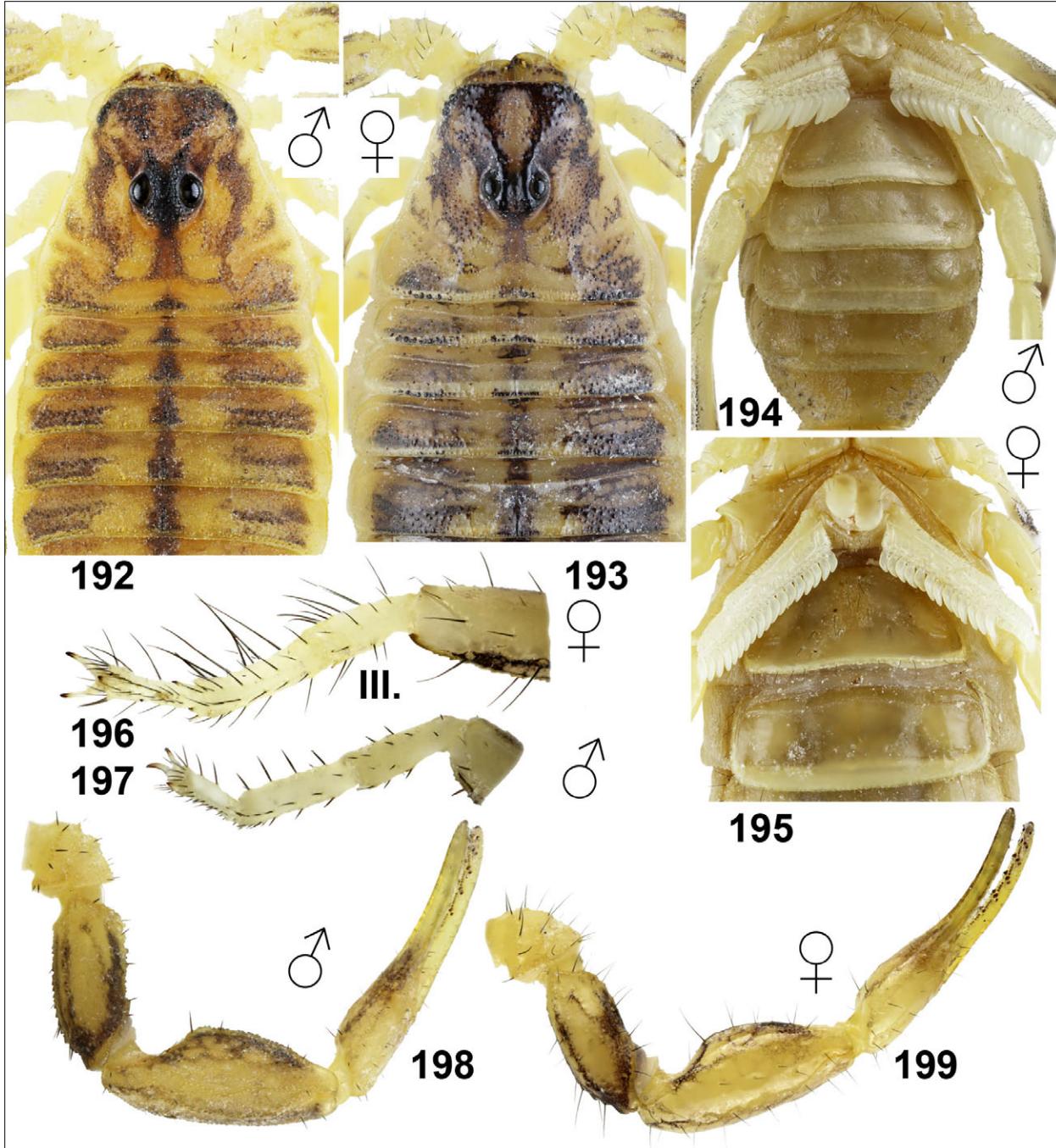
**Figures 190–191:** *Neobuthus ferrugineus*, Djibouti, Barra Yer (Petit Barre), 11°18'33.56"N 42°42'39.17"E. Female carapace and tergites (190), coxosternal area and sternites (191). UV fluorescence. Scale bar: 1 mm.

pedipalp patella in female absent; chela with carinae missing or weakly indicated.

**Carapace** (Figs. 217, 219, 221–222). Strongly trapezoidal (narrower anteriorly), wider than long (L/W 0.82–0.91); posterior median postocular area flat, anterior median preocular area gently sloped downwards towards anterior margin; lateral flanks steeply sloped; ocular tubercle broad, prominent, located slightly anterior to middle of carapace; anterior margin straight, finely microdenticulate, with coarser granules overlapping edge, bearing 6–8 macrosetae; anterior median

carinae present, coarsely granular, other carinae indistinct; dense granulation covering most of carapace.

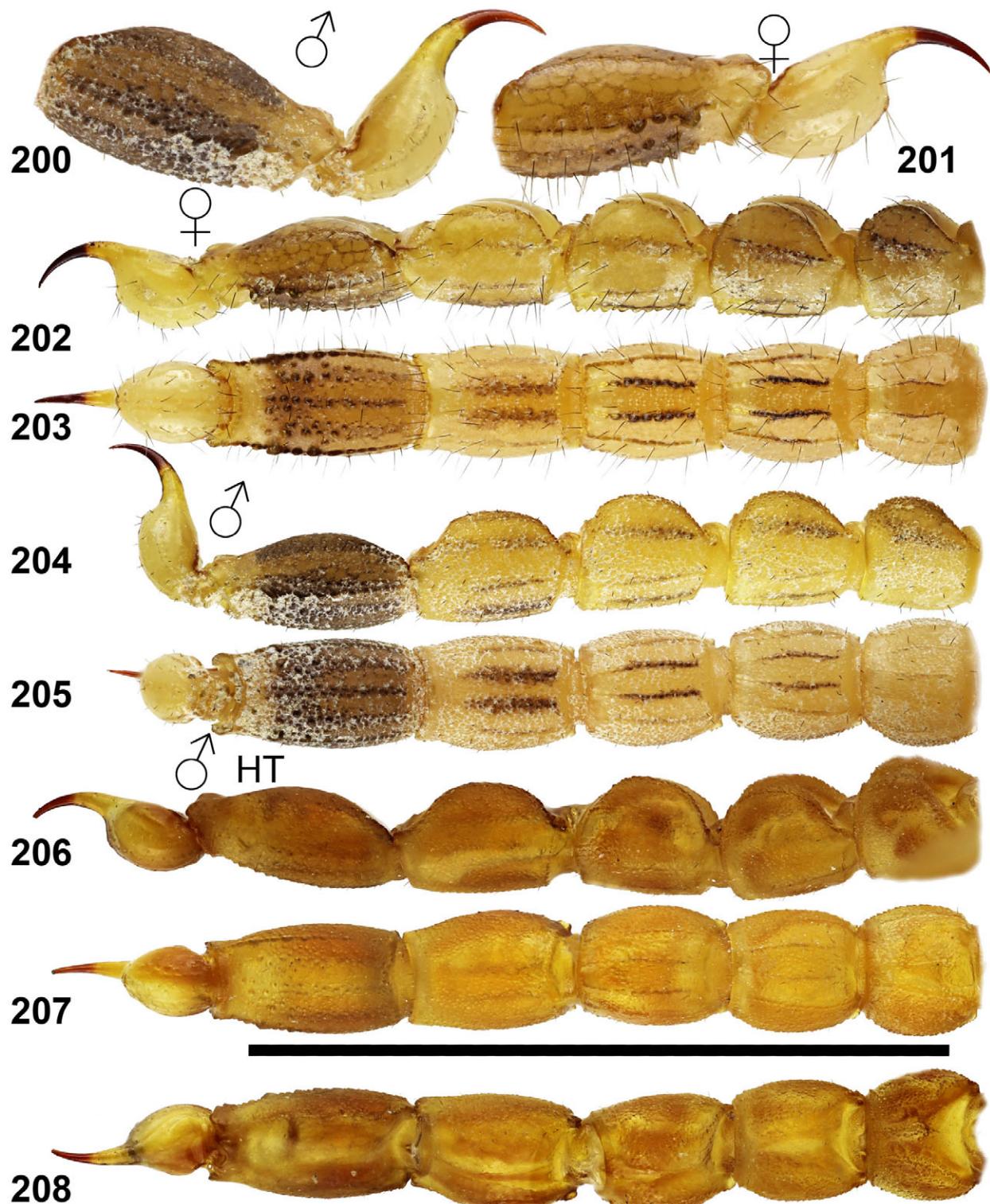
**Chelicera** (Figs. 255–257). Fingers with typical buthid dentition (Vachon, 1963, Lowe & Kovařík, 2016); fixed finger with large distal denticle, 1 subdistal denticle and 2 basal denticles fused into bicusp, single denticle on ventral surface at level of bicusp; dorsal margin of movable finger with 5 denticles: 1 large distal denticle, medium-sized subdistal and medial, and 2 small, partially fused basal denticles; ventral margin with 2 denticles.



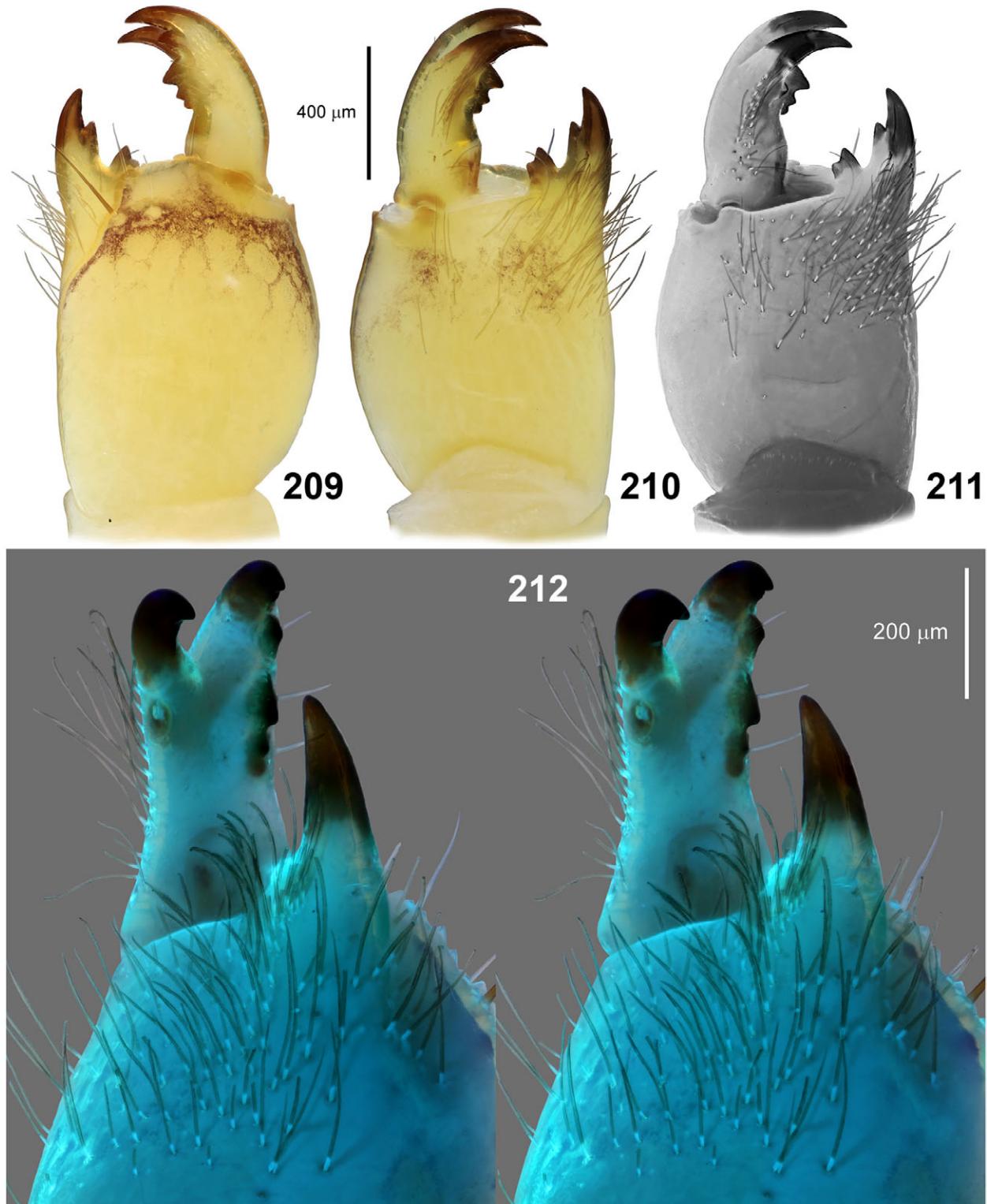
**Figures 192–199:** *Neobuthus ferrugineus*, Djibouti, Barra Yer (Petit Barre), 11°18'33.56"N 42°42'39.17"E. **Figures 192, 194, 197–198.** Male, carapace and tergites I–V (192), coxosternal area and sternites (194), leg III., retrolateral aspect (197), and pedipalp dorsal (198). **Figures 193, 195–196, 199.** Female, carapace and tergites I–IV (193), coxosternal area and sternites III–IV (195), leg III., retrolateral aspect (196), and pedipalp dorsal (199).

**Mesosoma** (Figs. 217–224). Tergites I–VI bear three carinae of which the lateral pair may be less conspicuous mainly on tergites I–IV; tergite VII bears five well-defined carinae (median, submedians and laterals); tergites I–VI densely granular, with coarser granules on posterior lateral areas; tergite VII densely granular; ster-

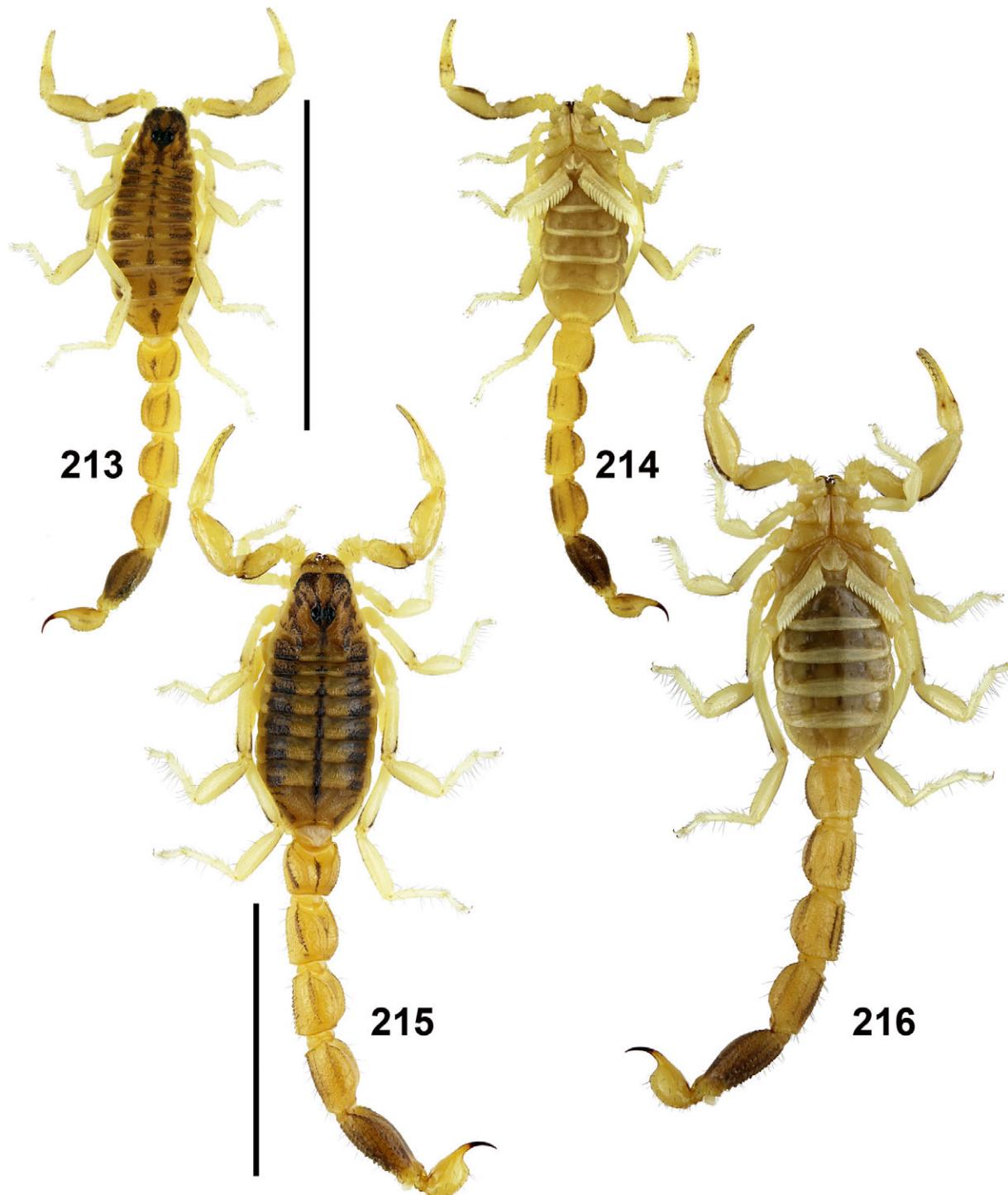
nites III–VI smooth in females, and dense finely granulated in males; sternite VII granulated in both sexes, more so in males, with four well-defined carinae; sternum type 1, triangular in shape, smooth, with deep posteromedian invagination; genital opercula smooth; genital papillae present; pectines extending to around a



**Figures 200–208:** *Neobuthus ferrugineus*, metasoma and telson. **Figures 200, 204–205.** Male from Djibouti, Barra Yer (Petit Barre), metasoma V and telson lateral view (200), metasoma and telson lateral (204) and ventral (205) views. **Figures 201–203.** Female from Djibouti, Barra Yer (Petit Barre), metasoma V and telson lateral view (201), metasoma and telson lateral (202) and ventral (203) views. **Figures 206–208.** Male holotype, metasoma and telson lateral (206), ventral (207), and dorsal (208) views. Scale bar: 10 mm (206–208).



**Figures 209–212:** *Neobuthus ferrugineus*, Djibouti, Barra Yer (Petit Barre),  $11^{\circ}18'33.56''\text{N}$   $42^{\circ}42'39.17''\text{E}$ . Female, right chelicera, dorsal (209) and ventral (210) views, ventral view under UV fluorescence (211), internal crossed stereoscopic view under UV fluorescence (212). Scale bars: 400  $\mu\text{m}$ , 200  $\mu\text{m}$ .

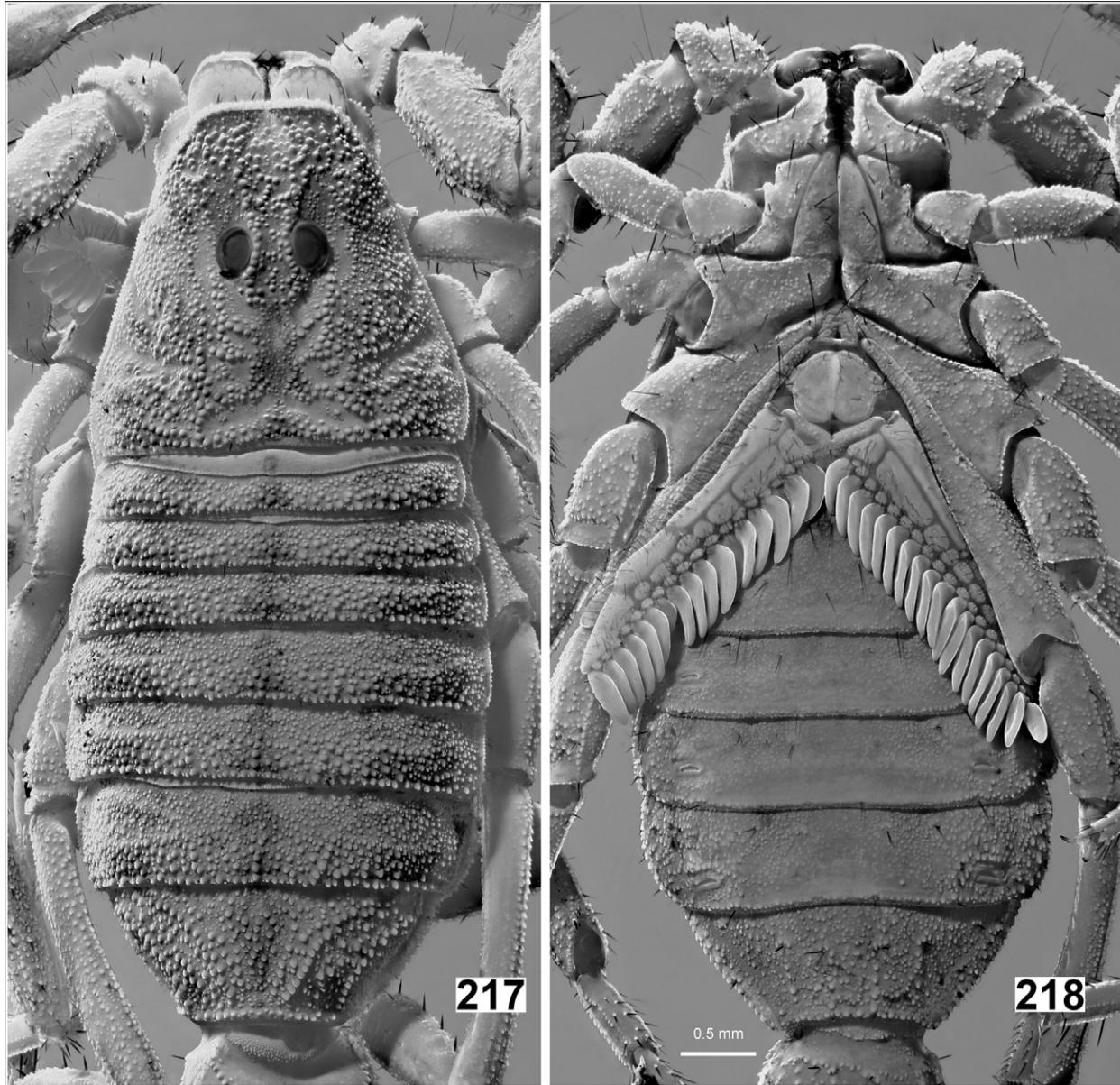


**Figures 213–216:** *Neobuthus gubanensis* sp. n.. **Figures 213–214.** Male holotype, dorsal (213) and ventral (214) views. **Figures 215–216.** Female paratype, dorsal (215) and ventral (216) views. Scale bars: 10 mm.

quarter of sternite V in male and around a quarter of sternite IV in female; pectine teeth 15–19 in males, 13–16 in females; combs with 3 marginal lamellae and 7–8 middle lamellae; marginal lamellae, middle lamellae and

fulcra with dense cover of short dark reddish macrosetae; fulcra with 2–4 setae.

**Hemispermatophore** (Figs. 258–262). Typical of the genus.

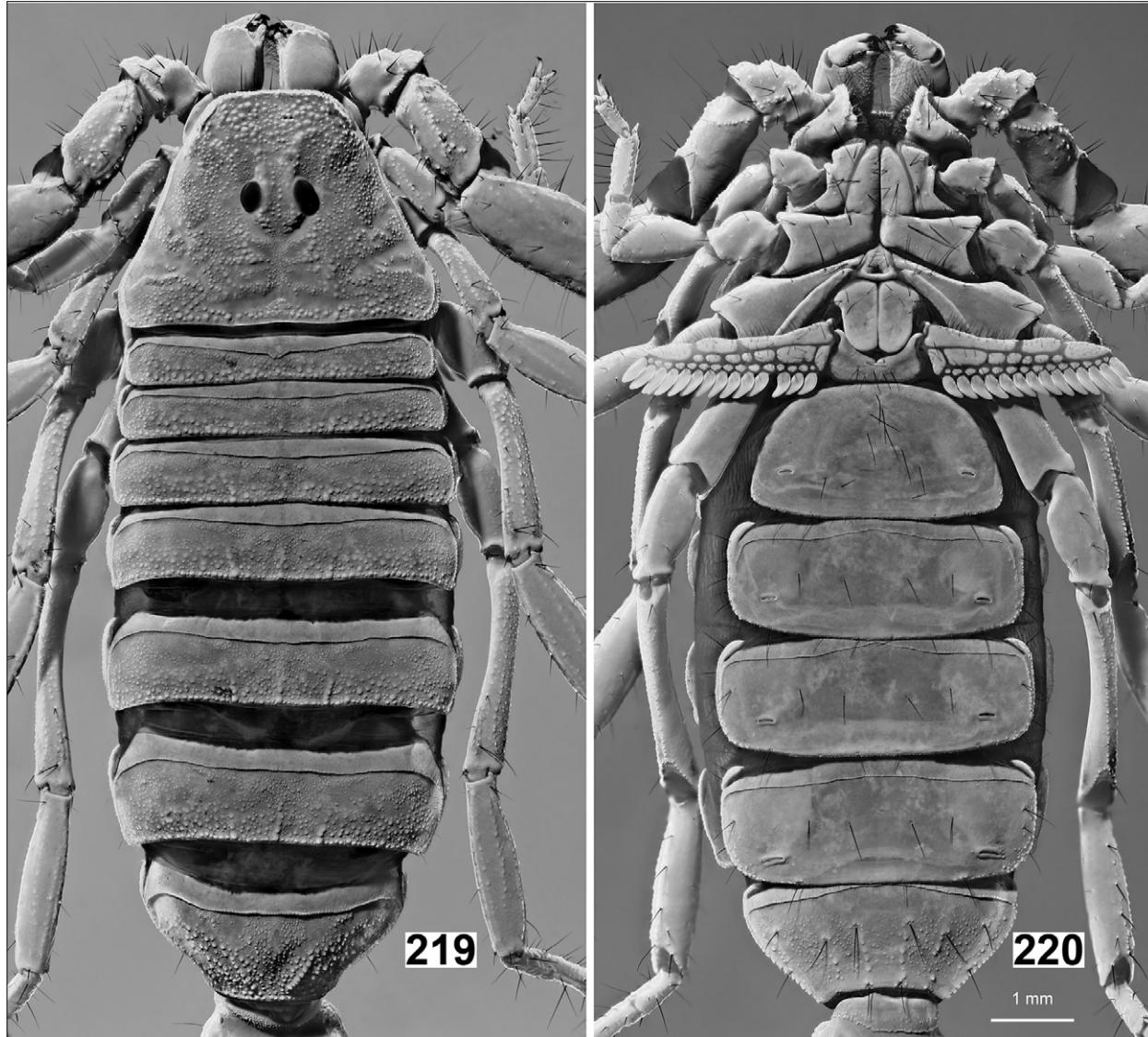


**Figures 217–218:** *Neobuthus gubanensis* sp. n., male paratype from type locality, carapace and tergites (217), coxosternal area and sternites (218). UV fluorescence. Scale bar: 0.5 mm.

**Legs** (Figs. 225–229). Coxa, femora, patella and tibia of all legs bearing variable numbers of short to medium length, straight, dark-reddish macrosetae; tarsi with mix of short and longer, dark-reddish macrosetae; basitarsi I–III slightly compressed with flat retrolateral surfaces, with bristle combs consisting of retrosuperior series of longer macrosetae, plus retroinferior and proinferior series of shorter macrosetae; telotarsi with two rows of short macrosetae on ventral aspect, 12–16 macrosetae on telotarsus III; moderate tibial spurs present on legs III and IV.

**Metasoma and telson** (Figs. 230–235). Metasoma and telson sparsely hirsute, macrosetae moderately short in

male and longer in female, straight and reddish; metasomal segments I–III with 10 carinae, IV with 6–8 carinae, V with 2 carinae; segments I–III with moderate, granulate dorsolateral carinae, other carinae relatively well developed; segment IV with weakly indicated dorsolateral carinae; segment V with strong, granulate to dentate-lobate ventrolateral carinae; segments I–IV with dense granulation on all intercarinal surfaces except dorsal surfaces which are sparsely granulated, mainly in females; segment V densely granular on lateral and ventral surfaces, more coarsely so on ventral surface, granules not arranged along any traces of carinae; telson smooth, ventral surface sparsely, weakly granular; ves-

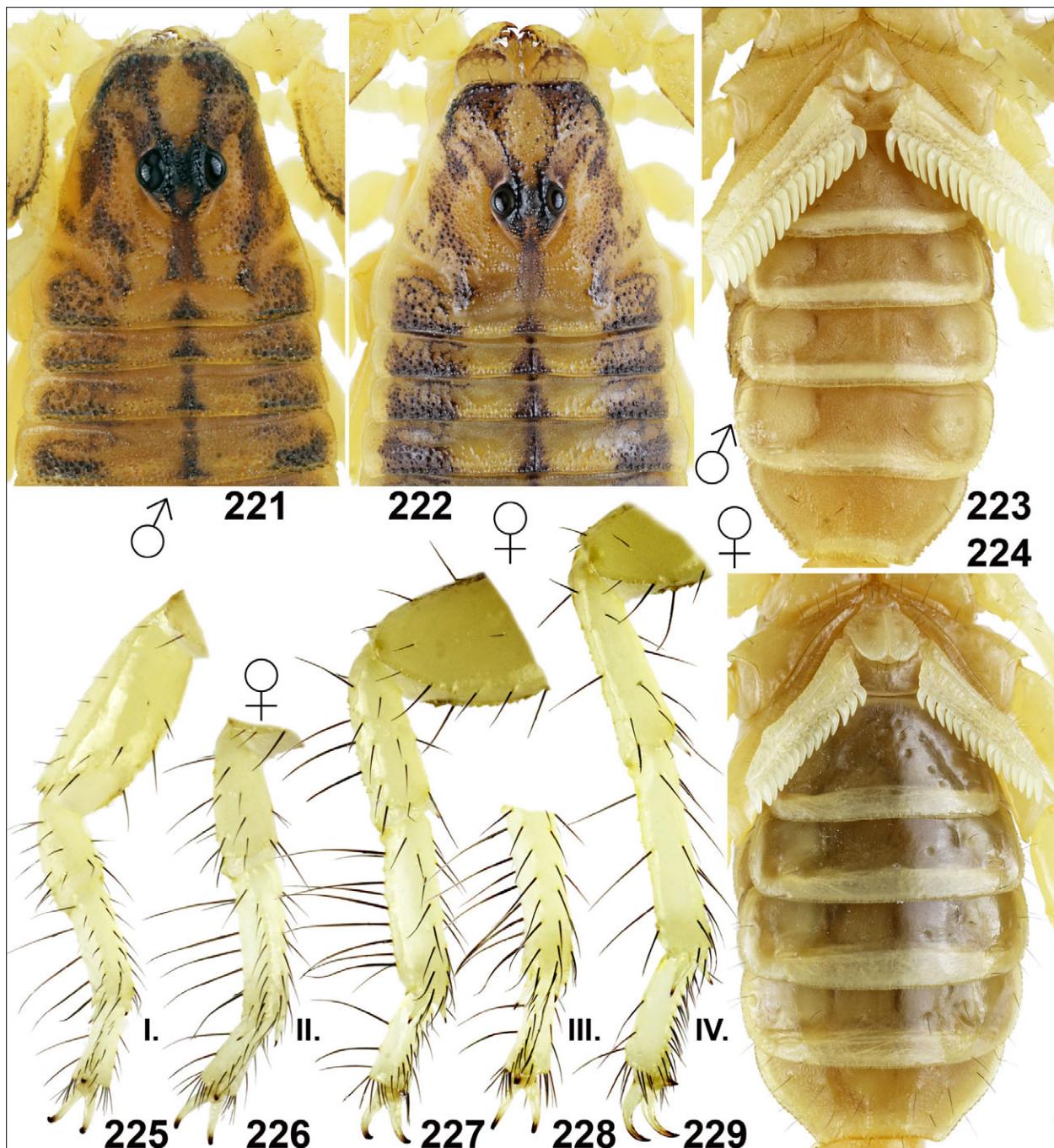


**Figures 219–220:** *Neobuthus gubanensis* sp. n., female paratype from type locality, carapace and tergites (219), coxosternal area and sternites (220). UV fluorescence. Scale bar: 1 mm.

icle slightly elongated; aculeus stout, shorter than vesicle, tip of aculeus almost vertically directed.

**AFFINITIES.** The described features distinguish *N. gubanensis* sp. n. from all other species of the genus. They are recounted in the key below. According to the distribution (see Fig. 438) the type locality of *N. gubanensis* sp. n. is near to the locality of *N. amoudensis* sp. n. and these two species are quite similar. However, the two can be unequivocally separated by the dorso-external carinae on the pedipalp patella which are present in females of *N. amoudensis* sp. n. (Fig. 46) and absent in females of *N. gubanensis* sp. n. (Fig. 249).

**COMMENTS ON LOCALITIES AND LIFE STRATEGY.** The type locality, 17ST is sandy semi-desert (figs. 76–77 in Kovařík et al., 2018: 19). The types of *Neobuthus gubanensis* sp. n. were recorded at night during UV collecting together with *Buthus berberensis* Pocock, 1900, *Compsobuthus somalilandus* Kovařík, 2012, *Gint gubanensis* Kovařík et al., 2018 (type locality), *Hottentotta polystictus* (Pocock, 1896), *Orthochirus afar* Kovařík et al., 2017 (first record for Somaliland), and *Parabuthus granimanus* Pocock, 1895 (Buthidae). The first author arrived at the locality at night on 11th September 2017 at 23.00. At this time, the temperature was 32.7 °C and the humidity 58%. He recorded a mini-



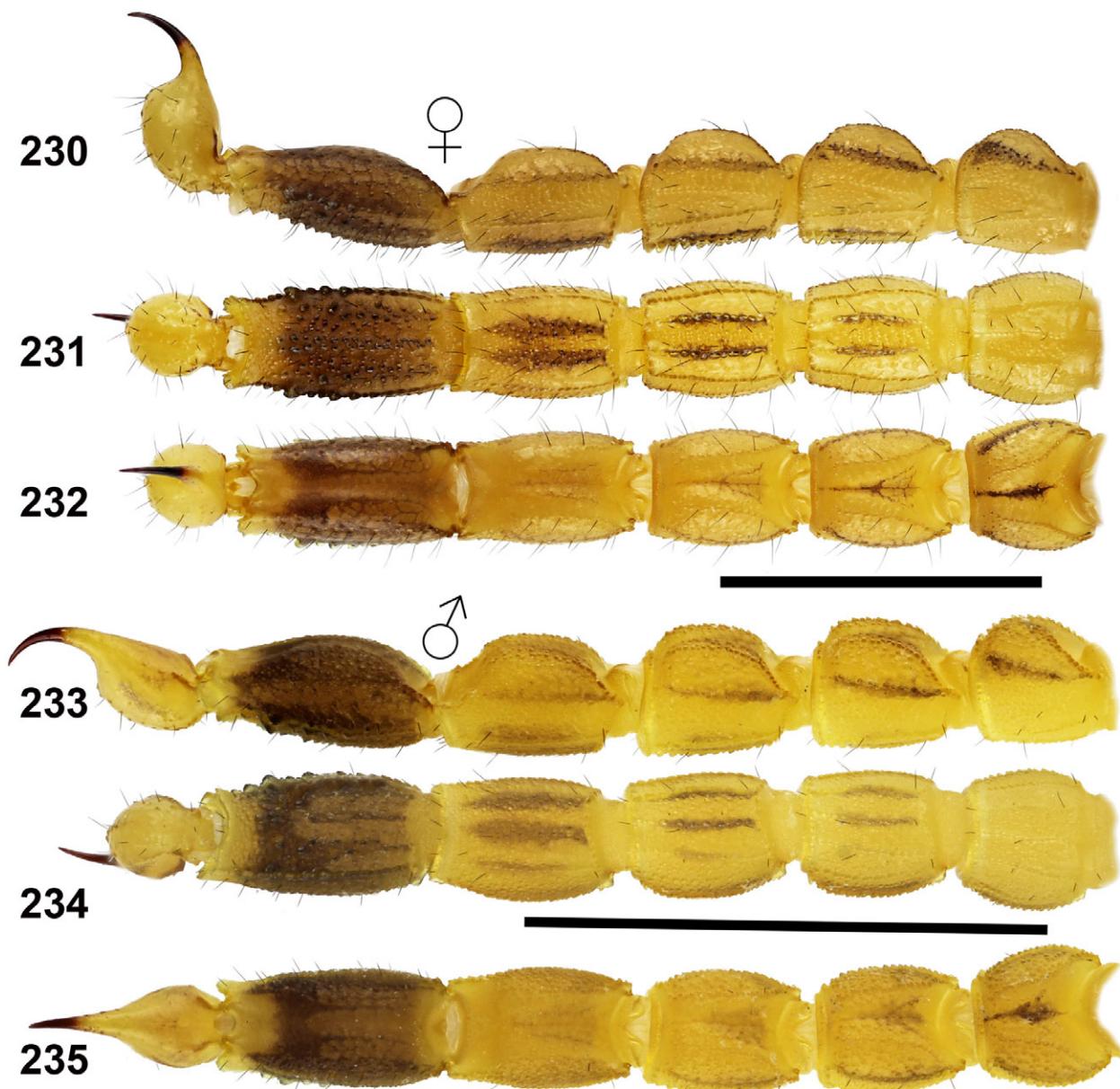
**Figures 221–229:** *Neobuthus gubanensis* sp. n.. **Figures 221 and 223.** Male holotype, carapace and tergites I–III (221) and coxosternal area and sternites (223). **Figures 222, 224–229.** Female paratype, carapace and tergites I–III (222), coxosternal area and sternites (224), and right legs I–IV, retrolateral aspect (225–229).

imum temperature 29.9 °C and humidity 47% on 12th September 2017 in the early morning.

***Neobuthus kloppersi* sp. n.**  
 (Figs. 270–310, 412, 424, 429, 438, Tables 3, 5)  
<http://zoobank.org/urn:lsid:zoobank.org:act:7362FE-D8-B545-4E43-B906-9DEAD8514D21>

TYPE LOCALITY AND TYPE DEPOSITORY. **Kenya**, South Horr, Kalama Conservancy, 0°42'22"N 37° 31'50"E ; FKCP.

TYPE MATERIAL EXAMINED. **Kenya**, South Horr, Kalama Conservancy, 0°42'22"N 37° 31'50"E (309–310), 8♂2 juvs.♂♀ (holotype and paratypes), VI.–IX.2018, leg.

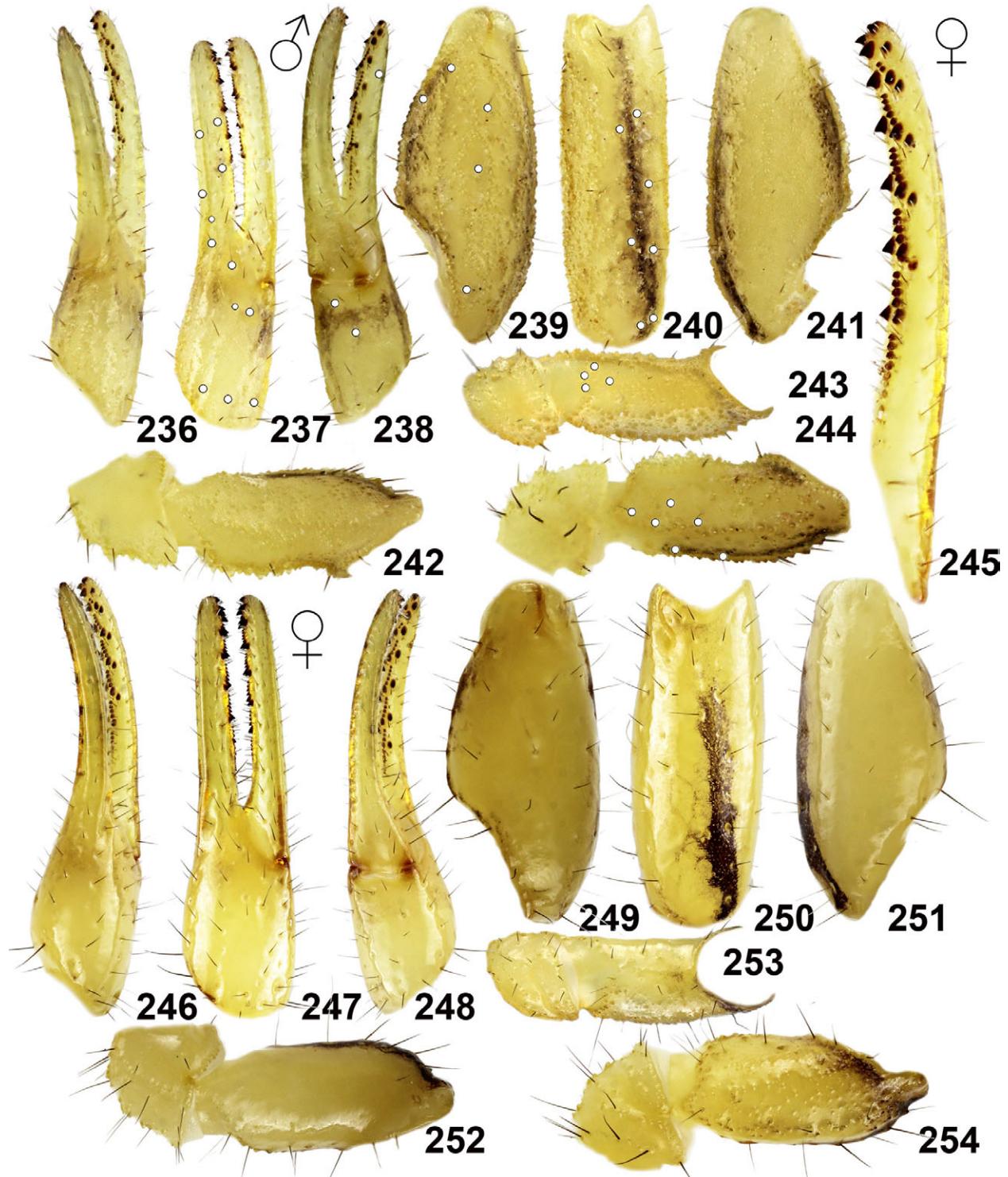


**Figures 230–235:** *Neobuthus gubanensis* sp. n., metasoma and telson. **Figures 230–232.** Female paratype, lateral (230), ventral (231), and dorsal (232) views. **Figures 233–235.** Male holotype, lateral (233), ventral (234), and dorsal (235) views. Scale bars: 10 mm.

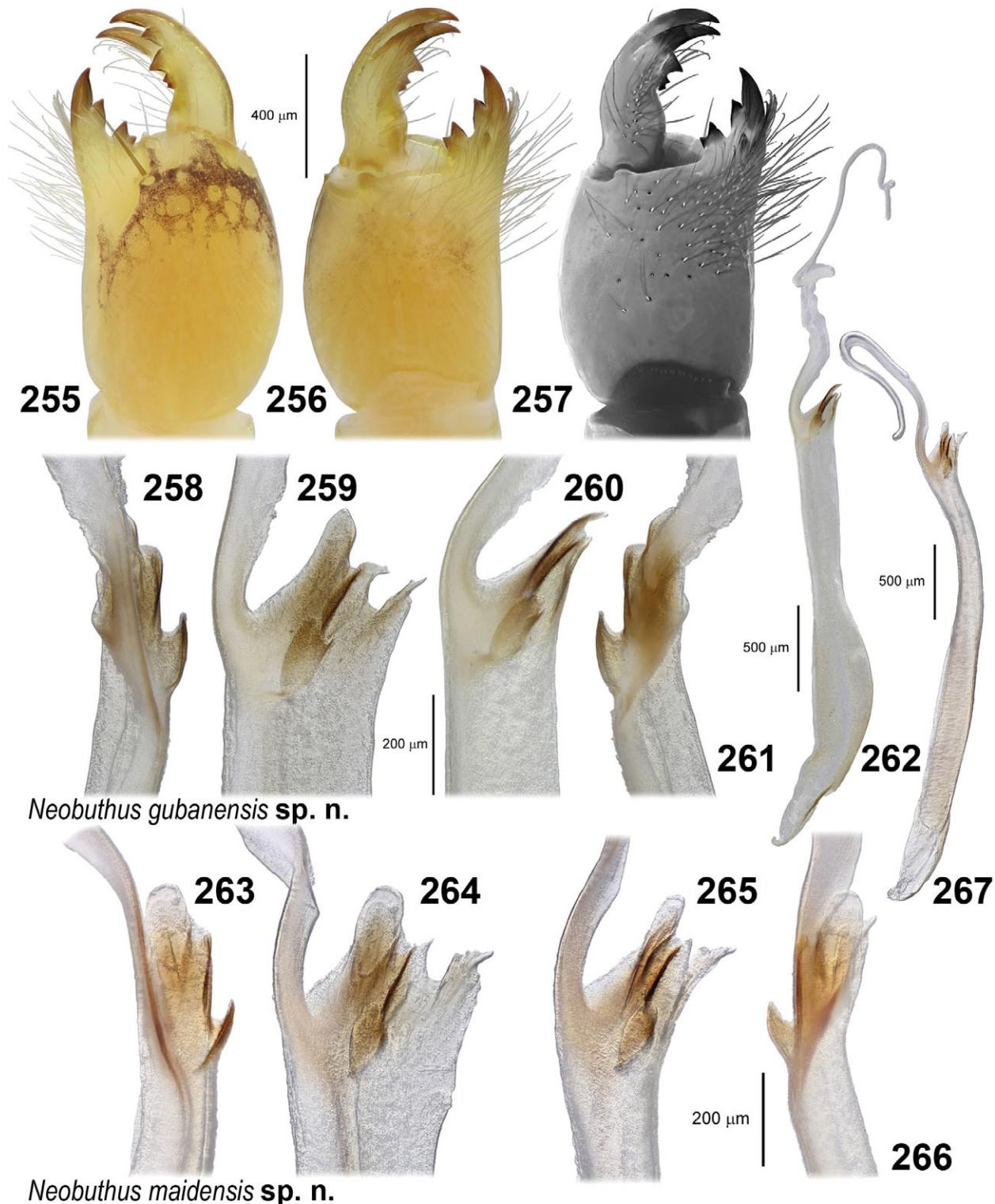
Johan Kloppers, FKCP; South Horr, near Koros camp, 02°14'26.5"N 36°55'56"E, 1♀ (paratype), 2018, leg. Neil Mcrae, FKCP.

**ETYMOLOGY.** A patronym in honor of Johan Kloppers, who collected the holotype and took photos used as Figs. 309–310. Johan grew up in South Africa and graduated from the University of Johannesburg with a BSc. degree in Zoology and Botany. He spent the next few years working in the pharmaceutical industry before retiring

his suit and ties and deciding to travel the world. During this time he became an underwater naturalist in areas as diverse as the Mediterranean, the Caribbean and the Pacific. It was also during this time that he became an Eco-Diver Trainer for the Reef Check Foundation, an international organization dedicated to the conservation of tropical reefs around the globe. Returning to the continent of his birth in 2015, he now works as a Lodge Manager in the Kalama Conservancy of North Central Kenya.



**Figures 236–254:** *Neobuthus gubanensis* sp. n., pedipalp segments. **Figures 236–244.** Male holotype, pedipalp chela, dorsal (236), external (237), and ventral (238) views, pedipalp patella, dorsal (239), external (240) and ventral (241) views, pedipalp femur and trochanter ventral (242), internal (243) and dorsal (244) views. **Figures 245–254.** Female paratype, pedipalp movable finger dentate margin (245), pedipalp chela, dorsal (246), external (247), and ventral (248) views, pedipalp patella, dorsal (249), external (250) and ventral (251) views, pedipalp femur and trochanter ventral (252), internal (253) and dorsal (254) views. The trichobothrial pattern is indicated in Figures 237–240 and 243–244 (white circles).



**Figures 255–267:** Figures 255–262: *Neobuthus gubanensis* sp. n. from type locality. **Figures 255–257.** Female paratype, right chelicera, dorsal (255) and ventral (256) views, and ventral view under UV fluorescence (257). Scale bar: 400 µm. **Figures 258–262.** Male paratype (No. 1300), right hemispermophore capsule region in posterior (258), convex compressed (259), convex (260) and anterior (261) views, and right hemispermophore, convex view (262). Scale bars: 200 µm, 500 µm. **Figures 263–267:** *Neobuthus maidensis* sp. n. male holotype (No. 1320), left hemispermophore (mirror image): capsule region in posterior (263), convex compressed (264), convex (265) and anterior (266) views, hemispermophore, convex view (267). Scale bars: 200 µm, 500 µm.



**Figures 268–269:** *Neobuthus gubanensis* sp. n. in vivo habitus. Male (268) and female (269) paratypes.

**DIAGNOSIS.** Total length 16–22 mm (males), 25.2 mm (female); carapace with area between anterior median carinae yellow to orange; tergites with fuscous variable pigmentation; pedipalp relatively slender, males with femur L/W 2.34–2.48, patella L/W 2.28–2.29, chela L/W 4.42–4.69; chela movable finger with 5–6 subrows

of primary denticles, 4–5 external accessory denticles flanking proximal end of each subrow; trichobothria  $d_2$  present on femur and patella; dorsoexternal and ventroexternal carinae on pedipalp patella in female absent; posterior margins of tergites without or with 1–2 pairs of macrosetae; pedipalps, legs, metasoma and telson with

		<i>N. erigavoensis</i> sp. n.		<i>N. gubanensis</i> sp. n.	
Dimensions (mm)		♂ holotype	♀ paratype	♂ holotype	♀ paratype
Carapace	L/W	2.963 / 3.200	2.750 / 3.275	2.200 / 2.425	3.400 / 4.075
Mesosoma	L	6.900	8.500	4,420	6.750
Tergite VII	L/W	1.800 / 2.950	1.775 / 3.025	1.225 / 2.400	1.750 / 3.850
Metasoma+telson	L	15.200	13.875	11.363	17.200
Segment I	L/W/D	1.825 / 2.000 / 1.850	1.750 / 1.850 / 1.650	1.413 / 1.500 / 1.350	2.150 / 2.250 / 1.932
Segment II	L/W/D	2.100 / 1.825 / 1.825	1.950 / 1.725 / 1.550	1.550 / 1.383 / 1.325	2.575 / 2.025 / 1.925
Segment III	L/W/D	2.350 / 1.800 / 1.800	2.025 / 1.700 / 1.625	1.700 / 1.368 / 1.325	2.625 / 2.000 / 1.925
Segment IV	L/W/D	2.850 / 1.800 / 1.775	2.500 / 1.750 / 1.475	2.000 / 1.325 / 1.213	3.025 / 1.950 / 1.775
Segment V	L/W/D	3.325 / 1.700 / 1.513	3.025 / 1.675 / 1.300	2.525 / 1.258 / 1.100	3.775 / 1.875 / 1.550
Telson	L/W/D	2.750 / 1.150 / 1.100	2.625 / 1.338 / 1.175	2.175 / 0.875 / 0.825	3.050 / 1.425 / 1.375
Pedipalp	L	7.575	6.875	5.900	8.650
Femur	L/W	1.975 / 0.758	1.625 / 0.800	1.450 / 0.600	2.025 / 0.900
Patella	L/W	2.425 / 1.040	2.225 / 1.050	1.975 / 0.808	2.975 / 1.275
Chela	L	3.175	3.025	2.475	3.650
Manus	L/W/D	1.175 / 0.733 / 0.775	0.975 / 0.838 / 0.800	0.925 / 0.513 / 0.525	1.475 / 0.875 / 0.950
Movable finger	L	2.000	2.050	1.55	2.175
<b>Total</b>	<b>L</b>	<b>25.06</b>	<b>25.13</b>	<b>17.98</b>	<b>27.35</b>

**Table 2:** Comparative measurements of adults of *Neobuthus erigavoensis* sp. n. and *N. gubanensis* sp. n. Abbreviations: length (L), width (W, in carapace it corresponds to posterior width), depth (D).

macrosetae very short, stout and spiniform in male, and long, fine setae in females; males with sternites III–VII finely granulated without carinae; females with sternites III–VI smooth, sternite VII granulated to smooth medially, with 4 granulated carinae; metasoma I–III with median lateral carinae absent in female and indicated in males; lateral surface of metasoma V sparsely granulated, with granules separated; soles of telotarsi with relatively sparse setation, leg III of adults with 12–16 ventral macrosetae on telotarsus; pectine teeth: 15–18 (males), 14–16 (females).

**DESCRIPTION.** Total length of adult males 16–19 mm, of adult female 25.2 mm; measurements of carapace, telson, segments of metasoma and pedipalps given in Table 1; positions and distribution of trichobothria of pedipalps shown in Figs. 288–291 and 294–295; trichobothrium  $d_2$  of pedipalp femur and patella present; base color pale yellow to light orange with variable fuscous pigmentation and extensive patterns of dark maculation on pedipalps, metasoma and legs; chelicerae yellow with dark reticulation on anterior manus, dentition reddish. **Sexual dimorphism:** strong, adult males substantially smaller, but without differences in shapes of pedipalps, metasoma and telson; pedipalp patella and femur granulate and matte in males, smooth and glossy in females; sternites smooth in females and partly granulated in males; macrosetae on pedipalps, legs, metasoma and telson much longer and finer in females than males; other sex differences cited below.

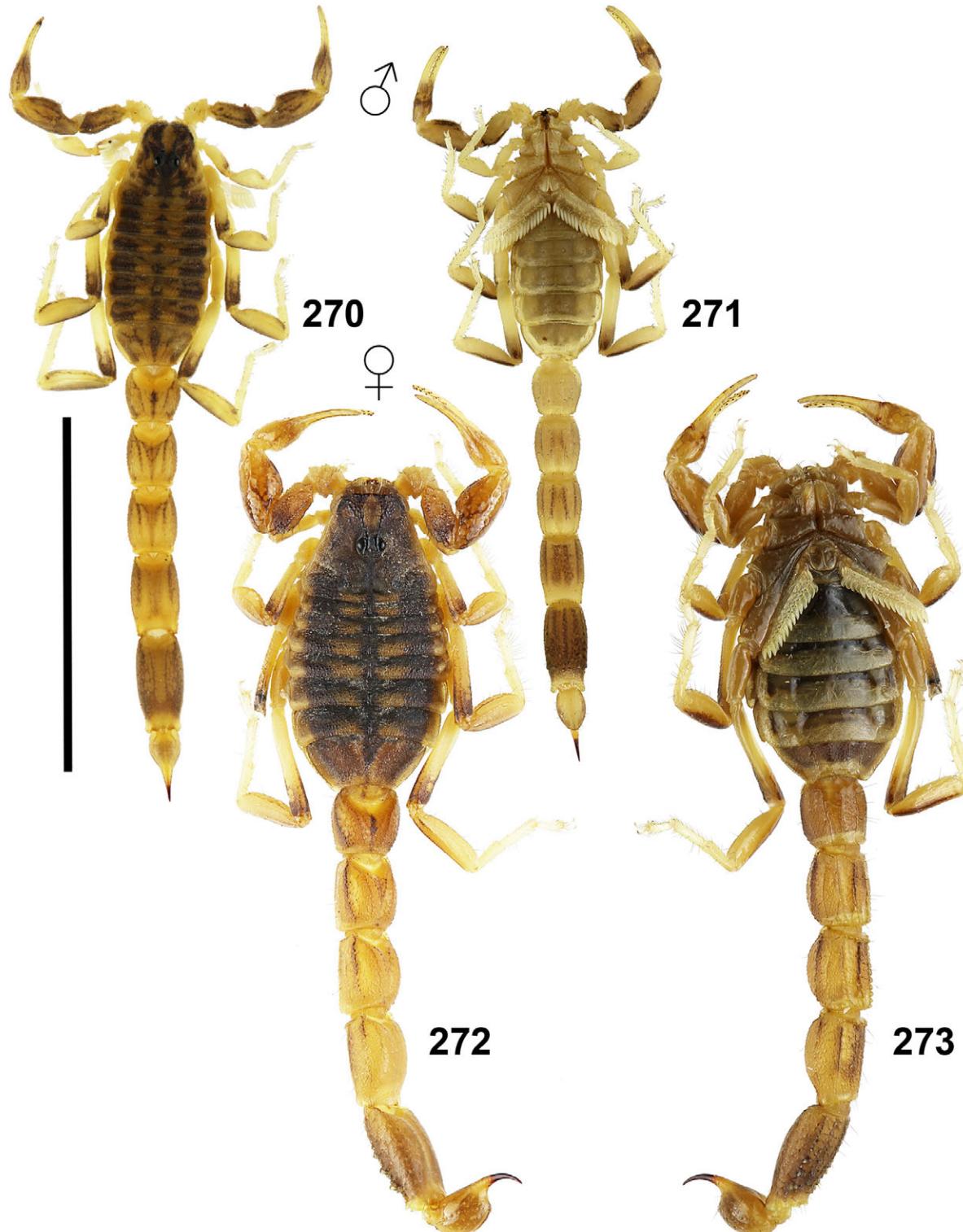
**Pedipalp** (Figs. 287–308). Pedipalp mostly sparsely hirsute; finely granulated in males and smooth in females; femur granulated in both sexes, with four conspicuously

granulose carinae; patella with seven granulose carinae developed in males and tuberculate, with three to five smooth carinae weakly indicated in females; ventro-external and dorsoexternal carinae on pedipalp patella in female absent; chela with smooth carinae weakly indicated.

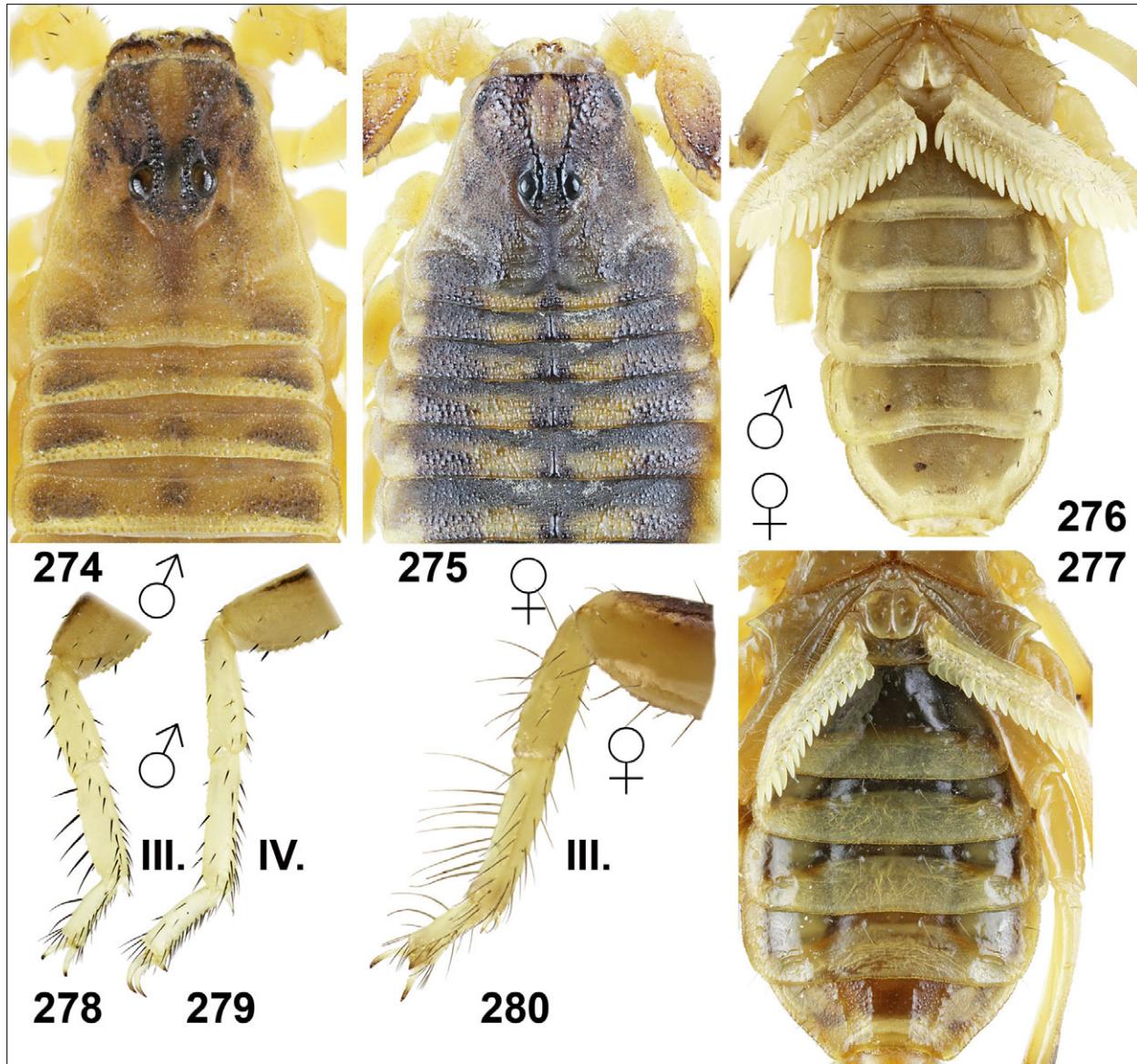
**Carapace** (Figs. 274–275). Strongly trapezoidal (narrower anteriorly), wider than long (L/W 0.82–0.94); posterior median postocular area flat, anterior median preocular area gently sloped downwards towards anterior margin; lateral flanks steeply sloped; ocular tubercle broad, prominent, located slightly anterior to middle of carapace; anterior margin straight, finely microdenticulate, with coarser granules overlapping edge, bearing 8 macrosetae; anterior median carinae developed, coarsely granular, other carinae indistinct; dense granulation covering most of carapace.

**Chelicera.** Fingers with typical buthid dentition (Vachon, 1963, Lowe & Kovařík, 2016); fixed finger with large distal denticle, 1 subdistal denticle and 2 basal denticles fused into bicusp, single denticle on ventral surface at level of bicusp; dorsal margin of movable finger with 5 denticles: 1 large distal denticle, medium-sized subdistal and medial, and 2 small, partially fused basal denticles; ventral margin with 2 denticles.

**Mesosoma** (Figs. 270–277). Tergites I–VI bear three carinae of which the lateral pair may be less conspicuous mainly on tergites I–IV; tergite VII bears five well-defined carinae (median, submedians and laterals); tergites I–VI densely granular, with coarser granules on posterior lateral areas; tergite VII densely granular; sternites III–VI smooth in female, and granulate in males; sternite VII granulated to smooth medially, with



**Figures 270–273:** *Neobuthus kloppersi* sp. n. **Figure 270.** Male paratype, dorsal view. **Figure 271.** Male holotype, ventral view. **Figures 272–273.** Female paratype from Kenya, South Horr, near Koros camp, 02°14'26.5"N 36°55'56"E, dorsal (272) and ventral (273) views. Scale bar: 10 mm.



**Figures 274–280:** *Neobuthus kloppersi* sp. n. **Figures 274, 276, 278–279.** Male holotype, carapace and tergites I–III (274), and coxosternal area and sternites (276), and right legs III–IV, retrolateral aspect (278–279). **Figures 275, 277, 280.** Female paratype from Kenya, South Horr, near Koros camp, 02°14'26.5"N 36°55'56"E, carapace and tergites I–V (275), coxosternal area and sternites (277), and right leg III, retrolateral aspect (280).

4 granulated carinae in female and finely granulated without or with weak carinae in males; sternum type 1, triangular in shape, smooth, with deep posteromedian invagination; genital opercula smooth; genital papillae present; pectines extending to around a quarter of sternite V in male and around end of sternite IV in female; pectine teeth 15–18 in males, 14–16 in female; combs with 3 marginal lamellae and 7–9 middle lamellae; marginal lamellae, middle lamellae and fulcra with dense cover of short macrosetae; fulcra with 2–4 setae.

**Legs** (Figs. 278–280). Coxa, femora, patella and tibia of all legs bearing variable numbers of short to medium length, straight, dark-reddish macrosetae; tarsi with mix

of short and longer, dark-reddish macrosetae; basitarsi I–III slightly compressed with flat retrolateral surfaces, with bristle combs consisting of retrosuperior series of longer macrosetae, plus retroinferior and proinferior series of shorter macrosetae; telotarsi with two rows of short setae on ventral aspect, 12–16 macrosetae on telotarsus III; tibial spurs moderate on legs III and IV.

**Metasoma and telson** (Figs. 281–286). Metasoma and telson sparsely hirsute, setae very short in males and longer in female, straight and reddish; metasomal segments I–III with 8–10 carinae, IV with 8 carinae, V with 2 carinae; segments I–III with well developed granulate dorsolateral carinae and absent (female) or weakly in-



**Figures 281–286:** *Neobuthus kloppersi* sp. n., metasoma and telson. **Figures 281–283.** Female paratype from Kenya, South Horr, near Koros camp, 02°14'26.5"N 36°55'56"E, lateral (281), dorsal (282), and ventral (283) views. **Figures 284–286.** Male holotype, lateral (284), dorsal (285), and ventral (286) views. Scale bars: 10 mm.

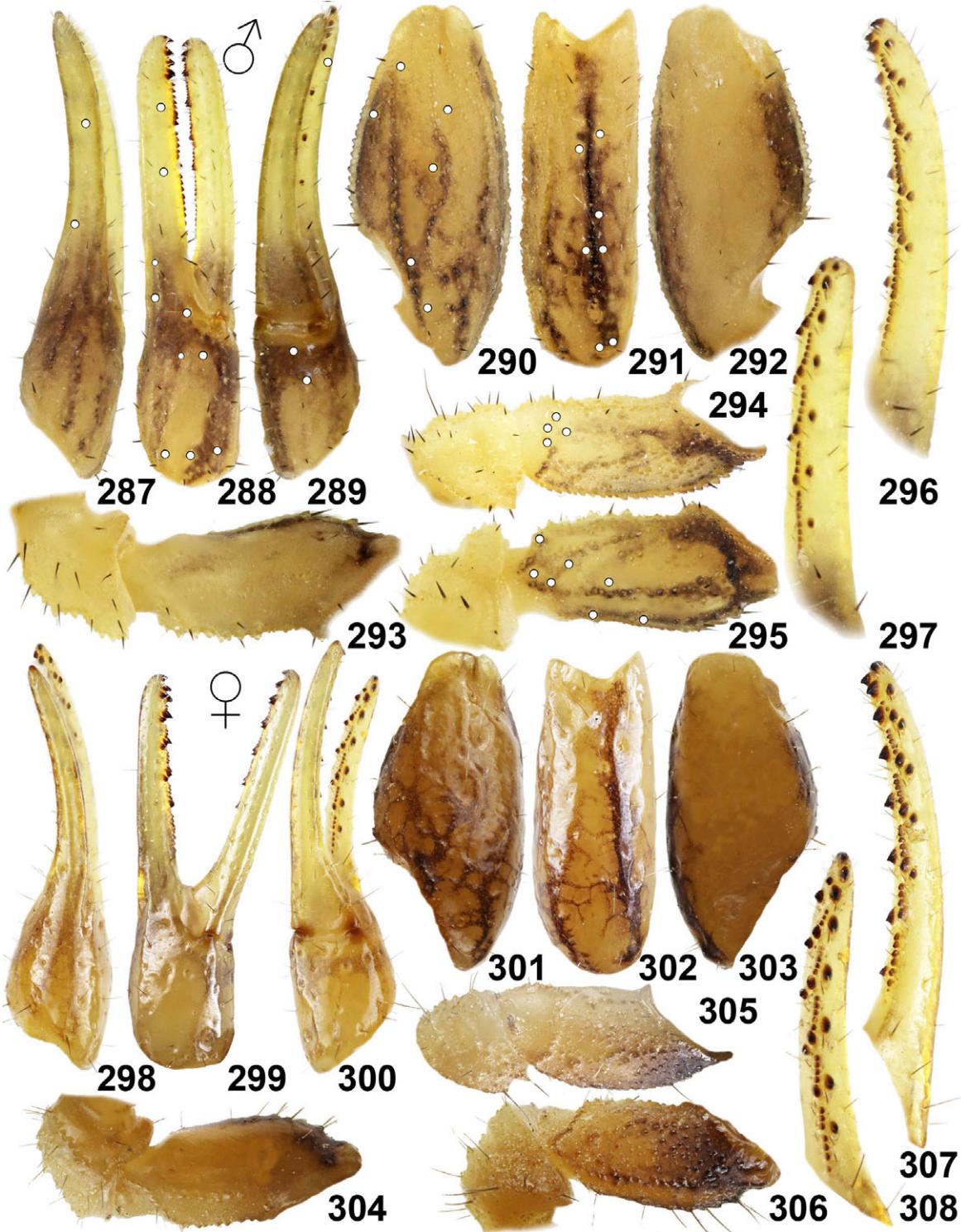
dicated (males) lateral carinae; other carinae relatively well developed; segment V with strong, granulate to dentate-lobate ventrolateral carinae; segments I–IV with dense granulation on all intercarinal surfaces including dorsal surfaces; segment V sparsely granular on lateral and densely granular on ventral surfaces, granules not arranged into any traces of carinae; telson rather smooth, ventral surface sparsely, weakly granular; vesicle slightly elongated; aculeus stout, shorter than vesicle, tip of aculeus almost vertically directed.

**AFFINITIES.** The described features distinguish *N. kloppersi* sp. n. from all other species of the genus. They are

recounted in the key below. Mainly, metasomal macrosetae very short, stout and spiniform in male (Fig. 425) with a combination of dorsally granulated metasomal segments I–III and absence of lateral carinae on metasomal segments I–III in females (Figs. 429) distinguishing *N. kloppersi* sp. n. from all other species of the genus.

***Neobuthus kutcheri* Lowe & Kovařík, 2016**  
(Figs. 413, 420, 438, Table 5)

*Neobuthus kutcheri* Lowe & Kovařík, 2016: 26–43, figs. 98–147, 154–156, 160–161, tables 3–5.



**Figures 287–308:** *Neobuthus kloppersi* sp. n., pedipalp segments. **Figures 287–297.** Male holotype, pedipalp chela, dorsal (287), external (288), and ventral (289) views, pedipalp patella, dorsal (290), external (291) and ventral (292) views, pedipalp femur and trochanter ventral (293), internal (294) and dorsal (295) views, pedipalp movable (296) and fixed (297) fingers dentate margin. **Figures 298–308.** Female paratype from Kenya, South Horr, near Koros camp,  $02^{\circ}14'26.5''N$   $36^{\circ}55'56''E$ , pedipalp chela, dorsal (298), external (299), and ventral (300) views, pedipalp patella, dorsal (301), external (302) and ventral (303) views, pedipalp femur and trochanter ventral (304), internal (305) and dorsal (306) views, pedipalp movable (307) and fixed (308) fingers dentate margin. The trichobothrial pattern is indicated in Figures 288–291 and 294–295 (white circles).



309



310

**Figures 309–310:** *Neobuthus kloppersi* sp. n., type locality, Kenya, South Horr, Kalama Conservancy, 0°42'22"N 37° 31'50"E.

TYPE LOCALITY AND TYPE REPOSITORY. **Ethiopia**, Somali State, Liben region, Filtu, 05°06'48.7"N 40°39'18.3"E, 1229 m a.s.l.; FKCP.

TYPE MATERIAL. **Ethiopia**, Somali State, Liben region, Filtu, 05°06'48.7"N 40°39'18.3"E, 1229 m a.s.l., (Locality No. 14EG, figs. 146–147 in Lowe & Kovařík,

Dimensions (mm)		<i>N. kloppersi</i> sp. n. ♂ holotype	<i>N. kloppersi</i> sp. n. ♀ paratype
Carapace	L/W	2.325 / 2.475	3.250 / 3.913
Mesosoma	L	4.650	5.600
Tergite VII	L/W	1.175 / 2.313	1.475 / 3.500
Metasoma+telson	L	12.008	16.350
Segment I	L/W/D	1.425 / 1.485 / 1.300	2.025 / 2.075 / 1.825
Segment II	L/W/D	1.675 / 1.375 / 1.288	2.300 / 1.855 / 1.775
Segment III	L/W/D	1.775 / 1.358 / 1.258	2.450 / 1.850 / 1.825
Segment IV	L/W/D	2.175 / 1.325 / 1.213	2.850 / 1.825 / 1.665
Segment V	L/W/D	2.658 / 1.325 / 1.092	3.575 / 1.850 / 1.525
Telson	L/W/D	2.300 / 0.908 / 0.850	3.150 / 1.400 / 1.263
Pedipalp	L	5.941	8.475
Femur	L/W	1.408 / 0.600	2.050 / 0.885
Patella	L/W	2.008 / 0.875	2.800 / 1.300
Chela	L	2.525	3.625
Manus	L/W/D	0.875 / 0.538 / 0.538	1.100 / 0.885 / 0.925
Movable finger	L	1.650	2.525
<b>Total</b>	<b>L</b>	<b>18.98</b>	<b>25.20</b>

**Table 3:** Comparative measurements of adults of *Neobuthus kloppersi* sp. n. Abbreviations: length (L), width (W, in carapace it corresponds to posterior width), depth (D).

2016: 36), 19.-21.XI.2014, 4♂ (holotype and paratypes) 6♀5♂ims.7juvs. (paratypes), FKCP, 2♂3♀3♂ims.2juvs. (paratypes), GLPC, leg. F. Kovařík et al. (UV detection).

DIAGNOSIS. Total length 21–23.3 mm (male), 27–31 mm (female); carapace with area between anterior median carinae yellow; tergites 3-striped with fuscous markings discontinuous, extending into median area, pale patches on either side of median stripe narrowed, disrupted and not forming broad longitudinal yellow bands; pedipalp relatively stout, males with femur L/W 2.28–2.30; patella L/W 2.19–2.32, chela L/W 4.40–4.50; chela movable finger with 4–6 subrows of primary denticles, 4–5 external accessory denticles flanking proximal end of each subrow; trichobothrium  $d_2$  of pedipalp femur usually absent,  $d_2$  of pedipalp patella usually present; dorsoexternal and ventroexternal carinae on pedipalp patella in female weakly absent; posterior margins of tergites bare, lacking macrosetae; pedipalps, legs, metasoma and telson with moderate length, mostly straight macrosetae in males, and long, fine curved setae in females; males with coxae and sternites III–VI smooth, sternite VII finely granulated with 4 weak, granulated carinae; females with sternites III–VI smooth, sternite VII sparsely shagreened with 4 weak carinae, metasoma I–III with median lateral carinae present in both sexes; lateral surface of metasoma V in males with granules fused to form rugose texture, without dense granulation; tarsi densely setose, telotarsi furnished with brushes of long macrosetae, leg III of adults with 24–37 ventral macrosetae on telotarsus; pectine teeth: 17–20 (males), 15–19 (females).

#### *Neobuthus maidensis* sp. n.

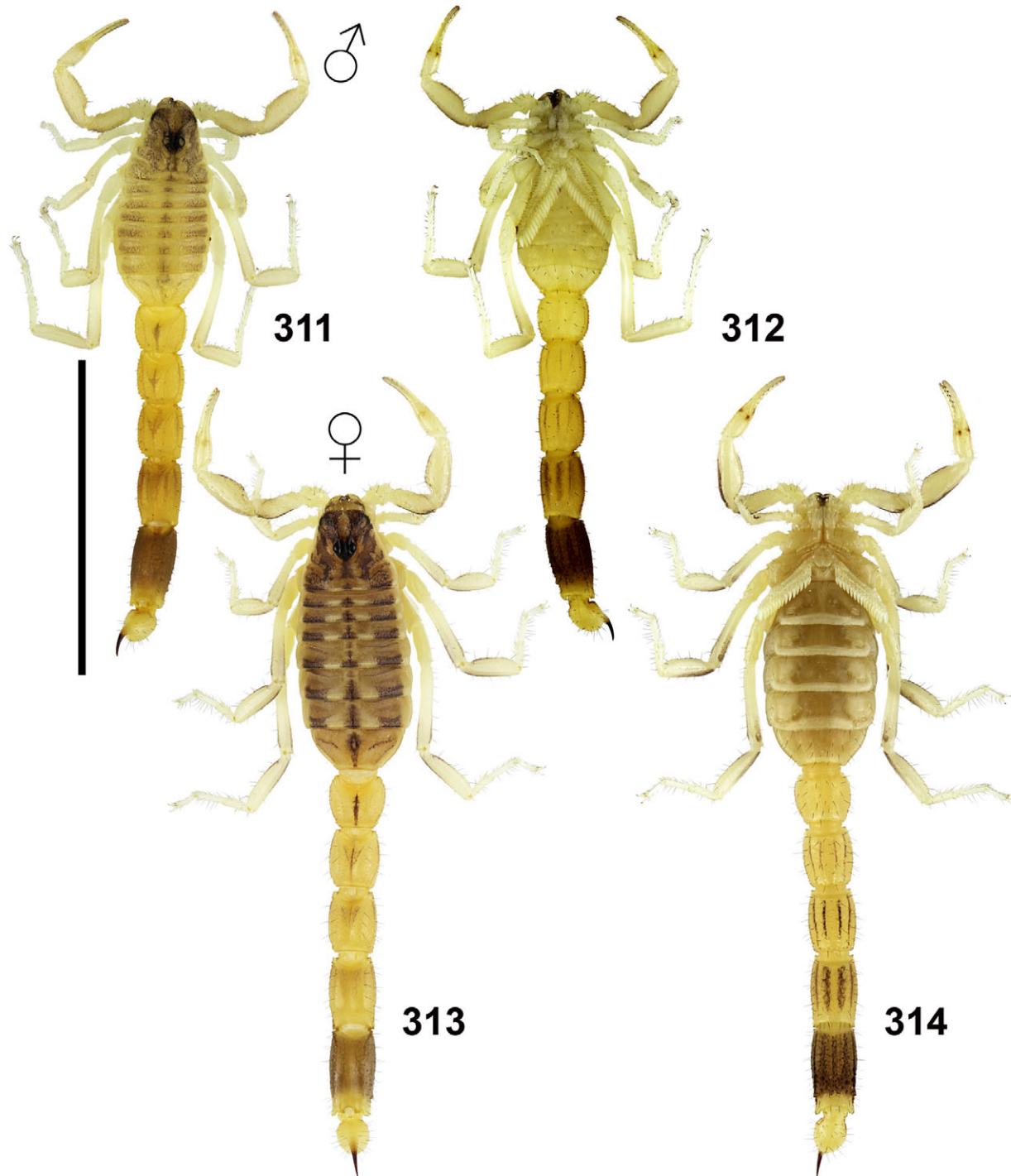
(Figs. 263–267, 311–348, 414, 417, 438, Tables 4–5)  
<http://zoobank.org/urn:lsid:zoobank.org:act:66CD407D-16F3-4EF1-9C4D-C32D57AD8267>

TYPE LOCALITY AND TYPE REPOSITORY. **Somaliland**, Maid, 11°00'03"N 47°06'30"E, 52 m a.s.l.; FKCP.

TYPE MATERIAL. **Somaliland**, Maid, 11°00'03"N 47°06'30"E, 52 m a.s.l. (Locality No. 17SN, fig. 120 in Kovařík et al., 2018: 26 and fig. 38 in Kovařík, 2018: 8), 3.–4.IX.2017, 1♂ (holotype, No. 1320) 1♀ (paratype), leg. F. Kovařík (UV detection), FKCP.

ETYMOLOGY. Named after the village of collection.

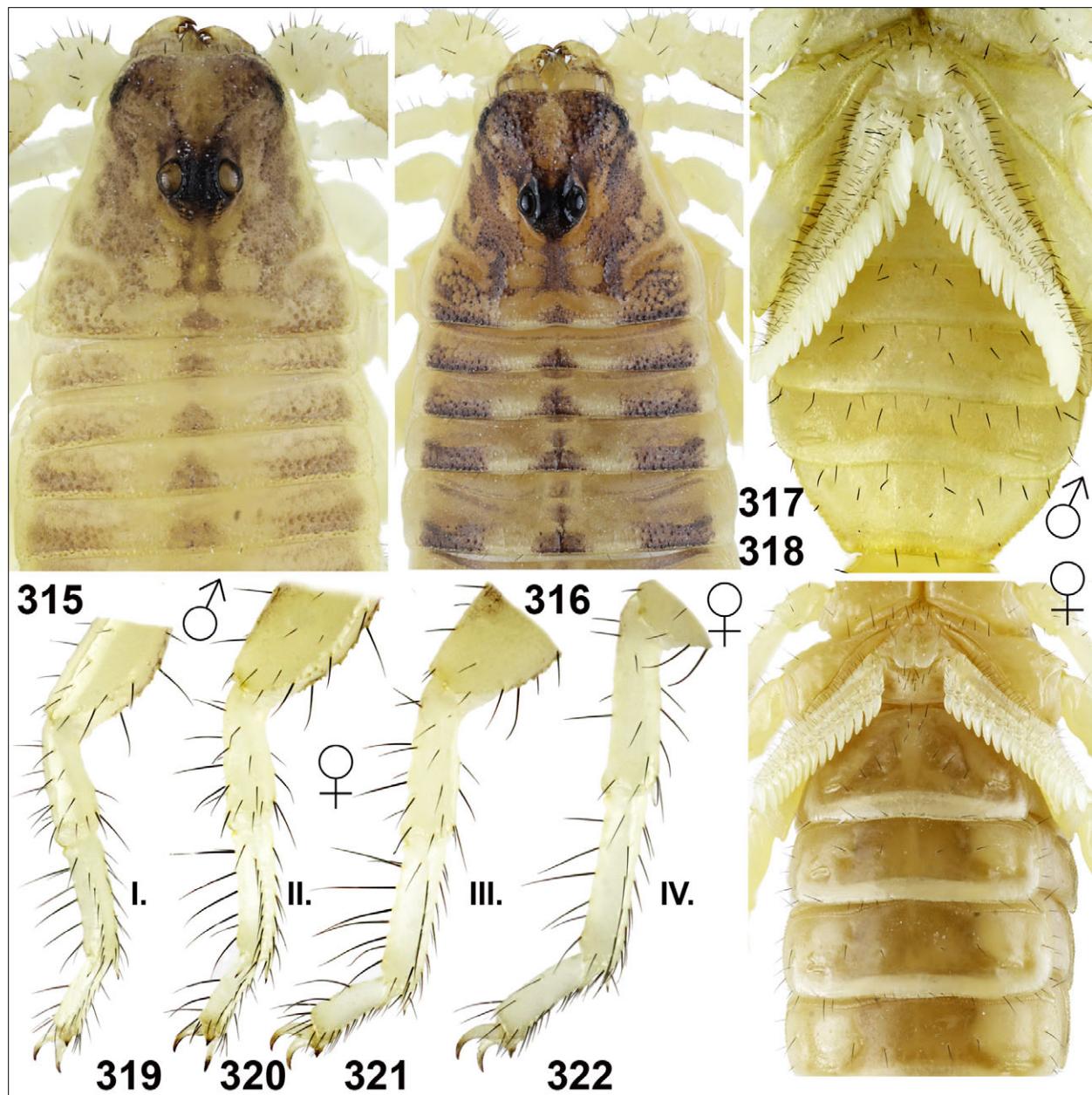
DIAGNOSIS. Total length 19.85 mm (male), 22.46 mm (female); carapace with area between anterior median carinae yellow to orange; tergites with 3 incomplete dark stripes; pedipalp relatively very slender, male with femur L/W 2.56, patella L/W 2.81, chela L/W 5.33; chela movable finger with 5 subrows of primary denticles, 4 external accessory denticles flanking proximal end of each subrow; trichobothria  $d_2$  usually absent from femur and patella; dorsoexternal and ventroexternal carinae on pedipalp patella in female present, smooth; posterior margins of tergites sparsely setose (male) or with 1–2 pairs of macrosetae (female); pedipalps, legs, metasoma and telson with moderately short, non-spiniform macrosetae in male, and long, fine setae in female; male with sternites III–VI shagreened to smooth medially, sternite VII finely granulated with 4 granulated carinae; female



**Figures 311–314:** *Neobuthus maidensis* sp. n. **Figures 311–312.** Male holotype, dorsal (311) and ventral (312) views. **Figures 313–314.** Female paratype, dorsal (313) and ventral (314) views. Scale bar: 10 mm.

with sternites III–VI smooth, sternite VII with 4 weak granulated carinae; metasoma I–III with median lateral

carinae present in both sexes; lateral surface of metasoma V in male densely granulated, with granules sep-



**Figures 315–322:** *Neobuthus maidensis* sp. n.. **Figures 315 and 317.** Male holotype, carapace and tergites I–IV (315) and coxosternal area and sternites (317). **Figures 316, 318–322.** Female paratype, carapace and tergites I–IV (316), coxosternal area and sternites III–VI (318), and right legs I–IV, retrolateral aspect (319–322).

arated; soles of telotarsi with relatively sparse setation, leg III of adults with 12–14 ventral macrosetae on telotarsus; pectine teeth: 19–21 (male), 15–16 (female).

**DESCRIPTION.** Total length of adult male 19.85 mm, of adult female 22.46 mm; measurements of carapace, telson, segments of metasoma and pedipalps given in Table 1; positions and distribution of trichobothria of pedipalps shown in Figs. 332–335 and 338–339; trichobothrium  $d_2$  usually absent from femur and patella; base color pale

yellow to white with variable fuscous pigmentation and patterns of dark maculation on metasoma, and very weakly on pedipalps and legs; chelicerae yellow with dark reticulation on anterior manus, dentition reddish. **Sexual dimorphism:** strong, adult males substantially smaller, but without differences in shapes of pedipalps, metasoma and telson; pedipalp patella and femur granulate and matte in male, smooth and glossy in female; sternites smooth in females and partly granulated in male; macrosetae on pedipalps, legs, metasoma and tel-

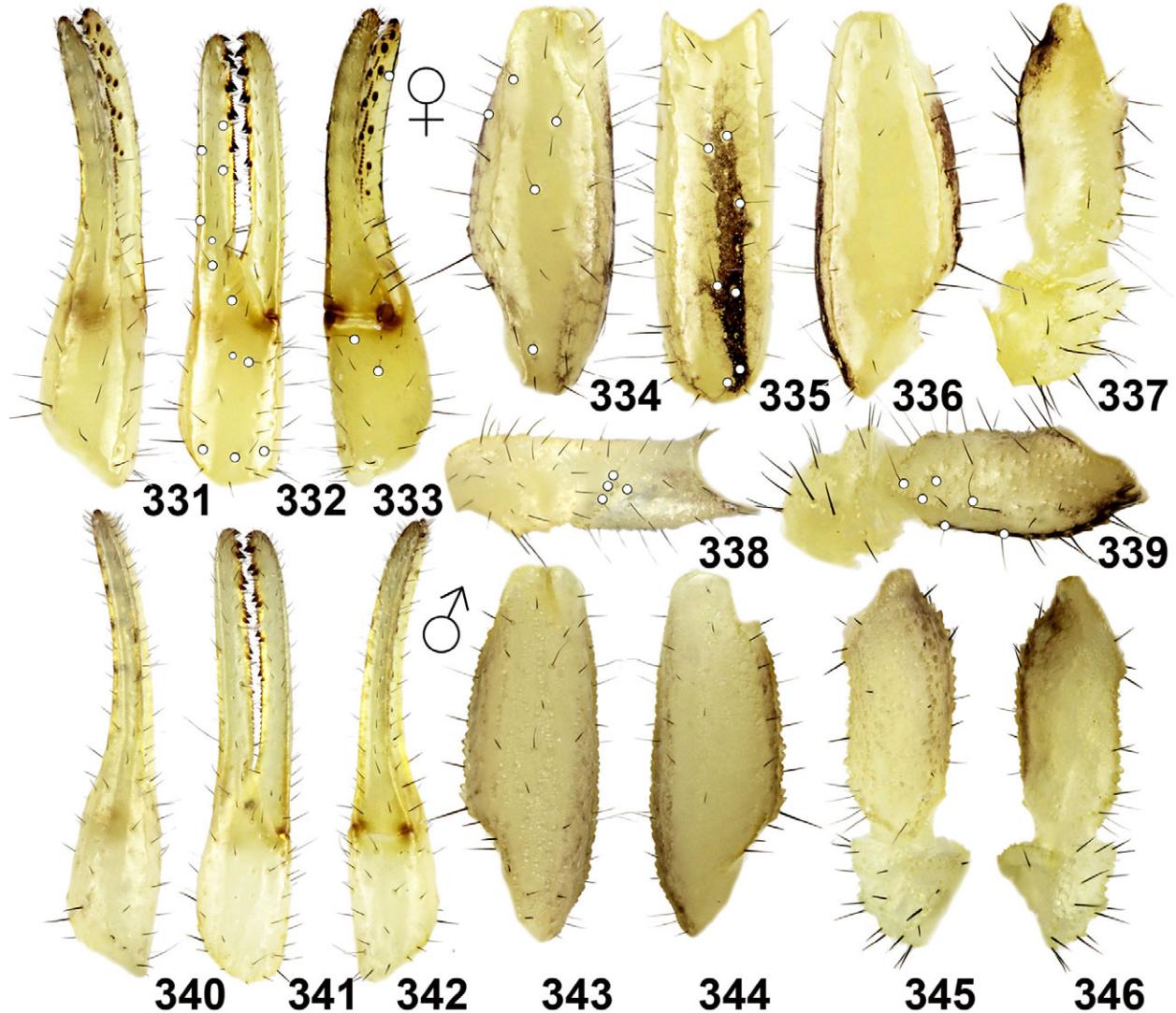


**Figures 323–330:** *Neobuthus maidensis* sp. n.. **Figures 323, 328–330.** Male holotype, metasoma V and telson lateral view (323), metasoma and telson lateral (328), dorsal (329), and ventral (330) views. **Figures 324–327.** Female paratype, metasoma V and telson lateral view (324), metasoma and telson lateral (328), dorsal (329), and ventral (330) views. Scale bar: 10 mm (325–330).

son much longer and finer in female than male; other sex differences cited below.

**Pedipalp** (Figs. 331–346). Pedipalp mostly sparsely hirsute; finely granulated in male and smooth in female;

femur with five conspicuously granulose carinae, more strongly developed in male; patella with seven granulose carinae developed in male, and five smooth carinae in female; ventroexternal and dorsoexternal carinae on ped-



**Figures 331–346:** *Neobuthus maidensis* sp. n., pedipalp segments. **Figures 331–339.** Female paratype, pedipalp chela, dorsal (331), external (332), and ventral (333) views, pedipalp patella, dorsal (334), external (335) and ventral (336) views, pedipalp femur and trochanter ventral (337), internal (338) and dorsal (339) views. **Figures 340–346.** Male holotype, pedipalp chela, dorsal (340), external (341), and ventral (342) views, pedipalp patella, dorsal (343) and ventral (344) views, pedipalp femur and trochanter dorsal (345) and ventral (346) views. The trichobothrial pattern is indicated in Figures 332–335 and 338–339 (white circles).

ipalp patella in female present, smooth; chela with smooth carinae indicated in male, and more clearly developed in female.

**Carapace** (Figs. 315–316). Strongly trapezoidal (narrower anteriorly), wider than long (L/W 0.82–0.83); posterior median postocular area flat, anterior median preocular area gently sloped downwards towards anterior margin; lateral flanks steeply sloped; ocular tubercle broad, prominent, located slightly anterior to middle of carapace; anterior margin straight, finely microdenticulate, with coarser granules overlapping edge, bearing 6–8 macrosetae; all carinae indistinct; dense granulation covering most of carapace.

**Chelicera.** Fingers with typical buthid dentition (Vachon, 1963, Lowe & Kovařík, 2016); fixed finger with large distal denticle, 1 subdistal denticle and 2 basal denticles fused into bicusp, single denticle on ventral surface at level of bicusp; dorsal margin of movable finger with 5 denticles: 1 large distal denticle, medium-sized subdistal and medial, and 2 small, partially fused basal denticles; ventral margin with 2 denticles.

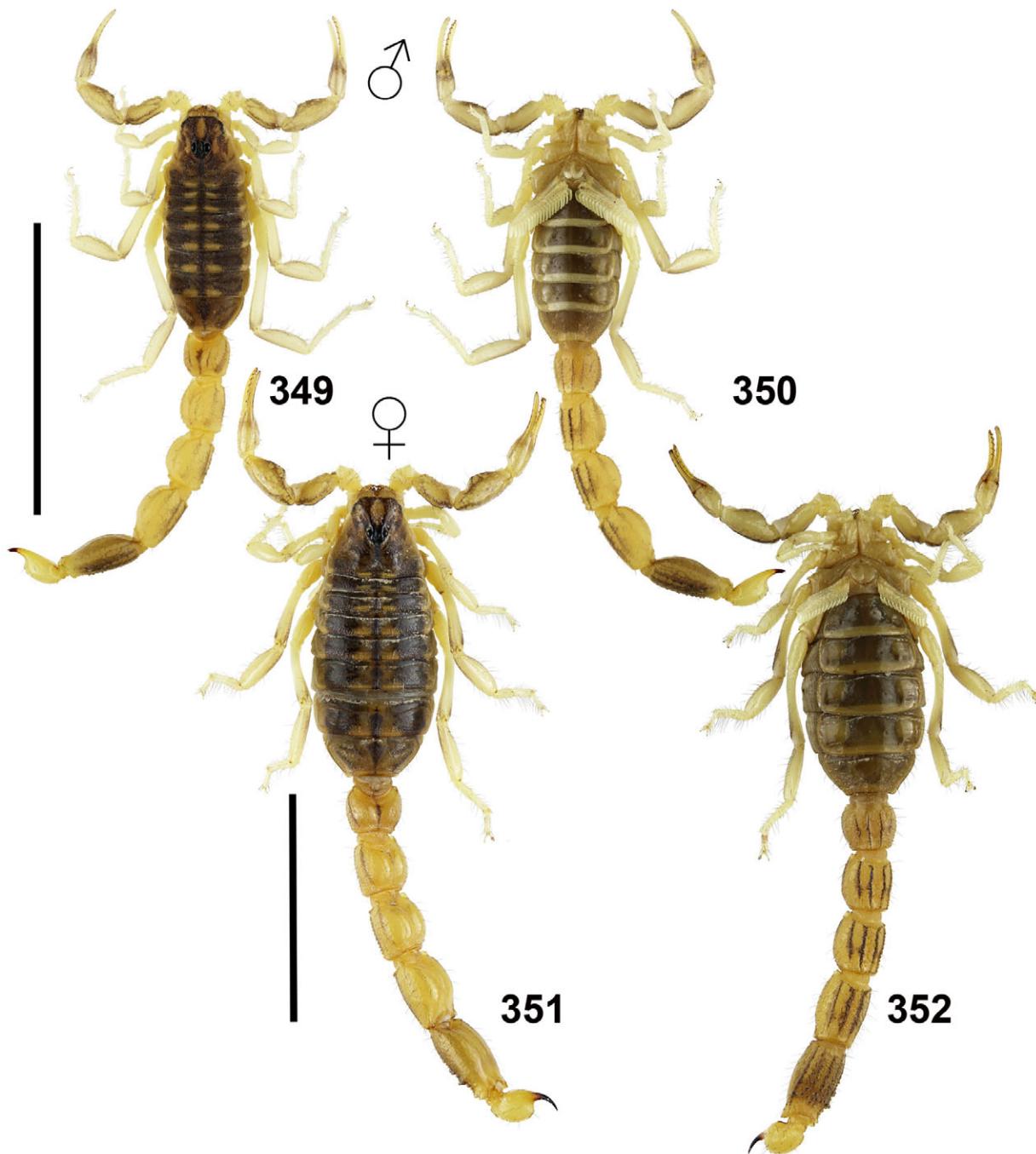
**Mesosoma** (Figs. 311–318). Tergites I–VI bear three carinae of which the lateral pair may be less conspicuous mainly on tergites I–IV; tergite VII bears five well-defined carinae (median, submedians and laterals); tergites I–VI granular, with coarser granules on posterior



**Figures 347–348:** *Neobuthus maidensis* sp. n. in vivo habitus. Male holotype (347) and female paratype (348).

lateral areas; tergite VII densely granular; sternites III–VI smooth medially and granulate laterally in male and smooth in female; sternite VII with four well-defined carinae, sternite VII densely, finely granulated in male and weakly granulated in female; sternum type 1, tri-

angular in shape, smooth, with deep posteromedian invagination; genital opercula smooth; genital papillae present; pectines extending to around a quarter of sternite V in male and around end of sternite IV in female; pectine teeth 19 and 21 in male, 15 and 16 in female;

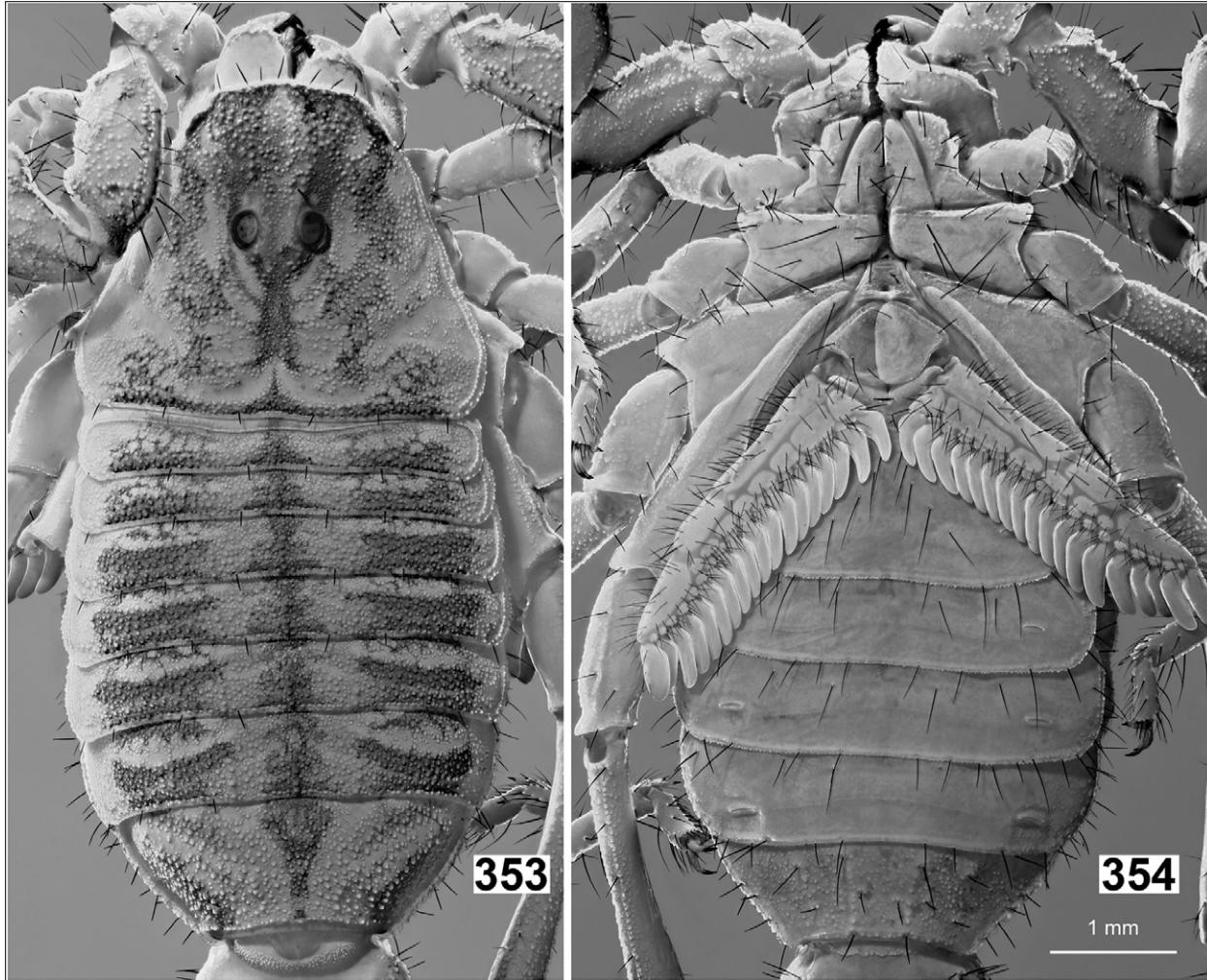


**Figures 349–352:** *Neobuthus montanus* sp. n. **Figures 349–350.** Male holotype, dorsal (349) and ventral (350) views. **Figures 351–352.** Female paratype, dorsal (351) and ventral (352) views. Scale bars: 10 mm.

combs with 3 marginal lamellae and 8–9 middle lamellae; marginal lamellae, middle lamellae and fulcra with dense cover of short dark reddish macrosetae; fulcra with 2–5 setae.

**Hemispermatophore** (Figs. 263–267). Typical of the genus.

**Legs** (Figs. 319–322). Coxa, femora, patella and tibia of all legs bearing variable numbers of short to medium length, straight, dark-reddish macrosetae; tarsi with mix of short and longer, dark-reddish macrosetae; basitarsi I–III slightly compressed with flat retrolateral surfaces, with bristle combs consisting of retrosuperior series of



**Figures 353–354:** *Neobuthus montanus* sp. n., male paratype (No. 1541) from type locality, carapace and tergites (353), coxosternal area and sternites (354). UV fluorescence. Scale bar: 0.5 mm.

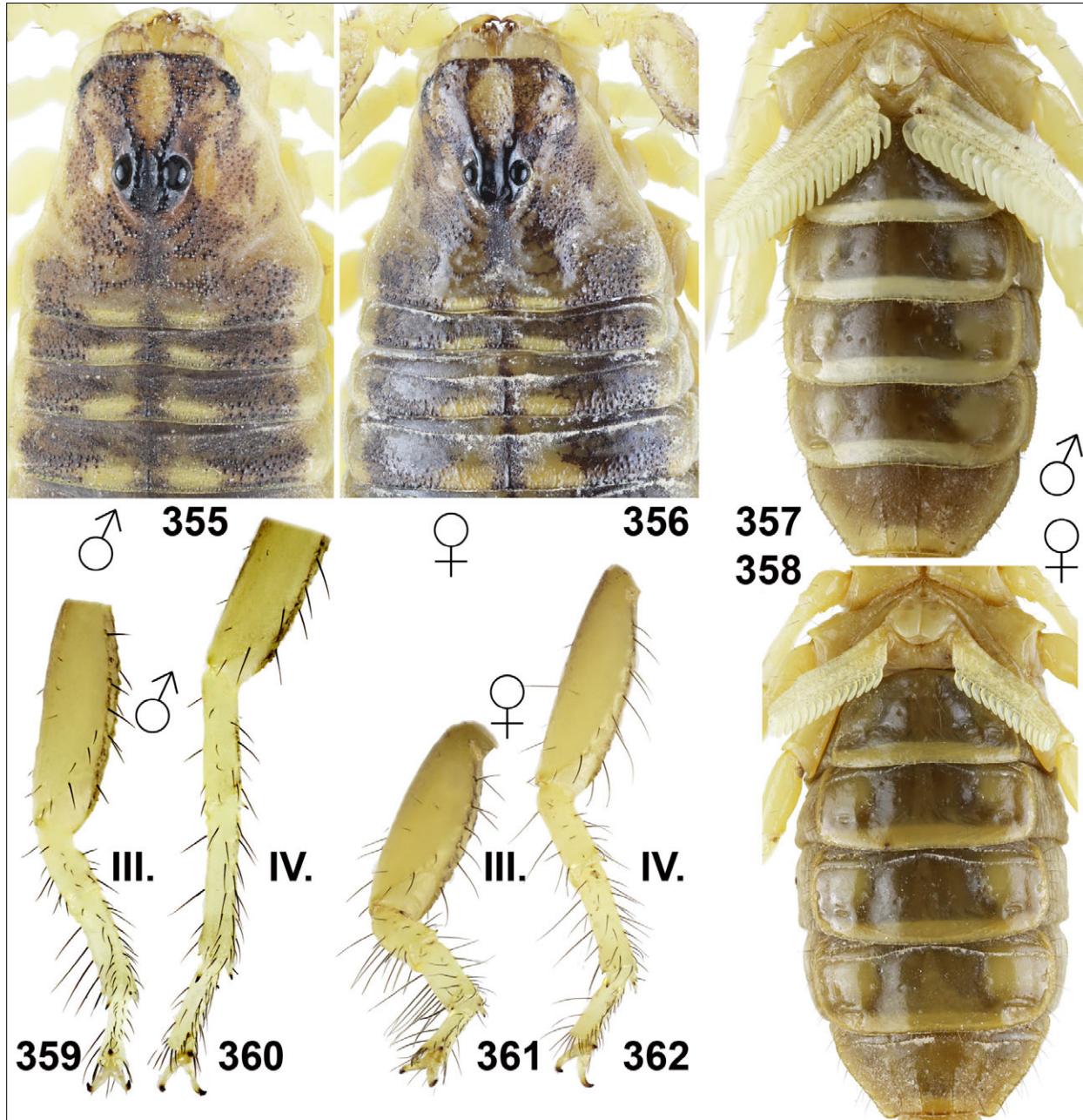
longer macrosetae, plus retroinferior and proinferior series of shorter macrosetae; telotarsi with two rows of short setae on ventral aspect, 12–14 macrosetae on telotarsus III; tibial spurs moderate on leg IV and reduced, very short on leg III.

**Metasoma and telson** (Figs. 323–330). Metasoma and telson sparsely hirsute, setae moderately short in male and longer in female, straight and reddish; metasomal segments I–III with 10 carinae, IV with 6–8 carinae, V with 2 carinae; segments I–III with moderate, granulate dorsolateral carinae, other carinae relatively well developed; segment IV with weakly indicated dorsolateral carinae; segment V with strong, granulate to dentate-lobate ventrolateral carinae; segments I–IV with dense granulation on all intercarinal surfaces including dorsal surfaces; segment V densely granular on lateral and ventral surfaces, more coarsely so on ventral surface, granules not arranged along any traces of carinae; telson smooth, ventral surface sparsely, weakly granular; ves-

icle slightly elongated; aculeus stout, shorter than vesicle, tip of aculeus almost vertically directed.

**AFFINITIES.** The described features distinguish *N. maidensis* sp. n. from all other species of the genus. *N. maidensis* sp. n. has the narrowest pedipalp patella among all *Neobuthus* species (Fig. 417) and several other unique characters, mainly almost white color (Figs. 347–348), and indistinct anterior median carapacial carinae. The limited available sample of specimens precludes us from characterizing intraspecific variability of this species.

**COMMENTS ON LOCALITIES AND LIFE STRATEGY.** The type locality, 17SN is sandy semi-desert to desert (fig. 120 in Kovařík et al., 2018: 26 and fig. 38 in Kovařík, 2018: 8). The types of *N. maidensis* sp. n. were obtained at night during UV collecting together with *Compsobuthus maidensis* Kovařík, 2018 (type locality), Gint



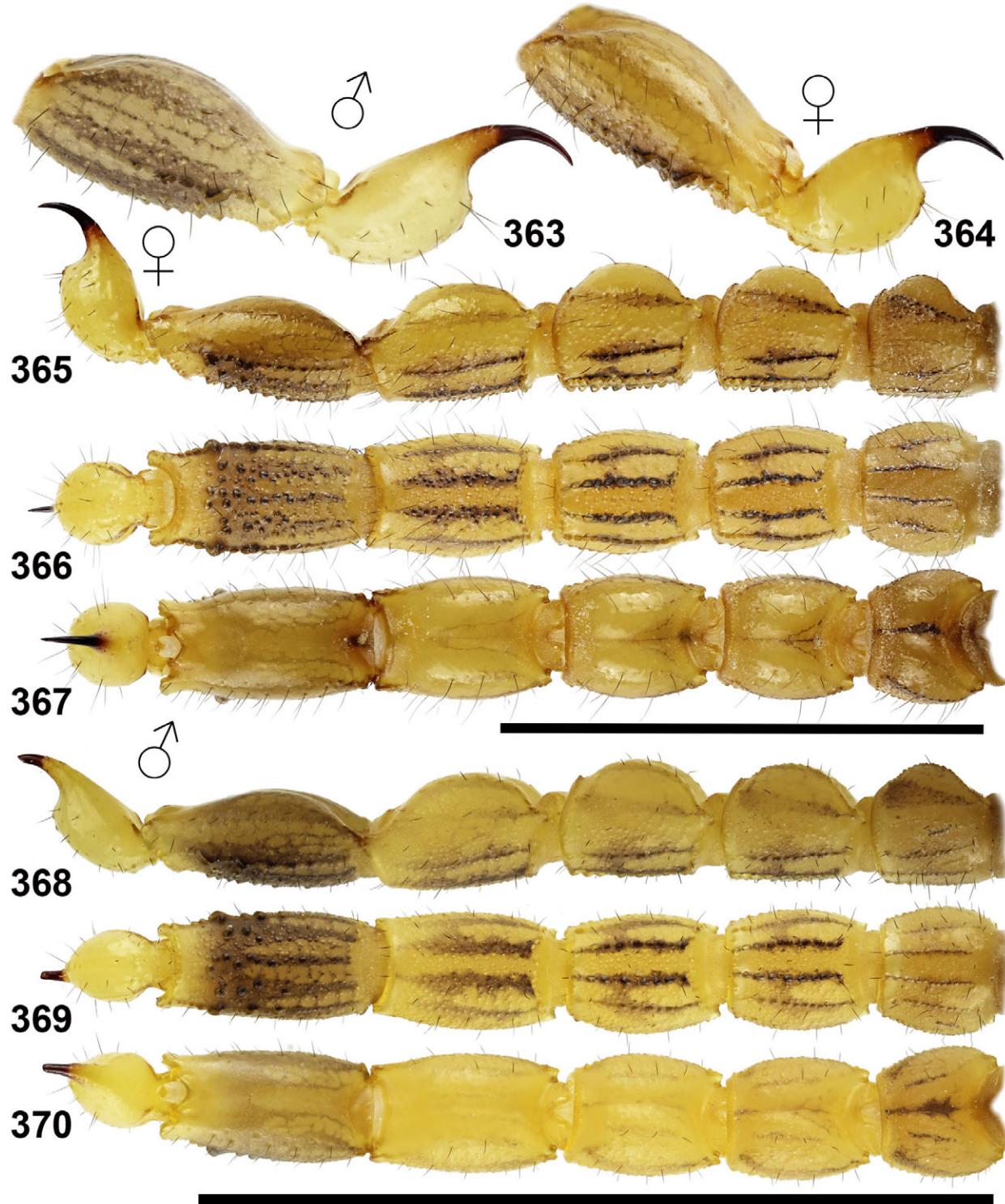
**Figures 355–362:** *Neobuthus montanus* sp. n.. **Figures 355, 357, 359–360.** Male holotype, carapace and tergites I–III (355) and coxosternal area and sternites (357), and right legs III–IV, retrolateral aspect (359–360). **Figures 356, 358, 361–362.** Female paratype, carapace and tergites I–III (356), coxosternal area and sternites (358), and right legs III–IV, retrolateral aspect (361–362).

*maidensis* Kovařík et al., 2018 (type locality), *Hottentotta* sp., and *Leiurus* sp. (Buthidae). The first author arrived at the locality at night on 3rd September 2017 at 21.00. At this time the temperature was 38.6 °C and humidity 52%. Minimum temperature of 31.9 °C and humidity of 46% were recorded on 4th September 2017 in the early morning.

#### *Neobuthus montanus* sp. n.

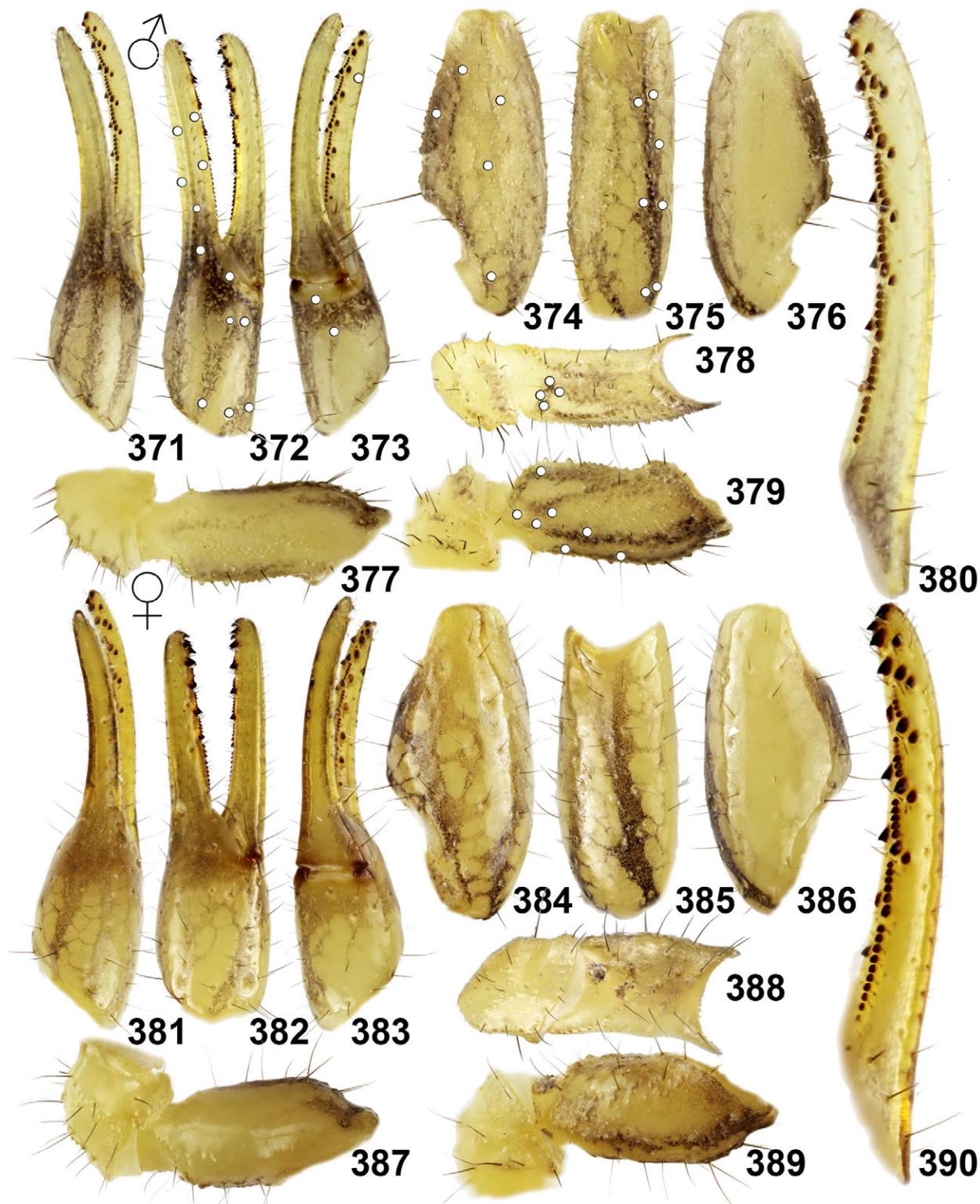
(Figs. 349–401, 415, 430, 435–438, Tables 4–5)  
<http://zoobank.org/urn:lsid:zoobank.org:act:C171742D-9364-4EEA-B253-C4AC45B9DB29>

TYPE LOCALITY AND TYPE REPOSITORY. **Somaliland**, Karim village, near Erigavo, 10°43'37"N 47°17'51"E, 2035–2070 m a.s.l.; FKCP.

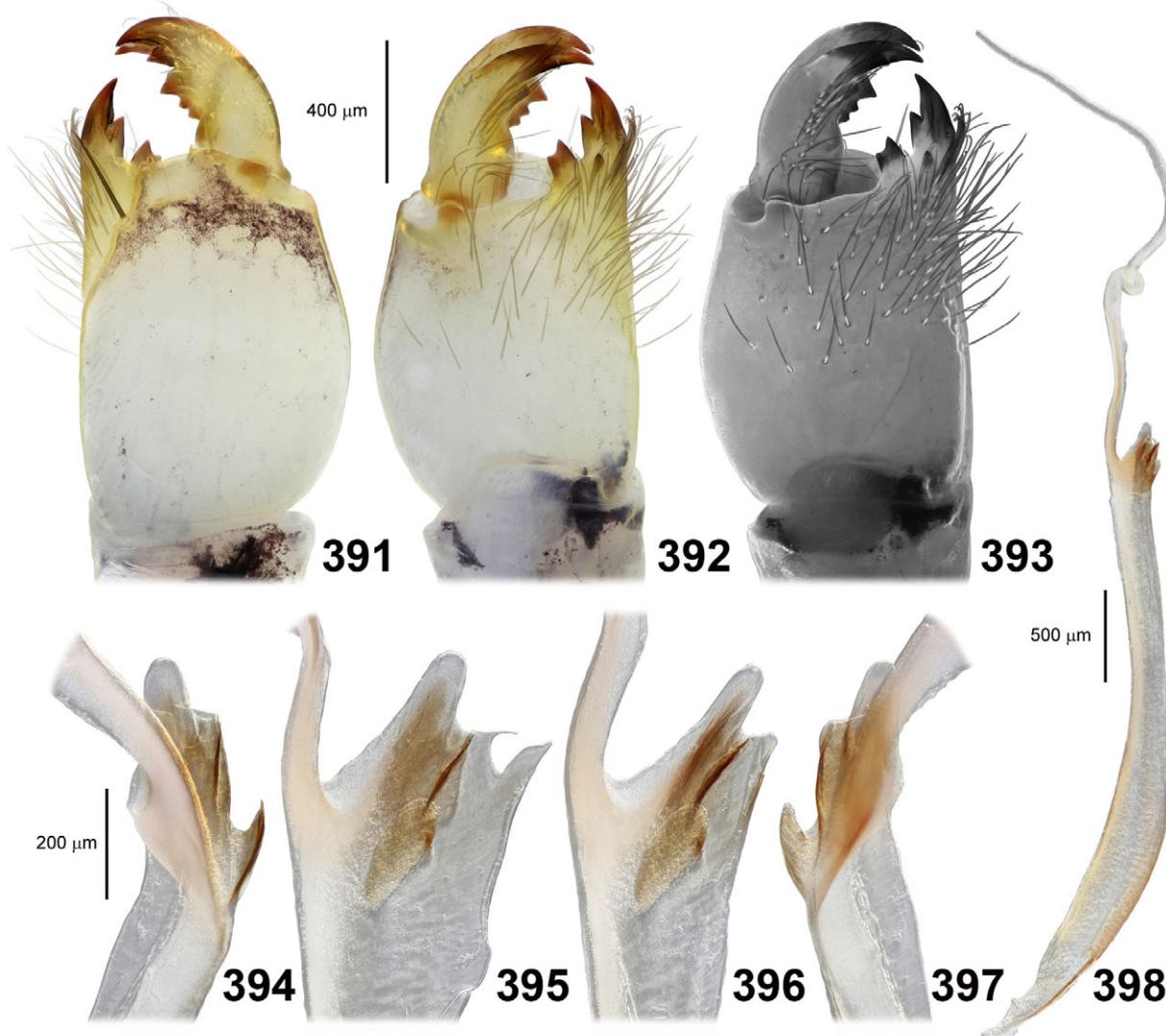


**Figures 363–370:** *Neobuthus montanus* sp. n.. **Figures 363, 368–370.** Male holotype, metasoma V and telson lateral view (363), metasoma and telson lateral (368), ventral (369), and dorsal (370) views. **Figures 364–367.** Female paratype, metasoma V and telson lateral view (364), metasoma and telson lateral (365), ventral (366), and dorsal (367) views. Scale bars: 10 mm (365–367, 368–370).

TYPE MATERIAL. **Somaliland**, Karim village, near Erigavo, 10°43'37"N 47°17'51"E, 2035–2070 m a.s.l. (Locality No. 18SC, Fig. 401), 22.VIII.2018, 4♂ 3♀ 1♂ juv. (holotype and paratypes, Nos. 1540, 1541, 1542), FKCP, 1♂ GLPC, leg. F. Kovařík (UV detection).



**Figures 371–390:** *Neobuthus montanus* sp. n., pedipalp segments. **Figures 371–380.** Male holotype, pedipalp chela, dorsal (371), external (372), and ventral (373) views, pedipalp patella, dorsal (374), external (375) and ventral (376) views, pedipalp femur and trochanter ventral (377), internal (378) and dorsal (379) views, pedipalp movable finger dentate margin (380). **Figures 381–390.** Female paratype, pedipalp chela, dorsal (381), external (382), and ventral (383) views, pedipalp patella, dorsal (384), external (385) and ventral (386) views, pedipalp femur and trochanter ventral (387), internal (388) and dorsal (389) views, pedipalp movable finger dentate margin (390). The trichobothrial pattern is indicated in Figures 372–375 and 378–379 (white circles).



**Figures 391–398:** *Neobuthus montanus* sp. n. from type locality. **Figures 391–393.** Male paratype (No. 1541), right chelicera, dorsal (391) and ventral (392) views, and ventral view under UV fluorescence (393). Scale bar: 400  $\mu\text{m}$ . **Figures 394–398.** Male paratype (No. 1542), right hemispermatophore capsule region in posterior (394), convex compressed (395), convex (396) and anterior (397) views; and male holotype (No. 1540), right hemispermatophore, convex view (398). Scale bars: 200  $\mu\text{m}$ , 500  $\mu\text{m}$ .

**ETYMOLOGY.** The type locality is in 2035–2070 m a.s.l. and represents the highest altitude where *Neobuthus* has been collected up to now. All other *Neobuthus* localities are between 30 and 1776 m a.s.l. That is why we named the new species *N. montanus*.

**DIAGNOSIS.** Total length 19–22 mm (males), 24–32 mm (females); carapace with area between anterior median carinae yellow; tergites with fuscous variable pigmentation; pedipalp relatively slender, males with femur L/W 2.18–2.34, patella L/W 2.28–2.44, chela L/W 4.18–4.44; chela movable finger with 5–6 subrows of primary denticles, 4 external accessory denticles flanking proximal end of each subrow; trichobothria  $d_2$  present or absent on dorsal surfaces of femur and patella; dorso-

external and ventroexternal carinae on pedipalp patella in female present, smooth; posterior margins of tergites without or with 2–4 pairs of macrosetae; pedipalps, legs, metasoma and telson with moderately short, not spiniform macrosetae in male, and long, fine setae in females; males with sternites III–VI smooth weakly shagreened on margins, sternite VII finely granulated with 4 weak, granulated carinae; females with sternites smooth, sternite VII with 4 weak granulated carinae; metasoma I with median lateral carinae present in both sexes, metasoma II–III with median lateral carinae absent in both sexes; lateral surfaces of metasoma I–V granulated in both sexes, metasoma I–III more densely granulated; dorsal metasomal carinae II–V wholly absent; soles of telotarsi with relatively sparse setation, leg



**Figures 399–400:** *Neobuthus montanus* sp. n. in vivo habitus. Male (399) and female (400) paratypes.

III of adults with 12–14 ventral macrosetae on telotarsus; pectine teeth: 16–20 (males), 13–14 (females).

DESCRIPTION. Total length of adult males 19–22 mm, of adult females 24–32 mm; measurements of carapace, tel-

son, segments of metasoma and pedipalps given in Table 1; positions and distribution of trichobothria of pedipalps shown in Figs. 372–375 and 378–379; trichobothrium  $d_2$  present or absent on femur and patella; base color pale yellow with variable fuscous pigmentation and patterns



**Figures 401:** *Neobuthus montanus* sp. n., type locality, Somaliland, Karim village, near Erigavo, 10°43'37"N 47°17'51"E.

of dark maculation on pedipalps, metasoma and partly on legs; chelicerae yellow with dark reticulation on anterior manus, dentition reddish. *Sexual dimorphism*: strong, adult males substantially smaller, but without differences in shapes of pedipalps, metasoma and telson; pedipalp patella and femur granulate and matte in males, smooth and glossy in females; sternites smooth in females and partially granulated in males; macrosetae on pedipalps, legs, metasoma and telson much longer and finer in females than males; other sex differences cited below.

**Pedipalp** (Figs. 371–390). Pedipalp mostly sparsely hirsute; finely granulated in males and smooth in females; femur with five conspicuously granulose carinae, more strongly developed in males; patella with seven granulose carinae developed in males, and five smooth carinae in females; ventroexternal and dorsoexternal carinae on pedipalp patella in female present, smooth; chela with carinae missing or weakly indicated.

**Carapace** (Figs. 353, 355–356). Strongly trapezoidal (narrower anteriorly), wider than long (L/ W 0.81–0.91); posterior median postocular area flat, anterior median preocular area gently sloped downwards towards anterior margin; lateral flanks steeply sloped; ocular tubercle broad, prominent, located slightly anterior to

middle of carapace; anterior margin straight, finely microdenticulate, with coarser granules overlapping edge, bearing 6–8 macrosetae; anterior median carinae weak, coarsely granular, other carinae indistinct; dense granulation covering most of carapace.

**Chelicera** (Figs. 391–393). Fingers with typical buthid dentition (Vachon, 1963, Lowe & Kovařík, 2016); fixed finger with large distal denticle, 1 subdistal denticle and 2 basal denticles fused into bicusp, single denticle on ventral surface at level of bicusp; dorsal margin of movable finger with 5 denticles: 1 large distal denticle, medium-sized subdistal and medial, and 2 small, partially fused basal denticles; ventral margin with 2 denticles.

**Mesosoma** (Figs. 353–358). Tergites I–VI bear three carinae of which the lateral pair may be less conspicuous mainly on tergites I–IV; tergite VII bears five well-defined carinae (median, submedians and laterals); tergites I–VI densely granular, with coarser granules on posterior lateral areas; tergite VII densely granular; sternites III–VI smooth in both sexes, but weakly shagreened on margins in males; sternite VII with four well-defined carinae and densely, finely granulated in both sexes; sternum type 1, triangular in shape, smooth, with deep posteromedian invagination; genital opercula

		<i>N. maidensis</i> sp. n.		<i>N. montanus</i> sp. n.	
Dimensions (mm)		♂ holotype	♀ paratype	♂ holotype	♀ paratype
Carapace	L/W	2.725 / 2.750	2.663 / 3.200	2.600 / 2.850	3.750 / 4.500
Mesosoma	L	4.200	6.120	5.320	9.100
Tergite VII	L/W	1.150 / 2.725	1.425 / 2.175	1.275 / 2.650	1.875 / 4.500
Metasoma+telson	L	12.925	13.675	13.368	19.013
Segment I	L/W/D	1.650 / 1.740 / 1.550	1.700 / 1.888 / 1.660	1.613 / 1.725 / 1.575	2.250 / 2.650 / 2.225
Segment II	L/W/D	1.800 / 1.625 / 1.550	1.950 / 1.700 / 1.550	1.950 / 1.625 / 1.575	2.700 / 2.475 / 2.250
Segment III	L/W/D	1.950 / 1.550 / 1.525	2.100 / 1.625 / 1.575	2.075 / 1.625 / 1.550	2.888 / 2.440 / 2.250
Segment IV	L/W/D	2.250 / 1.475 / 1.450	2.425 / 1.575 / 1.500	2.500 / 1.575 / 1.515	3.500 / 2.413 / 2.200
Segment V	L/W/D	2.725 / 1.450 / 1.325	2.800 / 1.550 / 1.388	2.850 / 1.450 / 1.263	4.175 / 2.200 / 1.950
Telson	L/W/D	2.550 / 1.038 / 0.958	2.700 / 1.050 / 1.013	2.380 / 0.975 / 0.750	3.500 / 1.675 / 1.533
Pedipalp	L	6.625	6.738	6.913	9.600
Femur	L/W	1.575 / 0.613	1.550 / 0.625	1.688 / 0.700	2.275 / 1.025
Patella	L/W	2.250 / 0.800	2.313 / 0.850	2.250 / 0.925	3.100 / 1.475
Chela	L	2.800	2.875	2.975	4.225
Manus	L/W/D	0.975 / 0.525 / 0.575	0.975 / 0.633 / 0.665	1.062 / 0.675 / 0.675	1.537 / 1.100 / 1.125
Movable finger	L	1.825	1.900	1.913	2.688
<b>Total</b>	<b>L</b>	<b>19.85</b>	<b>22.46</b>	<b>21.17</b>	<b>31.86</b>

**Table 4:** Comparative measurements of adults of *Neobuthus maidensis* sp. n. and *N. montanus* sp. n. Abbreviations: length (L), width (W, in carapace it corresponds to posterior width), depth (D).

smooth; genital papillae present; pectines extending to around end of sternite IV in male and around a quarter of sternite IV in female; pectine teeth 16–20 in males, 13–14 in females; combs with 3 marginal lamellae and 6–8 middle lamellae; marginal lamellae, middle lamellae and fulcra with dense cover of short dark reddish macrosetae; fulcra with 2–4 setae.

**Hemispermatophore** (Figs. 394–398). Typical of the genus.

**Legs** (Figs. 359–362). Coxa, femora, patella and tibia of all legs bearing variable numbers of short to medium length, straight, dark-reddish macrosetae; tarsi with mix of short and longer, dark-reddish macrosetae; basitarsi I–III slightly compressed with flat retrolateral surfaces, with bristle combs consisting of retrosuperior series of longer macrosetae, plus retroinferior and proinferior series of shorter macrosetae; telotarsi with two rows of short macrosetae on ventral aspect, 12–16 macrosetae on telotarsus III; tibial spurs moderate on leg IV and reduced on leg III.

**Metasoma and telson** (Figs. 363–370). Metasoma and telson sparsely hirsute, setae moderately short in male and longer in female, straight and reddish; metasomal segments I with 10 carinae, II–IV with 4–6 carinae, V with 2 carinae; segments I with moderate, granulate dorsolateral carinae, other carinae relatively well developed; segments II–V without dorsal carinae; segment V with strong, granulate to dentate-lobate ventrolateral carinae; segments I–IV with granulation on all intercarinal surfaces except dorsal surfaces which are smooth; segment V granular on lateral and ventral surfaces, more coarsely so on ventral surface, granules not arranged along any traces of carinae; telson smooth, ventral surface sparsely, weakly granular; vesicle slight-

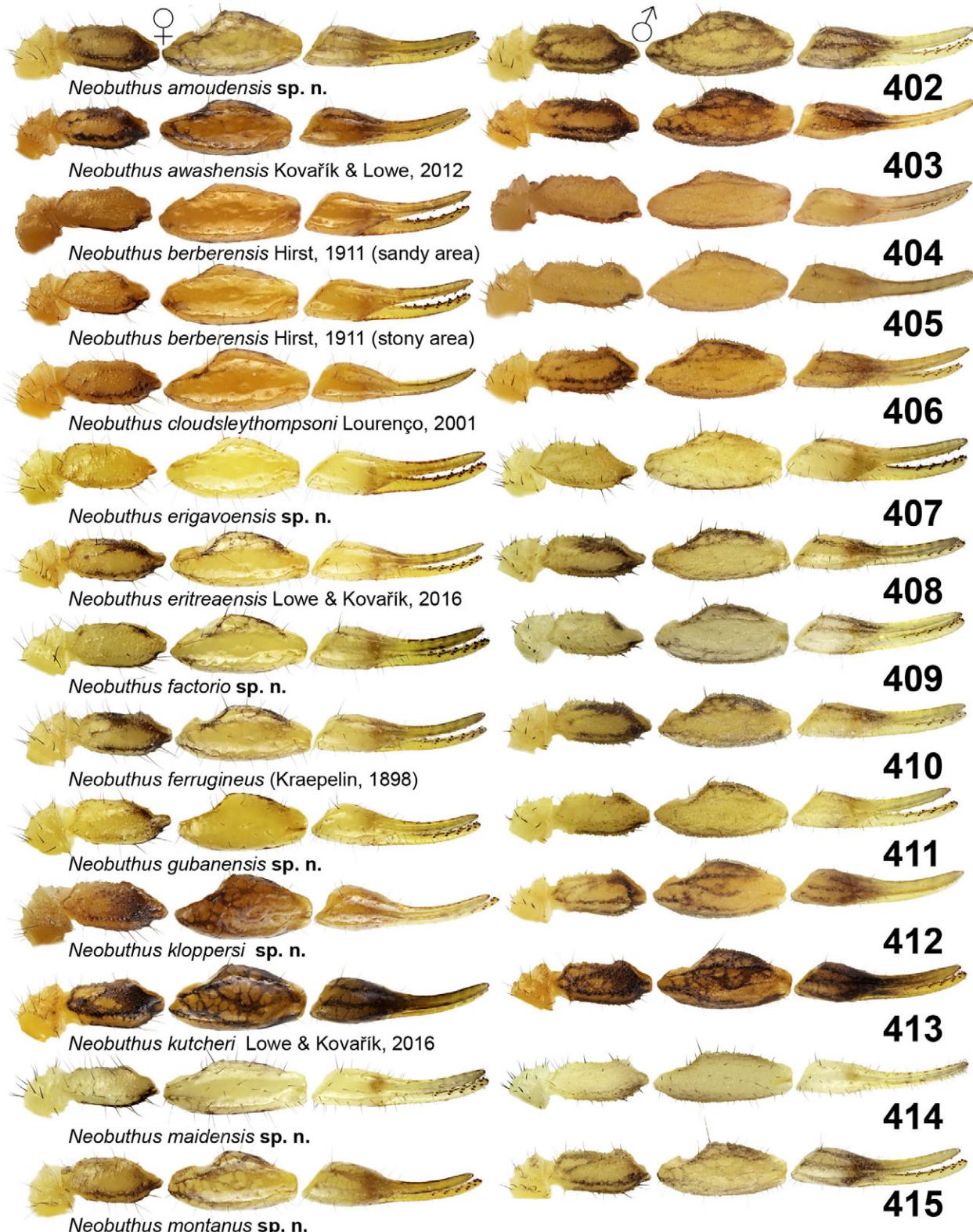
ly elongated; aculeus stout, shorter than vesicle, tip of aculeus almost vertically directed.

**AFFINITIES.** The described features distinguish *N. montanus* sp. n. from all other species of the genus. According to the distribution (see Fig. 348) the type locality of *N. montanus* sp. n. is near to the localities of *N. erigavoensis* sp. n.. These two species have missing dorsal metasomal carinae in females (Fig. 422), a unique character which differentiates these two species from all other *Neobuthus* species from Somaliland (Fig. 423). The characters which unequivocally separate these two species are presented in the key below.

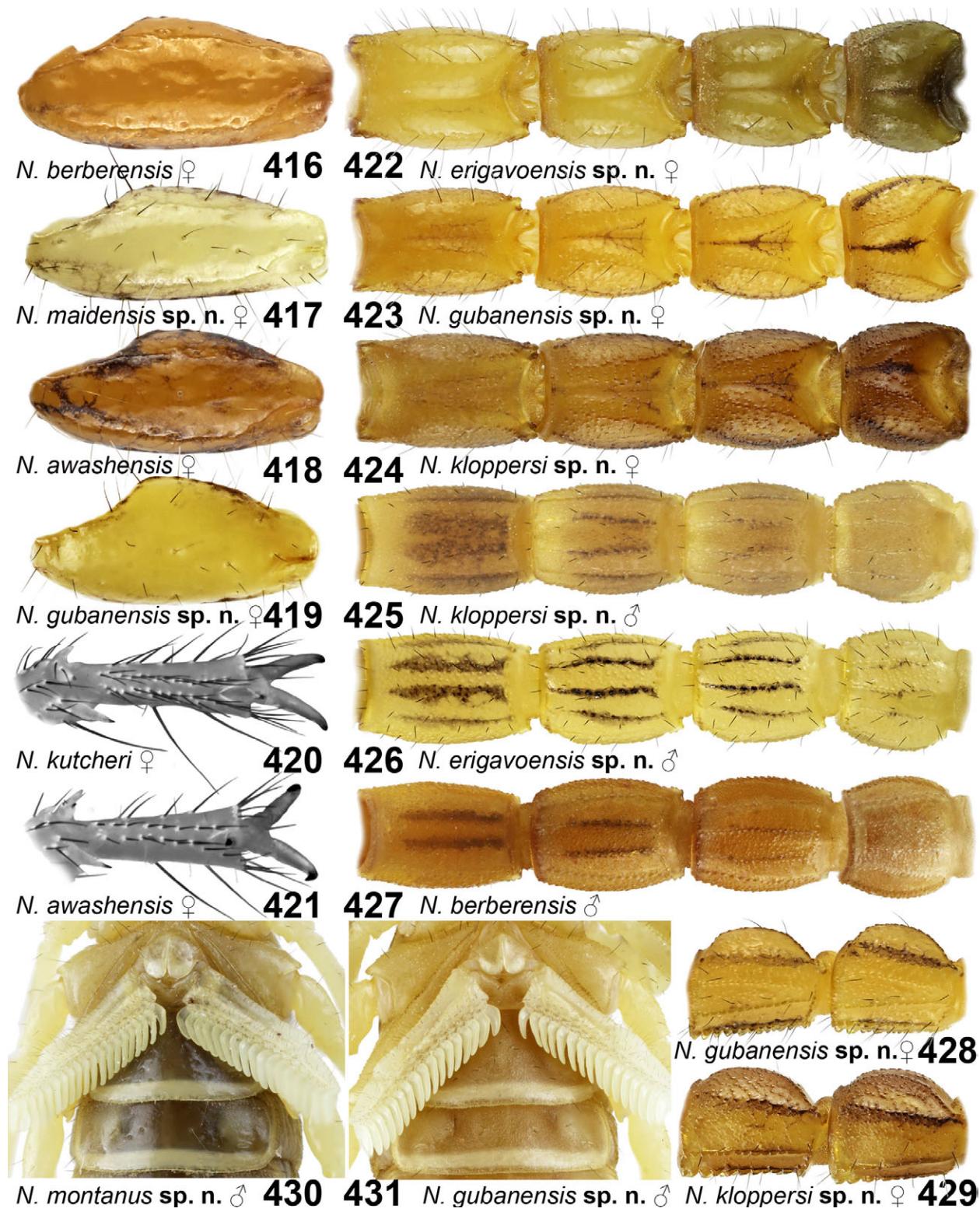
**COMMENTS ON LOCALITY AND LIFE STRATEGY.** The type locality 18SC (Fig. 401) is a semi-rocky plain on the margin of Karim village very near the mountain pass in Daalo Forest and near to the station on the top where we tried to collect scorpions at an altitude of 2180 m without success. The first author visited the locality in the dry season and collected all specimens at night with UV light with the help of Petra Frydlová and Tomáš Mazuch. At this locality, the first author recorded a minimum nighttime temperature of 15 °C. The recorded humidity was 67% (maximum at night).

#### Key to species of *Neobuthus*

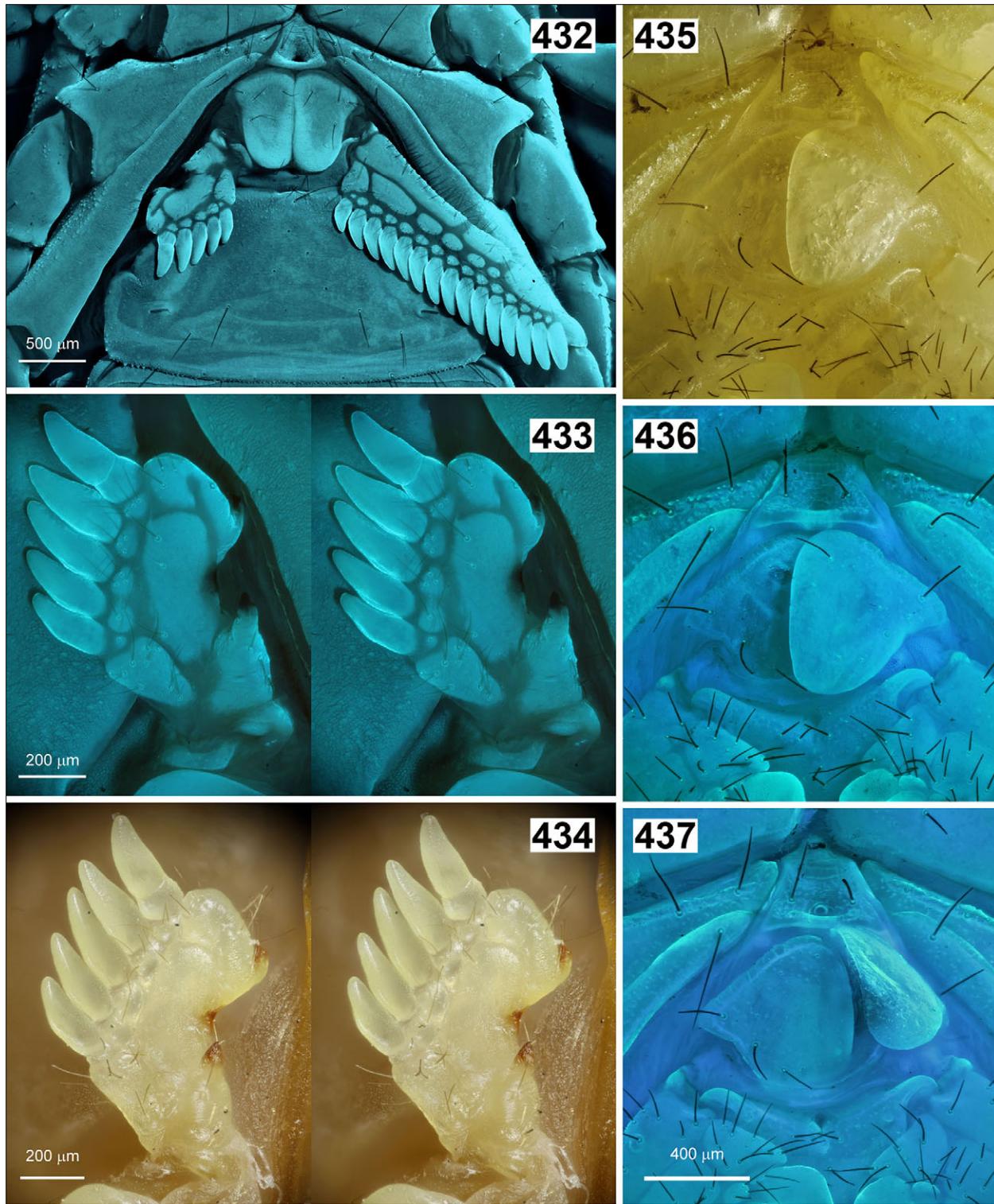
1. Pedipalps with numerous macrosetae (Figs. 417–419). .... 2
- Pedipalps very sparsely setose, or devoid of macrosetae (Fig. 416). .... *N. berberensis* Hirst, 1911 (population from sandy area)



**Figures 402–415:** Pedipalp femur, patella and chela dorsal views of female and male. **Figure 402.** *N. amoudensis* sp. n. **Figure 403.** *N. awashensis*. **Figure 404.** *N. berberensis* (from sandy area). **Figure 405.** *N. berberensis* (from stony area). **Figure 406.** *N. cloudsleythompsoni*. **Figure 407.** *N. erigavoensis* sp. n. **Figure 408.** *N. eritreaensis*. **Figure 409.** *N. factorio* sp. n. **Figure 410.** *N. ferrugineus*. **Figure 411.** *N. gubanensis* sp. n. **Figure 412.** *N. kloppersi* sp. n. **Figure 413.** *N. kutcheri*. **Figure 414.** *N. maidensis* sp. n. **Figure 415.** *N. montanus* sp. n.



**Figures 416–431:** *Neobuthus*, main characters used in the key to species. **Figures 416–419.** Pedipalp patella, dorsal view, female of *N. berberensis* (416), female of *N. maidensis* sp. n. (417), female of *N. awashensis* (418), and female of *N. gubanensis* sp. n. (419). **Figures 420–421.** Telotarsus III, ventral aspect, female of *N. kutcheri* (420), and female of *N. awashensis* (421). **Figures 422–424.** Metasoma IV–I, dorsal view, female of *N. erigavoensis* sp. n. (422), female of *N. gubanensis* sp. n. (423), and female of *N. kloppersi* sp. n. (424). **Figures 425–427.** Metasoma IV–I, ventral view, male of *N. kloppersi* sp. n. (425), male of *N. erigavoensis* sp. n. (426) and male of *N. berberensis* (427). **Figures 428–429.** Metasoma III–II, lateral view, female of *N. gubanensis* sp. n. (428), and female of *N. kloppersi* sp. n. (429). **Figures 430–431.** Sternites III–IV, male of *N. montanus* sp. n. (430), and male of *N. gubanensis* sp. n. (431).

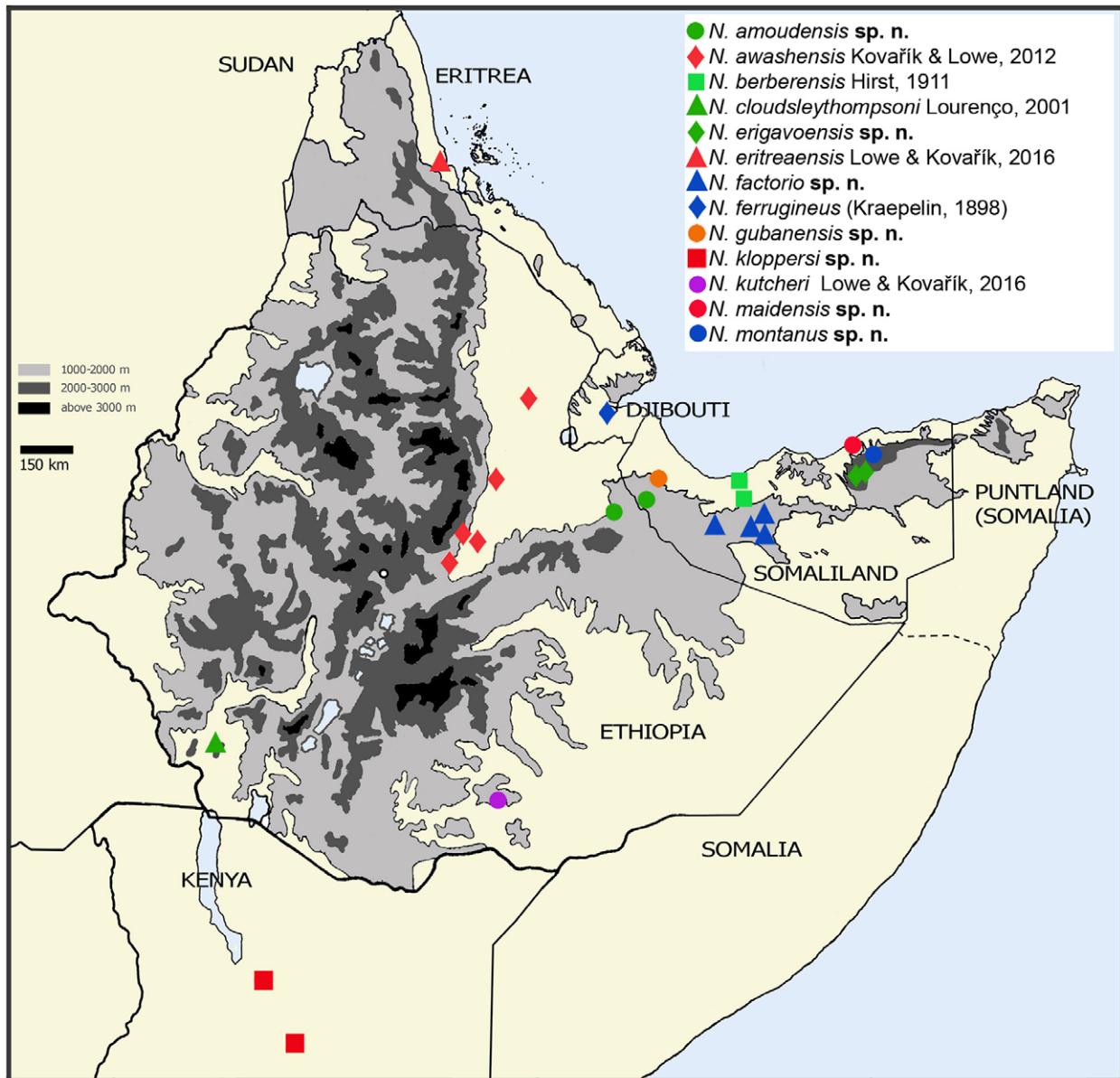


**Figures 432–437:** *Neobuthus*, developmental anomalies. **Figures 432–434.** Female of *N. gubanensis* sp. n. from type locality, sternopectinal area, showing normal left pectine and malformed right pectine (432), crossed stereoscopic views of malformed right pectine under UV fluorescence (433) and white light (434). Scale bars: 500 µm, 200 µm. **Figures 435–437.** Male of *N. montanus* sp. n. (No. 1541), genital opercula in situ under white light (435), UV fluorescence (436), and UV fluorescence with left operculum lifted to show abnormal location of right operculum (437). Scale bars: 400 µm.

		12	13	14	15	16	17	18	19	20	21	22	mean
<i>N. amoudensis</i> sp. n.	♂	—	—	—	1	2	15	12	2	1	—	1	17.58
	♀	—	—	10	13	1	1	—	—	—	—	—	14.72
<i>N. awashensis</i>	♂	—	—	—	—	—	1	6	28	27	6	—	19.46
	♀	—	—	—	9	23	14	2	—	—	—	—	16.19
<i>N. berberensis</i>	♂	—	—	—	—	—	1	4	—	1	—	—	18.16
	♀	—	1	1	3	4	—	—	—	—	—	—	15.11
<i>N. cloudsleythompsoni</i>	♂	—	—	—	8	28	31	10	2	—	—	—	16.62
	♀	1	8	5	3	—	—	—	—	—	—	—	13.59
<i>N. erigavoensis</i> sp. n.	♂	—	—	—	1	2	6	11	—	—	—	—	17.35
	♀	1	6	8	7	2	—	—	—	—	—	—	14.12
<i>N. eritreaensis</i>	♂	—	—	—	—	—	—	—	1	6	1	—	20.00
	♀	—	—	—	2	5	3	2	—	—	—	—	16.42
<i>N. factorio</i> sp. n.	♂	—	—	—	—	1	2	7	3	—	—	—	17.92
	♀	—	—	2	2	1	4	1	—	—	—	—	16.00
<i>N. ferrugineus</i>	♂	—	—	—	—	—	—	2	—	1	1	—	19.25
	♀	—	—	—	—	2	1	1	—	—	—	—	16.75
<i>N. gubanensis</i> sp. n.	♂	—	—	—	2	15	28	21	2	—	—	—	16.94
	♀	—	2	20	21	1	—	—	—	—	—	—	14.48
<i>N. kloppersi</i> sp. n.	♂	—	—	—	2	5	5	6	—	—	—	—	16.83
	♀	—	—	2	1	1	—	—	—	—	—	—	14.75
<i>N. kutcheri</i>	♂	—	—	—	—	—	2	8	9	1	—	—	18.45
	♀	—	—	—	4	4	11	3	2	—	—	—	16.79
<i>N. maidensis</i> sp. n.	♂	—	—	—	—	—	—	—	1	—	1	—	20.00
	♀	—	—	—	1	1	—	—	—	—	—	—	15.50
<i>N. montanus</i> sp. n.	♂	—	—	—	—	2	2	5	—	1	—	—	17.60
	♀	—	4	2	—	—	—	—	—	—	—	—	13.33

**Table 5:** Comparison among *Neobuthus* species (specimens), based upon pectinal teeth number.

2. Metasomal macrosetae moderately short in male, not very spiniform (Fig. 425). ..... 3  
 – Metasomal macrosetae very short in male, stout and spiniform (Fig. 426). ..... 10
3. Tarsi densely hirsute, adults 24–37 ventral macrosetae on telotarsus III (Fig. 420). ..... *N. kutcheri* Lowe & Kovařík, 2016  
 – Tarsi not densely hirsute; adults with 9–19 ventral macrosetae on telotarsus III (Fig. 421). ..... 4
4. Pedipalp patella narrow, L/W ratio 2.72–2.81 in both sexes (Fig. 417); marginal tips of pectines extend to a quarter of sternite VI in males. ..... *N. maidensis* sp. n.  
 – Pedipalp patella narrow, L/W ratio 2.10–2.70 in both sexes (Fig. 418); marginal tips of pectines extend to before half of sternite V in males. ..... 5
5. Female metasoma I–III with dorsal carinae absent (Fig. 422). ..... 6  
 – Female metasoma I–III with dorsal carinae present (Fig. 423). ..... 7
6. Pedipalps of female yellow with black spots developed or indicated; pedipalp femur L/W 2.18–2.34 in males; dorsoexternal carina on pedipalp patella in female present. ..... *N. montanus* sp. n.  
 – Pedipalps of female yellow without black spots; pedipalp femur L/W 2.45–2.61 in males; dorsoexternal carinae on pedipalp patella in female absent. ..... *N. erigavoensis* sp. n.
7. Dorsoexternal smooth carinae on pedipalp patella in female well developed (Fig. 418). ..... 8  
 – Dorsoexternal carinae on pedipalp patella in female absent or only weakly indicated (Fig. 419). ..... 9



**Figure 438:** Map showing distribution of *Neobuthus* spp.

- |  |   |   |
|--|---|---|
| 8. Space between anterior median carapacial carinae fuscous, sparsely granular ..... |   |   |
| ..... <i>N. awashensis</i> Kovařík & Lowe, 2012                                      |   |   |
| – Space between anterior median carapacial carinae pale, densely granular .....      | <i>N. amoudensis</i> sp. n.   |   |
| 9. Sternites III–VI smooth medially in males (Figs. 430, 138). ....                  | <i>N. factorio</i> sp. n.   |   |
| – Sternites III–VI with dense, fine granulation in males (Figs. 431, 218). ....      | <i>N. gubanensis</i> sp. n.   |   |
| 10. Female pedipalp femur more elongate, L/W 2.42–2.46. ....                         | 11  |   |
|  | – Female pedipalp femur more stout, L/W 2.10–2.36. ....                         | 12  |
|  | 11. Metasomal segments more elongate, metasoma IV L/D > 1.7, V L/D > 2.35. .... |   |
|  | ..... <i>N. eritreaensis</i> Lowe & Kovařík, 2016                               |   |
|  | – Metasomal segments more stout, metasoma IV L/D < 1.7, V L/D < 2.35. ....      | <i>N. ferrugineus</i> (Kraepelin, 1898)     |
|  | 12. Female metasoma I–III dorsally granulated (Fig. 424). ....                  | 13  |
|  | – Female metasoma I–III dorsally smooth (Fig. 422). ....                        | <i>N. cloudsleythompsoni</i> Lourenço, 2001 |

13. Metasoma I–III with median lateral carinae absent in female (Fig. 429). .... *N. kloppersi* sp. n.  
— Metasoma I–III with median lateral carinae present in female (Fig. 428). .... *N. berberensis* Hirst, 1911  
(population from stony area)

**COMMENTS ON KEYS TO SPECIES.** The taxonomic positions of most *Neobuthus* species are well supported by DNA and karyotype analysis which is a topic of a separate paper in preparation by colleagues from Charles University of Prague. However, the species key here is created strictly according to morphological characters which we verified from the specimens examined in this study (see mainly Figs. 416–431). The key could be used for a quick orientation in conjunction with the distribution data (see Fig. 438). There is a possibility that additional specimens may show intraspecific variability in some characters used in this key for separation at the species level.

We have not included *N. sudanensis* Lourenço, 2005 in this key because we have not had the opportunity to examine the female holotype, and the poor original description lacks details needed to differentiate it from other members of the genus.

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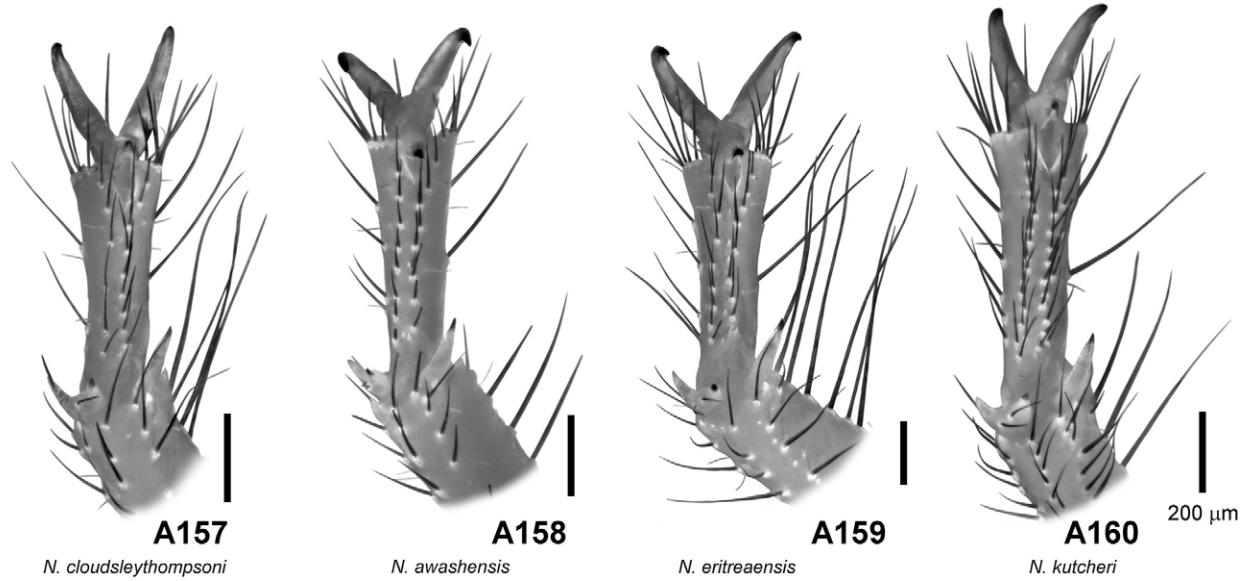
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## Appendix A Erratum

We here correct a figure in a previous publication (Lowe & Kovařík, 2016: 39, fig. 159). In that figure, the telotarsus labeled as *Neobuthus eritreaensis* was a duplicated figure of *N. cloudsleythompsoni*. The correct series of images is shown below.



**Figures A157–A160:** Corrected figures 157–160 of Lowe & Kovařík, 2016. Telotarsus III ventral setation of female *Neobuthus* spp. Figure A157. *N. cloudsleythompsoni* Lourenço, 2001. Figure A158. *N. awashensis* Kovařík & Lowe, 2012. Figure A159. *N. eritreaensis* Lowe & Kovařík, 2016, paratype. Figure A160. *N. kutcheri* Lowe & Kovařík, 2016, paratype. Scale bars: 200 µm.