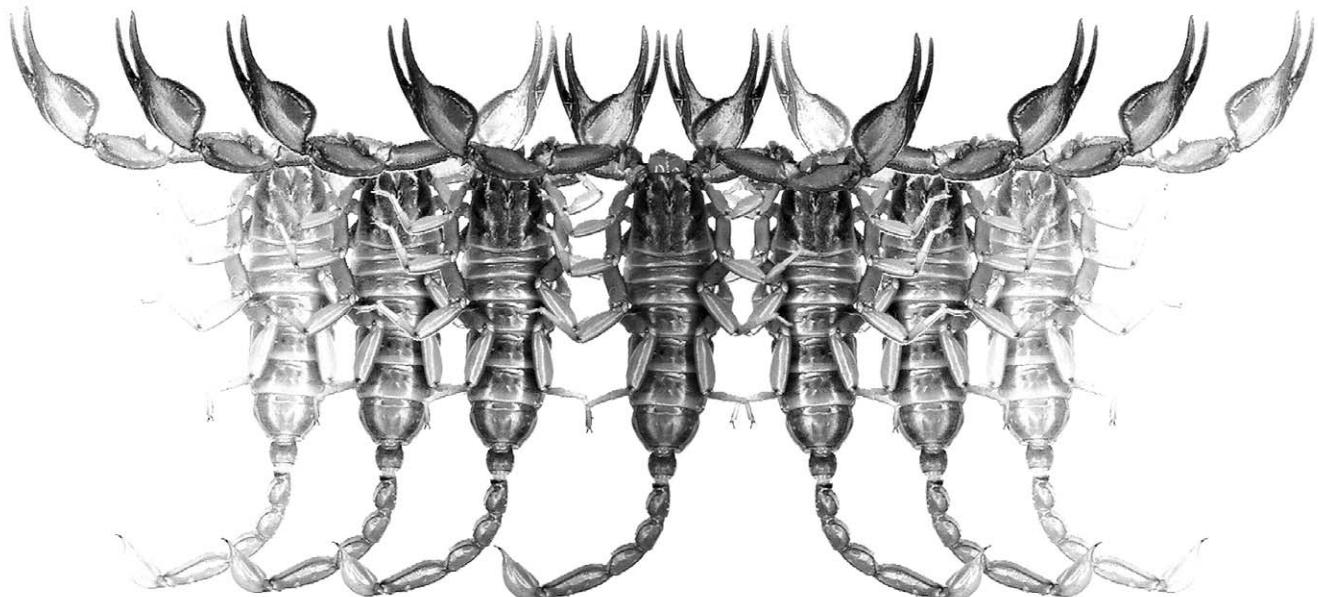


# *Euscorpius*

Occasional Publications in Scorpiology



**Scorpions of the Horn of Africa (Arachnida,  
Scorpiones). Part V. Two New Species of *Neobuthus*  
Hirst, 1911 (Buthidae), from Ethiopia and Eritrea**

Graeme Lowe & František Kovařík

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# *Euscorpius*

## Occasional Publications in Scorpiology

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

## Part V. Two new species of *Neobuthus* Hirst, 1911 (Buthidae), from Ethiopia and Eritrea

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<http://www.zoobank.org/urn:lsid:zoobank.org:pub:05492F8C-1F36-40EB-AAFF-A9FECAA915B7>

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### Summary

New information about the taxonomy and distribution of the genus *Neobuthus* Hirst, 1911 (Scorpiones: Buthidae) is presented, based on materials recently collected from Ethiopia and Eritrea. Emended diagnoses are provided for the genus *Neobuthus*, and for the species *N. awashensis* Kovařík et Lowe, 2012 and *N. cloudsleythompsoni* Lourenço, 2001. New records are given for *N. awashensis* in Ethiopia. We redescribe *N. cloudsleythompsoni*, and we describe two additional new species: *N. eritreaensis* sp. n. (the first record of the genus from Eritrea) and *N. kutcheri* sp. n. (southern Ethiopia, Somali State). We include a key to six members of the genus and discuss possible speciation mechanisms.

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### Introduction

The genus *Neobuthus* Hirst, 1911 includes several small buthid scorpions distributed in northeastern Africa (Horn of Africa). It is still a rather poorly known taxon because only limited materials are available. In a recent review (Kovařík & Lowe, 2012), we redefined the genus, clarified its distinctness from the genus *Buthaeolus*, and studied three species: *N. berberensis* Hirst, 1911 (type species), *N. ferrugineus* (Kraepelin, 1898) (transferred from *Nanobuthus* Pocock, 1895, described as *Butheolus* Simon, 1882), and *N. awashensis* Kovařík et Lowe, 2012. We have now had the opportunity to study additional representatives of *Neobuthus* collected by the second author and colleagues during recent collecting expeditions to Ethiopia and Eritrea. Based on studies of this new material, we provide emended diagnoses for the genus *Neobuthus*, and for the species *N. awashensis* and *N. cloudsleythompsoni* Lourenço, 2001. We also describe two new species, *N. kutcheri* sp. n. from Ethiopia, Somali State, and *N. eritreaensis* sp. n. from Eritrea (the first record of the genus from that country).

### Methods & Material

General laboratory and field methods followed Lowe et al. (2014), Sissom et al. (1990) and Volschenk

(2005). Specimens were found by ultraviolet (UV) detection by night, or by searching under surface debris and rocks by day. All collected material was preserved in 80% ethanol. Anatomical terminology generally follows Stahnke (1971) and Vachon (1952, 1963, 1974, 1975), with the following exceptions: on the pedipalp patella, dorsal carina is designated as ‘dorsointernal’ carina, and dorsointerior (= dorsal internal) carina is designated as ‘internal’ carina; carinal terminology of pedipalp chela follows Soleglad & Sissom (2001); carinal terminology of metasomal segments follows Prendini (2003); leg terminology follows Haradon (1984); hemispermatophore terminology follows Kovařík et al. (2016). Mensuration follows Stahnke (1971) and Sissom et al. (1990), with exceptions as noted in Navidpour & Lowe (2009). Preocular distance was measured from the middle of the ocular tubercle to the anterior margin of the carapace. Anatomical illustrations were prepared using a variety of methods: wet UV/ color imaging, and dry color or dry UV imaging, so as to provide different views of integument texture and coloration (methods cited in figure legends). In the first method, specimens were imaged in alcohol, and underlying color patterns were revealed under visible light and digitally merged with cuticular granulation and setation revealed under UV fluorescence (Lowe et al., 2014); in the second methods, specimens were dried and conventionally imaged in air either under visible light to show natural colors and details of cuticular reflectance

(glossiness), or by UV fluorescence to show cuticular granulation and topography.

### Abbreviations

*Specimen depositories.* FKCP, private collection of F. Kovařík, Prague, Czech Republic; GL, private collection of G. Lowe, Philadelphia, USA; MNHN, Muséum National d'Histoire Naturelle, Paris, France. *Morphometrics:* D, depth; L, length; W, width; aW, anterior width; pW, posterior width.

### Systematics

***Neobuthus*** Hirst, 1911  
(Figs. 1–165, Tables 1–5)

*Neobuthus* Hirst, 1911: 462; Kovařík & Lowe, 2012: 2; Kovařík et al., 2013: 4, 14; for complete generic synonymy prior to 2012, see Kovařík & Lowe, 2012: 2.

**EMENDED DIAGNOSIS.** Small buthid scorpions, total length 18–23 mm (males), 22–31 mm (females); carapace strongly trapezoidal, surface granular with only anterior median carinae developed; ventral aspect of cheliceral fixed finger with single denticle; 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 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, orthobothriotaxic or neobothriotaxic minorante, dorsal trichobothria of femur arranged in  $\beta$ -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, with regular dentition in males; capsule of hemispermatophore with 4 lobes, flagellum well separated from lobes.

**SUBORDINATE TAXA.** *N. awashensis* Kovařík et Lowe, 2012, *N. berberensis* Hirst, 1911 (type species), *N. cloudsleythompsoni* Lourenço, 2001, *N. eritreaensis* sp. n., *N. ferrugineus* (Kraepelin, 1898), *N. kutcheri* sp. n., and *N. sudanensis* Lourenço, 2005 (taxonomic position unclear).

***Neobuthus awashensis*** Kovařík et Lowe, 2012  
(Figs. 1–6, 158, 161–165)

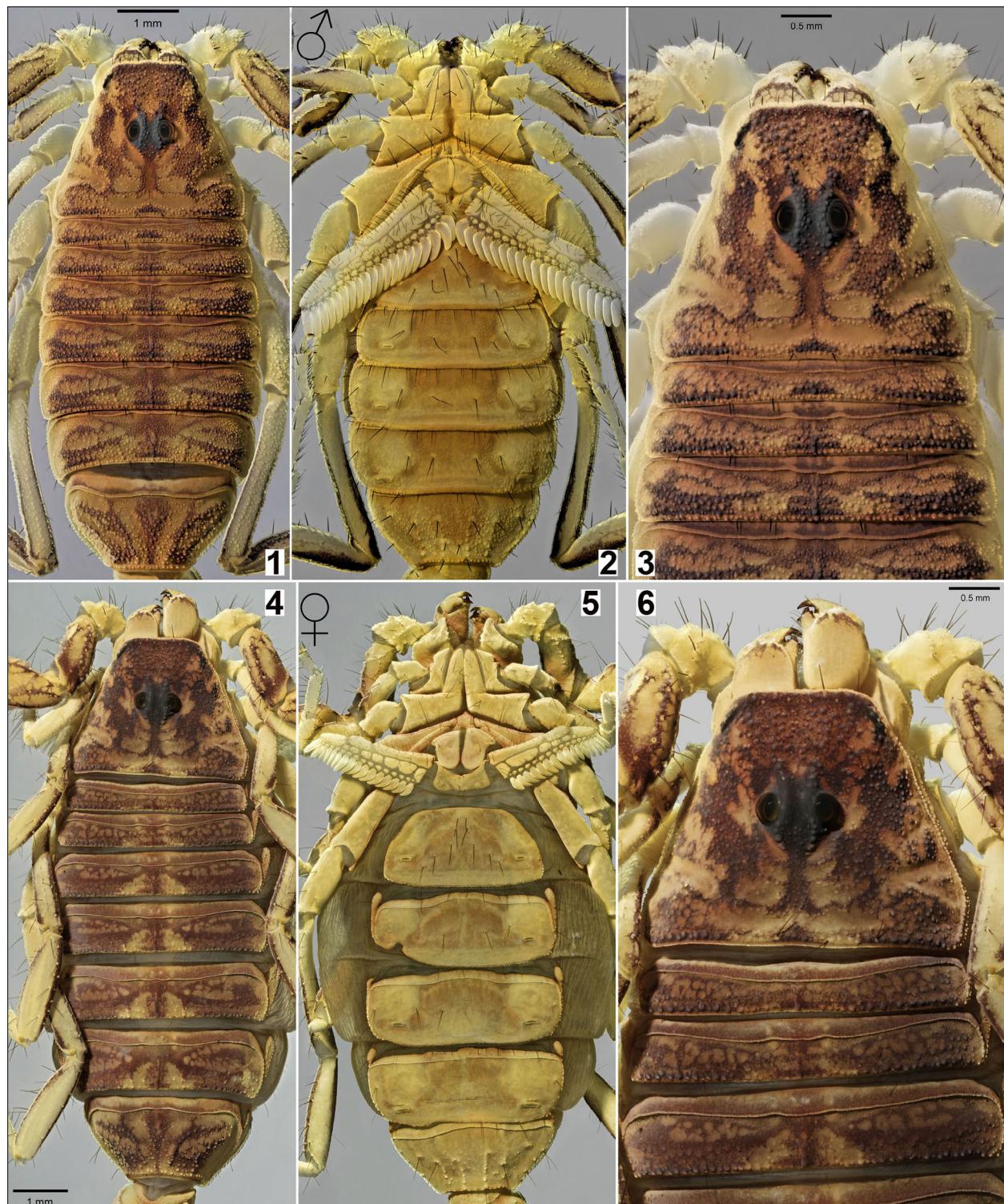
*Neobuthus awashensis* Kovařík & Lowe, 2012: 7–16, figs. 5–6, 18–21, 34–38, 44–47, 67–74, 86, 89, 92, 95–96, 100–101; Kovařík et al., 2015: 30.

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

**TYPE MATERIAL.** 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 are in the collection of the second author (FKCP), two paratypes (♂♀) are in the collection of the first author (GL).

**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, FKCP, 3♂2juvs, GL, leg. F. Kovařík; 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♀, topotypes, leg. F. Kovařík (UV detection), FKCP.

**EMENDED 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, pa-



**Figures 1–6:** *Neobuthus awashensis* Kovařík et Lowe, 2012. **Figures 1–3.** Male from Ethiopia, locality No. 12ER, 09°08'10.4"N 40°09'45.5"E, carapace and tergites (1), coxosternal area and sternites (2), carapace and tergites I–III (3). Scale bars: 1 mm (Figs. 1–2) and 0.5 mm (Fig. 3). **Figures 4–6.** Female paratype from Ethiopia, Awash, Metahara env., 08°54'N 39°54'E, carapace and tergites (4), coxosternal area and sternites (5), carapace and tergites I–III (6). Scale bars: 1 mm (Figs. 4–5) and 0.5 mm (Fig. 6). Wet UV/ color.

tella 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; posterior margins of carapace and tergites usually bearing 2–4 macrosetae; pedipalps, legs, metasoma and telson with short, stout macrosetae in males, and long, fine setae in females; 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 6–9 macrosetae in retroinferior series of basitarsus, 12–19 ventral macrosetae on telotarsus; pectine teeth: 17–21 (males), 15–18 (females).

***Neobuthus cloudsleythompsoni*** Lourenço, 2001  
(Figs. 7–42, 96, 148–150, 157, 161, Tables 1, 4–5)

***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.

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

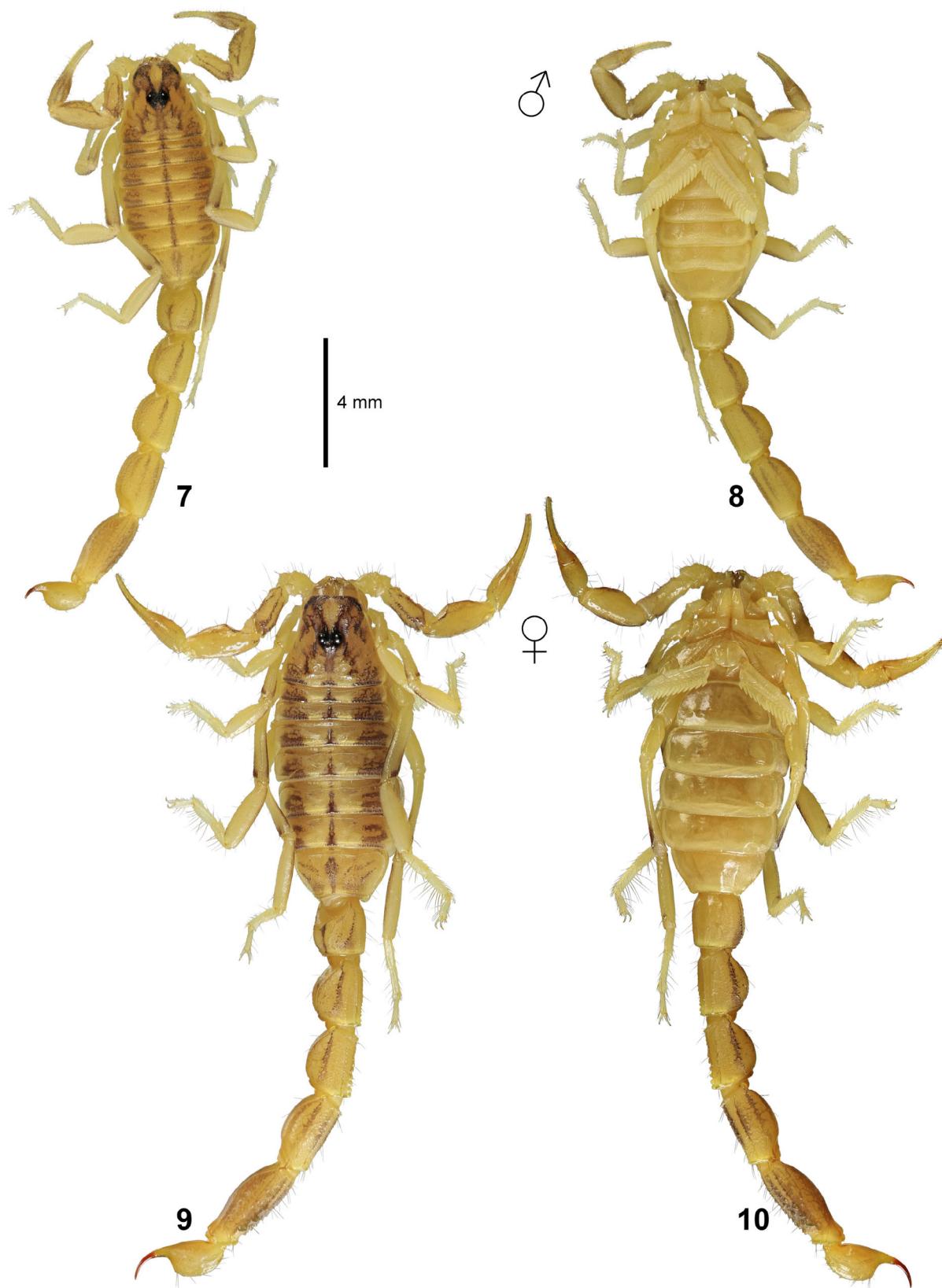
MATERIAL EXAMINED. Ethiopia, Southern Nationalities and Peoples Region Federal State (SNNPR), "lower valley of the Omo river", Chew Bahr, 04°50'38.5"N 36°44'11.4"E, 625 m a.s.l. (Locality No. 13EW), 5.–6.VII.2013, 43♂ 6♀ 8♂ im., leg. F. Kovařík, V. Socha, V. Trailin (UV detection), FKCP, GL.

EMENDED 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; trichobothria  $d_2$  usually present on patella; posterior margins of carapace and tergites usually lacking macrosetae, or sparsely setose 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 with 4

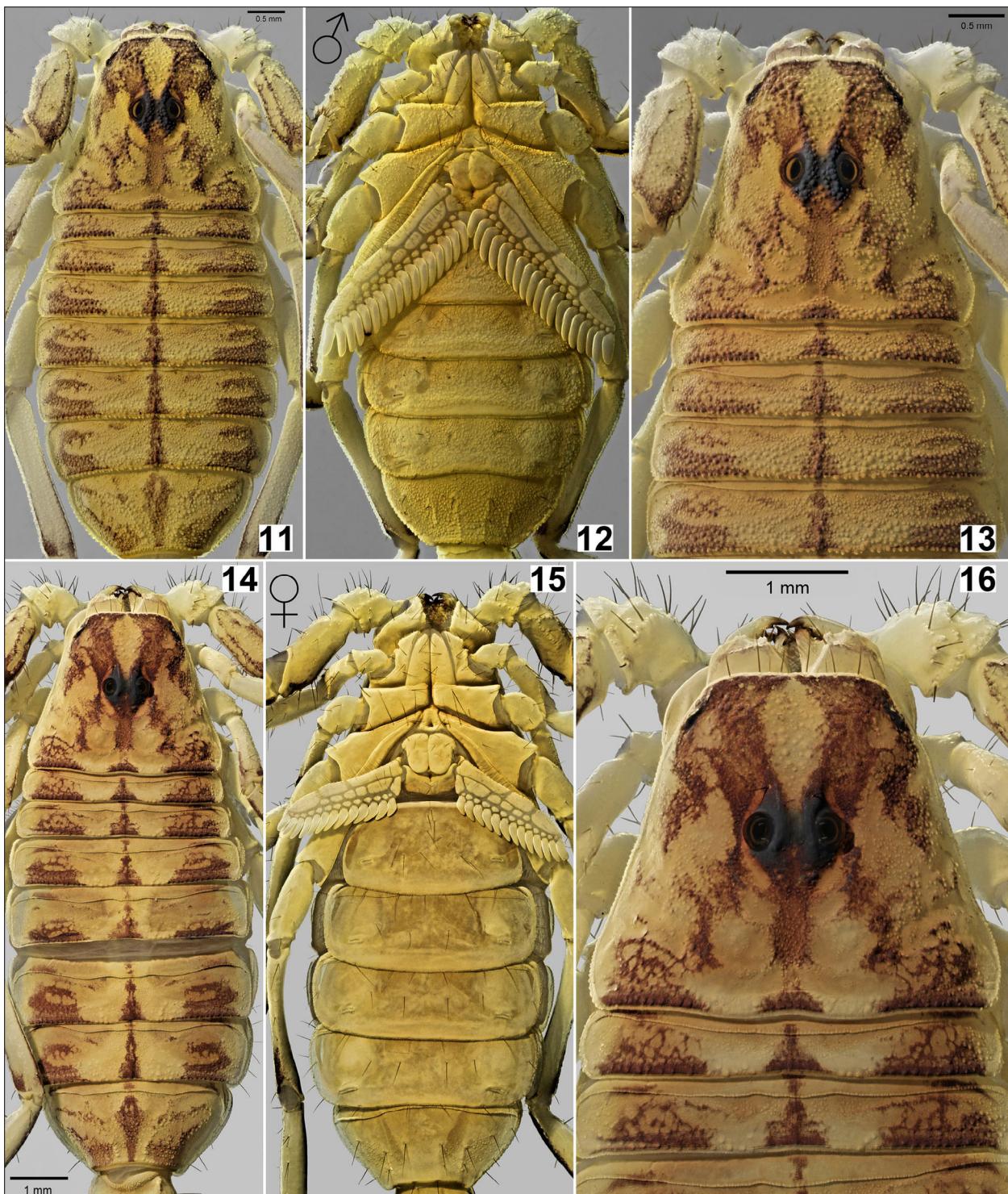
granulated carinae; females with sternites III–VI smooth, sternite VII sparsely shagreened with 4 weak carinae, median carinae smooth or weakly granulated; metasoma I–III with median lateral carinae present in both sexes; lateral surface of metasoma V in males densely granulated, with granules close but separated; soles of telotarsi with sparse setation, leg III of adults with 7–10 macrosetae in retroinferior series of basitarsus, 13–20 ventral setae on telotarsus; pectine teeth: 15–19 (males), 12–15 (females).

#### REDESCRIPTION (MALE).

**Coloration** (Figs. 7–8, 11–13, 19, 31–33, 34–37, 41). Base color yellow with patterns of dark maculation. *Carapace* with fuscosity extending over lateral interocular triangle from ocular tubercle, but dark pigment excluded from area between anterior median carinae; fuscosity patchy on lateral flanks, alternating with yellow areas; posterior median area with fuscous median longitudinal band behind ocular tubercle; posterior lateral area with fuscous edge bordering posterior median zone, reticulate marking on posterior marginal area; ocular tubercle black, surrounded by yellow patches laterally and posteriorly; posterior margin of carapace with dark lateral borders and median triangular patch. *Tergites* 3-striped, with fuscosity arranged longitudinally in narrow median and broad lateral bands; pale patches on either side of median stripe wide, forming broad longitudinal yellow bands; on each tergite, lateral bands with fuscosity more solid on posterior part, broken by reticular or fenestrated patterning on anterior part, faint on pretergite. *Sternites* and *coxosternal* area pale yellow. *Metasomal* segments I–IV mostly yellow with sparse reticulated fuscosity; dorsal surface of I–III with median line and Y-shaped pattern, of IV trilineate; dorsolateral carinae I–IV marked by broad stripe; lateral and ventral surfaces yellow on I–II, with fuscous stripes on ventrolateral and ventrosubmedian carinae on III–IV, the stripes broader and darker on IV; segment V covered by more extensive reticulated fuscosity, dorsal surface with single yellow anteromedian stripe, ventral surface with 2 pairs of yellow anterolateral stripes, posterior margin of V yellow on all sides. *Telson* vesicle almost yellow, with faint traces of fuscosity, aculeus yellow on basal half, dark reddish-black on distal half. *Chelicera* with broad fuscous band extending over anterior dorsal area of manus, interrupted by large, pale patch on internal aspect, remainder of dorsal surface pale, lacking reticulations. *Pedipalps* with fuscous markings on carinae of femur and patella, more extensive fuscosity on distal dorsal and distal internal surfaces of femur, and ventroexternal and ventrointernal surfaces of patella; patella uniformly yellow on dorsal surface between dorsoexternal and dorsointernal carinae; ventral surface of femur and patella pale yellow; pedipalp chela manus with weak fuscosity in longitudinal bands and broad dis-



**Figures 7–10:** *Neobuthus cloudsleythompsoni* Lourenço, 2001 from Ethiopia, locality No. 13EW, 04°50'38.5"N 36°44'11.4"E.  
Figures 7–8. Male in dorsal (7) and ventral (8) aspects. Figures 9–10. Female in dorsal (9) and ventral (10) aspects. Scale bar: 4 mm (Figs. 7–10). Dry color.



**Figures 11–16:** *Neobuthus cloudsleythompsoni* Lourenço, 2001 from Ethiopia, locality No. 13EW, 04°50'38.5"N 36°44'11.4"E. **Figures 11–13.** Male, carapace and tergites (11), coxosternal area and sternites (12), carapace and tergites I–IV (13). Scale bars: 0.5 mm. **Figures 14–16.** Female, carapace and tergites (14), coxosternal area and sternites (15), carapace and tergites I–II (16). Scale bars: 1 mm. Wet UV/ color.

tal areas; pedipalp fingers yellow. Legs with fuscous longitudinal stripes along distal half of dorsal, retro-superior and proinferior surfaces of femur, and retrodorsal surface of patella.

**Carapace** (Figs. 7, 11, 13, 41). Strongly trapezoidal, anterior width 0.40–0.60 times posterior width, wider than long (L/ W 0.88–1.0); posterior median postocular area flat, anterior median preocular area gently slope

downwards towards anterior margin; lateral flanks steeply sloped; ocular tubercle broad, prominent, located slightly anterior to middle of carapace (preocular distance 0.43–0.44 times carapace length); median eyes large, separated by 1.25 times their diameter (viewed in dorsal projection); anterior margin straight, finely microdenticulate, with coarser granules overlapping edge, bearing 7–9 macrosetae; lateral margins finely denticulate; anterior median carinae weak, coarsely granular, without macrosetae; other carinae indistinct; dense granulation covering most of carapace, interrupted only by restricted transverse smooth patches behind ocular tubercle, and in locations of posterior transverse, posterior marginal, and posterior lateral furrows; posterior margin of carapace almost smooth, with only very fine microdenticulations; macrosetae absent on carapace except for anterior margin, and 1–2 small macrosetae that may or may not occur on posterior margin.

**Chelicera.** Manus smooth on dorsal side, with subapical transverse series of granules; dorsointernal carina at base of fixed finger strong, almost smooth; *chaetotaxy*: 4 straight macrosetae on anterior dorsal surface, including 1 dark seta on dorsointernal carina, 1 pale seta on subapical margin, 2 pale setae on apical margin; 3 dorsal microsetae on distal half of movable finger; brush of longer curved setae on internodorsal surface at base of fixed finger; fingers with typical buthid dentition (Vachon, 1963); fixed finger with large distal denticle, 1 subdistal denticle and 2 basal denticles fused into bicuspid; single denticle on ventral surface at level of bicuspid; 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: 1 large distal, 1 small subdistal; dense fields of fine setae on ventrointernal surfaces of movable finger and anterior manus.

**Coxosternal area** (Figs. 8, 12). Coxae finely granulated, coxa I–II endites with weaker, sparser granulation, almost smooth; coxae I–III with sparse short to medium length reddish macrosetae: 5–8 on coxa I, 5–8 on II, 4–5 on III; coxa IV with single macroseta near anterior end, close to sternum, otherwise devoid of setae; sternum subtriangular, smooth, with deep posteromedian invagination, posterior transverse sulcus and 2 short reddish macrosetae; genital opercula smooth, cordate, with 2–3 short reddish macrosetae; genital papillae present.

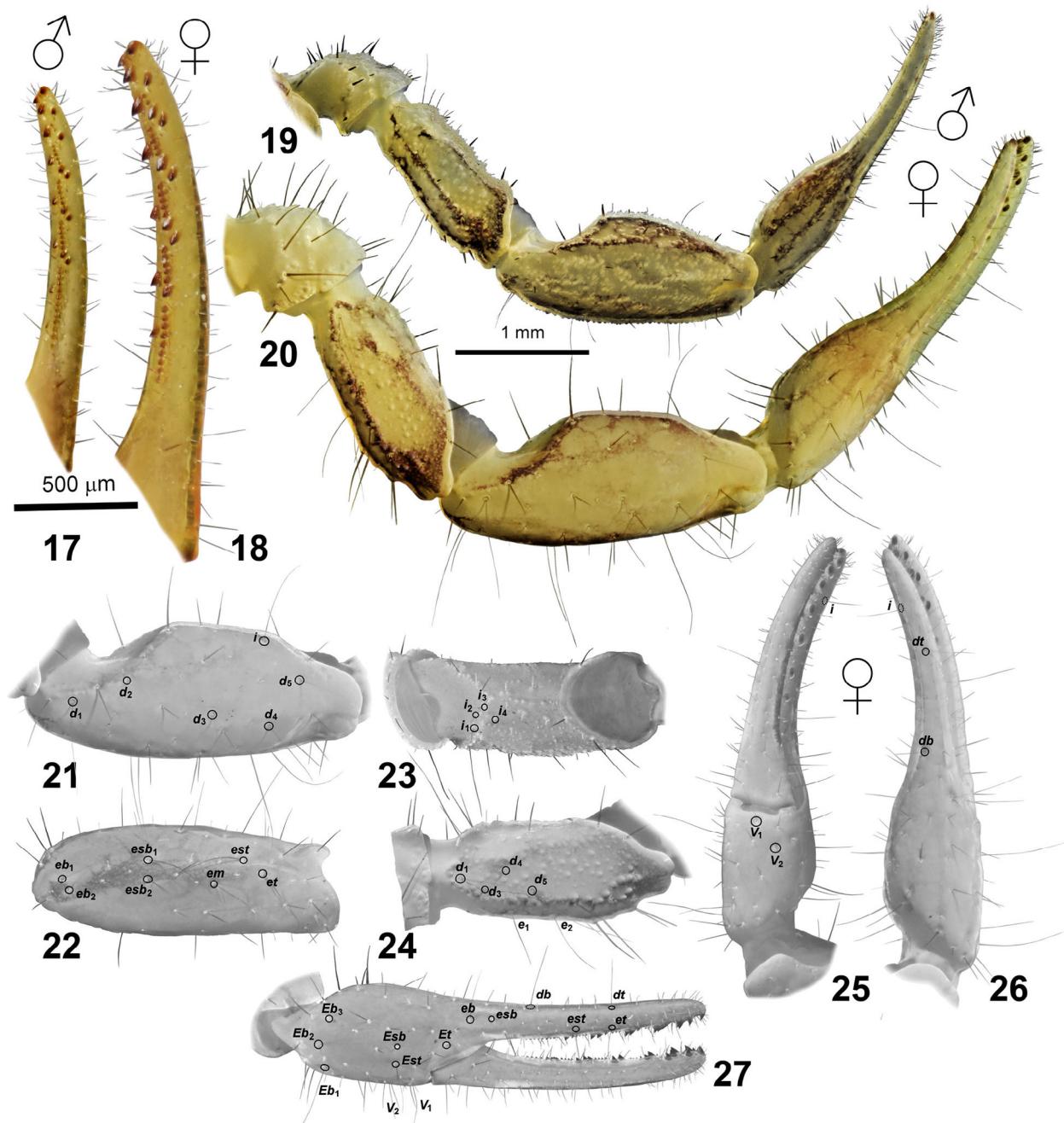
**Pectines** (Figs 8, 12). Basal piece smooth, with deep V-shaped anterior median invagination, 2–4 short reddish macrosetae; pectines long, distal tips extending to proximal 0.3–0.4 of length of trochanter IV; combs with 3 marginal lamellae, 6–7 middle lamellae, 15–19 teeth; posterobasal vertex of basal middle lamella extended, angulate; marginal lamellae, middle lamellae and fulcra with dense cover of short light reddish macrosetae; fulcra with 2–5 setae; when anterior margins of left and right pectines are aligned with posterior edges of coxae

IV, first and second teeth at base of combs overlap completely.

**Hemispermatophore** (Figs. 38–40). Elongate, slender, trunk 9.15 times length of capsule region; flagellum well separated from external lobe, pars recta short with internal lamina, pars reflecta narrower, cylindriform; capsule region with 4 lobes at base of flagellum; external lobe longest, apically rounded; median lobe carinate, apically truncate; internal lobe acuminate, same length as median lobe; basal lobe strongly developed, forming a pointed hook.

**Mesosoma** (Figs. 7–8, 11–13, 41). Moderately elongate, 2.0–2.4 times length of carapace. *Tergites*: pretergites smooth with finely micro-granular posterior margins; tergites I–VI a weak granular median carina only developed in posterior half; tergites II–VI with weakly indicated granular lateral carinae near posterior margins; tergites I–VI densely granular, with coarser granules on posterior lateral areas; tergite VII densely granular, with slight median hump, paired inner and outer lateral carinae weakly indicated, granular; posterior margins with very fine, microdenticulations in tergites I–VI, smooth in tergite VII; all tergites devoid of macrosetae. *Sternites*: presternites IV–VII smooth, posterior margins very weakly micro-crenulate; sternites III–VI covered with dense, fine granulation (finer near anterior margins), with transverse slit-like spiracles; areas of III covered by pectines very finely micro-shagreened; sternite V with narrow posterior marginal smooth patch free of granulation, widest medially; sternite VII densely, finely granulated, posterior 2/3 with 4 weak, granular carinae; lateral margins of all sternites finely denticulate; sternite macrosetae (non-marginal/ marginal): III 11–13/8–9, IV 4/13–16, V 6/11–12, VI 4–6/9–11, VII 6–7/3–5; setae on sternite VII shorter, thicker than setae on III–VI.

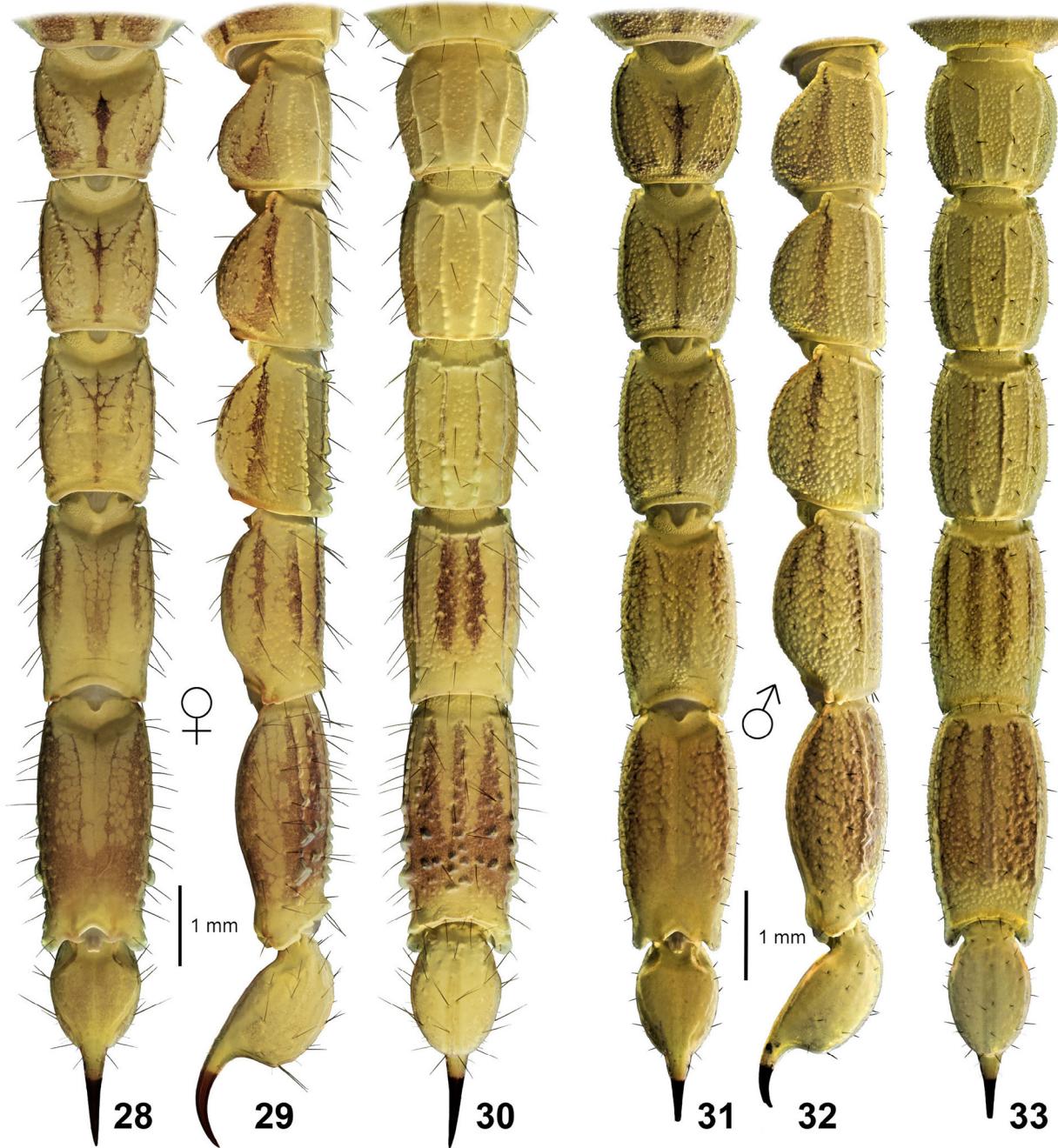
**Metasoma** (Figs. 7–8, 31–33, 41). Moderately elongate, total length of segments I–V 1.4 times length of prosoma + mesosoma; segment I as wide as long, segments II–V progressively longer than wide (L/W ratio increasing from 1.25 to 2.01); *carination*: segments I–II with 10 carinae, III with 8 carinae, IV–V with 2 carinae; segments I–III with moderate to strong, granulate or crenulate ventrosubmedian and ventrolateral carinae, weak, granulate lateral median carinae, and very weak or slightly indicated, granulate dorsolateral and dorsosubmedian carinae; segment III with strong, granulate ventrosubmedian and ventrolateral carinae, very weak or slightly indicated, granulate lateral median, dorsolateral and dorsosubmedian carinae; median lateral carinae complete on I–II, obsolete on anterior 1/5 of III; segment IV with weak, crenulated ventrolateral carinae; segment V with strong, granulate to lobate ventrolateral carinae; *granulation*: segments I–III with dense granulation on all intercarinal surfaces; segment IV densely granulated except for bilateral posterior smooth patches on dorsal



**Figures 17–27:** *Neobuthus cloudsleythompsoni* Lourenço, 2001 from Ethiopia, locality No. 13EW, 04°50'38.5"N 36°44'11.4"E, pedipalp. **Figures 17–18.** Movable finger dentition of male (17) and female (18). Scale bar: 0.5 mm. **Figures 19–20.** Dorsal view of whole pedipalp (trochanter, femur, patella and chela) of male (19) and female (20). Scale bar: 1 mm. **Figures 21–27.** Female, trichobothrial map. Patella dorsal (21) and external (22). Femur internal (23) and dorsal (24). Chela ventral (25), dorsal (26), and external (27). Dry color (17–18), wet UV/color (19–20), dry UV (21–26).

surface; segment V densely granular on lateral and ventral surfaces, lateral surface with coarse, scaly granulation, ventral surface with many large, coarse granules, some arranged in trace of ventromedian carina; lateral anal lobe with weak notch towards ventral end, ventral anal arc with 10–13 weak crenulations; chaetotaxy: segments I–IV with scattered macrosetae on

carinae and intercarinal surfaces; lateral surface of segment V with macrosetae arrayed in 2 longitudinal rows of 5–7 setae near dorsal and ventral margins, ventral surface with sparsely scattered setae; dorsal surfaces of all segments bare; all metasomal setae short, straight, reddish, shorter and more stout than coxosternal and sternal setae.

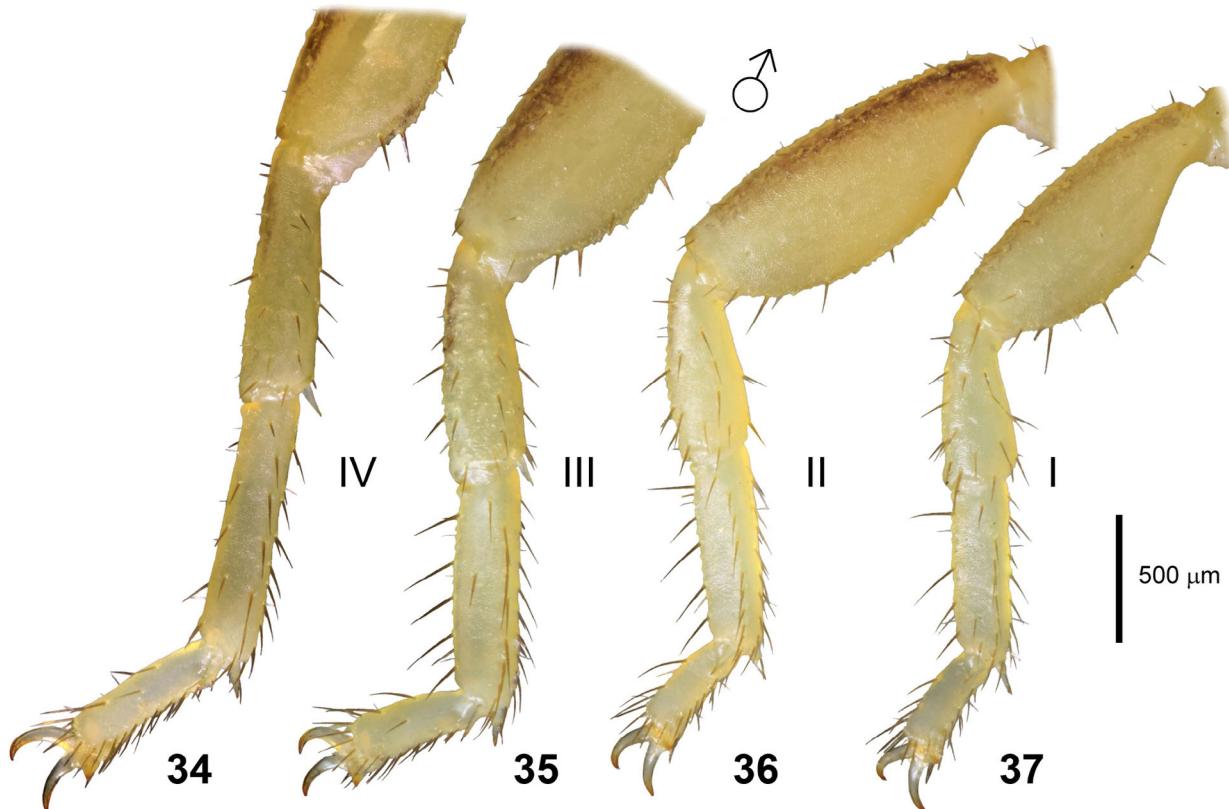


**Figures 28–33:** *Neobuthus cloudsleythompsoni* Lourenço, 2001 from Ethiopia, locality No. 13EW, 04°50'38.5"N 36°44'11.4"E, metasoma and telson. **Figures 28–30.** Female, dorsal (28), lateral (29), and ventral (30). **Figures 31–33.** Male, dorsal (31), lateral (32), and ventral (33). Scale bars: 1 mm. Wet UV/ color.

**Telson** (Figs. 7–8, 31–33, 41). Vesicle relatively bulbous, posterior surface steeply sloped, not quite truncate; aculeus stout, shorter than vesicle, tip of aculeus directed sub-vertically; ventral surface with scattered anteriorly-directed, stout, reddish macrosetae.

**Pedipalps** (Figs. 7–8, 17, 19, 41). *Femur*: relatively stout, 2.2–2.4 times longer than wide; dorsoexternal and external carinae weak, granulated; other carinae obso-

lete; dorsal, external and upper internal surfaces with coarse granulation, lower internal and ventral surfaces finely granulated, shagreened or almost smooth; 6–8 distal external accessory macrosetae. *Patella*: less stout, 2.3–2.6 times longer than wide; external, dorsomedian, dorsointernal, internal and ventrointernal carinae weak, finely granulated; other carinae obsolete; dorsal and upper internal surfaces with dense, coarse granulation,



**Figures 34–37:** *Neobuthus cloudsleythompsoni* Lourenço, 2001, male from Ethiopia, locality No. 13EW, 04°50'38.5"N 36°44'11.4"E, left legs IV–I, retrolateral aspect. Scale bar 0.5 mm. Dry color.

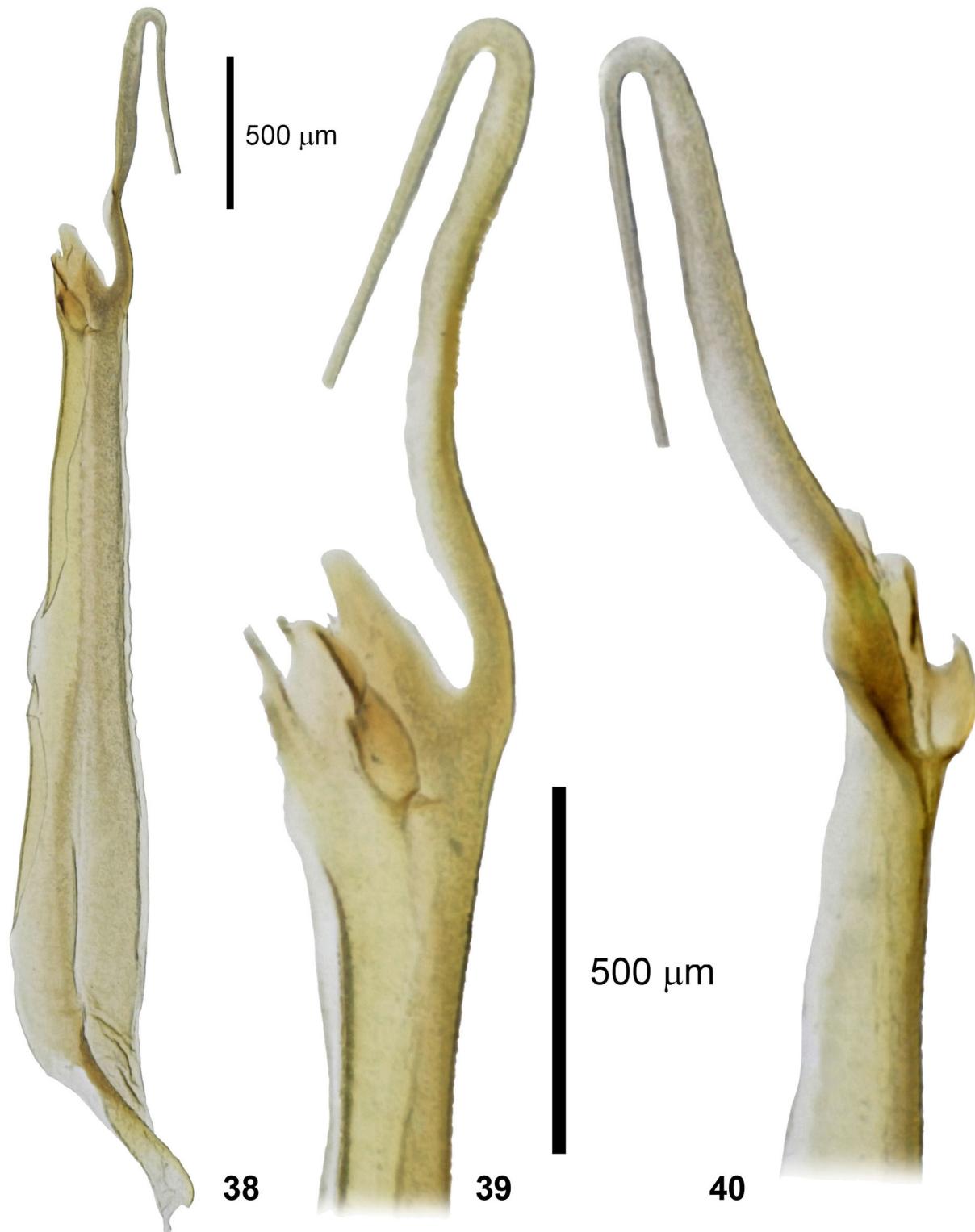
lower internal surface with fine granulation, external and ventral surfaces finely shagreened or almost smooth; short, straight reddish macrosetae scattered sparsely over carinae. *Chela*: Short, relatively stout, 4.4–5.5 times longer than wide; fingers robust, movable finger 1.8–2.0 times manus ventral length; carinae obsolete, but with weak to very weak granulation indicating positions of dorsointernal, dorsal marginal, digital and external carinae; manus, fixed and movable fingers equipped with numerous short, straight, reddish macrosetae; numerous fine, translucent microsetae on fingers; fixed finger with 4 subdistal denticles proximal to distal tooth, 3–6 (4–5 in 9/12 fingers) primary denticle subrows, 3 external and 4–5 internal accessory denticles; movable finger with 4 subdistal denticles proximal to distal tooth, 3–5 (5 in 10/12 fingers) primary denticle subrows, 3–4 external and 4–5 internal accessory denticles.

**Trichobothriotaxy.** Orthobothriotaxic or neobothriotaxic minorante, type A $\beta$  (Vachon, 1974); among buthid petite trichobothria, femur  $d_2$  and patella  $d_2$  may be reduced or absent (femur  $d_2$  was absent in 7/8 examined femora, patella  $d_2$  was present in 8/8 examined patellae), chela  $Eb_3$ ,  $Esb$  and  $esb$  usually present; patella with  $esb_1$  level with or slightly distal to  $esb_2$ .

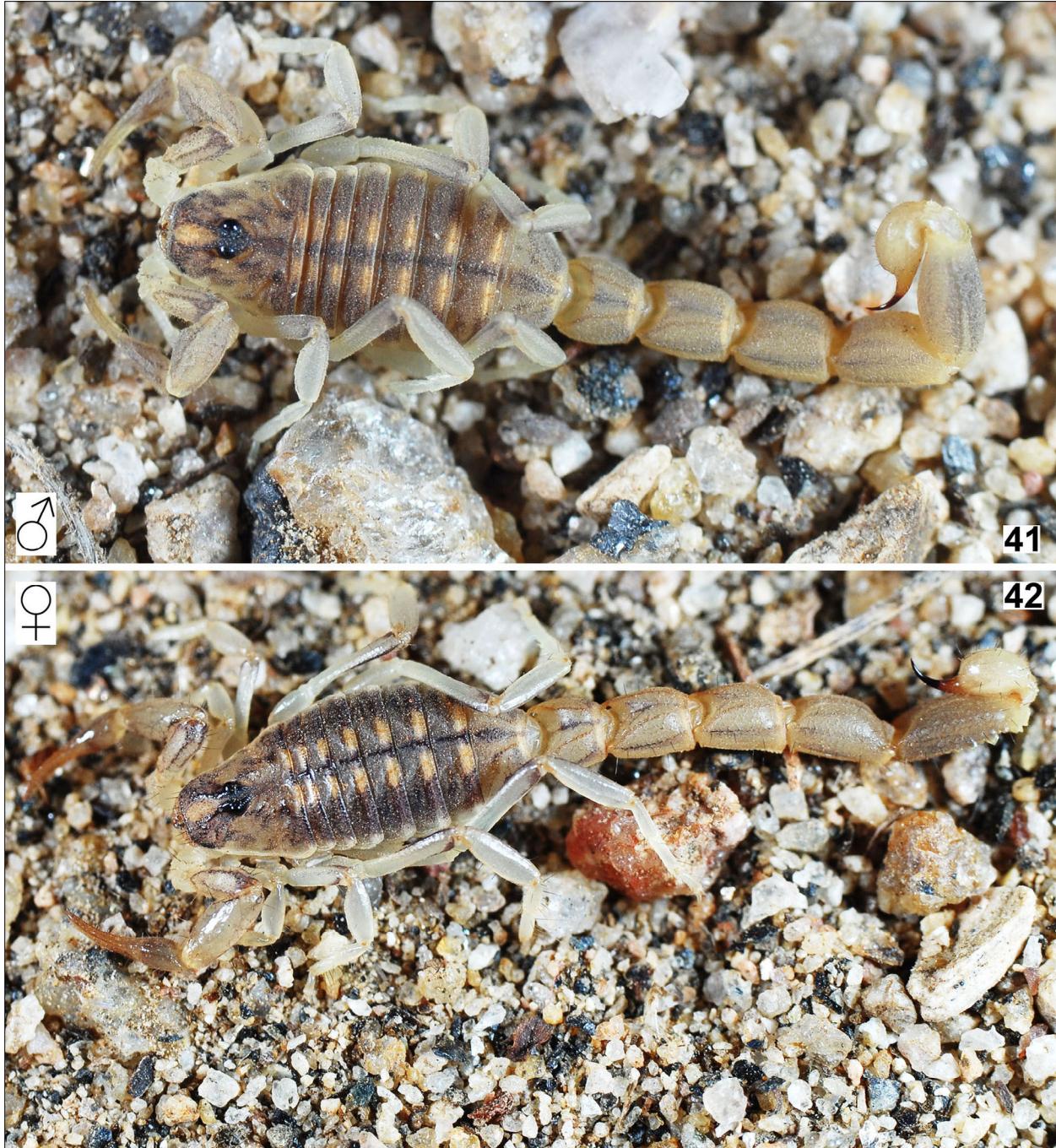
**Legs** (Figs. 34–37). Relatively short, stout; femora with finely denticulate carinae, surfaces granulated pro-

laterally, smooth retrolaterally; patellae with weakly granulated carinae, faintly granular prolaterally, smooth retrolaterally; tibiae and tarsomeres smooth; legs III–IV with small tibial spurs; retrolateral pedal spurs simple, non-setose; prolateral pedal spurs basally bifurcate (weakly so on I), bearing 0–1 macrosetae; *chaetotaxy*: coxa, femora, patella and tibia of all legs bearing variable numbers of very short, straight reddish macrosetae; tarsi with mix of short and longer, reddish macrosetae; basitarsi I–III compressed, with bristle combs consisting of retrosuperior series of longer macrosetae, plus retroinferior and proinferior series of shorter macrosetae; bristle comb setal counts (retrosuperior/ retroinferior): I 4–5/6–9, II 4–6/9–11, III 5–7/8–11; telotarsi with two rows of short setae on ventral aspect, 15–20 setae on telotarsus III.

**Female** (Figs. 9–10, 14–16, 18, 20–30, 42, 148–150, 157). Coloration pattern very similar to that of male, but with fuscosity reduced or absent on dorsointernal surface of pedipalp patella (which thus appears mostly yellow on dorsal side). Other differences include: larger size (total length of adult males 18.5–19 mm, adult females 23–25 mm); carapace wider (L/W 0.89–1.00 in males, 0.85–0.87 in females), with much weaker granulation; tergites I–VI with much weaker, sparser granulation, anterior areas weakly, finely shagreened to smooth; tergite



**Figures 38–40:** *Neobuthus cloudsleythompsoni* Lourenço, 2001, male from Ethiopia, locality No. 13EW,  $04^{\circ}50'38.5''N$   $36^{\circ}44'11.4''E$ , left hemispermophore. **Figure 38.** Whole hemispermophore, dorsal aspect. **Figures 39–40.** Capsule region and flagellum, dorsal aspect with capsule lobes flattened (39), and external aspect (40). Scale bar: 0.5 mm.



**Figures 41–42:** *Neobuthus cloudsleythompsoni* Lourenço, 2001, in vivo habitus. Male (41) and female (42) at Ethiopia, locality No. 13EW, 04°50'38.5"N 36°44'11.4"E.

VII with weaker, finer granulation; weak, granulated median carinae present on metasomal segments I–III; metasomal segments I–III with weaker, finer granulation on intercarinal surfaces, dorsal surfaces very sparsely granular, weakly shagreened to smooth; segments II–III with stronger dentate granulation on ventrosubmedian carinae, posterior denticles larger than anterior denticles;

female with lower mean number of denticles on ventrosubmedian carinae II ( $P = 0.0007$ ) and III ( $P = 0.0001$ ), the mean value of (left count + right count)/2 in males being II:  $17.98 \pm 1.68$ , III:  $15.78 \pm 1.53$  (range II: 16–22, III 13–21,  $N = 20$ ), and in females being II:  $14.00 \pm 2.61$ , III:  $11.75 \pm 1.71$  (range II: 10–17, III 10–16,  $N = 4$ ); segment IV smooth dorsally, weakly granu-

<i>Neobuthus cloudsleythompsoni</i> Lourenço, 2001					
Measurement (mm)		♂	♂	♀	♀
Total	L	18.50	19.00	23.00	25.00
Metasoma + Telson	L	11.50	12.00	14.70	15.00
Carapace	L/ aW/ pW	2.368 /1.143 /2.674	2.408 /1.102 /2.629	2.810 /1.459 /3.245	2.857 /1.470 /3.347
Preocular	L	1.021	1.061	1.327	1.327
Metasoma I	L/ W/ D	1.470 /1.470 /1.286	1.490 /1.514 /1.296	1.678 /1.735 /1.510	1.735 /1.796 /1.592
Metasoma II	L/ W/ D	1.684 /1.337 /1.286	1.755 /1.408 /1.296	2.041 /1.551 /1.510	2.041 /1.592 /1.633
Metasoma III	L/ W/ D	1.837 /1.327 /1.306	1.959 /1.388 /1.265	2.286 /1.510 /1.470	2.368 /1.592 /1.714
Metasoma IV	L/ W/ D	2.204 /1.306 /1.225	2.286 /1.388 /1.245	2.572 /1.510 /1.347	2.735 /1.596 /1.470
Metasoma V	L/ W/ D	2.633 /1.337 /1.143	2.715 /1.388 /1.184	3.225 /1.592 /1.270	3.347 /1.592 /1.388
Telson	L		2.408	2.837	2.898
Vesicle	L/ W/ D	1.470 /0.939 /0.857	1.470 /0.980 /0.894	1.633 /1.184 /1.123	1.674 /1.265 /1.225
Pedipalp chela	L/ W/ D	2.398 /0.545 /0.531	2.531 /0.531 /0.592	3.123 /0.735 /0.776	3.286 /0.776 /0.816
Pedipalp movable finger	L	1.955	1.837	2.531	2.551
Pedipalp manus ventral	L	0.878	0.837	1.102	1.102
Pedipalp fixed finger	L	1.265	1.388	1.633	1.796
Pedipalp femur	L/ W	1.449 /0.620	1.551 /0.653	1.633 /0.735	1.674 /0.786
Pedipalp patella	L/ W	1.980 /0.857	2.000 /0.796	2.449 /0.959	2.490 /1.049
Pectine	L	2.327	2.443	2.123	2.408
No. of lateral eyes	Left/ Right	5 /5	5 /5	5/4	4/3

**Table 1:** Measurements of adult *Neobuthus cloudsleythompsoni* Lourenço, 2001. Abbreviations: length (L), width (W), anterior width (aW), posterior width (pW), depth (D).

late laterally, strongly granulate ventrally; segment V with larger lobate granules on posterior ventrolateral carinae, lateral surface smooth (not granulate); telson more bulbous, vesicle with steeper posterior face (may be truncate), aculeus more stout with tip directed at shallower angle; sternites III–VI completely smooth; sternite VII smooth except for very faintly shagreened posteromedial area, and lightly shagreened posterolateral area, medial carinae very weak or obsolete, lateral carinae weak, smooth; genital opercula more elongated, with 4–7 setae; pectine basal piece with shallower, broader anterior invagination, not strongly V-shaped; pectines with smaller teeth, shorter, distal tips extending to or just short of distal limit of coxa IV, 5–6 middle lamellae, basal middle lamella considerably narrower along axial dimension; pedipalp femur and chela more stout (compare L/W ratios in Tab. 4); pedipalp femur with much weaker, sparser granulation, almost smooth; pedipalp patella and chela smooth; femora of legs smooth on prolateral surfaces; macrosetae on pedipalps, legs, metasoma and telson moderately longer and finer than in the male.

**Measurements.** See Tab. 1.

**VARIATION.** For variation in selected morphometric ratios and meristics, see Tabs. 4–5. Coloration patterns were consistent over the examined material, although the fuscous markings were darker in some individuals than in others.

**COMPARISONS.** Pectinal tooth counts for *N. cloudsleythompsoni* were significantly lower than for *N. eritreaensis* sp. n., *N. awashensis* and *N. kutcheri* sp. n.. Compared to males of *N. awashensis*, males of *N. cloudsleythompsoni* have a higher mean number of denticles on ventromedian carinae of metasoma II ( $P = 0.0014$ ) and III ( $P = 0.0243$ ); mean value of (left count + right count)/2 in *N. awashensis* was II:  $15.17 \pm 1.66$ , III:  $13.75 \pm 2.60$  (range II: 11–18, III 10–16,  $N = 6$ ).

**REMARKS.** In the original description, the holotype male was characterized as being orthobothrioxic, but its depicted trichobothrial map shows several peculiarities: (i) on the pedipalp chela manus, trichobothrium  $Eb_3$  is missing, a neobothrioxic condition (Lourenço, 2001: 180, fig. 18); in contrast, we always observed  $Eb_3$  on the manus ( $N = 18$  chelae) (Fig. 27); (ii) on the pedipalp fixed finger, trichobothrium  $i$  is plotted in a far distal position, at 73 % of the distance from  $dt$  to the tip of the fixed finger (Lourenço, 2001: 180, fig. 18); in contrast, we found that trichobothrium  $i$  was located more proximally, at 50–60 % of the distance from  $dt$  to the tip of the fixed finger ( $N = 17$  fingers) (Figs. 25–26); (iii) on the pedipalp patella, trichobothrium  $d_4$  is plotted distal to  $d_5$  (Lourenço, 2001: 180, fig. 17), an unprecedented

configuration; in contrast, we found that  $d_4$  was invariably located proximal to  $d_5$  ( $N = 18$  patellae) (Fig. 21), consistent with all other known type A patterns in extant bathids (Fet et al., 2005; Vachon, 1974).

**COMMENTS ON LOCALITIES AND LIFE STRATEGY.** The second author visited the locality 13EW (Fig. 96) on 5 July 2013, spent a night there and collected with UV light 80 specimens of *Neobuthus cloudsleythompsoni*. Males were active immediately after sunset and were very common but the first adult female was collected at 21:30 h and other females near 23:00 h. Specimens were mostly found motionless on sand and remain so when picked up, faking death (this cataleptic behavior is also observed in all other species of *Neobuthus*). At the locality, the second author recorded on 5 July 2013, during day a temperature 34 °C and humidity 43%, during sunset at 19:20 h a temperature of 28.7 °C, which gradually dropped to 24.4 °C (minimum temperature) before sunrise. Humidity during the night was a constant 40%. In addition to *N. cloudsleythompsoni* the second author recorded at this locality *Hottentotta trilineatus* (Peters, 1861), *Parabuthus* sp. and *P. pallidus* Pocock, 1895.

#### *Neobuthus eritreaensis* sp. n.

(Figs. 43–95, 97, 151–153, 159, 161, Tables 2, 4–5)

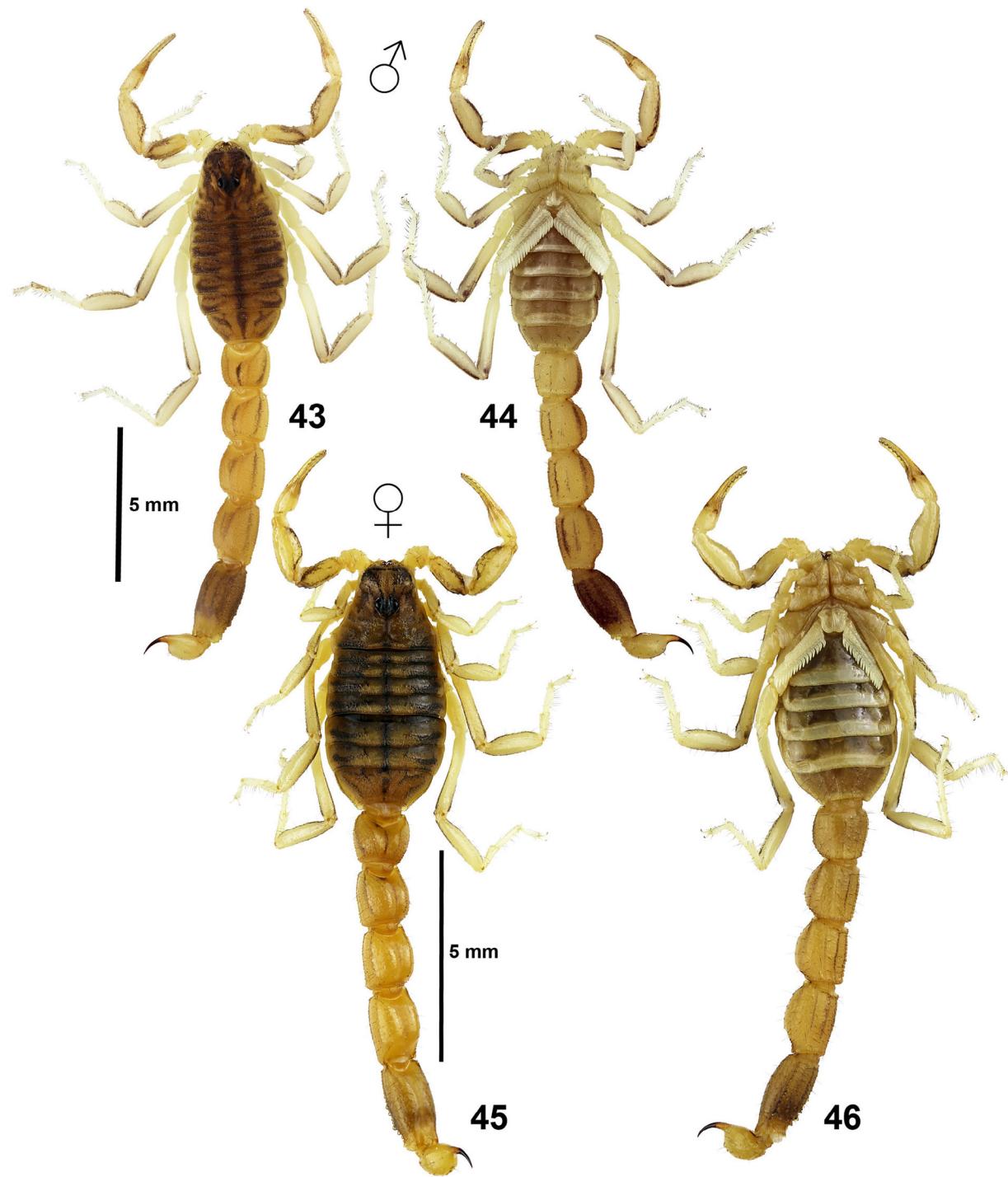
**http://www.zoobank.org/urn:lsid:zoobank.org:act:F7213F2C-0DFD-48EB-AC5D-F9CDEDA05525**

**TYPE LOCALITY AND TYPE REPOSITORY.** Eritrea, near Massawa, 15°36'58.7"N 39°22'32.8"E, 74 m a.s.l. (Locality No. 15EI, Fig. 97), 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), 1♂ (holotype) 4♀1♀im. (paratypes), FKCP, 1♂1♀ (paratypes), GL, 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.

**ETYMOLOGY.** Named after the country of collection, as this is the first record of the genus in Eritrea.

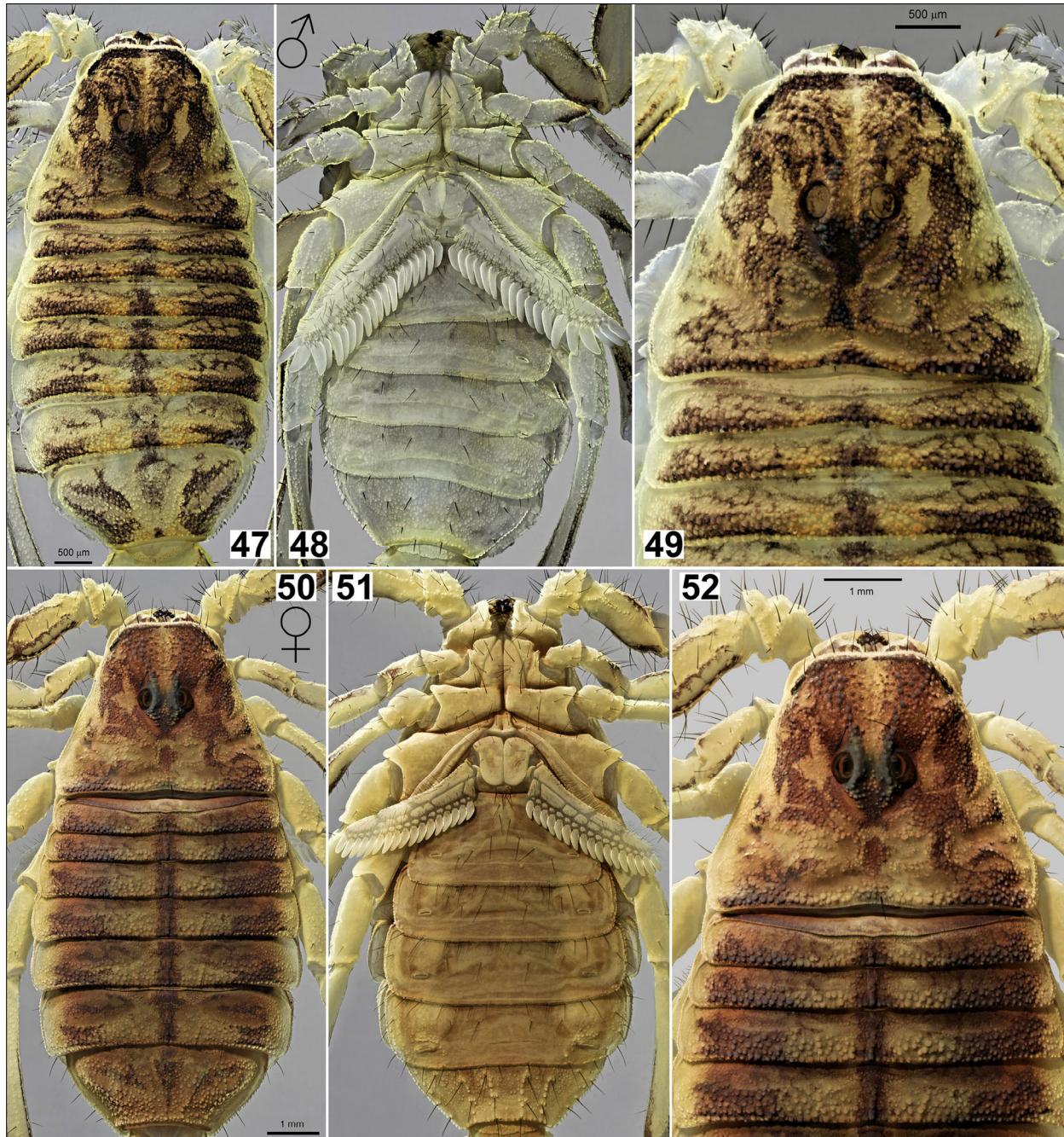
**DIAGNOSIS.** Total length 18 mm (male), 26.5 mm (female); carapace with area between anterior median carinae partially fuscous; tergites with 3 dark stripes, median stripe flanked on either side by broad longitudinal yellow bands that may be broken by fuscosity extending across anterior tergites; pedipalp 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



**Figures 43–46:** *Neobuthus eritreaensis* sp. n. from locality No. 15EI. **Figures 43–44:** Male holotype in dorsal (43) and ventral (44) aspects. Scale bar: 5 mm. **Figures 45–46:** Female paratype in dorsal (45) and ventral (46) aspects. Scale bar: 5 mm. Dry color.

external accessory denticles flanking proximal end of each subrow; posterior margins of carapace and tergites usually lacking macrosetae, or sparsely setose 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



**Figures 47–52:** *Neobuthus eritreaensis* sp. n. from locality No. 15EI. **Figures 47–49.** Male paratype, carapace and tergites (47), coxosternal area and sternites (48), carapace and tergites I–III (49). Scale bars: 0.5 mm. **Figures 50–52.** Female paratype, carapace and tergites (50), coxosternal area and sternites (51), carapace and tergites I–IV (52). Scale bars: 1 mm. Wet UV/ color.

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 surface of metasoma V in males densely granulated, with granules separated; tarsi with relatively sparse setation, leg III of adults with 7–10 macrosetae in retroinferior series of basitarsus, 13–20 ventral macro-

setae on telotarsus; pectine teeth: 15–19 (males), 12–15 (females).

#### DESCRIPTION (HOLOTYPE MALE).

**Coloration** (Figs. 43–44, 47–49, 53–54, 59, 61–67, 84–90, 94). Base color light greenish yellow with extensive patterns of dark maculation. *Carapace* fuscosity dis-

tributed over interocular triangle including most of area between anterior median carinae (but lighter dirty yellowish in narrow midline zone); fuscous areas continuous on lateral flanks and post-ocular tubercle, reticulate in posterior lateral areas; posterior median area dark on median strip and transverse lines; ocular tubercle black, surrounded by elongate yellow patches on laterally; posterior margin of carapace dark on lateral and median borders. *Tergites* 3-striped, with fuscosity arranged longitudinally in narrow median and broad lateral bands; pale patches on either side of median stripe narrow, forming longitudinal ochraceous-yellow bands; on each tergite, lateral bands with more dense fuscosity on posterior part, broken by reticular or fenestrated patterning on anterior part, faint on pretergite. *Sternites* and *coxosternal* area pale yellow. *Metasomal* segments I–IV with fuscous median dorsal markings, darker and solid on segment I, lighter and more diffuse on II–IV, forming anteriorly-directed trident pattern on II–III, divergent trilineate pattern on IV; lateral areas of dorsal surfaces of I–IV between dorsosubmedian carinae yellow; dorsolateral surfaces with reticulated pigmentation, dorsolateral carinae I–IV marked by darker broad stripe; lateral and ventral surfaces of I–III pale yellow with thin dark stripes on ventrolateral and ventro-submedian carinae, stripes very faint on I, increasingly darker on II–III; lateral and ventral surfaces of IV dirty yellow or yellow, ventrolateral carinae marked by thin line, areas of ventrosubmedian carinae by broad dark bands; segment V with alternating strips of reticulated and solid fuscosity on anterior 4/5, yellow on posterior 1/5, anterior median zone of dorsal surface with long brownish-yellow patch. *Telson* vesicle yellow, aculeus brownish-yellow on basal half, dark reddish-black on distal half. *Chelicera* with dark transverse band on sub-distal area of dorsal manus, yellow on internal and external margins; posterior edge of dark band transitioning to faded reticulation, with remaining basal areas of dorsal manus uniformly pale yellow. *Pedipalps* mostly pale yellow with dark markings on some carinae of femur, patella and chela; fuscous stripes heavier on distal dorsal and lower internal surfaces of femur, and external and internal surfaces of patella; patella uniformly yellow on dorsal surface between dorsoexternal and dorsointernal carinae, sparsely reticular on dorsointernal surface; ventral surface of femur and patella pale yellow; pedipalp chela manus with weak fuscosity on distal dorsal manus, and along positions of dorsointernal and interomedian carinae; pedipalp fingers yellow. *Legs* with fuscous longitudinal stripes along distal half of dorsal, distal retrosuperior, and proinferior surfaces of femur, and retrosuperior surface of patella.

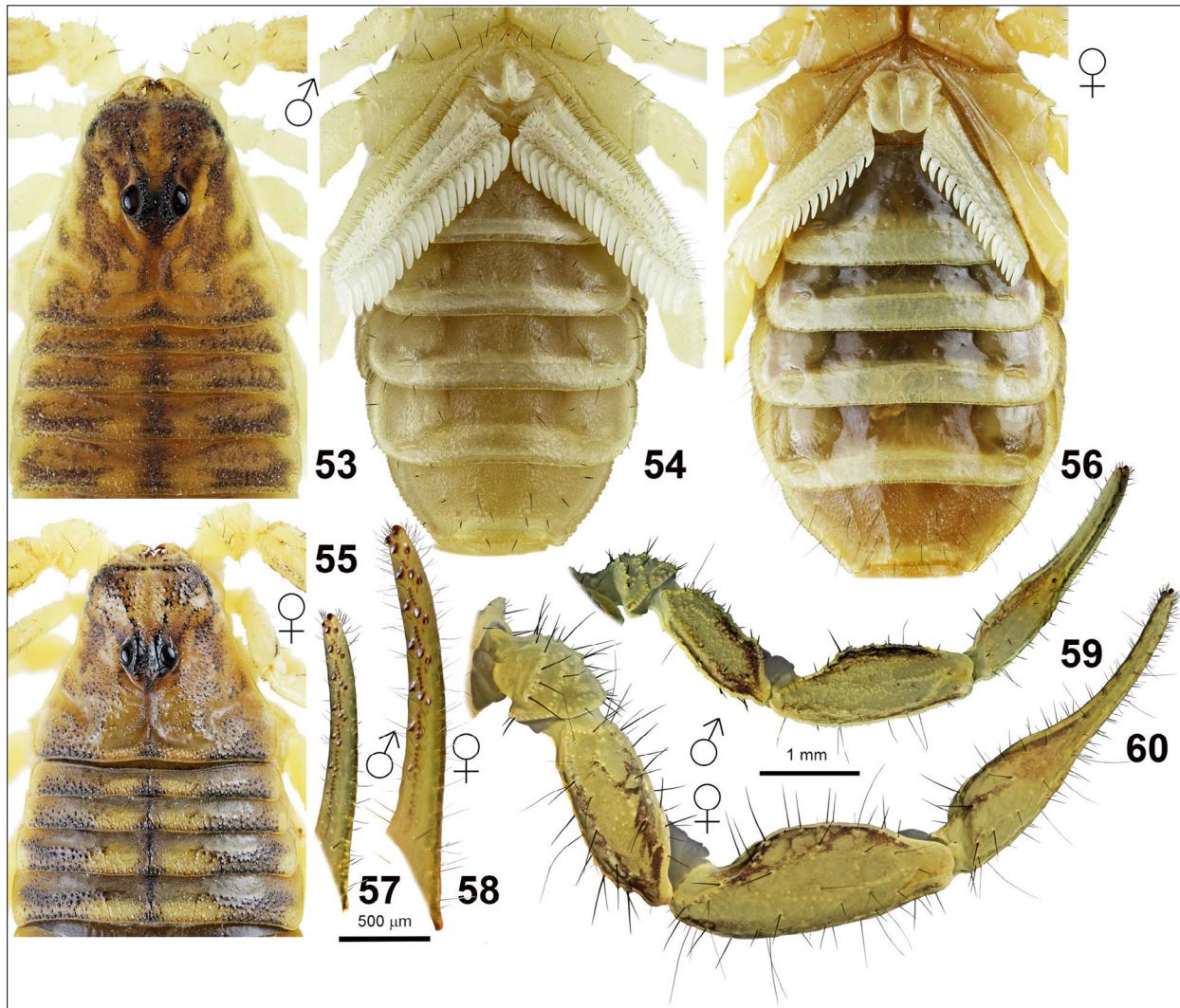
**Carapace** (Figs. 43, 47, 49, 53, 94). Strongly trapezoidal, anterior width 0.36 times posterior width, wider than long (L/W 0.83); posterior median postocular area flat, anterior median preocular area gently slope down-

wards towards anterior margin; lateral flanks steeply sloped; ocular tubercle broad, prominent, located slightly anterior to middle of carapace (preocular distance 0.45 times carapace length); median eyes large, separated by 1.25 times their diameter (viewed in dorsal projection); anterior margin straight, finely microdenticulate, with coarser granules overlapping edge, bearing 8 macrosetae; lateral margins finely denticulate; anterior median carinae weak, coarsely granular, with pair of macrosetae in front of ocular tubercle; other carinae indistinct; dense granulation covering most of carapace, interrupted only by short longitudinal smooth patches lateral to ocular tubercle, and restricted transverse smooth patches behind ocular tubercle and in locations of posterior transverse, posterior marginal, and posterior lateral furrows; posterior margin of carapace almost smooth, with only very fine micro-crenulations; carapace lacking other macrosetae except for one on right supraciliary carina, and one on posterior median margin.

**Chelicera.** Manus smooth on dorsal side, with coarse granules in transverse subapical row extending from dorsointernal carina, and small granule clusters at base of movable finger; dorsointernal carina strong, almost smooth; *chaetotaxy*: 4 straight macrosetae on anterior dorsal surface, including 1 large dark seta on dorsointernal carina, 1 pale seta on subapical granule row, 2 pale setae on apical margin; 2 dorsal microsetae on distal half of movable finger; brush of longer curved setae on internodorsal surface at base of fixed finger; fingers with typical buthid dentition (Vachon, 1963); 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: 1 large distal, 1 small subdistal; dense fields of fine setae on ventrointernal surfaces of movable finger and anterior manus.

**Coxosternal area** (Figs. 44, 48, 54). Coxae weakly, finely granulated, coxa I–II endites with weaker, sparser granulation, almost smooth; coxae I–III with mixture of short, straight macrosetae and longer curved dark reddish macrosetae: 4–8 on coxa I, 9–12 on II, 4–5 on III; coxa IV with single macroseta near anterior end, close to sternum, otherwise devoid of setae; sternum subtriangular, smooth, with deep posteromedian invagination, posterior transverse sulcus and 2 short reddish macrosetae; genital opercula smooth, cordate, with 4–5 short reddish macrosetae; genital papillae present.

**Pectines** (Figs. 44, 48, 54). Basal piece smooth, with deep V-shaped anterior median invagination, 4 short reddish macrosetae; pectines long, distal tips extending to proximal 0.4 of length of trochanter IV; combs with 3 marginal lamellae, 6–8 middle lamellae, 20–20 teeth;



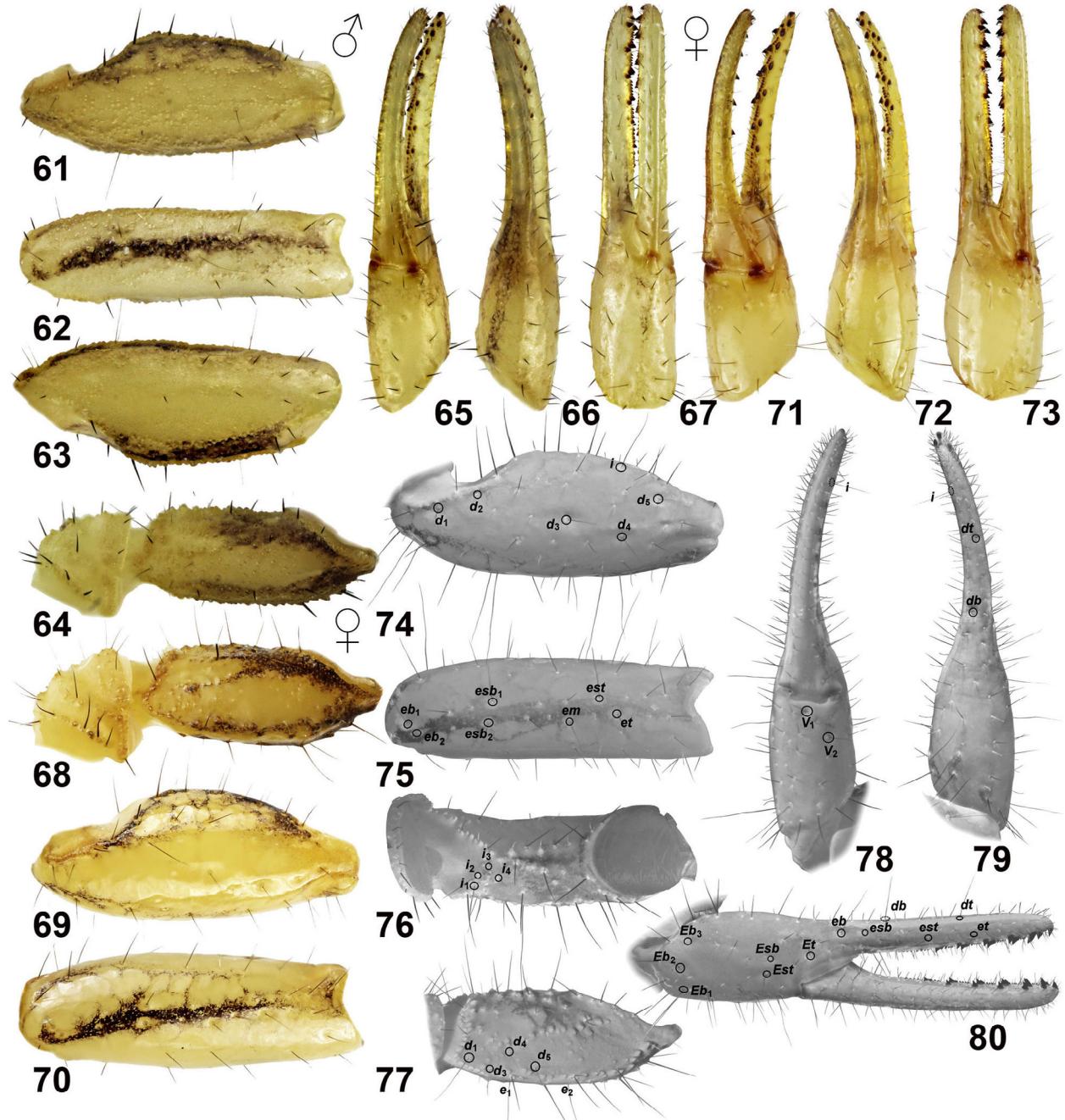
**Figures 53–60:** *Neobuthus eritreaensis* sp. n. from locality No. 15EI. **Figures 53–54.** Male holotype, carapace and tergites I–IV (53) and coxosternal area and sternites (54). **Figures 55–56.** Female paratype, carapace and tergites I–IV (55) and coxosternal area and sternites (56). **Figures 57–58.** Pedipalp movable finger dentition of paratypes male (57) and female (58). Scale bar: 0.5 mm. **Figures 59–60.** Dorsal view of whole pedipalp (trochanter, femur, patella and chela) of paratypes male (59) and female (60). Scale bar: 1 mm. Dry color (53–58), wet UV/ color (59–60).

postero basal vertex of basal middle lamella slightly extended, angulate; marginal lamellae, middle lamellae and fulcra with dense cover of short dark reddish macrosetae; fulcra with 2–4 setae; when anterior margins of left and right pectines are aligned with posterior edges of coxae IV, first and second teeth at base of combs overlap completely.

**Hemispermatophore** (Figs. 91–93). Elongate, slender, trunk 6.7 times length of capsule region; flagellum well separated from external lobe, pars recta short with internal lamina, pars reflecta narrower, cylindiform, slightly longer than pars recta; capsule region with 4 lobes at base of flagellum; external lobe longest, apically rounded; median lobe carinate, apically rounded; in-

ternal lobe apically truncate, same length as median lobe; basal lobe strongly developed, forming a pointed hook.

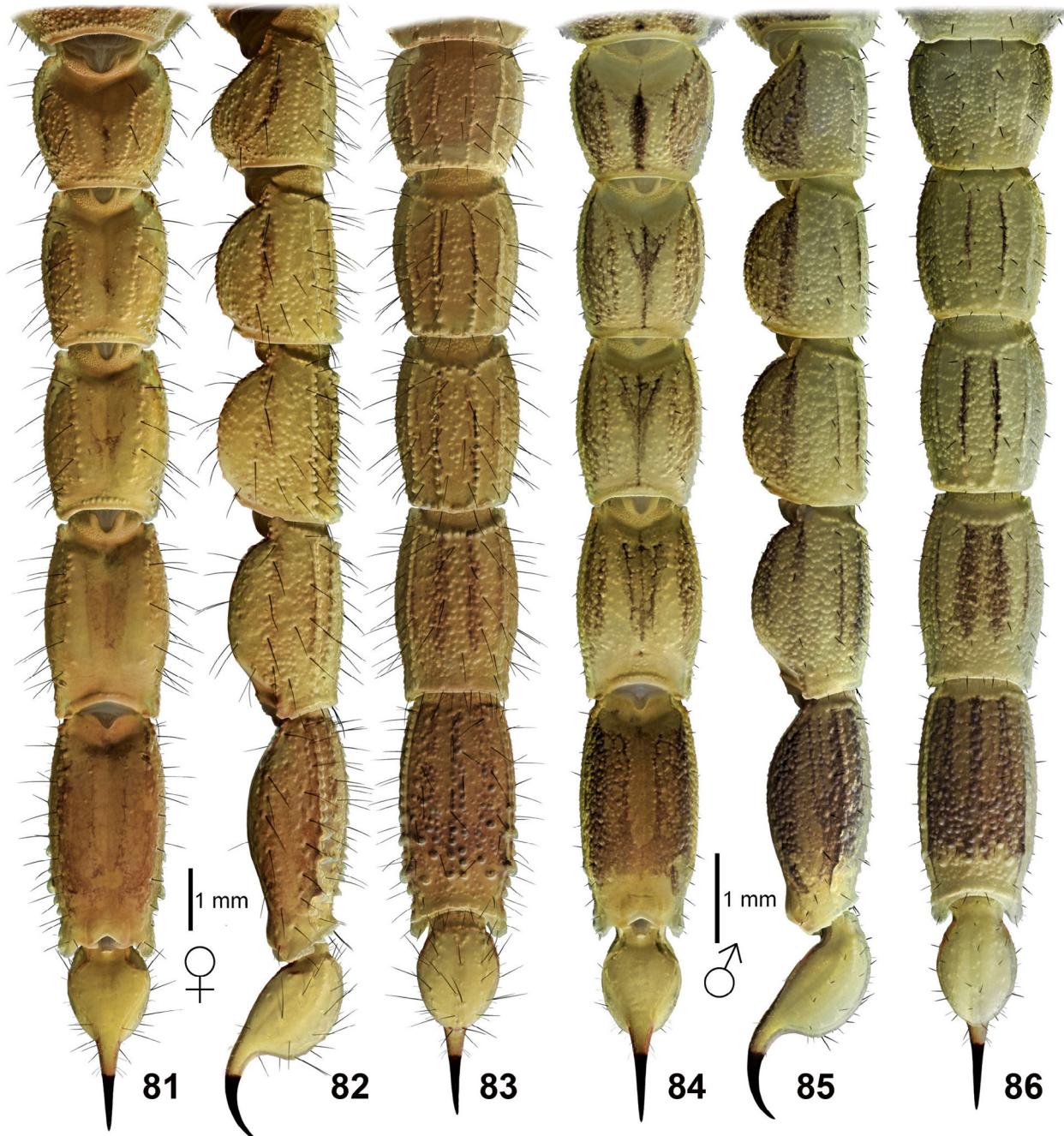
**Mesosoma** (Figs. 43–44, 47–49, 94). Moderately elongate, ca. 2 times length of carapace. **Tergites:** pretergites smooth with finely micro-crenulate posterior margins; tergites I–VI a weak granular median carina only developed in posterior half; tergites III–VI with weakly indicated granular lateral carinae near posterior margins; tergites I–VI densely granular, with coarser granules on posterior lateral areas; tergite VII densely granular, with slight median hump, paired inner and lateral carinae weakly indicated, granular, outer laterals obsolete; posterior margins with very fine, microdenticulations in



**Figures 61–80:** *Neobuthus eritreaensis* sp. n. from locality No. 15EI. **Figures 61–67.** Male holotype, pedipalp segments. Patella dorsal (61), external (62) and ventral (63). Femur dorsal (64). Chela ventral (65), dorsal (66), and external (67). **Figures 68–73.** Female paratype, pedipalp segments. Femur dorsal (68). Patella dorsal (69) and external (70). Femur dorsal (64). Chela ventral (71), dorsal (72), and external (73). **Figures 74–80.** Female, trichobothrial map. Patella dorsal (74) and external (75). Femur internal (76) and dorsal (77). Chela ventral (78), dorsal (79), and external (80). Dry color (61–73), dry UV (74–80).

tergites I–VI, smooth in tergite VII; all tergites devoid of macrosetae. *Sternites:* presternites IV–VII smooth, posterior margins very weakly micro-crenulate; sternites III–VI densely covered with weak, fine granulation, with transverse slit-like spiracles; areas of III covered by

pectines very finely micro-shagreened; sternite V with posterior marginal smooth patch free of granulation; sternite VII densely, finely granulated; median carinae weak or vestigial, granular, confined to posterior 2/3, lateral carinae obsolete; lateral margins of all sternites

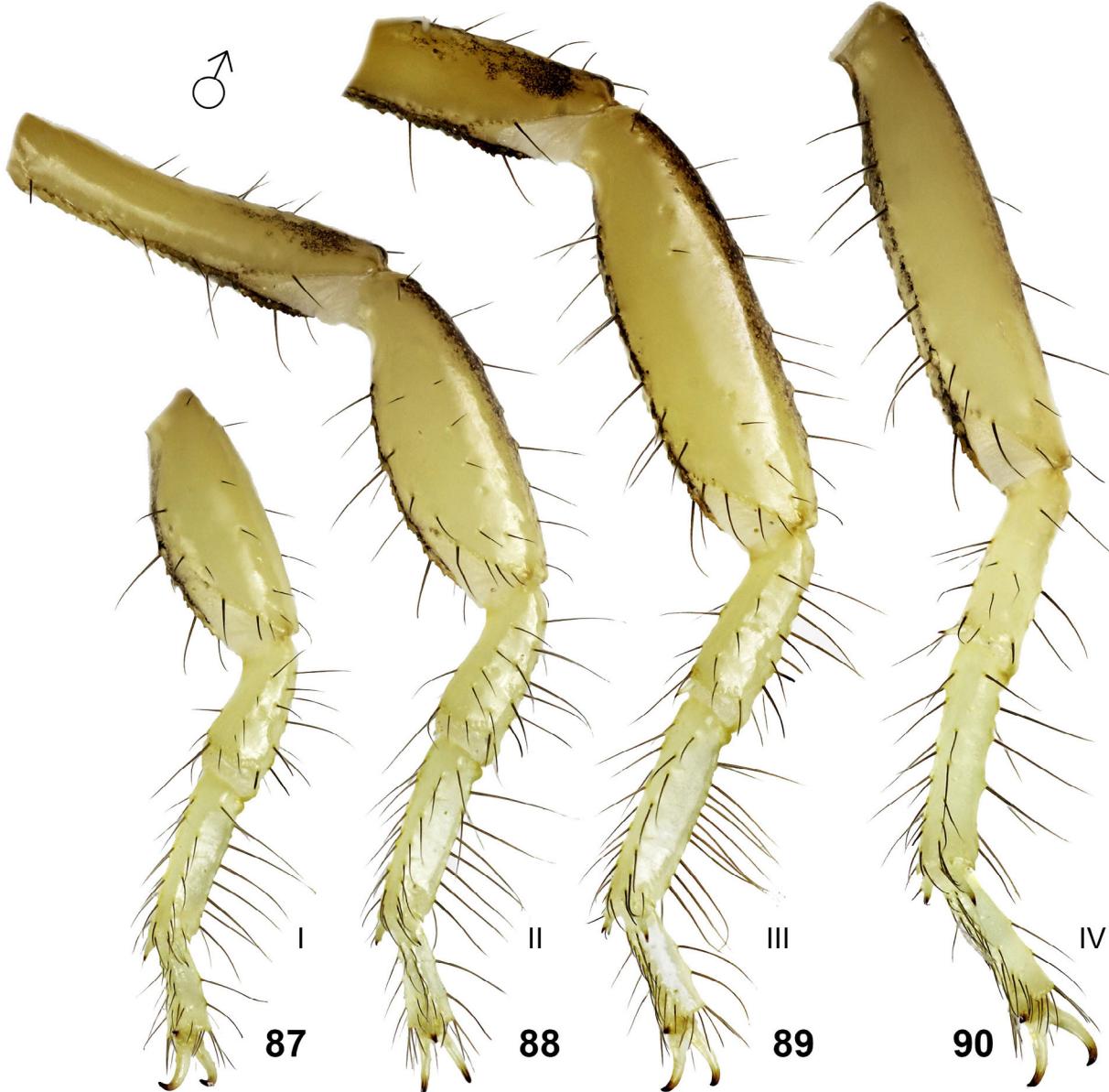


**Figures 81–86:** *Neobuthus eritreaensis* sp. n. from locality No. 15EI, paratypes, metasoma and telson. **Figures 81–83.** Female, dorsal (81), lateral (82), and ventral (83). **Figures 84–86.** Male, dorsal (84), lateral (85), and ventral (86). Scale bars: 1 mm. Wet UV/ color.

finely denticulate; sternite macrosetae (non-marginal/marginal): III 8/8, IV 5/11, V 6/12, VI 5/14, VII 8/6; setae on sternite VII similar to setae on III–VI.

**Metasoma** (Figs. 43–44, 84–86, 94). Moderately elongate, total length of segments I–V 1.5 times length of prosoma + mesosoma; segment I as wide as long, segments II–V progressively longer than wide (L/W ratio increasing from 1.2 to 2.0); *carination*: segments I–II

with 10 carinae, III with 8 carinae, IV–V with 2 carinae; segments I–III with moderate, granulate ventro-submedian and ventrolateral carinae, weak to vestigial, granulate dorsosubmedian carinae, obsolete dorsolateral carinae; lateral median carinae weak, granulate on I, very weakly indicated by granule series on II, obsolete on III; segment IV with weakly indicated, granulate ventrolateral carinae; segment V with strong, granulate



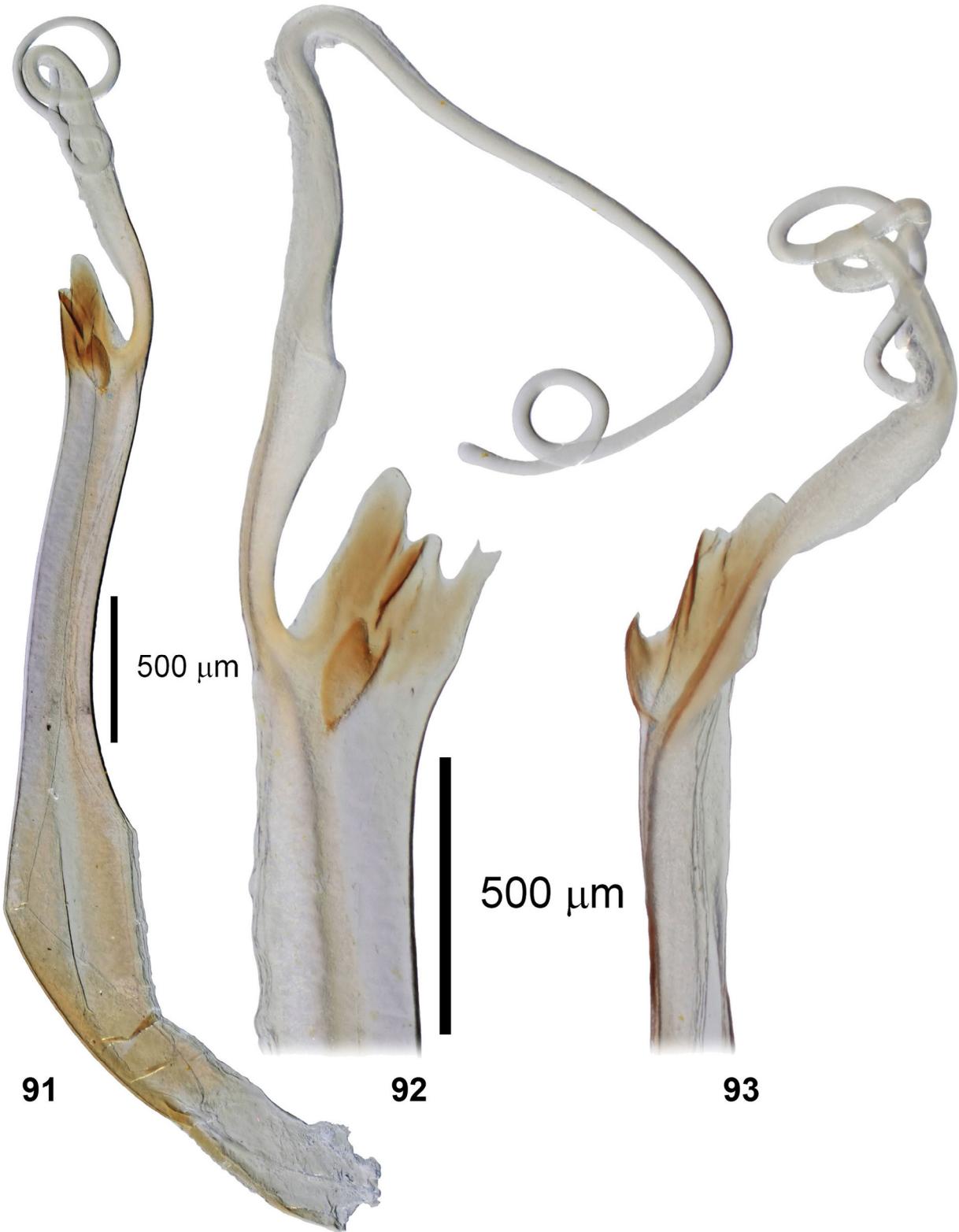
**Figures 87–90:** *Neobuthus eritreaensis* sp. n. from locality No. 15EI, holotype male, right legs I–IV, retrolateral aspect. Dry color.

to dentate-lobate ventrolateral carinae; *granulation*: segments I–III with dense granulation on all intercarinal surfaces; segment IV densely granulated except for bilateral posterior smooth patches on dorsal surface; segment V densely granular on lateral and ventral surfaces, more coarsely so on ventral surface, granules not arranged into any traces of carinae; lateral anal lobe with strong notch towards ventral end, ventral anal arc with ca. 10 weak crenulations; *chaetotaxy*: segments I–IV with scattered macrosetae on carinae and intercarinal surfaces; lateral surface of segment V with macrosetae arrayed in 2 longitudinal rows of 6–9 setae near dorsal and ventral margins, ventral surface with sparsely scat-

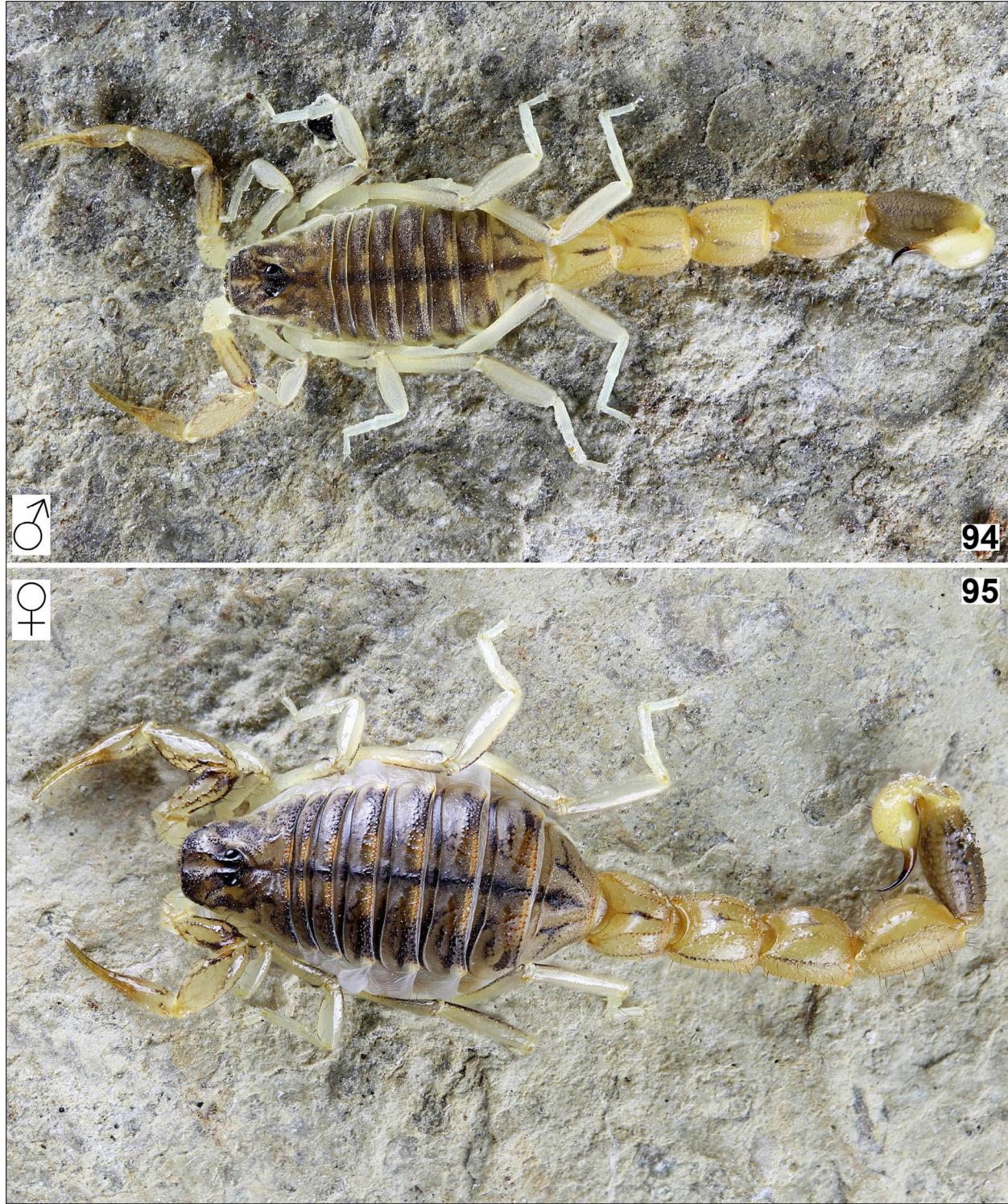
tered setae; dorsal surfaces of all segments bare; all metasomal setae short to very short, straight, reddish, shorter and more stout than coxosternal and sternal setae.

**Telson** (Figs. 43–44, 84–86, 94). Vesicle slightly elongated, posterior surface steeply sloped, not quite truncate; aculeus stout, shorter than vesicle, tip of aculeus directed almost vertically; ventral surface sparsely, weakly granular, with scattered anteriorly-directed, stout, reddish macrosetae.

**Pedipalps** (Figs. 43–44, 57, 59, 61–67, 94). *Femur*: moderately elongated, 2.53 times longer than wide; dorsoexternal and external carinae weak, granulated;



**Figures 91–93:** *Neobuthus eritreaensis* sp. n., hemispermatoophore, holotype male. **Figure 91.** Whole left hemispermatoaphore, dorsal aspect. **Figures 92–93.** Capsule region and flagellum, dorsal aspect of right hemispermatoaphore with capsule lobes flattened (92), external aspect of left hemispermatoaphore (93). Scale bars: 0.5 mm.



**Figures 94–95:** *Neobuthus eritreaensis* sp. n., *in vivo* habitus at locality No. 15EI. Paratypes male (94) and female (95).

other carinae obsolete; dorsal, external and internal surfaces with sparse fine granules, ventral surface sparsely shagreened, almost smooth; 4–5 distal external accessory macrosetae. *Patella*: moderately elongated, 2.55

times longer than wide; external, dorsoexternal, dorsomedian, dorsointernal, internal carinae weak, with coarse granules; ventrointernal carina vestigial, marked by series of medium to fine granules; ventral and

ventroexternal carinae obsolete; dorsoexternal, dorsal and upper internal surfaces with sparse, coarse granules, some areas smooth; ventrointernal, ventral and ventroexternal surfaces smooth or almost smooth with few fine granules; short, straight reddish macrosetae scattered sparsely over carinae. *Chela*: Short, relatively stout, 5.06 times longer than wide; fingers robust, movable finger 1.78 times manus ventral length; manus and fingers smooth, carinae obsolete; manus, fixed and movable fingers with sparse short, straight, reddish macrosetae; numerous fine, translucent microsetae on fingers; fixed finger with 4 subdistal denticles proximal to distal tooth, 6 primary denticle subrows, 3–4 external and 6 internal accessory denticles; movable finger with 4 subdistal denticles proximal to distal tooth, 5 primary denticle subrows, 3 external and 5 internal accessory denticles; right chela malformed, with conspicuous, broadly rimmed, crater-like depression between fixed finger trichobothria *eb* and *esb*.

**Trichobothriotaxy.** *Neobothriotaxic minorante*, type Aβ (Vachon, 1974); femur *d*<sub>2</sub> vestigial, indistinguishable from chemotactic microsetae, patella *d*<sub>2</sub> slightly larger; other buthid petite trichobothria, chela *Eb*<sub>3</sub>, *Esb* and *esb* present; patella with *esb*<sub>1</sub> slightly proximal to *esb*<sub>2</sub> on left segment, slight distal to it on right segment.

**Legs** (Figs. 87–90). Relatively elongated; femora with finely granulate or denticulate carinae, surfaces finely granulated prolaterally, faintly granulated or smooth retrolaterally; patellae with weakly granulated carinae, faintly granular prolaterally, smooth retrolaterally; tibiae and tarsomeres smooth; legs III–IV with small tibial spurs; retrolateral pedal spurs simple, non-setose; pro-lateral pedal spurs simple, non-setose on I–II, basally bifurcate, bearing single macroseta on III–IV; *chaetotaxy*: 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; bristle comb setal counts (retrosuperior/ retroinferior): I 4/6, II 4–5/8, III 6/8–9; telotarsi with two rows of short setae on ventral aspect, 16–18 setae on telotarsus III.

**Paratype female** (Figs. 45–46, 50–52, 55–56, 58, 60, 68–83, 95, 151–153, 159). Color pattern very similar to that of male, but fuscous patterns weaker on metasoma, and on dorsolateral surfaces of metasomal segments I–III. Other differences from male include: larger size (total length of adult male 18.0 mm, adult female 26.5 mm); carapace with less dense granulation, coarser well-separated granules on interocular triangle; tergites with sparser granulation, anterior areas finely shagreened medially, smooth laterally; tergite VII with weaker, finer granulation; weak, granulated median carinae present on

metasomal segments I–III; metasomal segments I–III sparser granulation on intercarinal surfaces, dorsal surface of I–II very sparsely granular, of III–V smooth; all metasomal carinae more strongly developed; segments II–III with stronger dentate granulation on ventro-submedian carinae, posterior denticles larger than anterior denticles; segment V with larger lobate granules on posterior ventrolateral carinae, lateral surface weakly, sparsely granular; telson more bulbous, with stronger granulation, sternites III–V completely smooth, IV smooth medially, sparsely granulated laterally; sternite VII with nearly uniform, fine granulation, somewhat more sparse than in male, 2 pairs of carinae well marked by enlarged granules; genital opercula more elongated, with 4–5 setae, posterior ends overlapping pectine basal piece; pectine basal piece with shallower, broader U-shaped anterior invagination; pectines with smaller teeth, shorter, distal tips extending to distal limit of coxa IV, 6–7 middle lamellae, basal middle lamella somewhat narrower along axial dimension; pedipalp chela more stout (compare L/ W ratios in Tab. 4); pedipalp femur with much weaker, sparser granulation, almost smooth; pedipalp patella and chela smooth; femora and patellae of legs smooth on prolateral surfaces; macrosetae on pedipalps, legs, metasoma and telson much longer and finer than in the male.

**Measurements.** See Tab. 2.

**VARIATION.** For variation in selected morphometric ratios and meristics, see Tabs. 4–5. Coloration patterns were fairly consistent across the examined material, although fuscous markings could be lighter or darker in some individuals.

**COMPARISONS.** *N. eritreaensis* sp. n. is similar to *N. cloudsleythompsoni*, sharing a 3-striped pattern on the tergites, very short macrosetae on male pedipalps and metasoma, and granulated male sternites. It differs from *N. cloudsleythompsoni* as follows: fuscosity infiltrating area between anterior median carinae of carapace (vs. clear), female sternite VII granulated with four granulated carinae (vs. smooth with carinae obsolete), higher mean pectinal tooth count (Tab. 5), more stout metasomal segments (Tab. 4), ventral surface of telson strongly granulated (vs. weakly granulated or smooth).

**COMMENTS ON LOCALITIES AND LIFE STRATEGY.** The second author visited the locality 15EI (Fig. 97) on 4 November 2015 and collected with UV light. Males of *Neobuthus eritreaensis* sp. n. were active immediately after sunset but females appeared later. At the locality, the second author recorded after sunset air temperature 31.5°C. In addition to *N. eritreaensis* sp. n. he recorded at this locality *Compsobuthus* sp. On 8 November 2015, the second author stopped on the second locality 15EK very near to 15EI and found



96



97

**Figures 96–97:** Habitats of *Neobuthus* spp. Collection sites for *Neobuthus cloudsleythompsoni* Lourenço, 2001 in Ethiopia, locality No. 15EW (96), and *N. eritreaensis* sp. n. in type locality, Eritrea, locality No. 15EI (97).

<i>Neobuthus eritreaensis</i> sp. n.			
Measurement (mm)		Holotype ♂	Paratype ♀
Total	L	18.00	26.50
Metasoma + Telson	L	11.50	17.00
Carapace	L/ aW/ pW	2.368 /1.041 /2.857	3.266 /1.633 /3.796
Preocular	L	1.072	1.510
Metasoma I	L/ W/ D	1.510 /1.612 /1.408	2.123 /2.204 /1.878
Metasoma II	L/ W/ D	1.714 /1.429 /1.388	2.449 /2.000 /1.959
Metasoma III	L/ W/ D	1.959 /1.388 /1.388	2.602 /1.970 /1.908
Metasoma IV	L/ W/ D	2.143 /1.408 /1.347	3.082 /2.000 /1.837
Metasoma V	L/ W/ D	2.612 /1.327 /1.174	3.653 /1.837 /1.596
Telson	L	2.306	2.898
Vesicle	L/ W/ D	1.347 /0.898 /0.847	1.755 /1.286 /1.190
Pedipalp chela	L/ W/ D	2.531 /0.500 /0.531	3.429 /0.755 /0.806
Pedipalp movable finger	L	1.633	2.204
Pedipalp manus ventral	L	0.918	1.286
Pedipalp fixed finger	L	1.367	1.735
Pedipalp femur	L/ W	1.551 /0.612	2.041 /0.837
Pedipalp patella	L/ W	2.000 /0.786	2.755 /1.102
Pectine	L	2.204	2.633
No. of lateral eyes	Left/ Right	5/ 5	5/ 5

**Table 2:** Measurements of holotype male and paratype female of *Neobuthus eritreaensis* sp. n. (both adults). Abbreviations: length (L), width (W), anterior width (aW), posterior width (pW), depth (D).

three specimens during day under stones lying in sand near *Acacia* trees. In addition to *N. eritreaensis* sp. n. the second author recorded at this locality *Compsobuthus* sp. and *Parabuthus abyssinicus* (Pocock, 1901).

#### *Neobuthus kutcheri* sp. n.

(Figs. 98–147, 154–156, 160–161, Tables 3–5)

<http://www.zoobank.org/urn:lsid:zoobank.org:act:E457D996-6534-4C1A-BBA5-805DD6AEAAD9>

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. (Locality No. 14EG, Figs. 146–147), 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), 19.-21.XI.2014, 4♂ (holotype and paratypes) 6♀ 5♂ ims. 7juvs. (paratypes), FKCP, 2♂ 3♀ 3♂ ims. 2juvs. (paratypes), GL, leg. F. Kovařík et al. (UV detection).

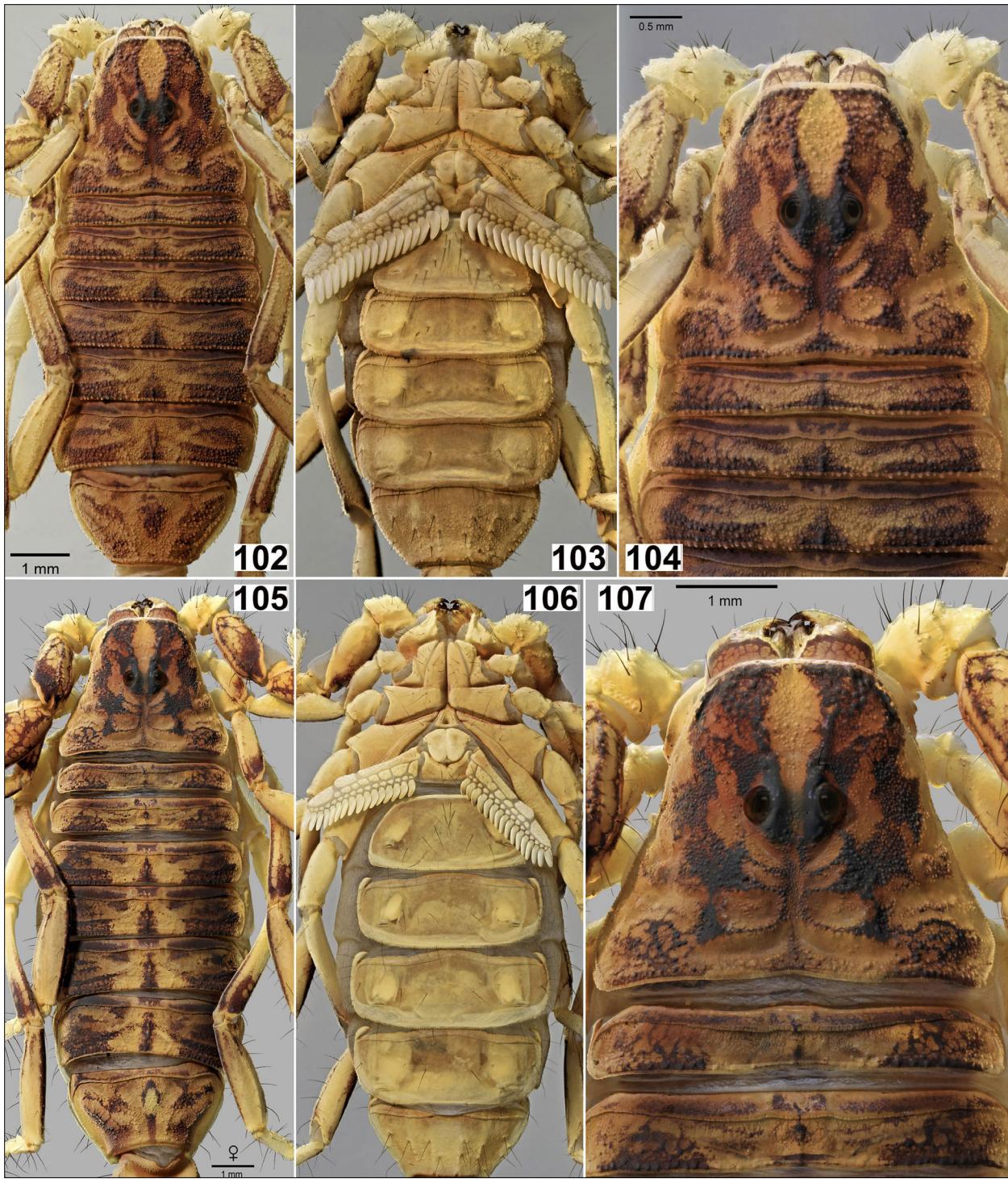
ETYMOLOGY. A patronym in honor of Steven R. Kutcher, California, for his friendship and lifelong

dedication to promoting insects and arachnids in education, arts and entertainment.

DIAGNOSIS. 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; trichobothria  $d_2$  usually present on patella; posterior margins of carapace and tergites 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



**Figures 98–101:** *Neobuthus kutcheri* sp. n. **Figures 98–99.** Male holotype in dorsal (98) and ventral (99) aspects. **Figures 100–101:** Female paratype in dorsal (100) and ventral (101) aspects. Dry color.

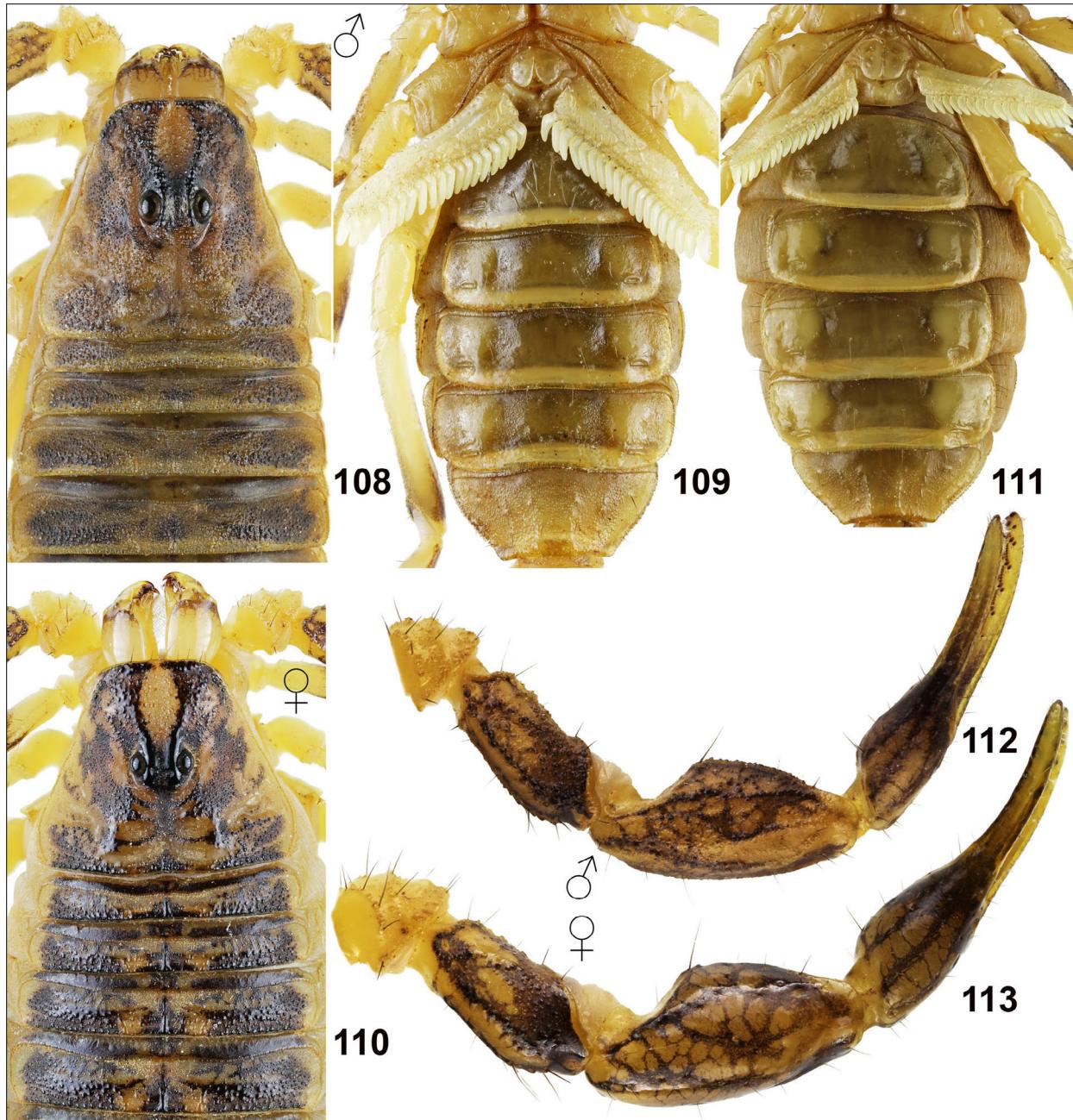


**Figures 102–107:** *Neobuthus kutcheri* sp. n. **Figures 102–104.** Male paratype, carapace and tergites (102), coxosternal area and sternites (103), carapace and tergites I–III (104). Scale bars: 1 mm (Figs. 102 and 103) and 0.5 mm (Fig. 104). **Figures 105–107.** Female paratype, carapace and tergites (105), coxosternal area and sternites (106), carapace and tergites I–II (107). Scale bars: 1 mm. Wet UV/ color.

long macrosetae, leg III of adults with 7–15 macrosetae in retroinferior series of basitarsus, 24–37 ventral macrosetae on telotarsus; pectine teeth: 17–20 (males), 15–19 (females).

#### DESCRIPTION (HOLOTYPE MALE).

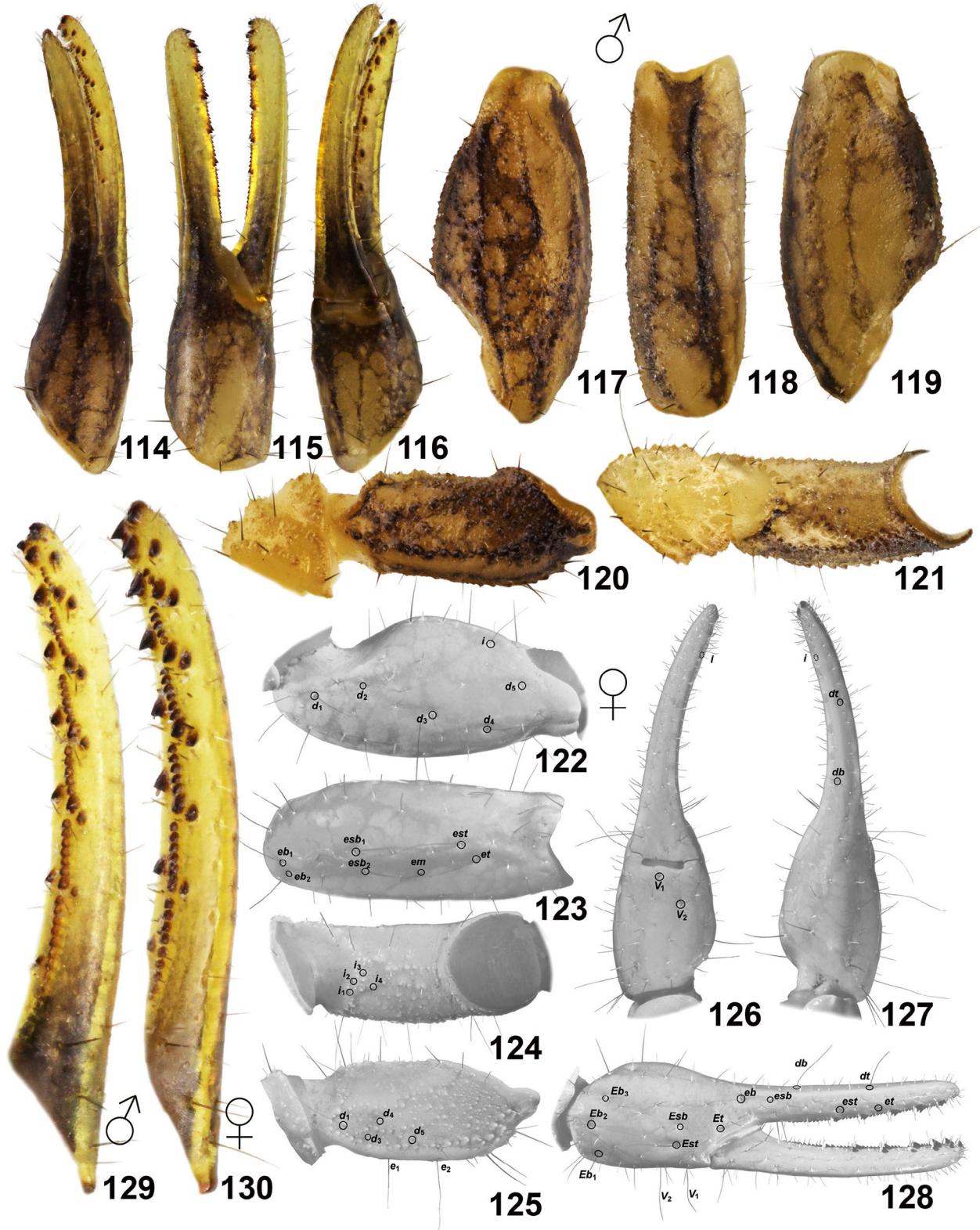
**Coloration** (Figs. 98–99, 102–104, 108–109, 112, 114–121, 129, 134–140, 144). Base color orange/ brownish-yellow with extensive, elaborate patterns of dark macu-



**Figures 108–113:** *Neobuthus kutcheri* sp. n. **Figures 108–109.** Male holotype, carapace and tergites I–IV (108) and coxosternal area and sternites (109). **Figures 110–111.** Female paratype, carapace and tergites I–IV (110) and coxosternal area and sternites (111). **Figures 112–113.** Dorsal view of whole pedipalp (trochanter, femur, patella and chela) of holotype male (112) and paratype female (113). Dry color.

lation. Carapace with fuscosity over lateral interocular triangle from ocular tubercle, but dark pigment excluded from area between anterior median carinae; fuscosity extending back continuously on lateral flanks, connecting behind ocular tubercle via transverse stripes on posterior median area; ocular tubercle black, bordered by pale patches laterally and posteriorly; posterior margin of carapace with dark border and median tri-

angular patch of dark pigment. Tergites 3-striped, with fuscosity arranged longitudinally in narrow median and broad lateral bands; pale patches on either side of median stripe narrow, disrupted, not forming broad longitudinal yellow bands; on each tergite, lateral bands with fuscosity almost solid on posterior part, broken by reticular or fenestrated patterning on anterior part, solid on pretergite. Sternites and coxosternal area yellow.



**Figures 114–130:** *Neobuthus kutcheri* sp. n. **Figures 114–121.** Male holotype, pedipalp segments. Chela dorsal (114), external (115), and ventral (116). Patella dorsal (117), external (118) and ventral (119). Femur dorsal (120) and internal (121). **Figures 122–128.** Female paratype, trichobothrial map. Patella dorsal (122) and external (123). Femur internal (124) and dorsal (125). Chela ventral (126), dorsal (127), and external (128). **Figures 129–130.** Pedipalp movable finger dentition of male holotype (129) and female paratype (130). Dry color (114–121), dry UV (122–128).

*Metasomal* segments I–IV bearing broken fuscous patterns on dorsal surfaces, other surfaces with longitudinal fuscous markings associated with carinae; segment V with fuscosity on posterior 1/3 of dorsal surface, with dorsolateral dark bands and 2 finer dorsal stripes extending to anterior 2/3 of segment; lateral surface of segment V with dark fenestration, ventral surface with 3 longitudinal fuscous bands broadening and fusing posteriorly; posterior-most margin of segment V yellow. *Telson* with vesicle uniformly yellow, aculeus yellow on basal 1/3, dark reddish-black on distal 2/3. *Chelicera* with dark pigment on dorsal surface of manus, forming broad continuous band along anterior margin, reticulated pattern restricted to distal half of manus (proximal half clear). *Pedipalps* with dark or reticulated pigmentation associated with carinae on femur and patella, with more extensive fuscosity on distal dorsal and distal internal surfaces of femur, and ventroexternal and internal surfaces of patella; ventral surface of femur and patella mostly yellow; chela with broad longitudinal dark bands on manus, extending to proximal fixed and movable fingers. *Legs* with limited fuscosity on dorsal, prodistal and retrodistal surfaces of femur, extensive fuscosity on retrodorsal surface of patella.

**Carapace** (Figs. 98, 102, 104, 108, 144). Strongly trapezoidal, anterior width 0.45 times posterior width, wider than long (L/ W 0.91); posterior median postocular area flat, anterior median preocular area gently slope downwards towards anterior margin; lateral flanks steeply sloped; ocular tubercle broad, prominent, located near middle of carapace (preocular distance 0.47 times carapace length); median eyes large, separated by 1.5 times their diameter (viewed in dorsal projection); anterior margin straight, almost smooth, with 8 macrosetae; lateral margins finely denticulate; anterior median carinae weak, granular, with single pair of macrosetae at 1/5 distance to anterior margin; other carinae indistinct; dense granulation covering surface of carapace, interrupted only by restricted smooth patches corresponding to locations of central transverse, central lateral, posterior transverse, posterior marginal, and posterior lateral furrows; posterior margin of carapace with very fine, microdenticulations.

**Chelicera.** Manus smooth on dorsal side, with subapical transverse series of large granules; dorsointernal carina at base of fixed finger strong, weakly crenulate; *chaetotaxy*: one long, reddish macroseta on dorsointernal carina, one short reddish macrosetae in anterior median area, 2 pale macrosetae on internal anterior margin; two pale dorsal microsetae on distal half of movable finger; brush of longer curved setae on internodorsal surface at base of fixed finger; fingers with typical buthid dentition (Vachon, 1963); fixed finger with large distal denticle, 1 subdistal denticle and 2 basal denticles fused into bicuspid, single denticle on ventral surface at level of bicuspid; dorsal margin of movable finger with 5 denticles: 1 large

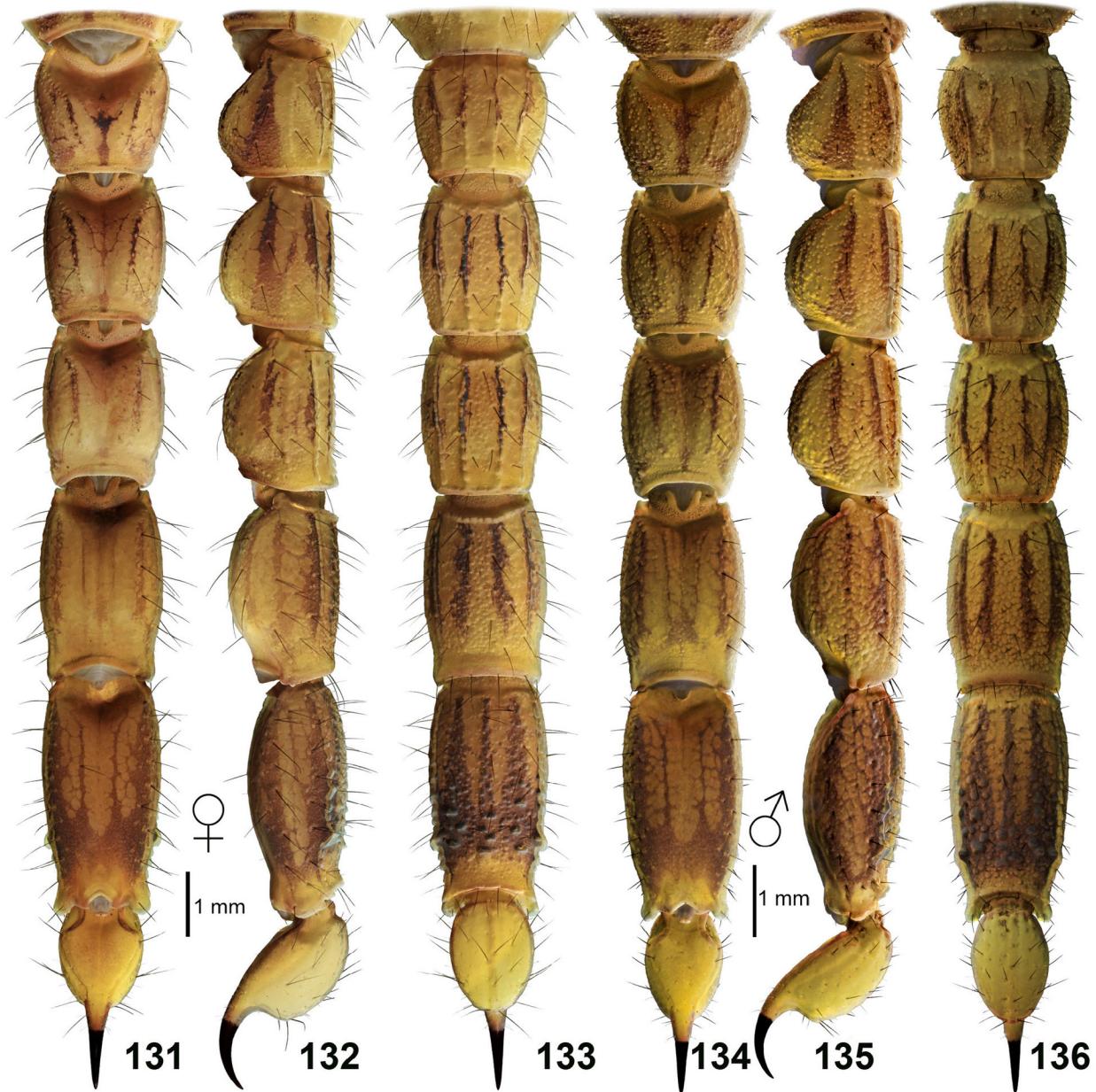
distal denticle, medium-sized subdistal and medial, and 2 small basal denticles; ventral margin with 2 denticles: 1 large distal, 1 small subdistal; dense fields of fine setae on ventrointernal surfaces of movable finger and anterior manus.

**Coxosternal area** (Figs. 99, 103, 109). Coxae smooth, coxa III with finely granular anterior margin; coxa I–II with numerous long reddish macrosetae, 12–14 on coxa I, 12–13 on coxa II endite and margins (main surface of II bare); coxa III with 6 long reddish macrosetae on anterior margin; coxa IV with single macroseta near anterior end, close to sternum, otherwise devoid of setae; sternum subtriangular, smooth, with deep median invagination, posterior transverse sulcus and 2 short reddish macrosetae; genital opercula smooth, cordate, with 4 short reddish macrosetae; genital papillae present.

**Pectines** (Figs. 99, 103, 109). Basal piece smooth, with deep V-shaped anterior median invagination, 3 short reddish macrosetae; pectines long, distal tips extending to proximal 1/6 of trochanter IV; combs with 3 marginal lamellae, 7–8 middle lamellae, 20–19 (right–left) teeth; posterobasal vertex of basal middle lamella extended, angulate; marginal lamellae, middle lamellae and fulcra with dense cover of medium length reddish macrosetae; fulcra with 3–6 setae; when anterior margins of left and right pectines are aligned with posterior edges of coxae IV, first and second teeth at base of combs overlap completely.

**Hemispermatophore** (Figs. 141–143). Elongate, slender, trunk 6.15 times length of capsule region; flagellum well separated from external lobe, pars recta short with internal lamina, pars reflecta ca. 1.5 times longer, cylindroid; capsule region with 4 lobes at base of flagellum; external lobe longest, apically rounded; median lobe carinate, apically truncate; internal lobe acuminate, same length as median lobe; basal lobe strongly developed, forming a pointed hook.

**Mesosoma** (Figs. 98–99, 102–104, 108–109, 144). Long, narrow, 2.33 times length of carapace. *Tergites*: pretergites smooth, posterior margins almost smooth with very fine micro-denticulation; tergites I–VI a weak granular median carina only developed in posterior half; tergites III–VI with traces of granular lateral carinae near posterior margins; tergites I–VI densely finely granular, with coarser granulation on posterior lateral areas; tergite VII finely granulate, with slight median hump, paired inner and outer lateral carinae very weakly indicated, granular; posterior margins with very fine, microdenticulations in tergites I–VI, smooth in tergite VII; all tergites devoid of macrosetae. *Sternites*: pre-sternites IV–VII smooth, posterior margins smooth; sternites III–VI nearly completely smooth, only III weakly micro-shagreened on areas covered by pectines and V–VI weakly micro-shagreened on outer lateral areas, with transverse slit-like spiracles; sternite VII finely granulated, posterior 2/3 with 4 weak, granular

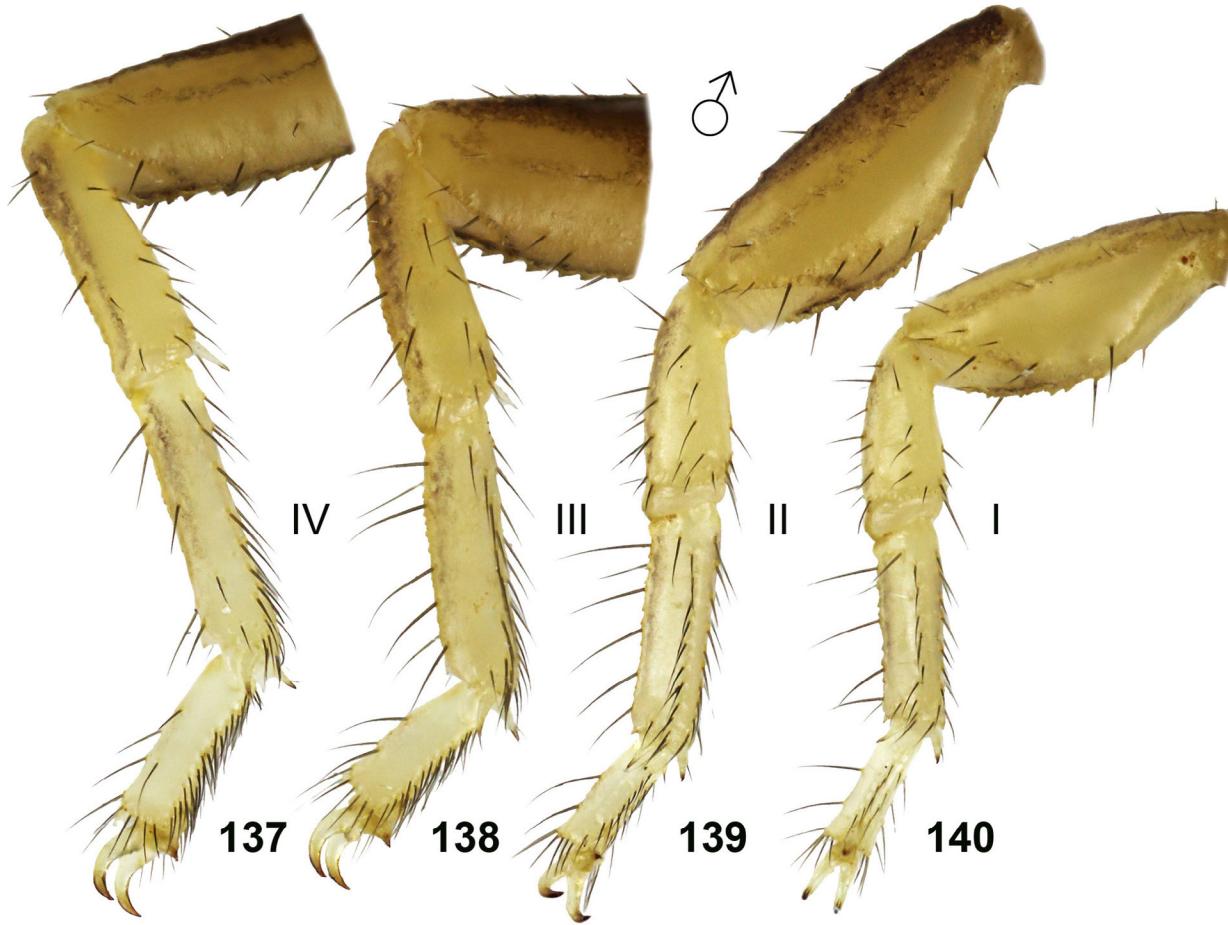


**Figures 131–136:** *Neobuthus kutcheri* sp. n., metasoma. **Figures 131–133.** Paratype female, dorsal (131), lateral (132), and ventral (133). **134–136.** Paratype male, dorsal (134), lateral (135), and ventral (136). Scale bars: 1 mm. Wet UV/ color.

carinae; lateral margins of all sternites weakly denticulate or crenulate; sternite macrosetae (non-marginal/marginal): III 15/9, IV 5/21, V 5/19, VI 5/21, VII 11/9; setae on sternite VII shorter, thicker than setae on III–VI.

**Metasoma** (Figs. 98–99, 134–136, 144). Moderately elongate, total length of segments I–V 1.4 times length of prosoma + mesosoma; segment I slightly wider than long, segments II–V progressively longer than wide (L/W ratio increasing from 1.17 to 2.09); *carination*: segments I–II with 10 carinae, III with 8 carinae, IV–V

with 2 carinae; segments I–II with moderate to strong, granulate or crenulate ventrosubmedian and ventrolateral carinae, weak, granulate lateral median carinae, and very weak or slightly indicated, granulate dorsolateral and dorsosubmedian carinae; segment III with moderate, granulate or crenulate ventrosubmedian and ventrolateral carinae, very weak or slightly indicated, granulate lateral median, dorsolateral and dorsosubmedian carinae; segment IV with weak, crenulated ventrolateral carinae; segment V with strong, granulate to lobate ventrolateral carinae; median lateral carinae complete on I–II, obso-



**Figures 137–140:** *Neobuthus kutcheri* sp. n., holotype male, left legs IV–I, retrolateral aspect. Dry color.

lete on anterior 1/4 of III; *granulation*: segments I–III with dense granulation on all intercarinal surfaces, coarser on dorsal areas; segment IV densely granulated on ventral and lateral surfaces, smooth on dorsal surface except for fine granulation in posterior median area; segment V with lateral surface coarsely roughened, granulation merging into rugose texture, ventral surface granulate-rugose studded with large rectangular granules on posterior half; lateral anal lobe with notch towards ventral end, ventral anal arc weakly crenulated with 9 fine notches; *chaetotaxy*: segments I–IV with scattered macrosetae on carinae and intercarinal surfaces; lateral surface of segment V with macrosetae arrayed in 2 longitudinal rows of 8–11 setae near dorsal and ventral margins, ventral surface with sparsely scattered setae; all metasomal setae of moderate length, straight, reddish, similar to those on sternite VII, shorter and more stout than coxosternal setae.

**Telson** (Figs. 98–99, 134–136, 144). Vesicle moderately elongated, posterior surface truncate; aculeus stout, shorter than vesicle, tip of aculeus directed vertically; ventral surface with scattered anteriorly-directed, stout, reddish macrosetae.

**Pedipalps** (Figs. 98–99, 112, 114–121, 129, 144). *Femur*: relatively stout, 2.28 times longer than wide; dorsoexternal, internal and ventrointernal carinae weak, granulated; external carina moderate, granulated; other carinae obsolete; granulation moderate and coarser on dorsal surface, sparse and finer on internal and ventral surfaces; external surface nearly smooth; 4–5 distal external accessory macrosetae. *Patella*: relatively stout, 2.32 times longer than wide; dorsomedian, dorsointernal and internal carinae weak, finely granulated; external carina weak, nearly smooth; other carinae obsolete; dorsal, upper internal and upper external surfaces finely granulated, ventral surface micro-shagreened or smooth; scattered short, straight reddish macrosetae on carinae, 5 on internal surface. *Chela*: Short, relatively stout, 4.50 times longer than wide; fingers robust, movable finger 1.84 times manus ventral length; carinae obsolete, all surfaces smooth; manus and fixed finger sparsely equipped with short, straight, reddish macrosetae, including regular ring of 10 around proximal edge of manus; numerous fine, translucent microsetae on fingers; movable finger with numerous short macrosetae on ventral aspect; fixed finger with 4 subdistal denticles



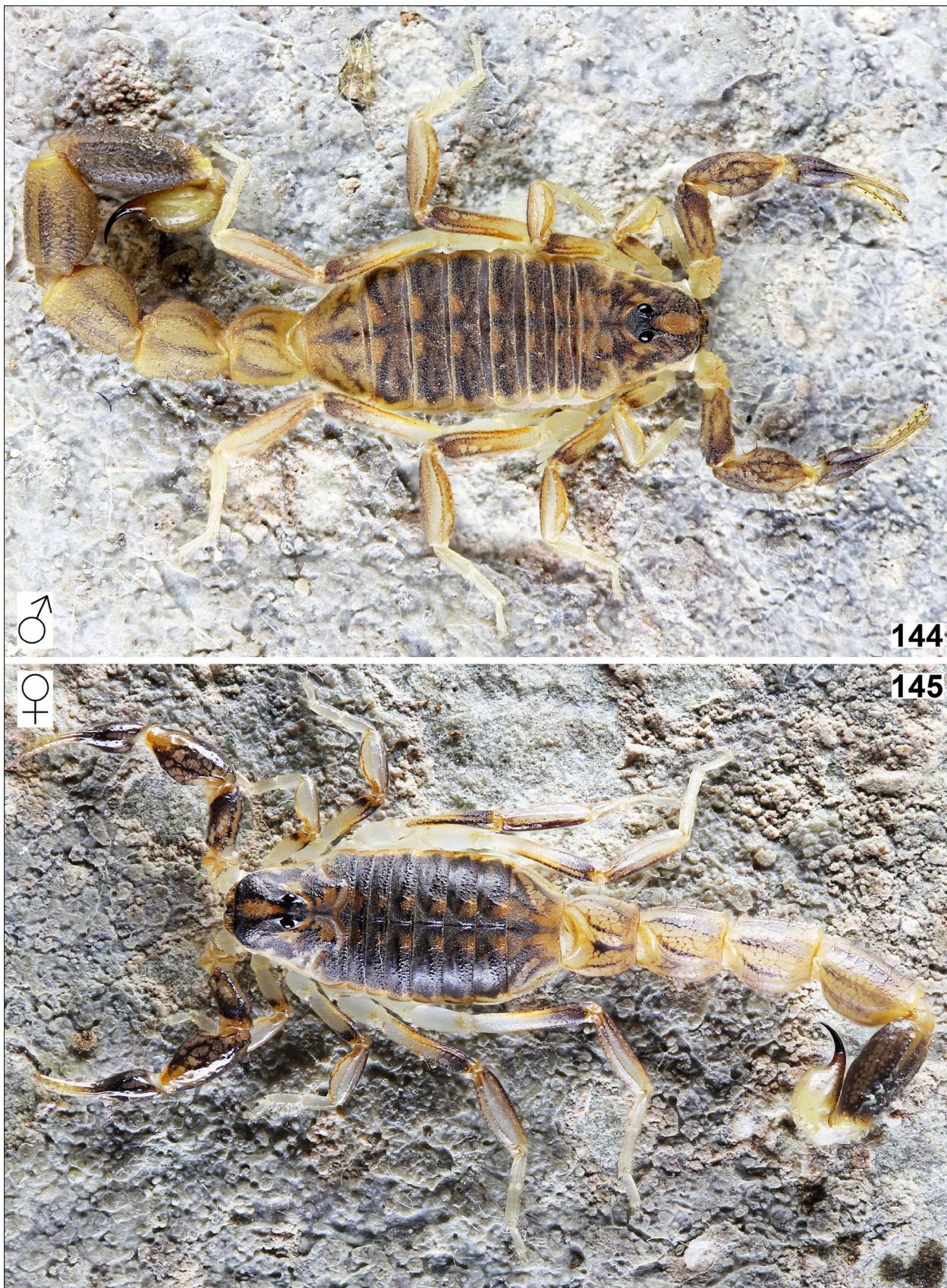
**Figures 141–143:** *Neobuthus kutcheri* sp. n., hemispermophore, holotype male. 141. Whole right hemispermophore, dorsal aspect. Figures 142–143. Capsule region and flagellum, dorsal aspect of left hemispermophore with capsule lobes flattened (142), internal aspect of right hemispermophore (143). Scale bars: 0.5 mm.

proximal to distal tooth, 5 primary denticle subrows, 4 external and 5 internal accessory denticles; movable finger with 3 subdistal denticles proximal to distal tooth, 6 primary denticle subrows, 4 external and 6 internal accessory denticles.

**Trichobothriotaxy.** Orthobothriotaxic or neobothriotaxic minorante, type Aβ (Vachon, 1974); among buthid petite trichobothria, femur  $d_2$  may be absent (absent in 6/8 examined femora), patella  $d_2$ , chela  $Eb_3$ ,  $Esb$  and  $esb$  are present; patella with  $esb_1$  level with or slightly distal to  $esb_2$ .

**Legs** (Figs. 137–140). Relatively short, stout; femora with weakly denticulate dorsal and ventral carinae, surfaces granulated prolaterally, smooth retrolaterally; patellae with weakly denticulate prolateral and ventral carinae, smooth dorsal carinae, all surfaces smooth or nearly smooth; tibiae and tarsomeres smooth; legs III–IV with small tibial spurs; retrolateral pedal spurs simple, non-setose; prolateral pedal spurs basally bifurcate, bearing 0

(I), 1 (II), 2 (III–IV) macrosetae; *chaetotaxy*: coxa, femora, patella and tibia of all legs bearing a mix of short and moderate length, straight reddish macrosetae; tarsi with longer, finer reddish macrosetae; basitarsi I–III compressed, with bristle combs consisting of retro-superior series of longer macrosetae, plus retroinferior and proinferior series of shorter macrosetae; bristle comb setal counts (retrosuperior/ retroinferior/ pro-inferior; left-right): I 4-5 /12-10 /9-10, II 5-5 /13-16 /12-12, III 6-7/ 14-13/ 13-13; telotarsi hirsute on ventral aspect, more densely so on more posterior legs, bearing two series of numerous long, fine macrosetae, with setal counts (left-right): I 13-11, II 21-22, III 33-37; IV 48-47. **Paratype female** (Figs. 100–101, 105–107, 110–111, 113, 122–128, 131–133, 145, 154–156, 160). Coloration pattern similar to that of male. Differs as follows: larger size (total length 31 mm, holotype male is 23 mm); carapace wider (L/ W 0.851), with weaker, finer granulation; tergites I–VI with much weaker granulation,



Figures 144–145: *Neobuthus kutcheri* sp. n., *in vivo* habitus. Paratypes male (144) and female (145).



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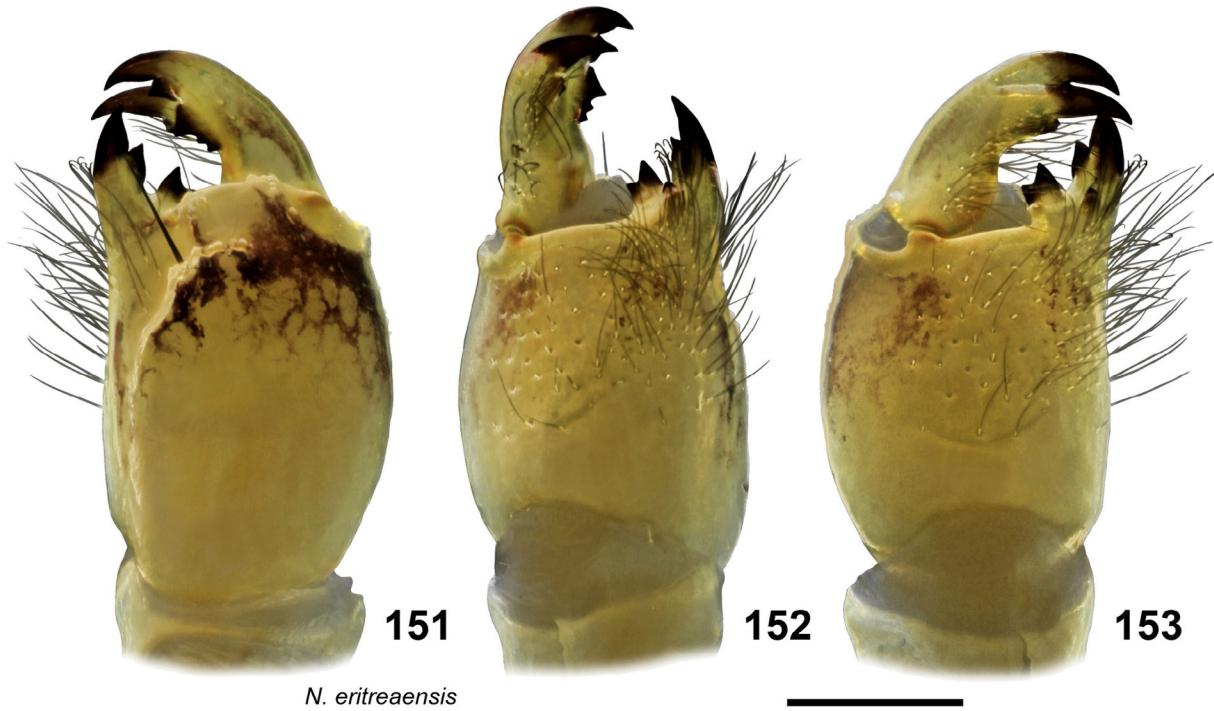


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**Figures 146–147:** *Neobuthus kutcheri* sp. n., type locality, Ethiopia, Somali State, Liben region, Filtu, 05°06'48.7"N 40°39'18.3"E, 1229 m a.s.l. (Locality No. 14EG).

Measurement (mm)	<i>Neobuthus kutcheri</i> sp. n.			
	Holotype ♂	Paratype male ♂	Paratype ♀	Paratype female ♀
Total	L	23.00	21.50	31.00
Metasoma + Telson	L	14.00	13.70	17.00
Carapace	L/ aW/ pW	2.674 /1.327 /2.939	2.572 /1.245 /2.694	3.449 /1.796 /4.062
Carapace preocular	L	1.245	1.225	1.633
Metasoma I	L/ W/ D	1.735 /1.853 /1.531	1.633 /1.796 /1.551	2.194 /2.306 /1.939
Metasoma II	L/ W/ D	2.000 /1.714 /1.551	1.919 /1.674 /1.592	2.490 /2.092 /1.959
Metasoma III	L/ W/ D	2.296 /1.704 /1.572	2.163 /1.653 /1.592	2.674 /2.082 /1.919
Metasoma IV	L/ W/ D	2.647 /1.714 /1.514	2.531 /1.633 /1.531	3.164 /2.070 /1.878
Metasoma V	L/ W/ D	3.137 /1.500 /1.337	3.062 /1.592 /1.316	3.898 /1.857 /1.714
Telson	L	2.572	2.449	3.225
Vesicle	L/ W/ D	1.674 /1.061 /0.969	1.510 /1.029 /0.939	2.021 /1.429 /1.306
Pedipalp chela	L/ W/ D	2.919/ 0.649/ 0.684	2.857/ 0.643/ 0.663	3.796/ 1.000/ 1.014
Pedipalp movable finger	L	1.955	1.837	2.531
Pedipalp manus ventral	L	1.061	1.021	1.388
Pedipalp fixed finger	L	1.551	1.429	1.898
Pedipalp femur	L/ W	1.674/ 0.735	1.592/ 0.694	2.000/ 0.959
Pedipalp patella	L/ W	2.347/ 1.010	2.143/ 0.980	2.919/ 1.357
Pectine	L	2.653	2.408	2.694
No. of lateral eyes	Left/ Right	5 /5	4 /5	5 /5

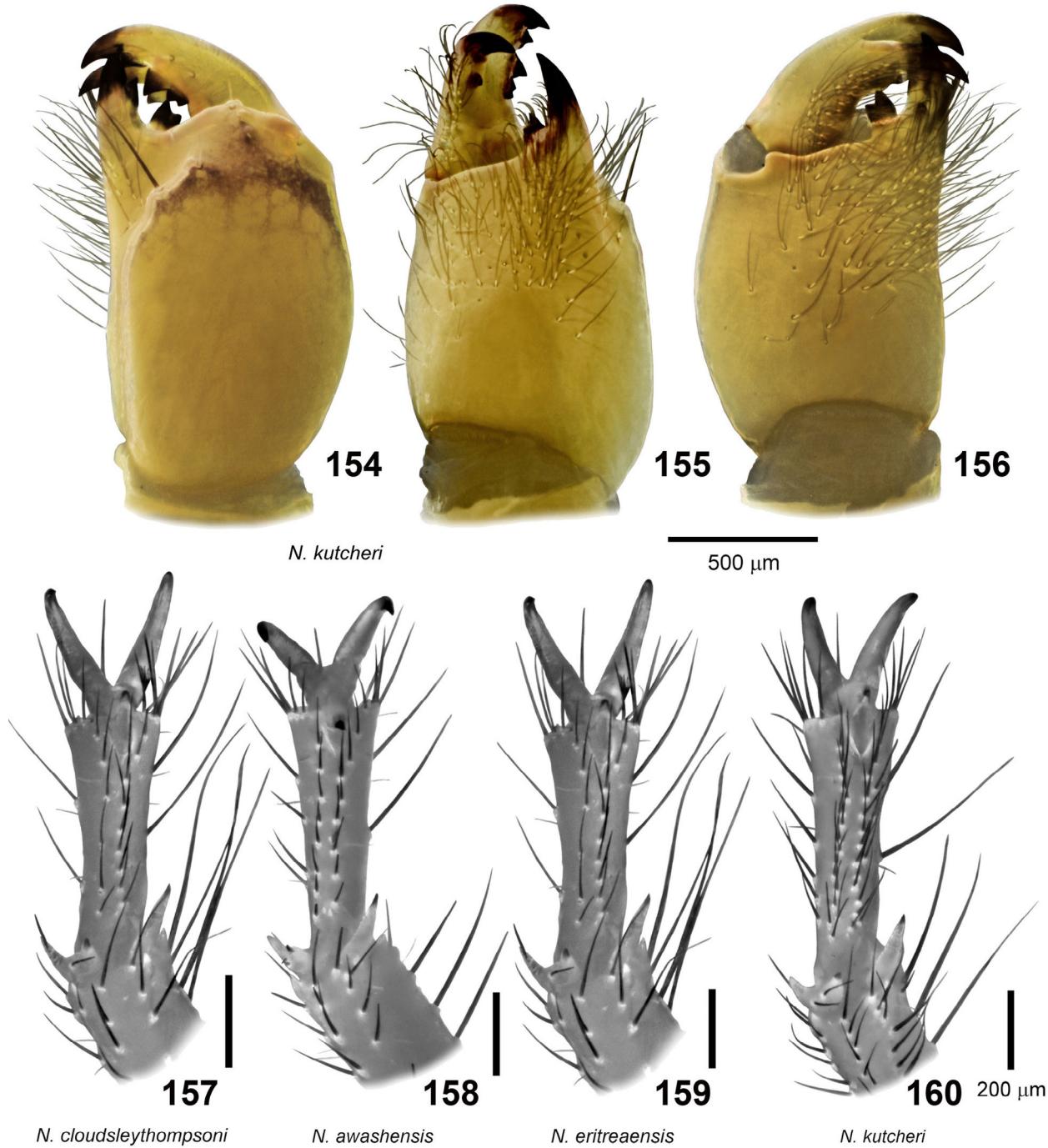
**Table 3:** Measurements of holotype male and paratype male and females of *Neobuthus kutcheri* sp. n. (all adults). Abbreviations: length (L), width (W), anterior width (aW), posterior width (pW), depth (D).



**Figures 148–153:** Chelicerae of female *Neobuthus* spp. **Figures 148–150.** *N. cloudsleythompsoni* Lourenço, 2001, dorsal (148), ventrointernal (149), and ventral (150). **Figures 151–153.** *N. eritreaensis* sp. n., paratype, dorsal (151), ventrointernal (152), and ventral (153). Scale bars: 0.5 mm. Wet UV/ color.

anterior areas finely shagreened or nearly smooth, posterior areas with sparser granulation; tergite VII with sparser, finer granulation; metasomal segments with sparser, finer granulation on all surfaces, dorsal surfaces of segments I–III nearly smooth; segments II–III with

stronger dentate granulation on ventrosubmedian carinae, posterior granules larger than anterior granules; segment V with larger lobate granules on posterior ventrolateral carinae, lateral surface smooth (not rugose-granulose); telson more bulbous, aculeus more stout



**Figures 154–160:** Figures 154–156. Chelicerae of female paratype *Neobuthus kutcheri* sp. n., dorsal (154), ventrointernal (155), and ventral (156). Scale bar: 0.5 mm. Figures 157–160. Telotarsus III ventral setation of female *Neobuthus* spp. **Figure 157.** *N. cloudsleythompsoni* Lourenço, 2001. **Figure 158.** *N. awashensis* Kovařík & Lowe, 2012. **Figure 159.** *N. eritreaensis* sp. n., paratype. **Figure 160.** *N. kutcheri* sp. n., paratype. Scale bars: 0.2 mm. Wet UV/ color (154–156), dry UV (157–160).

with tip directed sub-vertically; sternites III–VI completely smooth; sternite VII smooth anteriorly, with sparse, fine granulation posteromedially, densely shagreened posterolaterally; genital opercula more elongated, with 8–9 setae; pectine basal piece with shallower, broader anterior invagination, not strongly V-

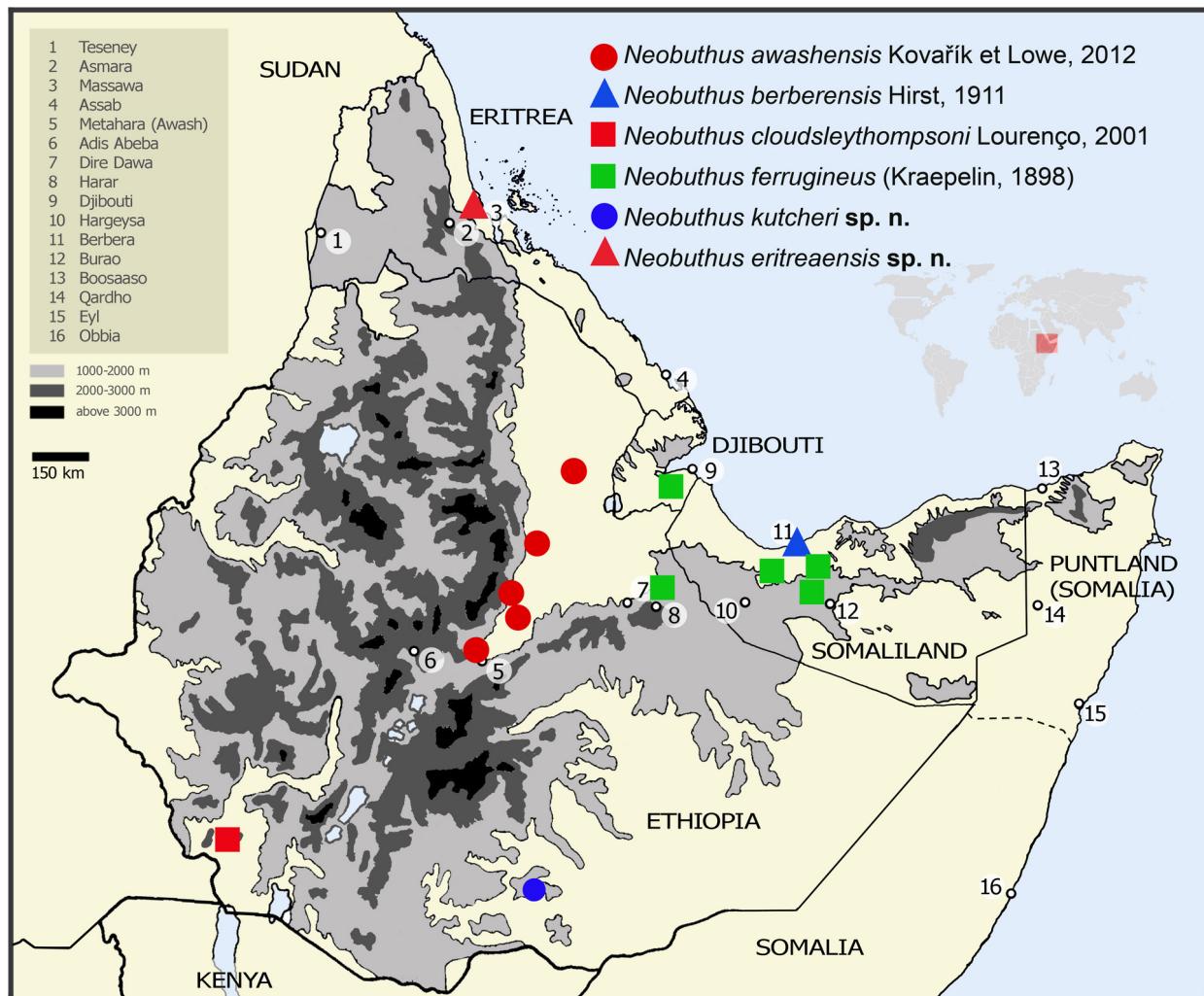
shaped; pectines with smaller teeth, shorter, distal tips not extending past distal limit of coxa IV, 6–7 middle lamellae, basal middle lamella slightly narrower along axial dimension; pedipalp segments shorter, more stout, L/W ratios: femur 2.09, patella 2.15, chela 3.80; pedipalp femur with weaker, sparser granulation; patella

Morphometric Ratio	<i>Neobuthus cloudsleythompsoni</i> Lourenço, 2001		<i>Neobuthus eritreaensis</i> sp. n.		<i>Neobuthus kutcheri</i> sp. n.	
	♂	♀	♂	♀	♂	♀
Metasoma I L/W	0.98 – 1.08 1.02 ± 0.05 (3)	0.97 – 1.17 1.01 ± 0.07 (8)	0.94	0.90 – 0.96 0.94 ± 0.03 (3)	0.91 – 0.94 (2)	0.93 – 0.95 (2)
Metasoma II L/W	1.25 – 1.26 (2) 1.30 ± 0.03 (7)	1.27 – 1.34	1.20	1.10 – 1.22 1.15 ± 0.07 (3)	1.15 – 1.17 (2)	1.19 – 1.21 (2)
Metasoma III L/W	1.39 – 1.41 (2) 1.45 ± 0.05 (7)	1.38 – 1.51	1.41	1.26 – 1.32 1.29 ± 0.03 (3)	1.31 – 1.35 (2)	1.28 – 1.31 (2)
Metasoma IV L/W	1.65 – 1.69 (2) 1.69 ± 0.05 (7)	1.61 – 1.75	1.52	1.51 – 1.58 1.54 ± 0.04 (3)	1.54 – 1.55 (2)	1.53 – 1.57 (2)
Metasoma V L/W	1.96 – 2.09 2.01 ± 0.07 (3)	1.88 – 2.19 2.07 ± 0.09 (8)	1.97	1.99 – 2.05 2.03 ± 0.03 (3)	1.92 – 2.09 (2)	1.99 – 2.10 (2)
Telson vesicle L/D	1.64 – 1.71 (2) 1.40 ± 0.03 (7)	1.36 – 1.46	1.59	1.39 – 1.52 1.46 ± 0.07 (3)	1.61 – 1.73 (2)	1.50 – 1.55 (2)
Pedipalp femur L/W	2.20 – 2.38 2.30 ± 0.09 (3)	2.13 – 2.25 2.20 ± 0.06 (3)	2.53	2.44	2.28 – 2.30 (2)	2.08 – 2.09 (2)
Pedipalp patella L/W	2.31 – 2.57 2.47 ± 0.14 (3)	2.37 – 2.60 2.51 ± 0.12 (3)	2.55	2.50	2.19 – 2.32 (2)	2.13 – 2.15 (2)
Pedipalp chela L/W	4.40 – 5.50 4.89 ± 0.56 (3)	4.13 – 4.25 4.20 ± 0.07 (3)	5.06	4.54	4.44 – 4.50 (2)	3.80 – 4.18 (2)
Pedipalp movable finger L/ manus ventral L	1.77 – 2.00 (2)	1.93 – 2.04 (2)	1.78	1.71	1.80 – 1.84 (2)	1.82 – 2.02 (2)

**Table 4:** Variation in selected morphometric ratios of *Neobuthus cloudsleythompsoni* Lourenço, 2001, *N. eritreaensis* sp. n. and *N. kutcheri* sp. n. (all adults). Data format is: range, mean ± standard deviation (n = sample size); when n = 2, only range is cited, single values correspond to n = 1. Abbreviations: length (L), width (W), depth (D).

Mericistic count	<i>Neobuthus cloudsleythompsoni</i> Lourenço, 2001		<i>Neobuthus eritreaensis</i> sp. n.		<i>Neobuthus kutcheri</i> sp. n.	
	♂	♀	♂	♀	♂	♀
Pectinal tooth count	15 – 19 16.75 ± 0.78 (92)	12 – 15 13.73 ± 0.83 (30)	20 – 22 20.50 ± 0.93 (8)	15 – 18 16.50 ± 0.93 (8)	17 – 20 18.64 ± 0.74	15 – 19 16.64 ± 0.99
Metasoma II ventrosubmedian carina granules	15 – 22 17.98 ± 1.76 (40)	10 – 17 14.00 ± 2.51 (8)	15 – 16 15.75 ± 0.46 (8)	17 (2)	11 – 15 12.67 ± 1.37 (6)	11 – 16 13.07 ± 1.49 (14)
Metasoma III ventrosubmedian carina granules	13 – 21 15.78 ± 1.75 (40)	10 – 16 11.75 ± 1.98 (8)	13 – 15 14.25 ± 0.71 (8)	14 – 15 (2)	11 – 13 12.00 ± 0.63 (6)	11 – 15 12.36 ± 1.15 (14)
Basitarsus III retroinferior setae adult	8 – 11 9.50 ± 0.93 (8)	7 – 9 7.50 ± 1.00 (4)	8 – 9 (2)	6 – 6 (2)	10 – 15 12.75 ± 2.06 (4)	7 – 10 8.75 ± 1.26 (4)
Telotarus III inferior setae adult	15 – 20 17.00 ± 1.41 (8)	13 – 16 14.75 ± 1.26 (4)	16 – 18 (2)	15 – 17 (2)	28 – 37 31.75 ± 4.11 (4)	24 – 29 26.50 ± 2.38 (4)
Pedipalp movable finger subrows	3 – 6 4.80 ± 0.92 (10)	3 – 5 4.50 ± 0.76 (8)	6 (2)	6 – 6 (2)	6 (6)	4 – 6 5.64 ± 0.63 (14)
Pedipalp fixed finger subrows	5 – 5 (10)	3 – 5 4.63 ± 0.74 (8)	5 (2)	5 – 5 (2)	4 – 5 4.83 ± 0.41 (6)	4 – 6 5.00 ± 0.39 (14)
Pedipalp movable finger external accessory denticles	3 – 4 3.60 ± 0.52 (10)	2 – 4 3.38 ± 0.74 (8)	3 – 4 (2)	4 – 4 (2)	4 – 5 4.33 ± 0.52 (6)	4 – 5 4.21 ± 0.43 (14)
Metasoma V dorsolateral macrosetae	5 – 6 5.50 ± 0.53 (10)	5 – 7 5.75 ± 0.89 (8)	4 – 5 (2)	7 – 8 (2)	6 – 7 6.83 ± 0.41 (6)	5 – 7 6.14 ± 0.77 (14)

**Table 5:** Variation in selected meristic data of *Neobuthus cloudsleythompsoni* Lourenço, 2001, *N. eritreaensis* sp. n. and *N. kutcheri* sp. n. adults). Data format is: range, mean ± standard deviation (N = sample size); when N = 2, only range is cited. Values of N indicate number of bilateral anatomical structures analyzed (i.e. N/2 = number of individual animals).



**Figures 161:** Map of known localities for six *Neobuthus* spp. *N. awashensis* Kovařík et Lowe, 2012 (red circles), *N. berberensis* Hirst, 1911 (blue triangle), *N. cloudsleythompsoni* Lourenço, 2001 (red square), *N. ferrugineus* (Kraepelin, 1898) (green square), *N. kutcheri* sp. n. (blue circle) and *N. eritreaensis* sp. n. (red triangle). Plotted localities include data from Kovařík & Lowe (2012).

smooth; orthobothriotaxic, with femoral  $d_2$  present on internal surface; femora of legs smooth on prolateral surfaces; macrosetae on pedipalps, legs, metasoma and telson moderately longer and finer than in the male.

**Measurements.** See Tab. 3.

**VARIATION.** For variation in selected morphometric ratios and meristics, see Tabs. 4–5. Coloration patterns were quite consistent over the type series, with immatures and juveniles bearing much darker fuscous markings. Juvenile male (carapace length 2.225 mm) with weaker granulation on all surfaces, lateral surface of metasoma V and dorsal surface of pedipalp patella smooth.

**COMPARISONS.** *N. kutcheri* sp. n. differs from other *Neobuthus* species as follows: fuscous patterns extending

over the dorsal surface of the pedipalp patella; tarsi bearing denser, longer macrosetae, including much higher numbers of setae on the ventral telotarsus; and much less pronounced sexual dimorphism in setation, with longer, finer macrosetae present on the male pedipalps, legs, sternite VII, metasoma and telson.

**COMMENTS ON LOCALITIES AND LIFE STRATEGY.** The second author visited the locality 14EG (Figs. 146–147) on 19–21 November 2014, spent two nights there and collected 32 specimens with UV light. Males of *Neobuthus kutcheri* sp. n. were active immediately after sunset but females appeared later. At the locality, the second author recorded after sunset a nighttime temperature of 28.8 °C, which gradually dropped to 17.4 °C (minimum temperature) before sunrise. Humidity during the nights varied between 67% and 50%. In addition to

*N. kutcheri* sp. n. the second author recorded at this locality *Hottentotta trilineatus* (Peters, 1861) and *Parabuthus* sp. This is a psammophilous species that was observed at night sitting on or running over sand, near vegetation. During the day, they were collected only under rocks that were on sand. This habitat specialization is correlated with the presence of large bristle combs on the basitarsi, and dense brushes of long macrosetae on the ventral surfaces of the telotarsi.

### Key to six species of *Neobuthus*

1. Pedipalps with numerous macrosetae ..... 2  
Pedipalps very sparsely setose, or devoid of macrosetae ..... *N. berberensis* Hirst, 1911
2. Metasomal macrosetae moderately short in male, not very spiniform; sternites III–V smooth in males .... 3  
Metasomal macrosetae very short in male, stout and spiniform; sternites III–V with dense, fine granulation in males ..... 4
3. Tarsi densely hirsute, adults with 7–15 retroinferior macrosetae on basitarsus III, 24–37 ventral macrosetae on telotarsus III; tergites without posterior marginal macrosetae ..... *N. kutcheri* sp. n.  
Tarsi not densely hirsute; adults with 6–9 retroinferior macrosetae on basitarsus III, 12–19 ventral macrosetae on telotarsus III; tergites with posterior marginal macrosetae ..... *N. awashensis* Kovařík et Lowe, 2012
4. Female with strongly granulate telson vesicle, female pedipalp femur more elongate, L/W 2.44 – 2.46; male pectinal tooth count 20–22 ... *N. eritreaensis* sp. n.  
Female with smooth or weakly granulate telson vesicle, female pedipalp femur more stout, L/W 2.10 – 2.30; male pectinal tooth count 15 – 21 ..... 5
5. Metasoma more stout, female L/W of segment III 1.18, segment IV 1.50; female sternite VII granulated ..... *N. ferrugineus* (Kraepelin, 1898)  
Metasoma less stout, female L/W of segment III 1.38 – 1.51, segment IV 1.61 – 1.75; female sternite VII smooth ..... *N. cloudsleythompsoni* Lourenço, 2001

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

**COMMENTS ON *NEOBUTHUS* LIFE STRATEGY.** The second author observed predation behavior of *N. awashensis* in the field at night. Adult scorpions were able to capture and feed on coleopteran (Tenebrionidae, probably Pimeliinae) larvae much larger than themselves. These larvae were found in burrows at the bottom of funnels in sand, similar to ant lion larvae (Myrmeleontidae). The scorpions seized the larvae with the tips of their pedipalp fingers and extended the meta-

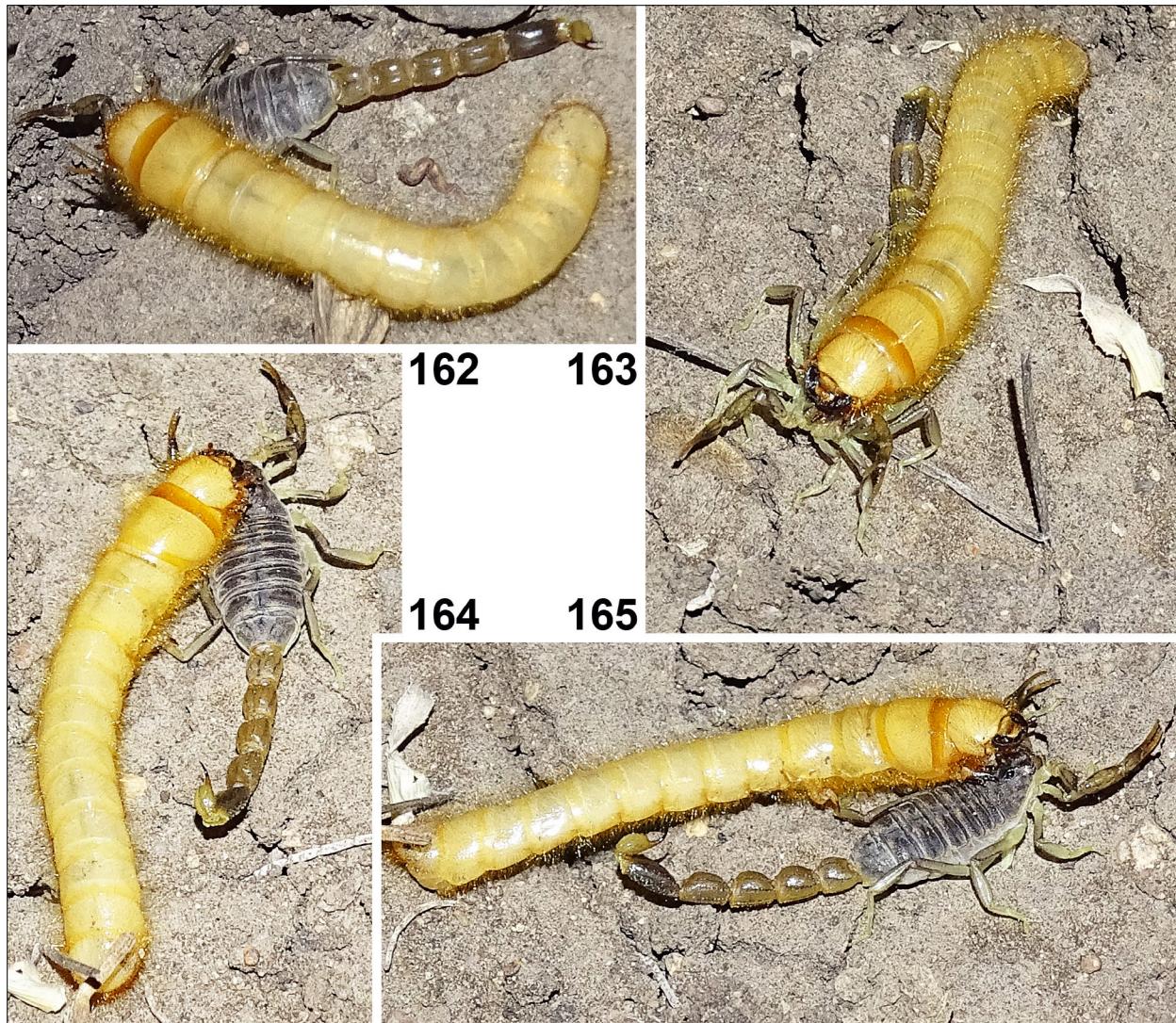
soma and telson over the entire body to sting it. After waiting for the injected venom to induce flaccid paralysis and loosen the muscles of the prey, it pulls out the larva and carries it to a nearby shrub, climbs up on a twig and devours it there.

### Discussion

The discovery of two additional species of *Neobuthus* brings the total number of known species to seven, a significant increase. Most of the species (6/7) are distributed in Ethiopia, Somaliland and Eritrea (Fig. 161), a region with diverse ecological and climatic conditions, varied substrates, and a complex topography with a wide range of elevations, including mountains > 4,000 m a.s.l.. Physiography of the region is dominated by the Ethiopian highlands consisting of extensive dissected plateaus > 1,500 m a.s.l., that were originally formed by tectonic uplift in the Oligocene and Miocene. This suggests a long period of climatic, geologic and erosional processes that could have been major factors in the evolution of endemic scorpion fauna. Speciation of *Neobuthus* may reflect the combined effects of vicariance due to physiographic barriers (Ethiopian highlands), and local adaptation to different substrates. Thus, *N. cloudsleythompsoni* in the Omo River drainage on the southwestern side of the highlands may have been effectively isolated from other species residing on the eastern side, and *N. eritreaensis* sp. n. on the east coastal margin of Eritrea may have been cut off by mountainous or rocky volcanic terrain extending to the Red Sea between Eritrea and Ethiopia. Vicariant speciation may also have produced the psammophile *N. kutcheri* sp. n., which occurs on the southeastern side of the highlands. Other species display a variety of habitat specializations. In the Afar Depression, *N. awashensis* occurs in sandy, semi-desert habitats with volcanic rock. In Somaliland, *N. berberensis* inhabits hot, sand deserts at lower elevation, whereas *N. ferrugineus* inhabits rocky semi-desert at higher elevation (Kovařík & Lowe, 2012). What has allowed this local diversification of *Neobuthus*? It may be significant that this region of Africa lacks certain other widespread genera of small buthid scorpions. For example *Butheolus* does not inhabit the region and *Orthochirus* occurs rarely only in the north part of Ethiopia. Thus, *Neobuthus* and other small buthids found here, such as *Butheoloides*, *Gint*, and *Somalicharmus* (Kovařík, 1998 and 2015; Kovařík et al., 2007 and 2013; Kovařík & Mazuch, 2015; Kovařík & Whitman, 2005), could have radiated and colonized niches available to scorpions in this small size class.

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**Figures 162–165:** Predation on coleopteran (Tenebrionidae) larvae by *Neobuthus awashensis* Kovařík & Lowe, 2012. Shown is an adult female at locality No. 12ER, 09°08'10.4"N 40°09'45.5"E. Photos were taken during the night.

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