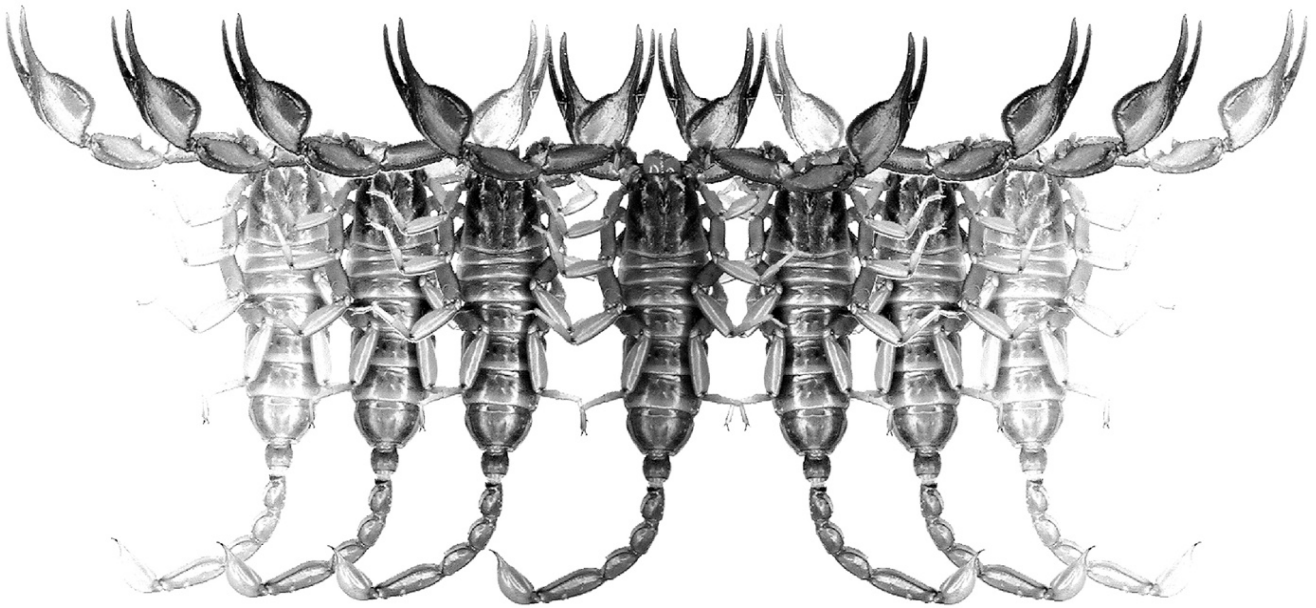


# *Euscorpius*

Occasional Publications in Scorpiology



**Scorpions of the Horn of Africa (Arachnida: Scorpiones).  
Part XXX. *Parabuthus* (Buthidae) (Part III), with description  
of three new species from Somaliland and occurrence of  
*Parabuthus eritreaensis* Kovařík, 2003**

František Kovařík, Graeme Lowe, Hassan Sh Abdirahman Elmi & František Štáhlavský

April 2024 — No. 385

# *Euscorpius*

## *Occasional Publications in Scorpiology*

EDITOR: **Victor Fet**, Marshall University, ‘[fet@marshall.edu](mailto:fet@marshall.edu)’

ASSOCIATE EDITOR: **Michael E. Soleglad**, ‘[msoleglad@gmail.com](mailto:msoleglad@gmail.com)’

TECHNICAL EDITOR: **František Kovařík**, ‘[kovarik.scorpio@gmail.com](mailto:kovarik.scorpio@gmail.com)’

*Euscorpius* is the first research publication completely devoted to scorpions (Arachnida: Scorpiones). *Euscorpius* takes advantage of the rapidly evolving medium of quick online publication, at the same time maintaining high research standards for the burgeoning field of scorpion science (scorpiology). *Euscorpius* is an expedient and viable medium for the publication of serious papers in scorpiology, including (but not limited to): systematics, evolution, ecology, biogeography, and general biology of scorpions. Review papers, descriptions of new taxa, faunistic surveys, lists of museum collections, and book reviews are welcome.

### *Derivatio Nominis*

The name *Euscorpius* Thorell, 1876 refers to the most common genus of scorpions in the Mediterranean region and southern Europe (family Euscorpiidae).

*Euscorpius* is located at: <https://mds.marshall.edu/euscorpius/>  
Archive of issues 1-270 see also at: <http://www.science.marshall.edu/fet/Euscorpius>

(Marshall University, Huntington, West Virginia 25755-2510, USA)

---

### ICZN COMPLIANCE OF ELECTRONIC PUBLICATIONS:

Electronic (“e-only”) publications are fully compliant with ICZN (*International Code of Zoological Nomenclature*) (i.e. for the purposes of new names and new nomenclatural acts) when properly archived and registered. All *Euscorpius* issues starting from No. 156 (2013) are archived in two electronic archives:

- **Biotaxa**, <http://biotaxa.org/Euscorpius> (ICZN-approved and ZooBank-enabled)
- **Marshall Digital Scholar**, <http://mds.marshall.edu/euscorpius/>. (This website also archives all *Euscorpius* issues previously published on CD-ROMs.)

Between 2000 and 2013, ICZN *did not accept online texts* as “published work” (Article 9.8). At this time, *Euscorpius* was produced in two *identical* versions: online (*ISSN 1536-9307*) and CD-ROM (*ISSN 1536-9293*) (laser disk) in archive-quality, read-only format. Both versions had the identical date of publication, as well as identical page and figure numbers. **Only copies distributed on a CD-ROM** from *Euscorpius* in 2001-2012 represent published work in compliance with the ICZN, i.e. for the purposes of new names and new nomenclatural acts.

In September 2012, ICZN Article 8. What constitutes published work, has been amended and allowed for electronic publications, disallowing publication on optical discs. From January 2013, *Euscorpius* discontinued CD-ROM production; only online electronic version (*ISSN 1536-9307*) is published. For further details on the new ICZN amendment, see <http://www.pensoft.net/journals/zookeys/article/3944/>.

---

Publication date: 6 April 2024

<http://zoobank.org/urn:lsid:zoobank.org:pub:E8574BC9-E5DA-4737-A900-DCB4F2EA6987>

**Scorpions of the Horn of Africa (Arachnida: Scorpiones).  
Part XXX. *Parabuthus* (Buthidae) (Part III), with description  
of three new species from Somaliland and occurrence of  
*Parabuthus eritreaensis* Kovařík, 2003**

František Kovařík<sup>1</sup>, Graeme Lowe<sup>2</sup>, Hassan Sh Abdirahman Elmi<sup>3</sup> & František Šťáhlavský<sup>1</sup>

<sup>1</sup>Department of Zoology, Charles University, Viničná 7, CZ-128 44 Praha 2, Czech Republic; [www.scorpio.cz](http://www.scorpio.cz)

<sup>2</sup>Monell Chemical Senses Center, 3500 Market St., Philadelphia, PA 19104-3308, USA

<sup>3</sup>Amoud University, Borama, Republic of Somaliland

<http://zoobank.org/urn:lsid:zoobank.org:pub:E8574BC9-E5DA-4737-A900-DCB4F2EA6987>

---

## Summary

A new record of an adult female of *Parabuthus eritreaensis* Kovařík, 2003 in Somaliland confirms true distribution of this species, already discussed in Kovařík et al. (2016: 19–21). Three new species are described from Somaliland, *P. dorisae* sp. n., *P. evae* sp. n., and *P. quincyae* sp. n.. The hemispermatophore of *P. dorisae* sp. n. is illustrated and described. In addition to the analyses of external morphology and hemispermatophore, we have provided descriptions of the karyotypes of *P. dorisae* sp. n. and *P. quincyae* sp. n. Despite the presence of multivalents (CVIII and CXIV), both species exhibit karyotypes with  $2n=16$  and chromosomes that gradually decrease in length, with the exception of the first chromosome, which is longer than the following chromosomes. A map of distribution of *Parabuthus* species in the Horn of Africa is included.

---

## Introduction

Kovařík et al. (2016, 2018) revised all known species of *Parabuthus* Pocock, 1890 in the Horn of Africa. Analysis of a large number of specimens collected recently, allowed to describe three new species from Somaliland, *P. dorisae* sp. n., *P. evae* sp. n., and *P. quincyae* sp. n..

A new record of an adult female of *Parabuthus eritreaensis* Kovařík, 2003 confirms true distribution of this species, already discussed in Kovařík et al. (2016: 19–21); it is further discussed here; we include photographs of a live specimen and the new locality, the first one for this species Somaliland.

Variation of *P. dorisae* sp. n. shows for the first time that the color of metasoma V is not a stable character; at least in juveniles it can be colored dark while adult can be rather yellow.

## Methods, Material & Abbreviations

Nomenclature and measurements follow Stahnke (1971), Kovařík (2009), and Kovařík & Ojanguren Affilastro (2013), except for trichobothriotaxy (Lowe & Kovařík, 2019; Vachon, 1974). Hemispermatophore terminology follows Kovařík et al. (2016, 2018).

Karyotype analyses were conducted on chromosome preparations prepared using the spreading technique, a frequently used method in scorpions (e.g., Kovařík et al.,

2009; Sadílek et al., 2015). The chromosomes were stained with a 5% Giemsa solution in Sörensen phosphate buffer for 20 min. Measurements of five spermatocyte nuclei were performed using Image J 1.45r software (<http://rsbweb.nih.gov/ij>) with the Levan plugin (Sakamoto & Zacaro, 2009). The relative length of the chromosomes was calculated for the diploid set.

*Specimen Depositories*: FKCP (František Kovařík, private collection, Prague, Czech Republic, to be merged in future with collections of National Museum of Natural History, Prague, Czech Republic); MZUF (Museo Zoologico de “La Specola”, Firenze, Italy).

*Morphometrics*: D, depth; L, length; W, width.

## Systematics

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

#### *Parabuthus* Pocock, 1890

(Figures 1–129, Table 1)

*Buthus* (*Parabuthus*): Pocock, 1890: 124–125.

*Parabuthus*: Pocock, 1895: 309–314, plate IX, figs. 4a–d; Fet & Lowe, 2000: 200–211 (complete reference list until 2000); Kovařík, 2009: 22, 31; Prendini & Esposito, 2010: 673–710, figs. 1–17; Kovařík et al., 2016: 1–58, figs. 1–204, tables 1–2; Kovařík et al., 2019: 1–62, figs. 1–305, tables 1–5.

- = *Heterobuthus* Kraepelin, 1891: 205–211 (63–69) (syn. by Kraepelin, 1895: 79 (7)).  
 = *Riftobuthus* Lourenço et al., 2010: 281, figs. 1 and 2 (syn. by Kovařík et al., 2016: 2).

TYPE SPECIES. *Androctonus (Prionurus) liosoma* Ehrenberg in Hemprich et Ehrenberg, 1828

DIAGNOSIS. Total length 35–180 mm. Carapace without distinct carinae, in lateral view with entire dorsal surface horizontal or nearly so. Five pairs of lateral eyes and eyespot present. Pectines with fulcra, female pectines typically with dilated or lobate basal middle lamella. Pectine teeth number 18–62. Hemispermatophore flagelliform, capsule with ‘2+1’ lobe configuration, with broad posterior lobe, small simple anterior lobe, and robust hook-like basal lobe; flagellum arising distally from posterior lobe, pars recta short and narrow, pars reflecta long and fusiform. Sternum subtriangular. Mesosoma with tergites I–VI monocarinate, sternites III–VI with slit-like spiracles. Dorsal surfaces of first and second metasomal segments with stridulatory areas. Telson without subaculear tubercle. Chelicera with typical buthid dentition, fixed finger with two ventral denticles. Orthobothriotaxitic type A, dorsal trichobothria of pedipalp femur arranged in  $\alpha$ -configuration. Patellar trichobothrium  $d_2$  is located external to dorsomedian carina (when carina is present). Chela manus with trichobothria  $V_1$  and  $V_2$  axis oblique,  $Eb_{1-3}$  in  $\gamma$ -configuration. Trichobothrium  $eb$  is located on fixed finger of chela. Dentate margin of pedipalp chela movable finger with distinct granules divided into 9–14 rows, 3 terminal granules and one basal terminal granule. Tibial spurs present on third and fourth pairs of legs.

REMARKS ON THE KARYOTYPES. We analyzed the male karyotypes of two new *Parabuthus* species from Somaliland. The chromosomes of both species (Figs. 122–127) exhibit typical characteristics observed in all members of the family Buthidae. These chromosomes are holocentric, and males have achiasmatic meiosis. Additionally, species within this family typically have a low number of chromosomes (see Schneider et al., 2023). The karyotypes of *P. dorisae* sp. n. (sample S2037) (Figs. 122–124) and *P. quincyae* sp. n. (sample S2134) (Figs. 125–127) possess 16 chromosomes. This chromosome count is commonly observed in species from the Horn of Africa, including *P. abyssinicus*, *P. kabateki*, *P. robustus*, and *P. somalilandus* (Kovařík et al., 2016; 2019). In both analyzed species, the first chromosome is slightly longer (7.54 % and 10.70% respectively), while the remaining chromosomes gradually decrease in length (6.89–4.45% and 10.70–4.17%). This difference likely is due to reciprocal translocations, resulting in the formation of multivalent associations: eight chromosomes in *P. dorisae* sp. n. (Fig. 123) and 14 chromosomes in *P. quincyae* sp. n. (Fig. 126). These longest chromosomes are consistently associated within these multivalents. Similar chromosome associations are frequently observed in representatives of the family Buthidae (see Šťáhlavský et al., 2020). Despite the fact that the 2n

count is consistent among the mentioned *Parabuthus* species, the diploid number may vary among other taxa (2n=18 in *P. kajibu*, *P. mossambicensis*, *P. planicauda*, *P. raudus* from Zimbabwe or 2n=20 in *P. capensis*, *P. pallidus*, *P. raudus* from Namibia and *P. transvaalicus*) (see Schneider et al., 2023). Therefore, cytogenetic characteristics hold promise for use in the taxonomy of this group.

### *Parabuthus eritreensis* Kovařík, 2003

(Figures 1–26, 128–129, Table 1)

*Parabuthus eritreensis* Kovařík, 2003: 142–143, 159, figs. 10–11, table 2; Kovařík, 2004: 18–19, fig. 6; Kovařík & Whitman, 2005: 110; Kovařík et al., 2016: 19–21, figs. 40–41, 89, 174–175, 189, 198, 204; Kovařík et al., 2019: 10, figs. 286–287, 305.

TYPE LOCALITY AND TYPE REPOSITORY. Eritrea, Asmara env. (incorrect locality, see comment in Kovařík et al., 2016: 19–21 and below); FKCP.

TYPE MATERIAL EXAMINED. “Eritrea, Asmara env.”, 1♂ (holotype) 1♀ (allotypic paratype), 1983, leg. Dorsak; FKCP.

ADDITIONAL MATERIAL EXAMINED. **Somalia** (Puntland), Gardo, Migiurtina, V. 1930, 1♂, leg. M. Milano & Luppi, FKCP No. 1133; Run, 16.VIII.1969, 1♂, S.B.S., MZUF No. 1127.

NEW MATERIAL EXAMINED. **Somaliland**, near Garadak, 09.489036°N 46.867009°E, 758 m a. s. l. (Locality No. 21SF, Fig. 2), 9.X.2021, 1♀ (DNA-1995, Figs. 1, 3–26, 129), leg. F. Kovařík, FKCP.

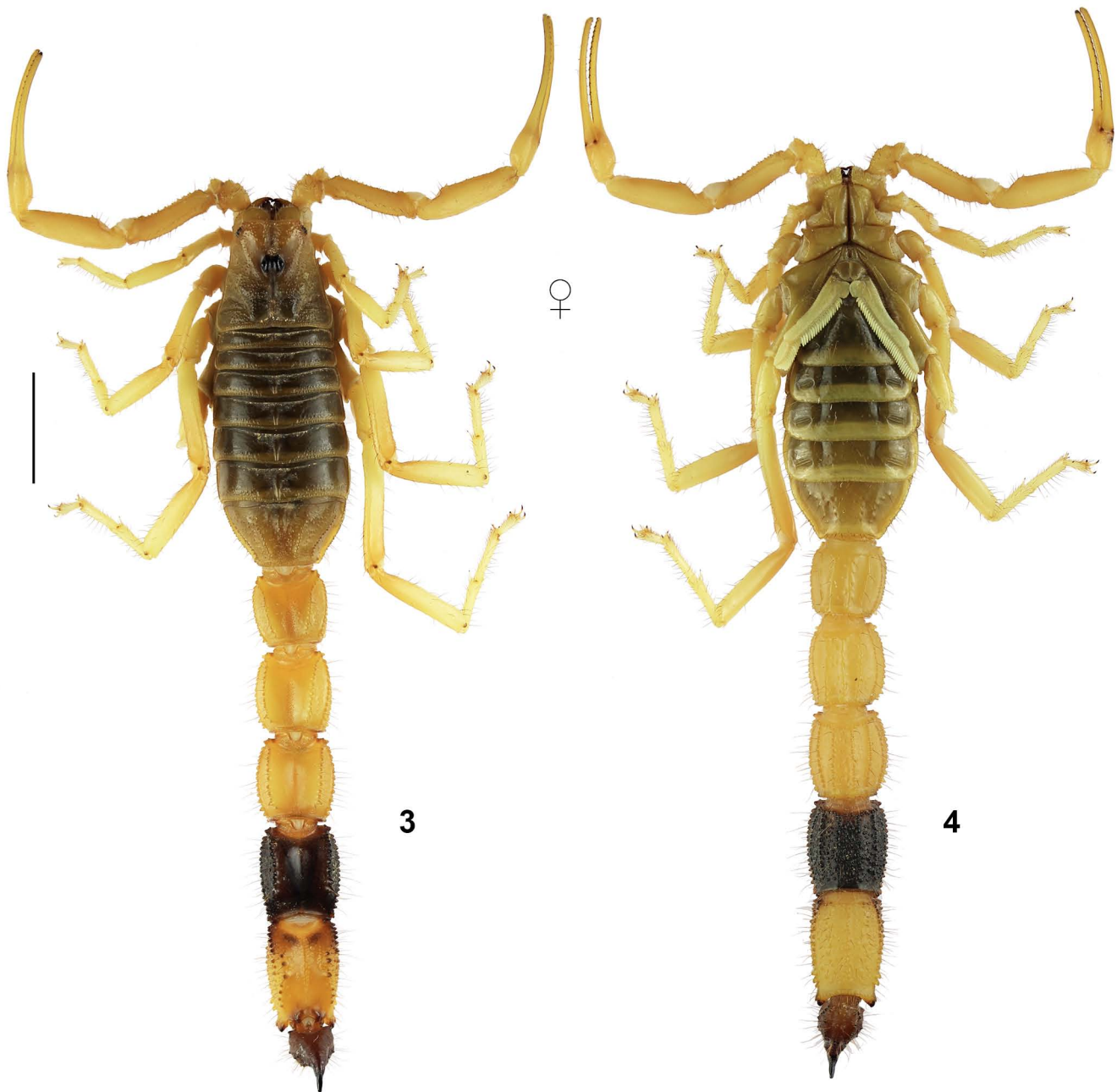
DIAGNOSIS. Adults from 71.5 mm (male) to 90 mm (female) long. Base color uniformly yellow to yellowish brown, only fourth metasomal segment and telson dark. Pectine teeth number 39 in male and 35–36 in female. Stridulatory area present on dorsal surface of metasoma I–II, reduced to absent in metasoma III, and absent in metasoma IV–V. Metasoma densely hirsute. Movable finger of pedipalp more than twice as long as manus, bearing 13–15 rows of granules which include both external and internal granules. Manus of pedipalp hirsute, smooth and very narrow in both sexes, pedipalp chela length/width ratio 6.13 in male and 7.22–7.23 in female. Tarsomere I of all legs with bristle-combs.

DISTRIBUTION (Fig. 128). Somalia (Puntland) and Somaliland (first report).

COMMENTS. The true distribution of the species was discussed in Kovařík et al. (2016: 19–21): its type locality “Eritrea, Asmara env.” looked suspicious. According to two males in FKCP and MZUF, it rather appeared that the real distribution range of this species lies in Somalia (Puntland). A new confirmed locality in western Somaliland confirms distribution of the species in Somaliland and Somalia (Puntland); however, the validity of the type locality is still doubtful.



Figures 1–2: *Parabuthus eritreaensis*, female. **Figure 1.** Female in vivo habitus. **Figure 2.** Locality, Somaliland, vicinity of Garadak.



Figures 3–4. *Parabuthus eritreensis*, female, in dorsal (3) and ventral (4) views. Scale bar: 10 mm.

COMMENTS ON LOCALITY AND LIFE STRATEGY. The Somaliland locality 21SH is rocky semi-desert terrain at 750 m a. s. l. (Fig. 95). First author (FK) visited the locality and collected the specimen in open terrain at night by UV detection together with *Parabuthus dorisae* sp. n. and *Pandinops* cf. *pugilator* Pocock, 1900.

***Parabuthus dorisae* sp. n.**

(Figs. 27–57, 122–124, 128, Table 1)

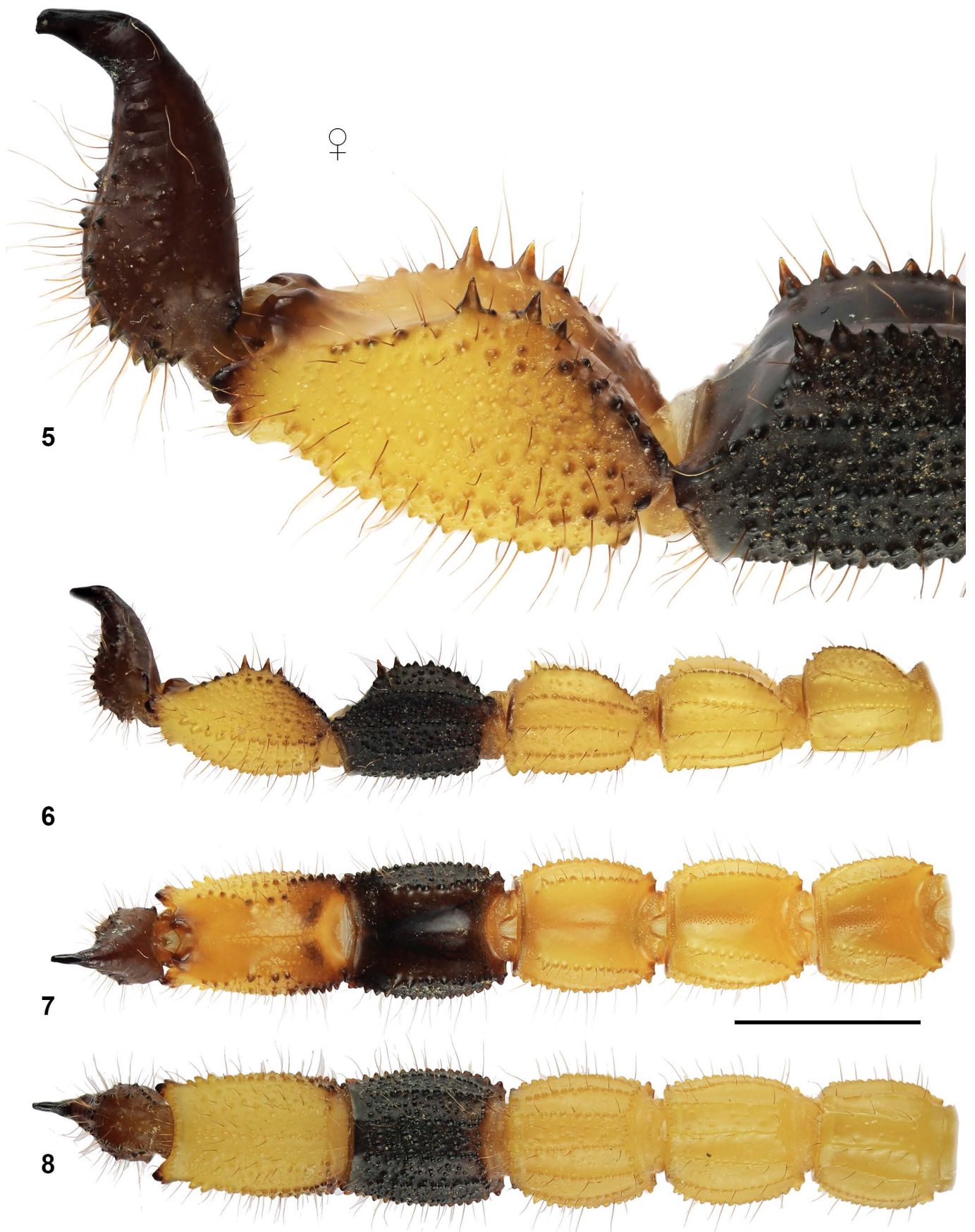
<http://zoobank.org/urn:lsid:zoobank.org:act:579AE9CC-D732-4F81-991C-AAB343BD2598>

TYPE LOCALITY AND TYPE REPOSITORY. **Somaliland**, God Heeli, 9.472021°N 46.857536°E; FKCP.

TYPE MATERIAL (FKCP). **Somaliland**, God Heeli, 9.472021°N 46.857536°E, (Locality No. **21SE**, Fig. 53), 9.X.2021, 1♂ (holotype, DNA-2037, Figs. 27–28, 31–52, 54–57, 122–124) 2♀juvs. (paratypes 60 and 27 mm long, DNA-1993, 1994, Figs. 29–30), leg. F. Kovařík.

ETYMOLOGY. Three species described in this paper are named in honour of three important ladies: Doris Benison, Eva Šebková, and Quincy Isis who helped the first author during a complicated period of his life.

DIAGNOSIS. Adult male holotype 71 mm long, adult female unknown. Base color uniformly yellow to yellowish orange, tergites yellow to yellowish brown, metasoma IV and telson



**Figures 5–8:** *Parabuthus eritreensis*, female. **Figure 5.** End of metasoma IV, metasoma V, and telson in lateral view. **Figures 6–8.** Metasoma and telson in lateral (6), dorsal (7), and ventral (8) views. Scale bar: 10 mm (6–8).



9

10

11



♀

I.

II.

III.

IV.

12

13

14

15

Figures 9–15: *Parabuthus eritreensis*, female. **Figure 9.** Carapace and tergites I–IV. **Figures 10–11.** Sternoplectinal area and sternites.. **Figures 12–15.** Right legs I–IV, retrolateral aspect.





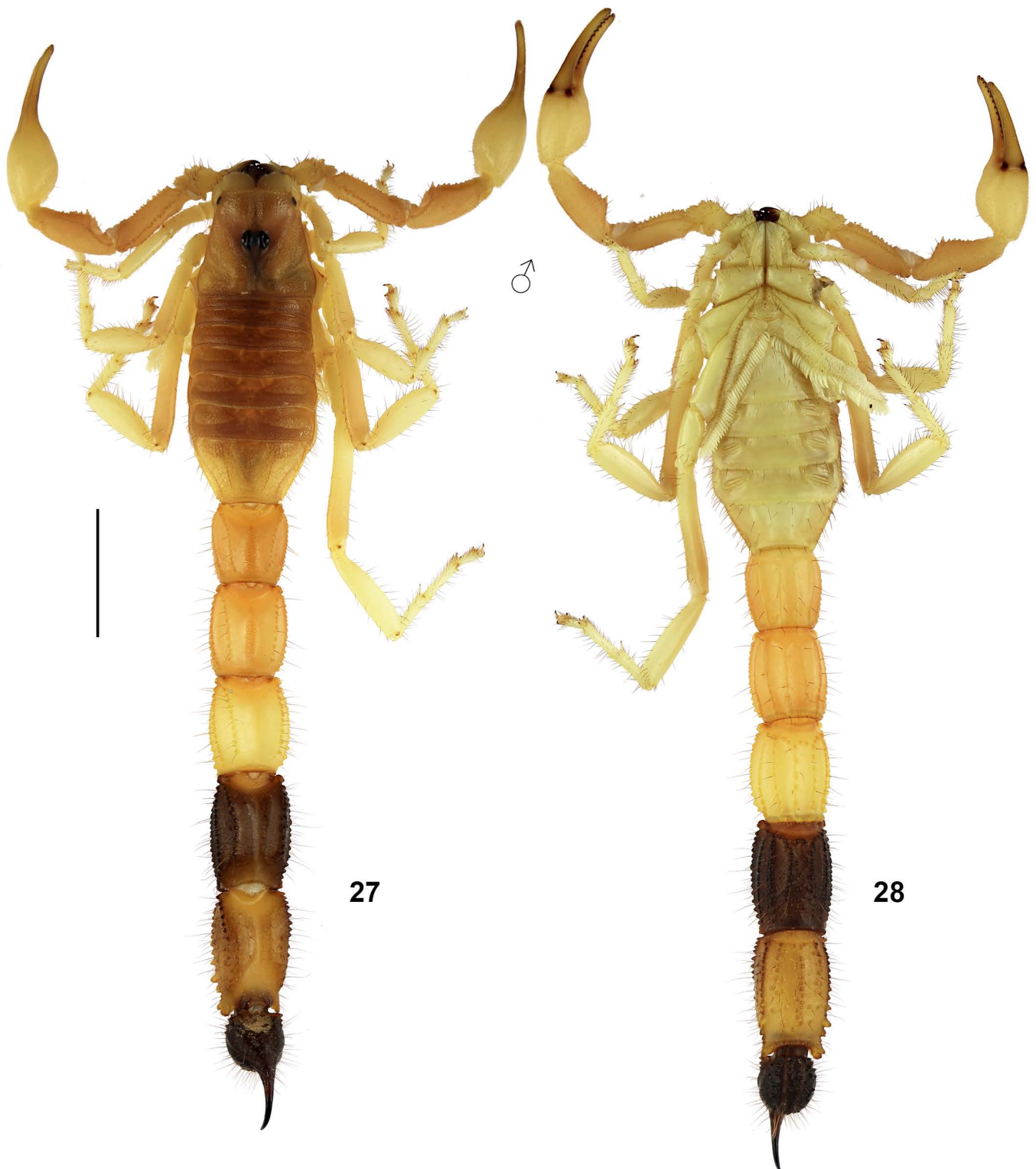
**Figures 16–26.** *Parabuthus eritreensis*, female, right pedipalp, chela in dorsal (16), external (17), and ventral (18) views, patella in dorsal (19), external (20), and ventral (21) views, femur and trochanter in internal (22), dorsal (23), and ventral (24) views. Dentate margins of movable (25) and fixed (26) fingers. Trichobothrial pattern indicated in Figures 17–20 and 22–23 by white circles.

black, metasoma V yellowish brown to brown (black in juveniles). Pectine teeth number 43–44 in male and 32–39 in juvenile females. Stridulatory area present on dorsal surface of metasoma I–II, reduced to absent in metasoma III, and absent in metasoma IV–V. Metasoma densely hirsute. Metasoma V length/ width ratio is 1.68. Dorsal carina of metasoma IV composed posteriorly of blunt denticles, of which the posterior-most denticle is not enlarged. Movable and fixed fingers of pedipalp bear 13 rows of granules, all with external and internal accessory granules. Fingers of pedipalp not elongated. Fingers of pedipalps of male with inner side of base smooth, no trace of tubercle. Manus of pedipalp of male broad, pedipalp chela length/ width ratio 3.35. Pedipalp chela smooth and patella finely granulated. Tarsomere I of legs I–III with bristle-combs.

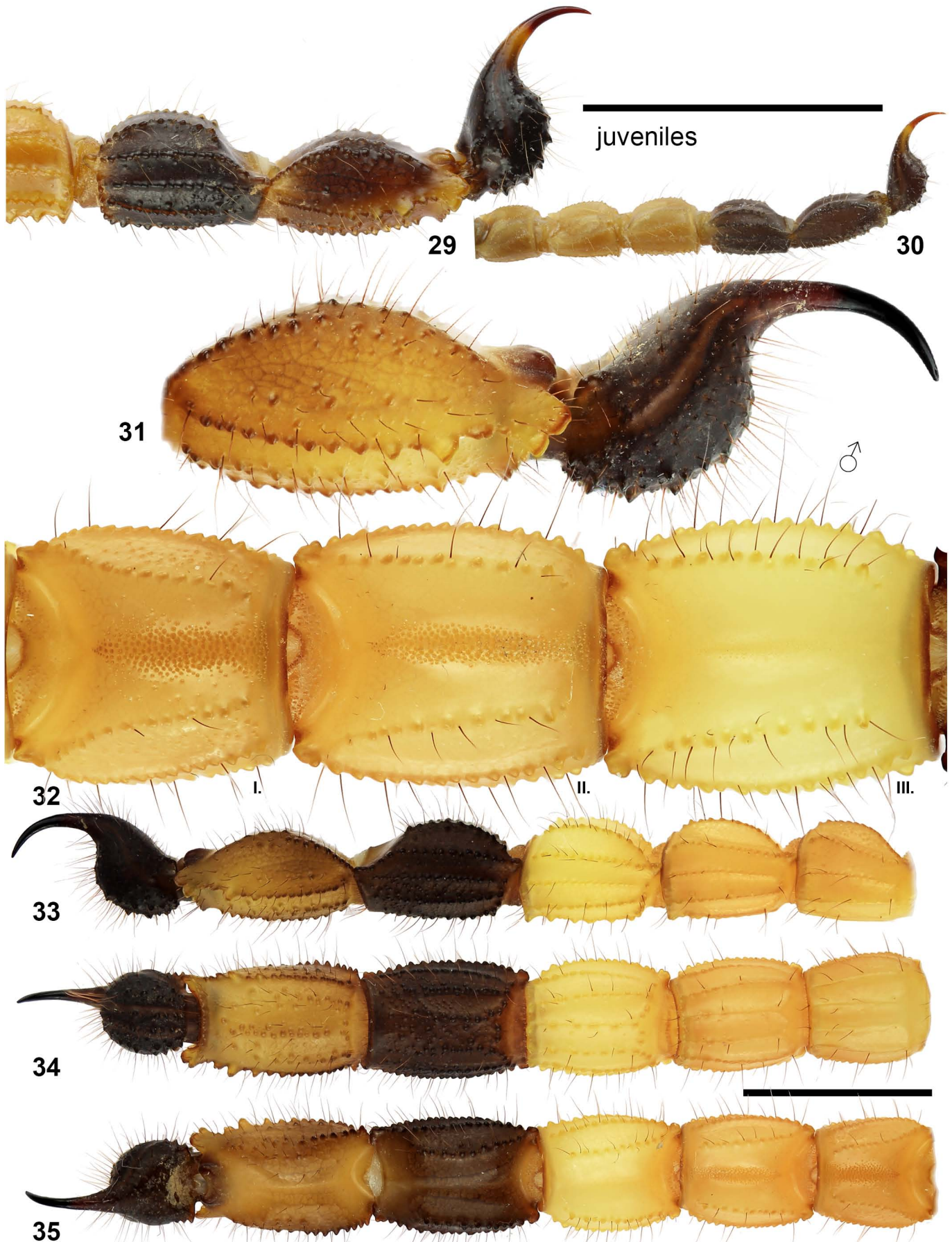
**DESCRIPTION** ♂. The adult male holotype is 71 mm long. The habitus is shown in Figs. 27–28. For position and distribution of trichobothria of pedipalps see Figs. 37–40, 42–43.

**Coloration** (Figs. 27–28). The base color is uniformly yellow to yellowish orange, tergites yellow to yellowish brown. The pedipalps and legs are yellow. The metasoma I–III is yellow, metasoma IV is black, and metasoma V is yellow with black pattern. Telson is black. Carapace and tergites are yellowish brown, sternites yellow.

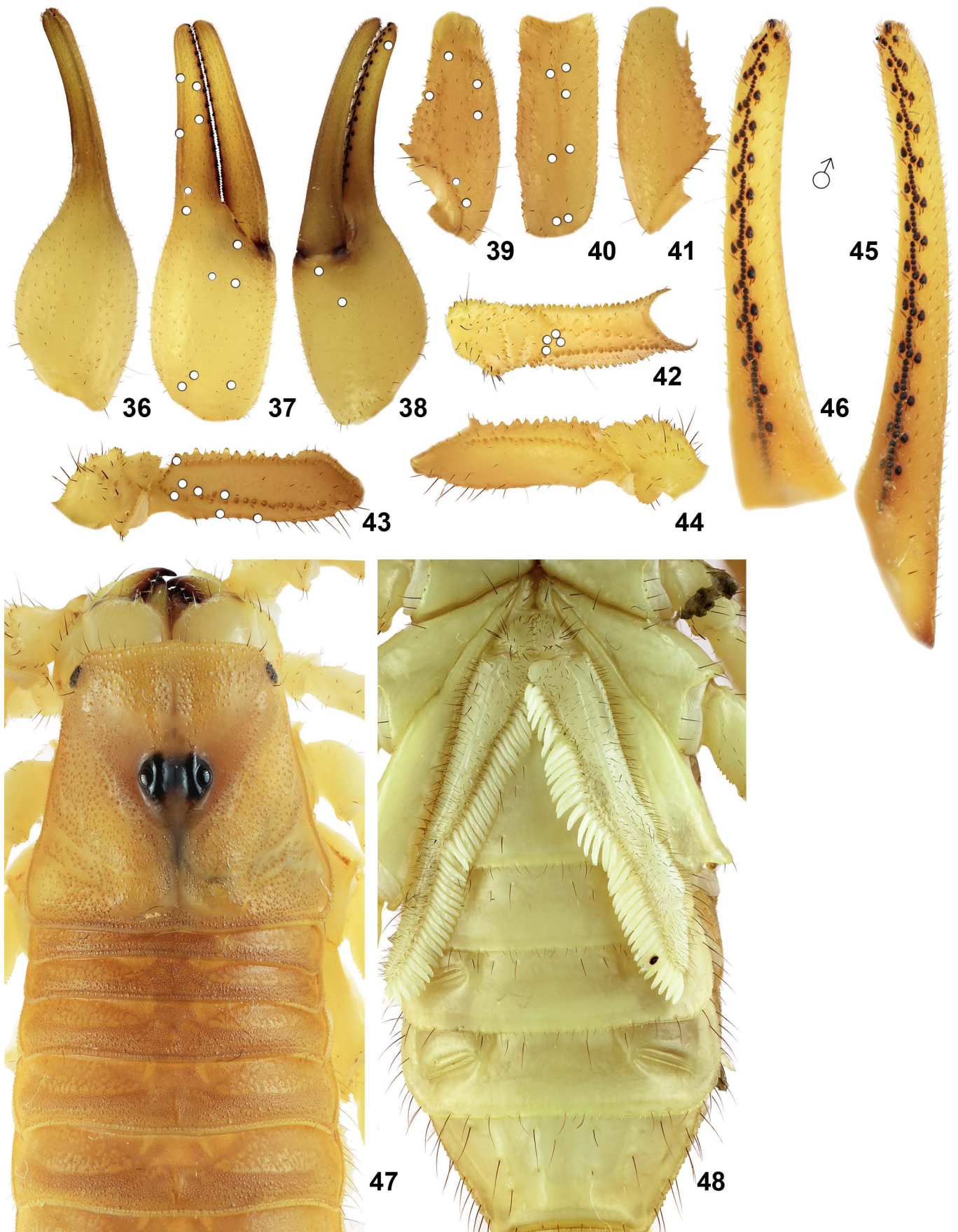
**Carapace and mesosoma** (Figs. 27–28, 47–48). The entire carapace is covered with large granules, carinae are absent. The anterior margin of the carapace is medially weakly convex, and bears 14 symmetrically distributed short, stout spiniform macrosetae. The tergites are densely granulated. Tergite VII is pentacarinata, with lateral pairs of carinae strong,



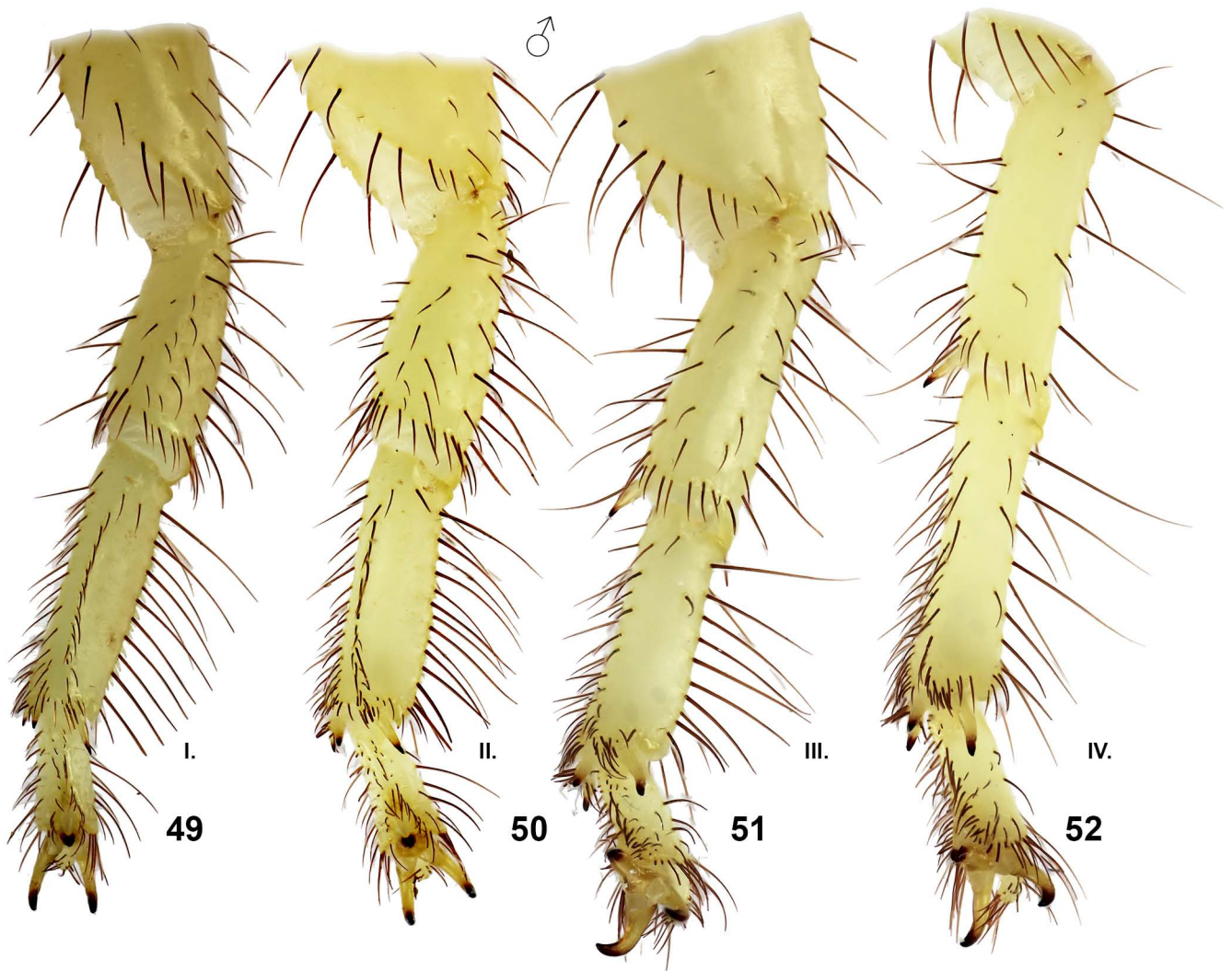
Figures 27–28. *Parabuthus dorisae* sp. n., male holotype, in dorsal (27) and ventral (28) views. Scale bar: 10 mm.



Figures 29–35: *Parabuthus dorisae* sp. n. **Figure 29.** Juvenile paratype 60 mm long, metasoma IV–V and telson lateral. **Figure 30.** Juvenile paratype 27 mm long, metasoma and telson lateral. **Figures 31–35:** Male holotype. **Figure 31.** Metasoma V, and telson in lateral view. **Figure 32.** Metasoma I–III in dorsal view. **Figures 33–35.** Metasoma and telson in lateral (33), ventral (34), and dorsal (35) views. Scale bars: 10 mm (29–30, 33–35).



**Figures 36–48:** *Parabuthus dorisae* sp. n., male holotype. **Figures 36–46.** Right pedipalp, chela in dorsal (36), external (37), and ventral (38) views, patella in dorsal (39), external (40), and ventral (41) views, femur and trochanter in internal (42), dorsal (43), and ventral (44) views. Dentate margins of movable (45) and fixed (46) fingers. Trichobothrial pattern indicated in Figures 37–40 and 42–43 by white circles. **Figure 47.** Carapace and tergites I–V. **Figures 48.** Sternoplectinal area and sternites.



**Figures 49–53:** *Parabuthus dorisae* sp. n., male holotype.. **Figures 49–52.** Right legs I–IV, retrolateral aspect. **Figure 53.** Type locality, Somaliland, vicinity of God Heeli.

Dimensions (MM)		<i>P. eritreaensis</i>	<i>P. dorisae</i> sp. n.	<i>P. evae</i> sp. n.	<i>P. quincyae</i> sp. n.
		♀ Somaliland	♂ holotype	♂ holotype	♂ holotype
Carapace	L / W	9.44 / 10.09	8.03 / 8.99	10.59 / 12.47	7.88 / 9.36
Mesosoma	L	20.71	15.41	27.77	16.70
Tergite VII	L / W	5.51 / 10.74	4.69 / 8.51	7.32 / 13.40	4.81 / 8.91
Metasoma + telson	L	48.39	47.23	59.10	46.94
Segment I	L / W / D	7.09 / 6.61 / 5.48	5.99 / 5.69 / 5.06	7.98 / 8.08 / 6.91	5.74 / 8.91 / 5.57
Segment II	L / W / D	7.52 / 6.73 / 5.52	6.90 / 5.80 / 5.44	8.65 / 8.18 / 6.84	7.18 / 6.38 / 5.50
Segment III	L / W / D	7.57 / 6.99 / 5.90	7.19 / 6.09 / 5.01	9.16 / 8.43 / 6.76	7.52 / 6.56 / 5.68
Segment IV	L / W / D	8.43 / 7.09 / 5.69	8.65 / 6.03 / 5.49	10.17 / 8.52 / 6.76	8.29 / 6.55 / 5.62
Segment V	L / W / D	9.58 / 6.53 / 5.21	9.22 / 5.49 / 4.73	11.02 / 7.72 / 6.40	9.16 / 5.81 / 5.02
Telson	L / W / D	8.20 / 3.91 / 3.38	9.28 / 4.32 / 3.84	12.12 / 5.77 / 5.09	9.05 / 4.59 / 3.88
Pedipalp	L	32.46	26.75	32.44	26.10
Femur	L / W	8.59 / 2.14	6.53 / 2.14	8.60 / 2.09	6.59 / 2.31
Patella	L / W	9.34 / 2.63	7.41 / 2.94	8.67 / 2.99	7.26 / 2.90
Chela	L	14.53	12.81	15.17	12.25
Manus	W / D	2.01 / 2.22	3.82 / 3.81	2.70 / 2.73	3.90 / 3.93
Movable finger	L	10.96	7.71	10.65	7.66
<b>Total</b>	<b>L</b>	<b>78.54</b>	<b>70.67</b>	<b>97.46</b>	<b>71.52</b>

**Table 1.** Comparative measurements of adults of *Parabuthus eritreaensis* Kovařík, 2003, *P. dorisae* sp. n., *P. evae* sp. n., and *P. quincyae* sp. n. Abbreviations: length (L), width (W, in carapace it corresponds to posterior width), depth (D).

serrato-crenulate. The pectinal tooth count is 43–44. The pectine marginal tips extend to the third quarter of the five sternite. The pectines have three marginal lamellae and 14 middle lamellae. The lamellae and fulcra bear numerous dark setae. All sternites are smooth, except that there is a stridulatory area on the third sternite. Sternite VII bears four smooth carinae.

**Metasoma and telson** (Figs. 31–35). The metasoma I–IV with a total of 10 granulated carinae. The fifth segment has five carinae, and its ventral and lateral surfaces are strongly granulated. The ventral surface of metasomal segment V has several strong paired granules symmetrically located laterally in the middle part. Dorsolateral carinae of the third and fourth segments composed of blunt denticles, of which the posterior-most denticle is not enlarged. The stridulatory area is located on the dorsal surface of the metasoma I–II. On the third segment it is reduced and on fourth and fifth segments the stridulatory area is absent. The entire metasoma and the telson are pilose with long hairs. The ventral surface of the telson is strongly granulated. The metasomal segment V length/width ratio is 1.68. The telson is rather bulbous, with the aculeus approximately the same length as the vesicle.

**Pedipalps** (Figs. 36–46). The pedipalps are hirsute with shorter setae on the chela and the patella, and longer setae on the femur, and trochanter. The femur bears four carinae. The chela is smooth without carinae and the patella is finely granulated with carinae indicated. The movable and fixed fingers of pedipalp bear 12–13 rows of granules, all with external and internal accessory granules. The fingers of pedipalps of male with inner side of base smooth, tubercle absent. The manus of pedipalp of male broad, pedipalp chela length/width ratio 3.35.

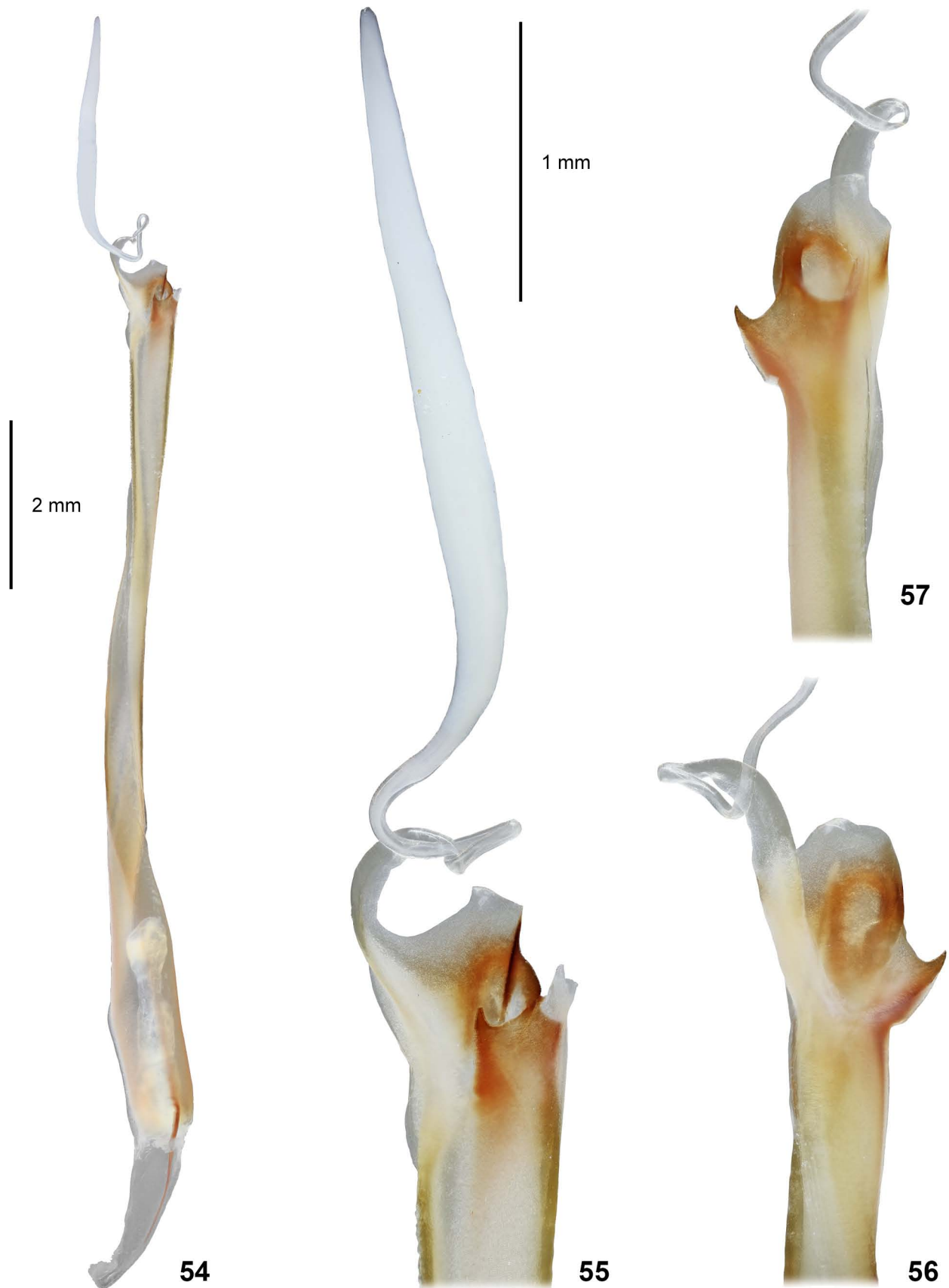
**Legs** (Figs. 49–52). Legs III and IV bear tibial spurs. Retrolateral and prolateral pedal spurs are present on all legs. All legs without distinct carinae and smooth. The tarsomeres bear two rows of macrosetae on the ventral surface and other macrosetae on the other surfaces. The bristle-combs are present on all legs, although slightly reduced on the fourth leg.

**Hemispermatothore** (Figs. 54–57). Flagelliform, elongate and slender. Trunk ca. 10 times length of capsule. Flagellum arising from posterior lobe of capsule; pars recta narrow, hyaline, coiled, ribbon-like, 2.3× length of capsule; pars reflecta thick, white, fusiform, 3.2× length of capsule. Sperm hemiduct with 3 lobes: a broad posterior lobe with angulate apical margin and strong anterior carina; a small anterior lobe; and a robust, hook-like basal lobe with pointed tip. Left and right hemispermatothores were similar. Hemispermatothore is similar to that reported for other *Parabuthus* species (Alexander, 1959, Kovařík et al., 2016; 2019; Lamoral, 1979).

**Measurements.** See Table 1.

**VARIABILITY.** There are two paratypes, both juvenile females 60 and 27 mm long. Analysis of DNA confirmed that both juveniles belong to the same species as male holotype. These juveniles have 32–39 pectinal teeth and the main difference from the holotype is that their metasoma V is black or almost black (Figs. 29–30).

**AFFINITIES.** According to the characters used in the key published in Kovařík et al. (2019) the new species which is also confirmed by DNA phylogeny (paper in preparation) is most similar to *P. somalilandus*. Male of *P. dorisae* sp. n. has metasoma relatively slightly slender than males



**Figures 54–57:** *Parabuthus dorisae* sp. n., holotype, right hemispermatophore. **Figure 54.** Whole hemispermatophore, convex view. **Figure 55.** Capsule and flagellum, convex view. **Figures 56–57.** Capsule, in posterior (56) and anterior (57) views. Scale bars: 2 mm (54), 1 mm (55–57).

of *P. somalilandus*, metasoma I L/W 1.05 (0.98–1.01 in *P. somalilandus*), metasoma V L/W 1.68 (1.58–1.60 in *P. somalilandus*). Metasoma V is entirely yellow in *P. somalilandus* but yellowish brown to brown (black in juveniles) in *P. dorisae* sp. n.

COMMENTS ON LOCALITY AND LIFE STRATEGY. See comments under *P. eritreensis*.

DISTRIBUTION. Somaliland (Fig. 128).

***Parabuthus evae* sp. n.**

(Figs. 58–82, 128, Table 1)

<http://zoobank.org/urn:lsid:zoobank.org:act:EA52C688-FC35-48A1-BA0A-9A4747B71BF7>

TYPE LOCALITY AND TYPE REPOSITORY. **Somaliland**, E of Las Anod, 8.530814°N 47.420496°E, 623 m a. s. l.; FKCP

TYPE MATERIAL (FKCP). **Somaliland**, E of Las Anod, 8.530814°N 47.420496°E, 623 m a. s. l. (Locality No. **21SC**, Fig. 59), 8.X.2021, 1♂ (holotype, DNA-1991, Figs. 58, 60–82), leg. F. Kovařík.

ETYMOLOGY. See etymology under *Parabuthus dorisae* sp. n.

DIAGNOSIS ♂. Adult male 97.5 mm long, female unknown. Base color uniformly yellow, only metasoma IV–V and telson dark. Pectine teeth number 58–59 in male. Stridulatory area present on dorsal surface of metasoma I–II, reduced to absent in metasoma III, and absent in metasoma IV–V. Metasoma and pedipalps densely hirsute. Dorsal carina of metasoma IV composed posteriorly of blunt denticles, of which the posterior-most denticle is not enlarged. Movable and fixed fingers of pedipalp bear 13 rows of granules, all with external and internal accessory granules. Fingers of pedipalp elongated. Manus of pedipalp smooth and densely hirsute, pedipalp chela length/ width ratio 5.62 in male. Tarsomere I of all legs with bristle-combs.

DESCRIPTION ♂. The adult male holotype is 97.5 mm long. The habitus is shown in Figs. 58, 60–61. For position and distribution of trichobothria of pedipalps see Figs. 73–76, 78–79.

**Coloration** (Figs. 58, 60–61). The base color is uniformly yellow. The pedipalps and legs are yellow. The metasoma I–III is yellow, metasoma IV–V and telson are black. Anterior part of carapace yellow, posterior part and tergites are grey, sternites brown.

**Carapace and mesosoma** (Figs. 58, 60–61, 62–63). The anterior part of carapace is covered with large granules, carinae are absent. The anterior margin of the carapace is medially straight, weakly convex medially, and bears 30 symmetrically distributed short, stout spiniform macrosetae. The tergites are smooth anteriorly and densely granulated posteriorly. Tergite VII is densely granulated, pentacarinata, with lateral pairs of carinae strong, serratocrenulate. The pectinal tooth count is 58–59. The pectine marginal tips extend to the half of the five

sternite. The pectines have three marginal lamellae and 17 middle lamellae. The lamellae and fulcra bear numerous dark setae. All sternites are smooth. Sternite VII bears two carinae indicated by strong granules.

**Metasoma and telson** (Figs. 68–71). The metasoma I–IV with a total of 10 granulated carinae. Surfaces between carinae densely granulated on metasoma II–IV in lateral and ventral surfaces. The fifth segment has five carinae, and its ventral and lateral surfaces are strongly granulated. Dorsolateral carinae of the third and fourth segments composed of blunt denticles, of which the posterior-most denticle is not enlarged. The stridulatory area is located on the dorsal surface of the metasoma I–II. On the third segment it is reduced and on fourth and fifth segments the stridulatory area is absent. The entire metasoma and the telson are pilose with long hairs. The ventral surface of the telson is strongly granulated. The metasomal segment V length/ width ratio is 1.43. The telson is rather bulbous, with the aculeus approximately the same length as the vesicle.

**Pedipalps** (Figs. 72–82). The pedipalps are densely hirsute with long setae. The femur bears four carinae. The chela is smooth without carinae and the patella is smooth with carinae indicated. The movable and fixed fingers of pedipalp bear 13 and 12 rows of granules, all with external and internal accessory granules. The fingers of pedipalps of male with inner side of base smooth, tubercle absent. The manus of pedipalp of male narrow, pedipalp chela length/ width ratio 5.62.

**Legs** (Figs. 64–67). Legs III and IV bear tibial spurs. Retrolateral and prolateral pedal spurs are present on all legs. All legs without distinct carinae and smooth. The tarsomeres bear two rows of macrosetae on the ventral surface and other macrosetae on the other surfaces. The bristle-combs are present on all legs, although slightly reduced on the fourth leg.

**Measurements.** See Table 1.

AFFINITIES. According to the characters used in the key of Kovařík et al. (2019), the new species is most similar to *P. cimrmani*. Male of *P. evae* sp. n. has 58–59 pectinal teeth, which is higher than in males of all other *Parabuthus* species found in the Horn of Africa, except male of *P. cimrmani* which is the scorpion species with the highest number of pectinal teeth (61–62). Males of *P. evae* sp. n. and *P. cimrmani* have similar morphology of pedipalp segments (see Figures 72–82 versus 83–93) but *P. cimrmani* has narrower patella of pedipalp (pedipalp patella L/W ratio in holotype of *P. evae* sp. n. is 2.9 and 3.3 in holotype of *P. cimrmani*). These two species differ in morphology of metasoma which is narrower in *P. cimrmani*; metasoma I is wider than long (metasoma I L/W ratio 0.99) in *P. evae* sp. n. and longer than wide in *P. cimrmani* (metasoma I L/W ratio 1.05).

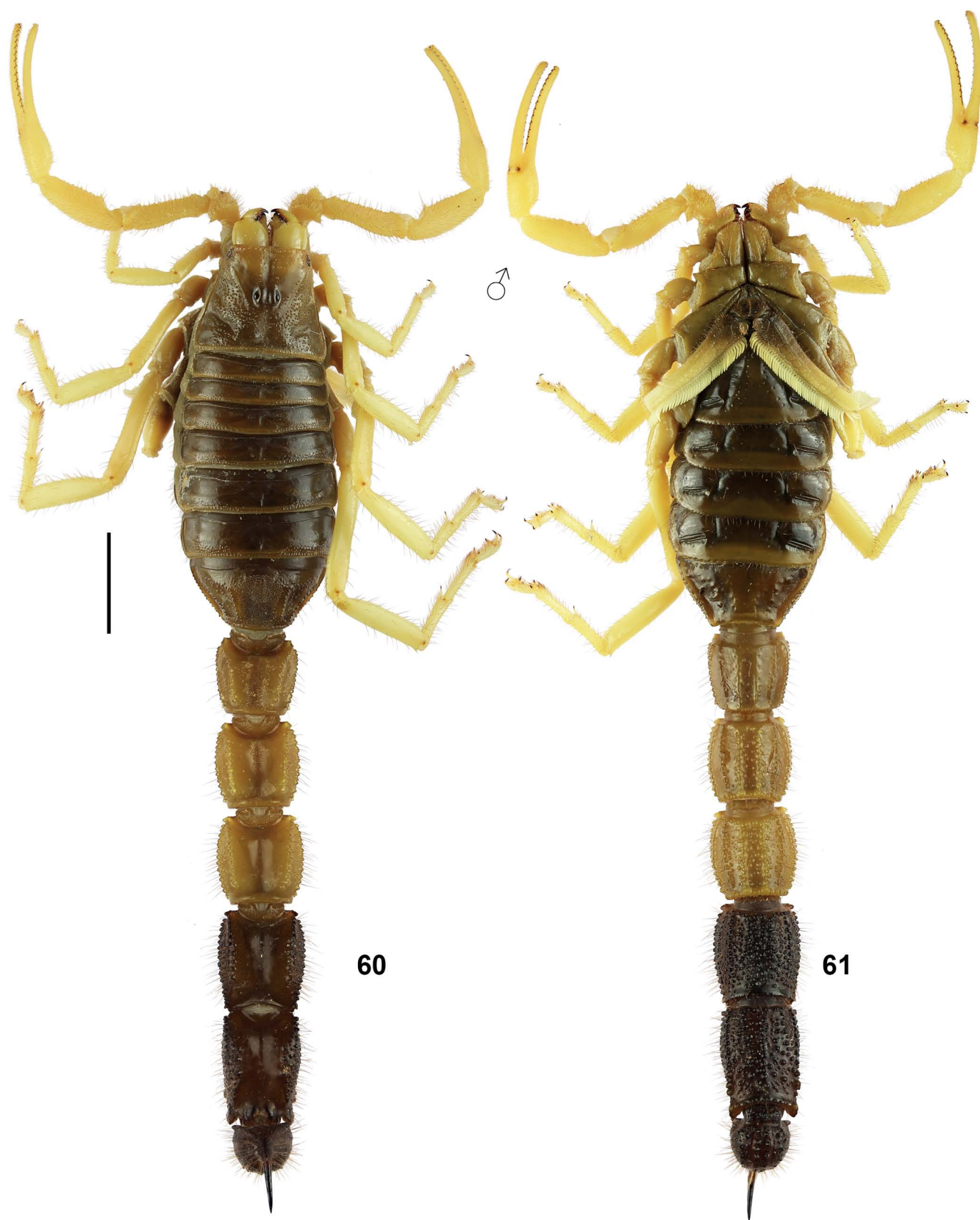
COMMENTS. The type locality 21SC is rocky semi-desert terrain at 600–650 m a. s. l. (Fig. 59). First author (FK) visited the locality and collected the specimen in open terrain during day under stones together with *Hottentotta* sp., *Neobuthus* sp., and *Parabuthus kabateki* Kovařík et al., 2019.

DISTRIBUTION. Somaliland (Fig. 128).

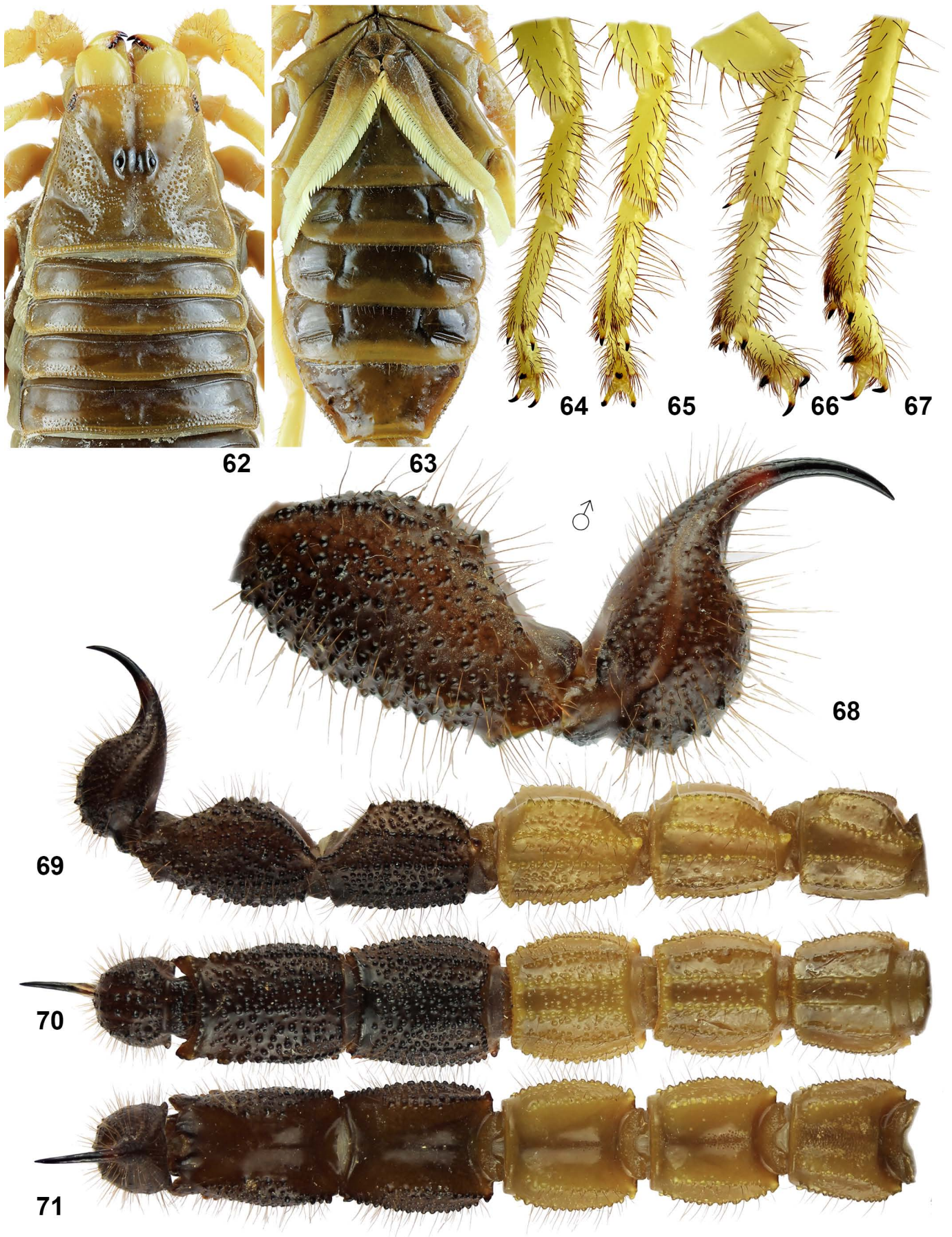




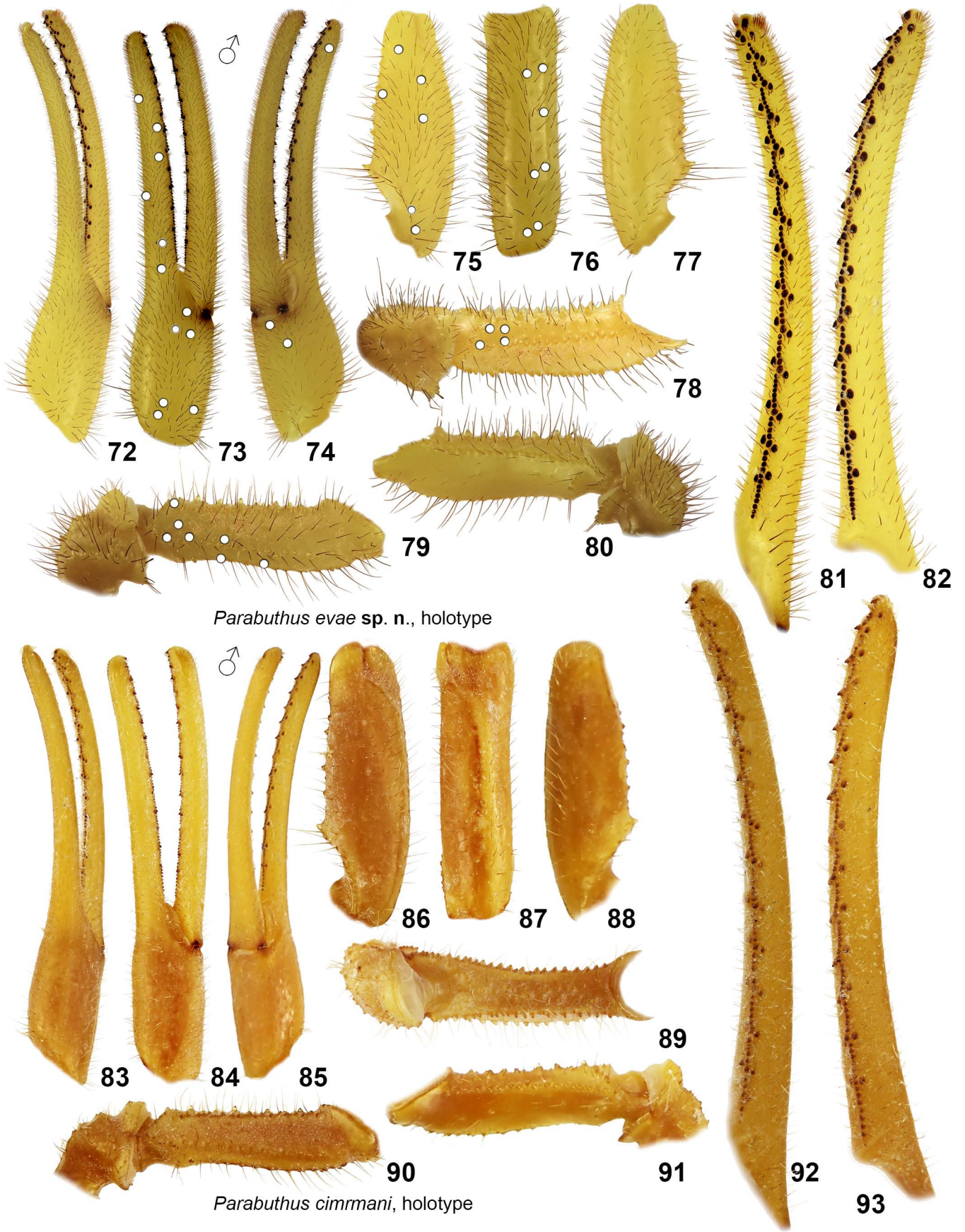
Figures 58–59: *Parabuthus evae* sp. n., male holotype. Figure 58. Female holotype in vivo habitus. Figure 59. Locality, Somaliland, E of Las Anod.



Figures 60–61. *Parabuthus evae* sp. n., male holotype, in dorsal (60) and ventral (61) views. Scale bar: 10 mm.



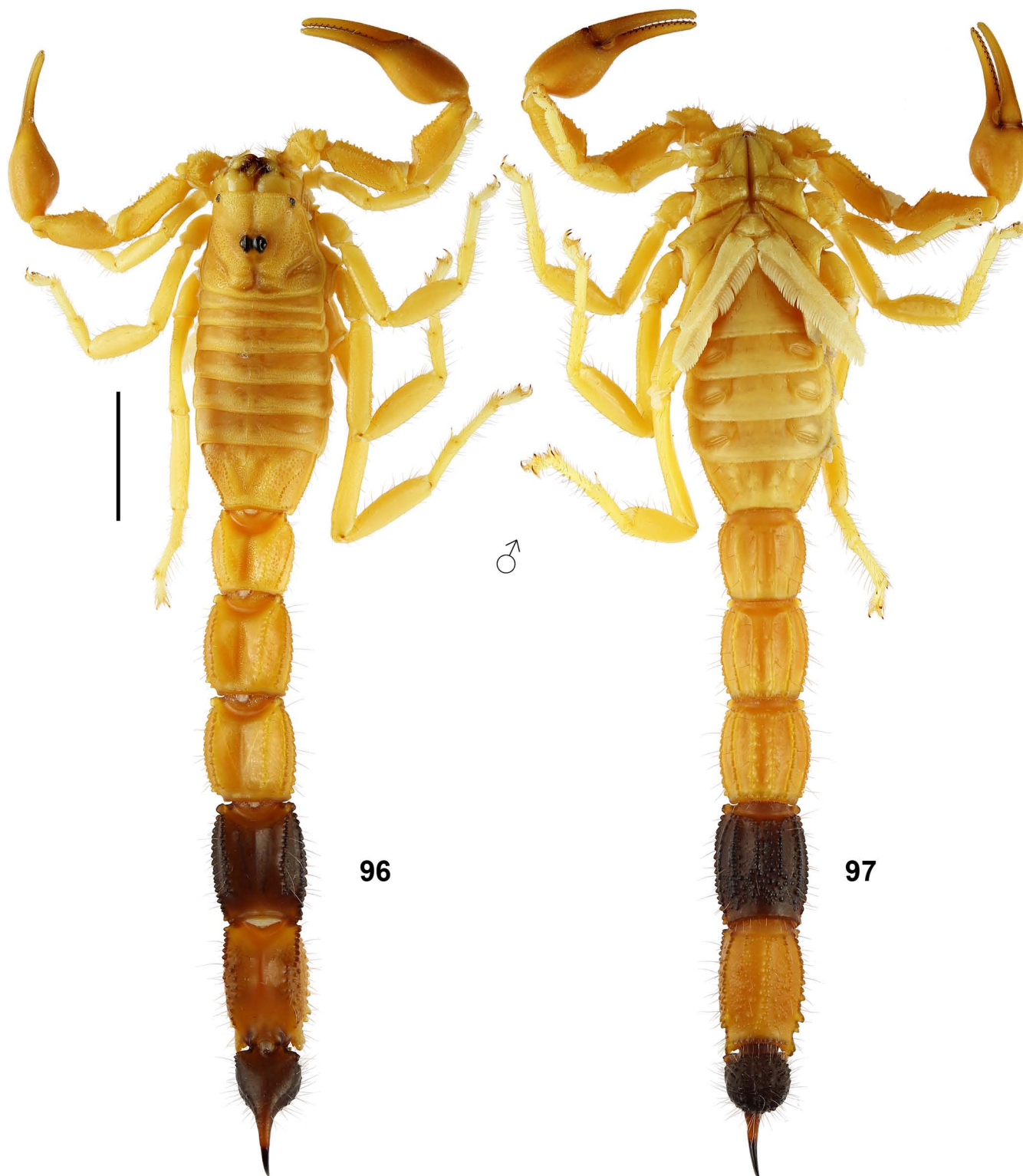
Figures 62–71: *Parabuthus evae* sp. n., male holotype. **Figure 62.** Carapace and tergites I–V. **Figure 63.** Sternoplectinal area and sternites. **Figures 64–67.** Right legs I–IV, retrolateral aspect. **Figure 68.** Metasoma V, and telson in lateral view. **Figures 69–71.** Metasoma and telson in lateral (69), ventral (70), and dorsal (71) views. Scale bars: 10 mm (69–71).



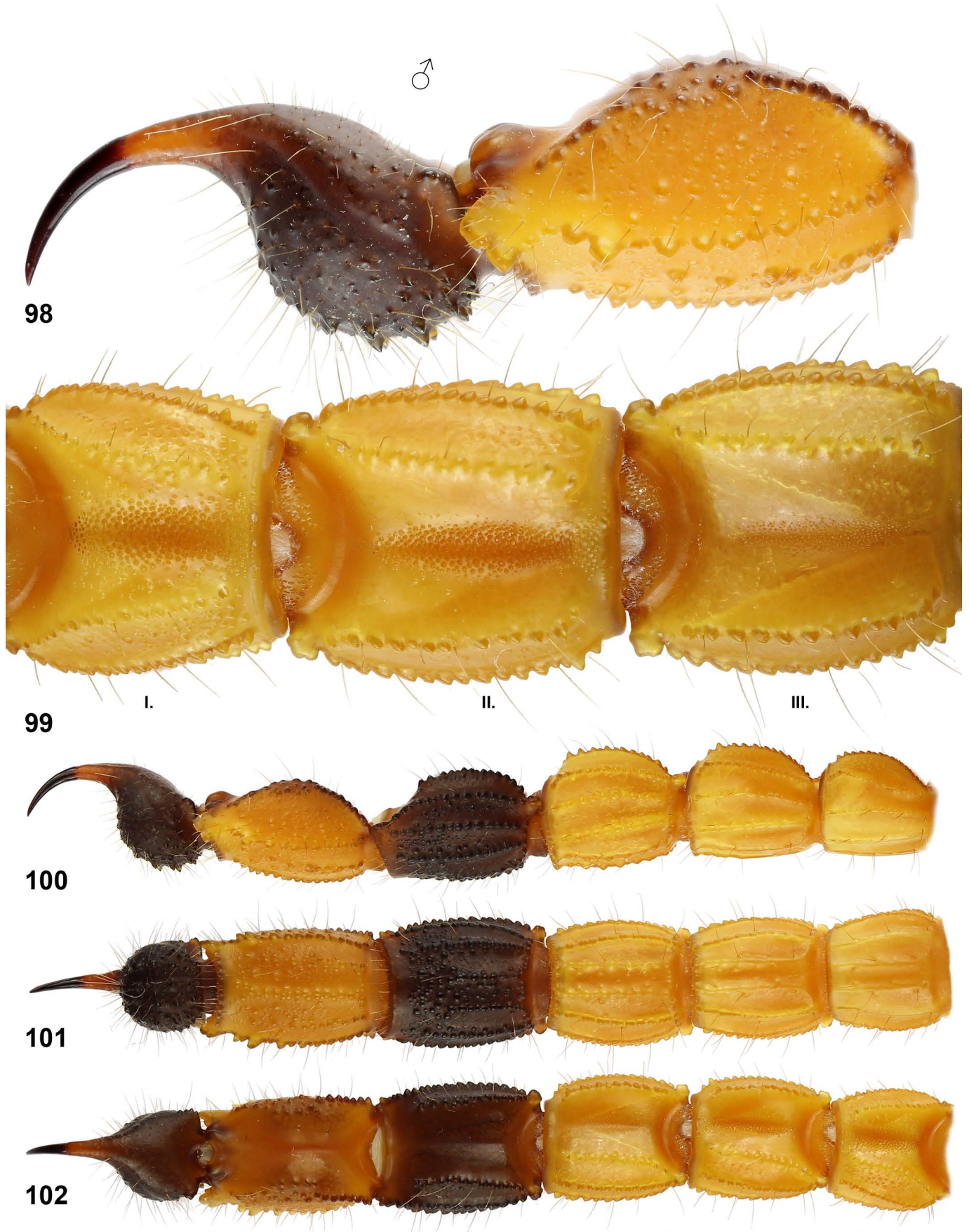
**Figures 72–93:** **Figures 72–82:** *Parabuthus evae* sp. n., male holotype. **Figures 83–93:** *Parabuthus cimrmani*, male holotype. **Figures 72–93.** Right pedipalp, chela in dorsal (72, 83), external (73, 84), and ventral (74, 85) views, patella in dorsal (75, 86), external (76, 87), and ventral (77, 88) views, femur and trochanter in internal (78, 89), dorsal (79, 90), and ventral (80, 91) views. Dentate margins of movable (81, 92) and fixed (82, 93) fingers. Trichobothrial pattern indicated in Figures 73–76 and 78–79 by white circles.



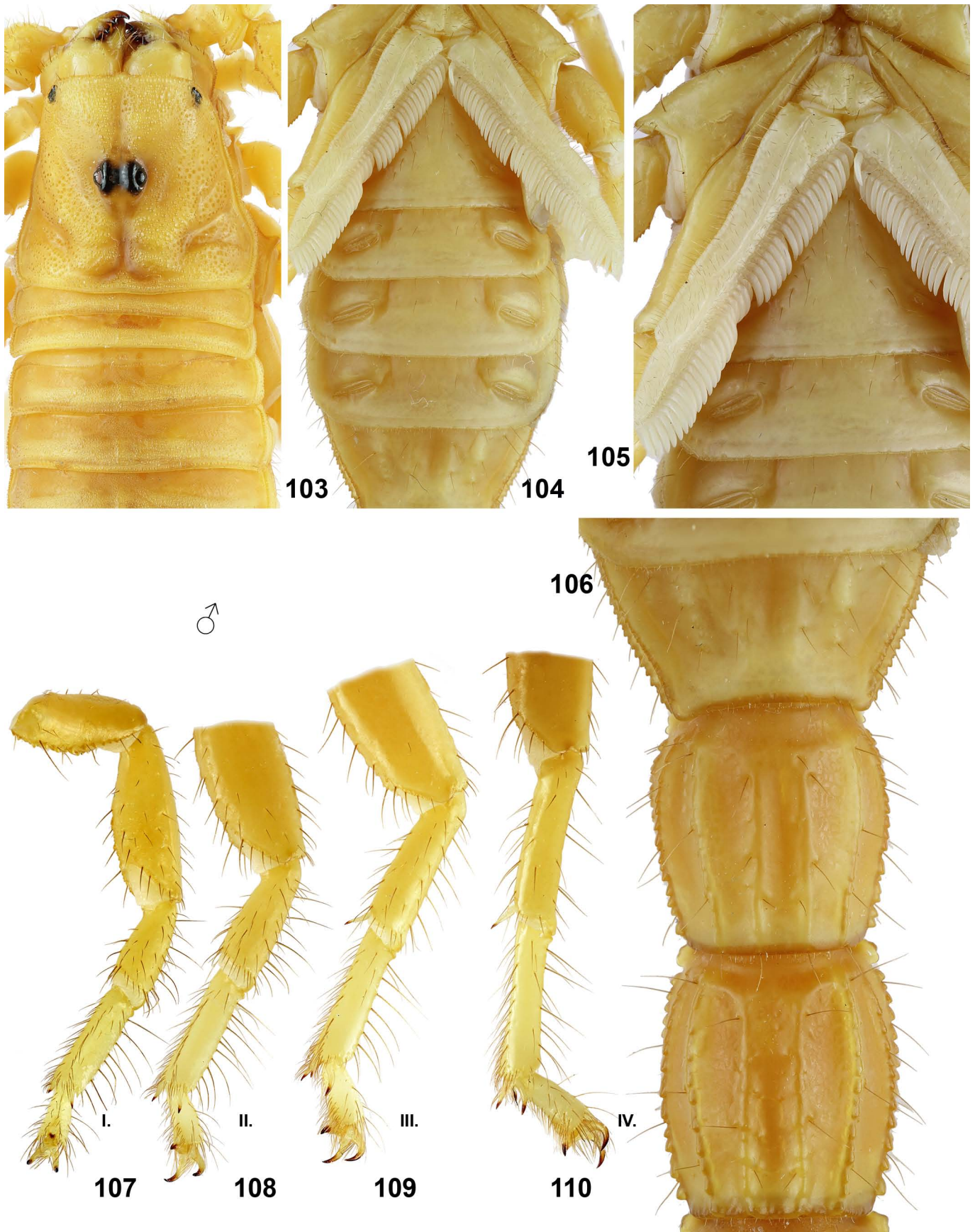
Figures 94–95: *Parabuthus quincyae* sp. n., male holotype. Figure 94. Male holotype in vivo habitus. Figure 95. Locality, Somaliland, vicinity of Huluul.



Figures 96–97. *Parabuthus quincyae* sp. n., male holotype, in dorsal (96) and ventral (97) views. Scale bar: 10 mm.

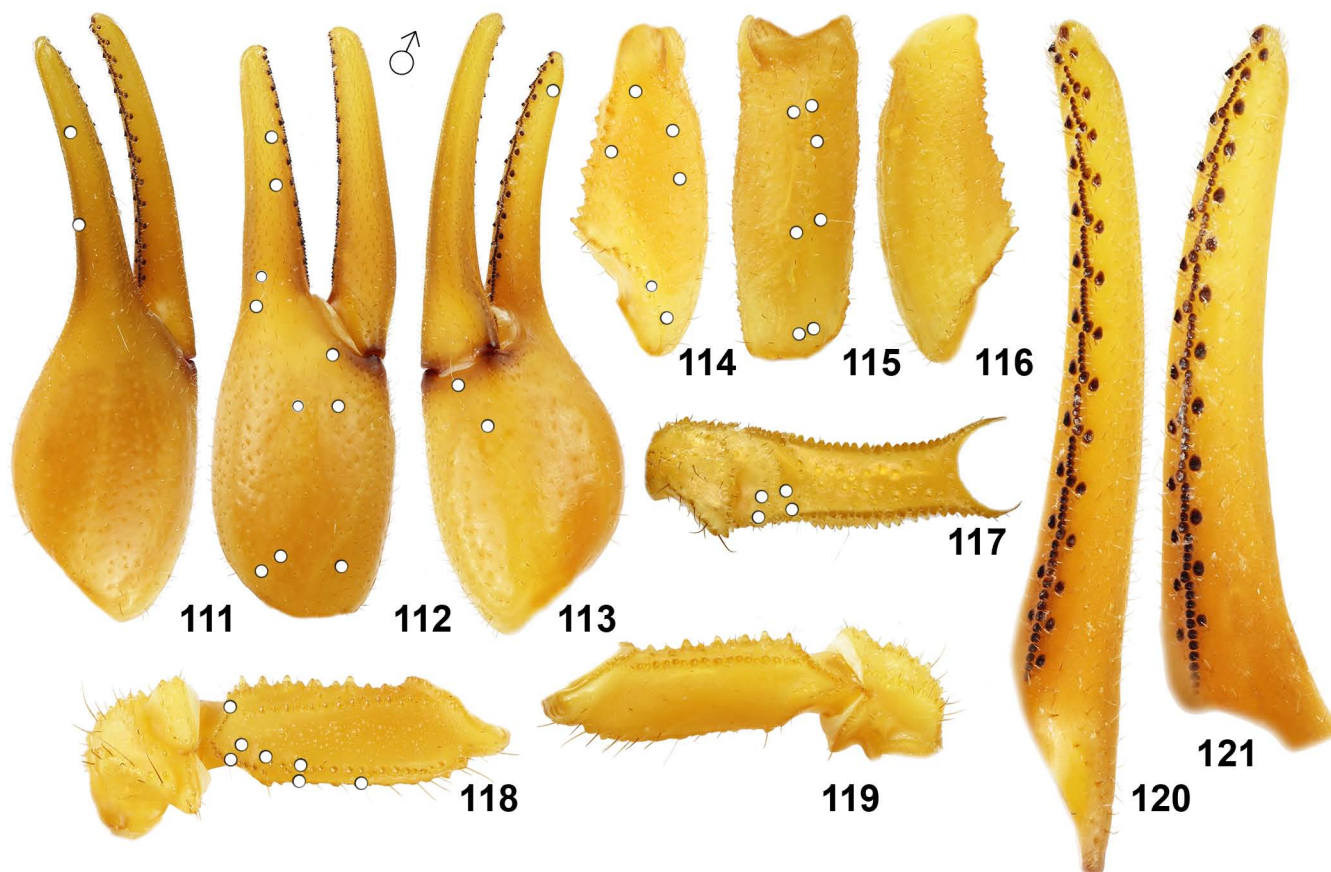


Figures 98–102: *Parabuthus quincyae* sp. n., male holotype. **Figure 98.** Metasoma V, and telson in lateral view. **Figure 99.** Metasoma I–III in dorsal view. **Figures 100–102.** Metasoma and telson in lateral (100), ventral (101), and dorsal (102) views. Scale bar: 10 mm (100–102).



**Figures 103–110:** *Parabuthus quincyae* sp. n., male holotype. **Figure 103.** Carapace and tergites I–IV. **Figures 104–105.** Sternoplectinal area and sternites. **Figure 106.** Sternite VII and metasoma I–II ventral. **Figures 107–110.** Right legs I–IV, retrolateral aspect.





**Figures 111–121.** *Parabuthus quincyae* sp. n., male holotype. Right pedipalp, chela in dorsal (111), external (112), and ventral (113) views, patella in dorsal (114), external (115), and ventral (116) views, femur and trochanter in internal (117), dorsal (118), and ventral (119) views. Dentate margins of movable (120) and fixed (121) fingers. Trichobothrial pattern indicated in Figures 111–115 and 117–118 by white circles.

***Parabuthus quincyae* sp. n.**

(Figs. 94–121, 125–127, Table 1)

<http://zoobank.org/urn:lsid:zoobank.org:act:31DE45C9-719D-41EA-80AF-DAAF21F08A67>

TYPE LOCALITY AND TYPE REPOSITORY. **Somaliland**, Huluul, 09.977614°N 46.6932°E, 811 m a. s. l.; FKCP.

TYPE MATERIAL (FKCP). **Somaliland**, Huluul, 09.977614°N 46.6932°E, 811 m a. s. l. (Locality No. **21SI**, Fig. 95 and fig. 55 in Kovařík & Lowe, 2021: 10), 10.-11.X.2021, 1♂ (holotype, DNA-2134, Figs. 94, 96–121, 125–127), leg. F. Kovařík.

ETYMOLOGY. See etymology under *Parabuthus dorisae* sp. n.

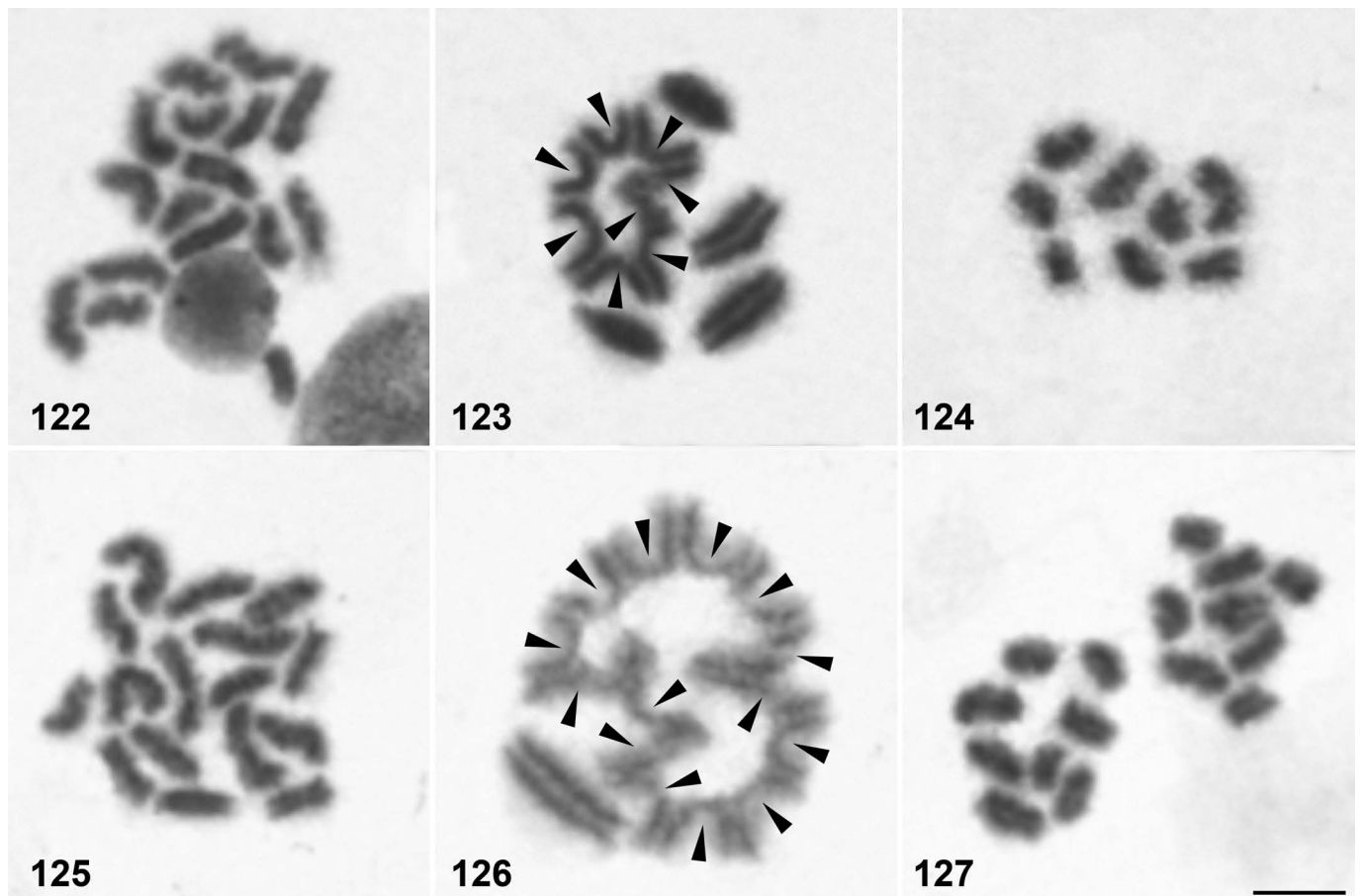
**DIAGNOSIS** ♂. Adult male holotype 72 mm long, female unknown. Base color uniformly yellow, tergites yellow to yellowish brown, fourth metasomal segment and telson black. Pectine teeth number 43–44 in male. Stridulatory area present on dorsal surface of metasoma I–III, and absent in metasoma IV–V. Metasoma densely hirsute. Metasoma V length/width ratio is 1.58. Dorsal carina of metasoma IV composed posteriorly of blunt denticles, of which the posterior-most denticle is not enlarged. Movable and fixed fingers of pedipalp

bear 13 rows of granules, all with external and internal accessory granules. Fingers of pedipalp not elongated. Fingers of pedipalps of male with inner side of base smooth, no trace of tubercle. Manus of pedipalp of male broad, pedipalp chela length/width ratio 3.14. Pedipalp chela smooth and patella finely granulated. Tarsomere I of legs I–III with bristle-combs.

**DESCRIPTION** ♂. The adult male holotype is 72 mm long. The habitus is shown in Figs. 94, 96–97. For position and distribution of trichobothria of pedipalps see Figs. 111–115, 117–118.

**Coloration** (Figs. 96–97). The base color is uniformly yellow to yellowish orange, tergites yellow to yellowish brown. The pedipalps and legs are yellow. The metasoma I–III is yellow, metasoma IV is black, and metasoma V is yellow with black pattern. Telson is black. Carapace and tergites are yellowish brown, sternites yellow.

**Carapace and mesosoma** (Figs. 96–97, 103–106). The entire carapace is covered with large granules, carinae are absent. The anterior margin of the carapace is medially weakly convex, and bears 12 symmetrically distributed short, stout spiniform macrosetae. The tergites are densely granulated. Tergite VII is pentacarinata, with lateral pairs of carinae strong, serratocrenulate. The pectinal tooth count is 43–44. The



**Figures 122–127.** Male mitotic metaphases (122, 125), postpachytene (123, 126), one sister (124) and two sister metaphases II (127) of *Parabuthus* species. *Parabuthus dorisae* sp. n. (sample 2037) ( $2n=16$ , 4II+CVIII) (122–124), *P. quincyae* sp. n. (sample S2134) ( $2n=16$ , II+CXIV) (125–127). Arrowheads show chromosomes in multivalent association during postpachytene. Scale bar: 5  $\mu\text{m}$ . (122–127).

pectine marginal tips extend to the end of the fourth sternite. The pectines have three marginal lamellae and 13–14 middle lamellae. The lamellae and fulcra bear numerous dark setae. All sternites are smooth, except that there is a stridulatory area on the third sternite. Sternite VII bears four smooth reduced carinae.

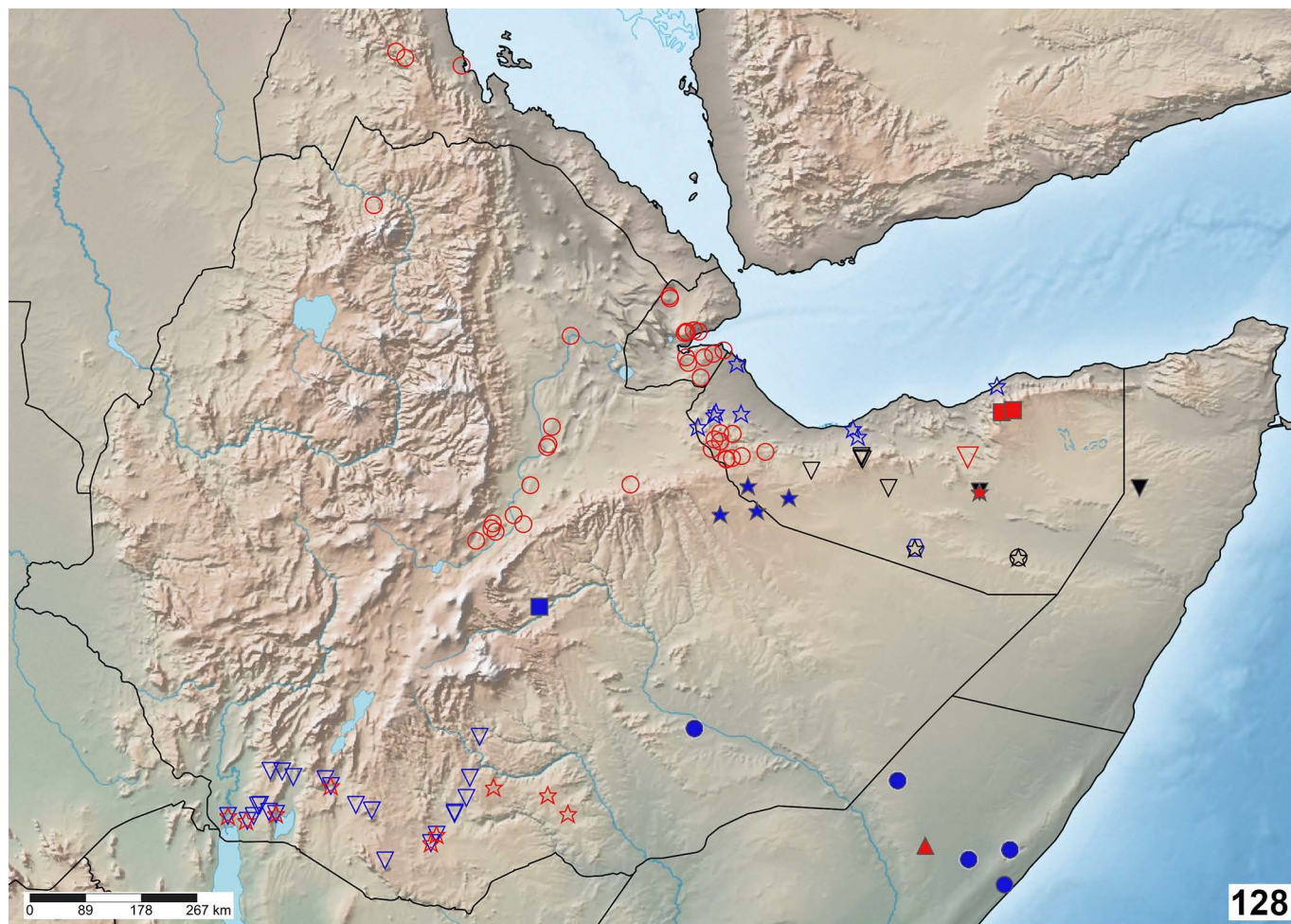
**Metasoma and telson** (Figs. 98–102). The metasoma I–IV with a total of 10 granulated carinae. The fifth segment has five carinae, and its ventral and lateral surfaces are strongly granulated. The ventral surface of metasomal segment V has several strong paired granules symmetrically located laterally in the middle part. Dorsolateral carinae of the third and fourth segments composed of rather blunt denticles, of which the posterior-most denticle is not enlarged. The stridulatory area is located on the dorsal surface of the metasoma I–III. On the fourth and fifth segments the stridulatory area is absent. The entire metasoma and the telson are pilose with long hairs. The ventral surface of the telson is strongly granulated. The metasomal segment V length/width ratio is 1.58. The telson is rather bulbous, with the aculeus approximately the same length as the vesicle.

**Pedipalps** (Figs. 111–121). The pedipalps are hirsute with shorter setae on the chela and the patella, and longer setae on the femur, and trochanter. The femur bears four carinae.

The chela is smooth without carinae and the patella is finely granulated with carinae indicated. The movable and fixed fingers of pedipalp bear 12–13 rows of granules, all with external and internal accessory granules. The fingers of pedipalps of male with inner side of base smooth, tubercle absent. The manus of pedipalp of male broad, pedipalp chela length/width ratio 3.14.

**Legs** (Figs. 107–110). Legs III and IV bear tibial spurs. Retrolateral and prolateral pedal spurs are present on all legs. All legs without distinct carinae and smooth. The tarsomeres bear two rows of macrosetae on the ventral surface and other macrosetae on the other surfaces. The bristle-combs are present on all legs, although slightly reduced on the fourth leg. **Measurements.** See Table 1.

**AFFINITIES.** According to the characters used in the key published in Kovařík et al. (2019) the new species which is also confirmed by DNA phylogeny (paper in preparation) is most similar to *P. somalilandus*. *P. quincyae* sp. n. has stridulatory area present on dorsal surface of metasoma I–III (present on metasoma I–II, reduced or absent in metasoma III in *P. somalilandus*), manus of pedipalp of male broader, pedipalp chela L/W ratio 3.14 in male holotype (3.38–3.91 in males of *P. somalilandus*).



- *Parabuthus abyssinicus* Pocock, 1901
- ▲ *Parabuthus cimrmani* Kovařík, 2004
- ★ *Parabuthus dorisae* sp. n.
- *Parabuthus erigavoensis* Kovařík et al., 2019
- ▼ *Parabuthus eritreaensis* Kovařík, 2003
- *Parabuthus evae* sp. n.
- ☆ *Parabuthus granimanus* Pocock, 1895
- ★ *Parabuthus hamar* Kovařík et al., 2016
- *Parabuthus heterurus* Pocock, 1897
- ☆ *Parabuthus kabateki* Kovařík et al., 2019
- *Parabuthus kajibu* Kovařík et al., 2016
- *Parabuthus mazuchi* Kovařík et al., 2019
- ▽ *Parabuthus pallidus* Pocock, 1895
- ▽ *Parabuthus quincyae* sp. n.
- ★ *Parabuthus robustus* Kovařík et al., 2019
- ▽ *Parabuthus somalilandus* Kovařík et al., 2019



**Figures 128–129: Figure 128.** Map showing confirmed distribution of *Parabuthus* spp. in Djibouti, Eritrea, Ethiopia, Somalia, and Somaliland. **Figure 129.** *Parabuthus eritreaensis*, female from Somaliland in vivo habitus.

**COMMENTS ON LOCALITY AND LIFE STRATEGY.** The type locality 21SI is a rocky semi-desert terrain with consolidated substrate at 800–850 m a. s. l. (Fig. 95 and fig. 55 in Kovařík & Lowe, 2021: 10). First author (FK) visited the locality and collected the specimen in open

terrain at night by UV detection together with *Lanzatus huluul* Kovařík & Lowe, 2021 (type locality), *Neobuthus* sp., and *Hemiscorpius* sp.

**DISTRIBUTION.** Somaliland (Fig. 128).

## Acknowledgments

Thanks are due to Zdeněk Faltýnek, Petr Kabátek, and Tomáš Mazuch (Czech Republic) who participated and helped in the expeditions to Somaliland in 2021. Special thanks to Tomáš Mazuch for providing photo used as Figure 53; Sulieman Ahmed Gulair (President of Amound University), Ahmed A. Boqore (Vice President, Academic Affairs of Amound University), Shukuri Haji Ismail and Abdinasir Hussein (Ministry of Environment & Rural Development, Hargeisa, Republic of Somaliland) and many local people for their help. Further, we thank two anonymous reviewers for their comments on the manuscript.

## References

- ALEXANDER, A. J. 1959. Courtship and mating in the buthid scorpions. *Proceedings of the Zoological Society of London*, 133 (1): 145–169.
- FET, V. & G. LOWE. 2000. Family Buthidae C. L. Koch, 1837. Pp. 54–286 in Fet, V., W. D. Sissom, G. Lowe & M. E. Braunwalder. *Catalog of the Scorpions of the World (1758–1998)*. New York: The New York Entomological Society, 689 pp.
- KOVAŘÍK, F. 2003. Scorpions of Djibouti, Eritrea, Ethiopia, and Somalia (Arachnida: Scorpiones), with a key and descriptions of three new species. *Acta Societatis Zoologicae Bohemicae*, 67: 133–159.
- KOVAŘÍK, F. 2004. *Parabuthus cimrmani* sp. nov. from Somalia (Scorpiones: Buthidae). *Acta Societatis Zoologicae Bohemicae*, 68: 15–19.
- KOVAŘÍK, F. 2009. *Illustrated catalog of scorpions. Part I. Introductory remarks; keys to families and genera; subfamily Scorpioninae with keys to Heterometrus and Pandinus species*. Prague: Clairon Production, 170 pp.
- KOVAŘÍK, F. & G. LOWE. 2021. Scorpions of the Horn of Africa (Arachnida, Scorpiones). Part XXVII. *Lanzatus huhul* sp. n. from Somaliland (Buthidae). *Euscorpius*, 344: 1–12.
- KOVAŘÍK, F., G. LOWE, H. S. A. ELMİ & F. ŠTÁHLAVSKÝ. 2019. Scorpions of the Horn of Africa (Arachnida: Scorpiones). Part XXI. *Parabuthus* (Buthidae) (Part II), with description of five new species from Somaliland and Ethiopia. *Euscorpius*, 290: 1–63.
- KOVAŘÍK, F., G. LOWE, P. JUST, A. I. AWALE, H. SH A. ELMİ & F. ŠTÁHLAVSKÝ. 2018. Scorpions of the Horn of Africa (Arachnida: Scorpiones). Part XVI. Review of the genus *Gint* Kovařík et al., 2013, with description of three new species from Somaliland (Scorpiones, Buthidae). *Euscorpius*, 258: 1–41.
- KOVAŘÍK, F., G. LOWE, J. PLÍŠKOVÁ & F. ŠTÁHLAVSKÝ. 2016. Scorpions of the Horn of Africa (Arachnida: Scorpiones). Part VII. *Parabuthus Pocock*, 1890 (Buthidae), with description of *P. hamar* sp. n. and *P. kajibu* sp. n. from Ethiopia. *Euscorpius*, 228: 1–58.
- KOVAŘÍK, F. & A. A. OJANGUREN AFFILASTRO. 2013. *Illustrated catalog of scorpions. Part II. Bothriuridae; Chaerilidae; Buthidae I. Genera Compsobuthus, Hottentotta, Isometrus, Lychas, and Sassanidotus*. Prague: Clairon Production, 400 pp.
- KOVAŘÍK, F., F. ŠTÁHLAVSKÝ, T. KOŘÍNKOVÁ, J. KRÁL & T. VAN DER ENDE. 2009. *Tityus ythieri* Lourenço, 2007 is a synonym of *Tityus magnimanus* Pocock, 1897 (Scorpiones: Buthidae): a combined approach using morphology, hybridization experiments, chromosomes, and mitochondrial DNA. *Euscorpius*, 77: 1–12.
- KOVAŘÍK, F. & S. WHITMAN. 2005. Cataloghi del Museo di Storia Naturale dell'Università di Firenze – sezione di zoologia «La Specola» XXII. Arachnida Scorpiones. Tipi. Addenda (1998–2004) e checklist della collezione (Euscorpiinae esclusi). *Atti della Società Toscana di Scienze Naturali, Memorie, serie B*, 111 (2004): 103–119.
- KRAEPELIN, K. 1891. Revision der Skorpione. I. Die Familie des Androctonidae. *Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten*, 8(1890): 144–286 (1–144).
- KRAEPELIN, K. 1895. Nachtrag zu Theil I der Revision der Skorpione. *Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten*, 12(1894): 73–96.
- LAMORAL, B.H. 1979. The scorpions of Namibia (Arachnida: Scorpionida). *Annals of the Natal Museum*, 23 (3): 497–784.
- LOURENÇO, W. R., B. DUHEM & J. L. CLOUDSLEY-THOMPSON. 2010. A new relictual buthid scorpion from the region of the Great Rift Valley in Kenya (Scorpiones, Buthidae). *Comptes Rendus Biologies*, 333(2010): 280–285.
- LOWE, G. & F. KOVAŘÍK. 2019. Review of *Grosphus* Simon, 1880, with description of *Teruelius* gen. n., a new buthid genus from Madagascar (Scorpiones: Buthidae). *Euscorpius*, 281: 1–128.
- POCOCK, R. I. 1890. A revision of the genera of scorpions of the family Buthidae, with descriptions of some South-African species. *Proceedings of the Zoological Society of London*, 1890: 114–141.

- POCOCK, R. I. 1895. On the Arachnida and Myriapoda obtained by Dr. Anderson's collector during Mr. T. Bent's expedition to the Hadramaut, South Arabia; with a supplement upon the scorpions obtained by Dr. Anderson in Egypt and the Eastern Soudan. *Journal of the Linnaean Society*, 25: 292–316.
- PRENDINI, L. & L. A. ESPOSITO. 2010. A reanalysis of *Parabuthus* (Scorpiones, Buthidae) phylogeny with descriptions of two new *Parabuthus* species endemic to the central Namib gravel plains, Namibia. *Zoological Journal of the Linnean Society*, 159: 673–710.
- SADÍLEK, D., P. NGUYEN, H. KOÇ, F. KOVAŘÍK, E. A. YAĞMUR & F. ŠTÁHLAVSKÝ. 2015. Molecular cytogenetics of *Androctonus* scorpions: an oasis of calm in the turbulent karyotype evolution of the diverse family Buthidae. *Biological Journal of the Linnean Society*, 115: 69–76.
- SAKAMOTO, Y. & A.A. ZACARO. 2009. LEVAN, an ImageJ plugin for morphological cytogenetic analysis of mitotic and meiotic chromosomes. Available at: <http://rsbweb.nih.gov/ij/plugins/levan/levan.html>. Accessed 3rd June 2016.
- SCHNEIDER M. C., MATTOS, V. F. & D. M. CELLA. 2013. The Scorpion Cytogenetic Database. Current version: 11.5 (Feb 28, 2023) <https://arthropodcytogenetics.bio.br/scorpiondatabase/>
- ŠTÁHLAVSKÝ F., NGUYEN P., SADÍLEK D., ŠTUNDLOVÁ J., JUST P., HADDAD C.R., KOC H., RANAWANA K.B., STOCKMANN M., YAGMUR E.A. & KOVAŘÍK F. 2020. Evolutionary dynamics of rDNA clusters on chromosomes of buthid scorpions (Chelicerata: Arachnida). *Biological Journal of the Linnean Society*, 131: 547–565.
- STAHNKE, H. L. 1971. Scorpion nomenclature and mensuration. *Entomological News*, 81: 297–316.
- VACHON, M. 1974. Études des caractères utilisés pour classer les familles et les genres des scorpions (Arachnides). 1. La trichobothriotaxie en arachnologie. Sigles trichobothriaux et types de trichobothriotaxie chez les Scorpions. *Bulletin du Muséum national d'Histoire naturelle*, 3e série, 140 (Zoologie, 104): 857–958.