Euscorpius

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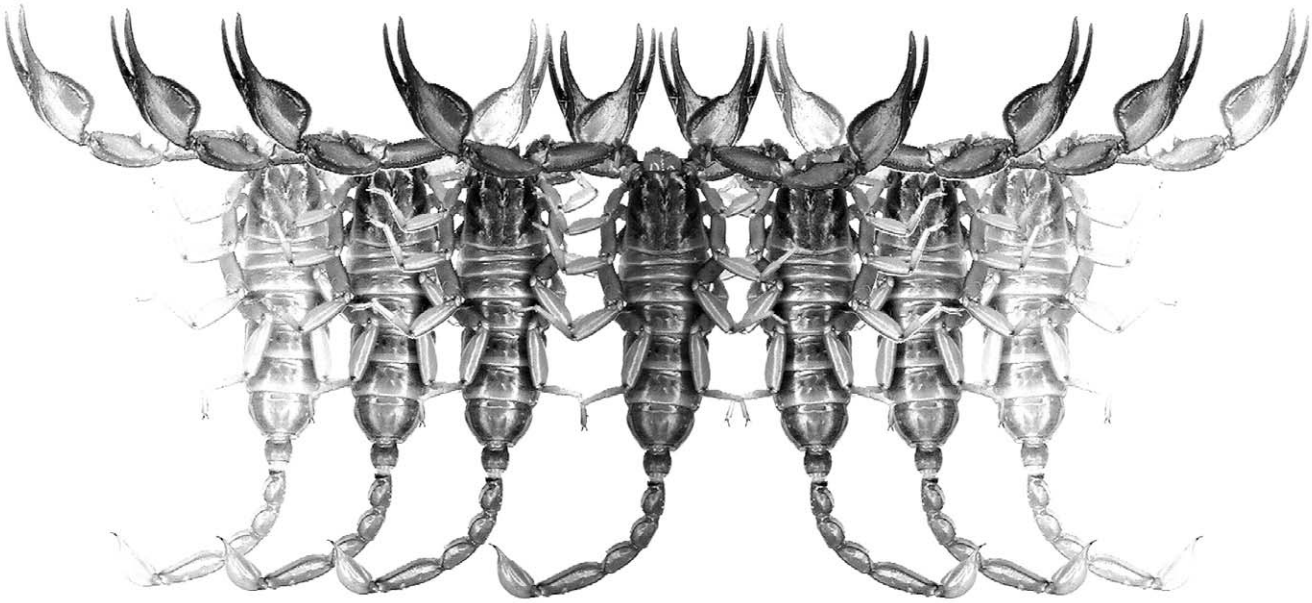

Scorpions of the Horn of Africa (Arachnida: Scorpiones). Part IX. *Lanzatus*, *Orthochirus*, and *Somalicharmus* (Buthidae), with Description of *Lanzatus somalilandus* sp. n. and *Orthochirus afar* sp. n.

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Euscorpius — Occasional Publications in Scorpiology. 2016, No. 232

Scorpions of the Horn of Africa (Arachnida: Scorpiones). Part IX. *Lanzatus*, *Orthochirus*, and *Somalicharmus* (Buthidae), with description of *Lanzatus somalilandus* sp. n. and *Orthochirus afar* sp. n.

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Summary

The rare Horn of Africa buthid genera *Lanzatus* Kovařík, 2001, *Orthochirus* Karsch, 1891, and *Somalicharmus* Kovařík, 1998 were newly collected. *Lanzatus* is reported for the first time from Somaliland, and *Orthochirus* for the first time from Ethiopia. We describe two new species, *Lanzatus somalilandus* **sp**. **n**. from Somaliland, and *Orthochirus afar* **sp**. **n**. from Ethiopia, both discovered during scorpiological expeditions in 2011–2016. Information is provided for all Horn of Africa species belonging to these three genera: their taxonomy, distribution, and ecology, fully complemented with color photos of live and preserved specimens, as well as their habitat. The morphology of the enigmatic scorpion *Somalicharmus whitmanae* Kovařík, 1998 is illustrated in detail. The first author recently collected 52 specimens including the first known females, which reveal natural colors, and show sexual dimorphism in the shape of the pedipalp chela and metasoma which are broader in males, and in the shape of the basal middle lamella of the pectines, which in females is extremely dilated and rounded. We describe the hemispermatophore, which is furnished with an atypically elongated basal lobe, and the chelicera, which differs from that of all other known extant buthids. Other characters indicate possible affinity with the south African buthid *Karasbergia methueni* Hewitt, 1913. We also describe karyotypes of *S. whitmanae*. We identified 2n=20 in seven males from two localities and 2n=21 in one male. In both analyzed localities we found males with reciprocal translocations that form conspicuous multivalents. The male with 2n=21 includes fission of one chromosome that increases the diploid number and implicates an odd number of chromosomes.

Introduction

In the years 2011–2016, the first author (FK) has had the opportunity to participate in a number of expeditions to the Horn of Africa, study scorpions, and publish several articles on this fauna (Kovařík, 2011a, 2011b, 2012, 2013, 2015, 2016; Kovařík & Lowe, 2012; Kovařík & Mazuch, 2011, 2015; Kovařík et al., 2013a, 2015, 2016a, 2016b; and Lowe & Kovařík, 2016). To date, 93 localities have been sampled, 5 of which have yielded specimens of the rare buthid genera *Lanzatus* Kovařík, 2001, *Orthochirus* Karsch, 1892, and *Somalicharmus* Kovařík, 1998. We analyze these specimens in this paper, the ninth in a series of articles concerning the composition and distribution of particular scorpion genera in the Horn of Africa.

Lanzatus was formerly monotypic and known only from localities in Somalia of *Lanzatus somalicus* Kovařík, 2001. Here we describe from a new locality in Somaliland, a second species, *Lanzatus somalilandus* **sp**. **n**.

Orthochirus is widely distributed in both Asia and Africa. The new localities cited here represent the first records of the genus from Ethiopia and the southern limits of its distribution.

Somalicharmus whitmanae Kovařík, 1998 was newly collected (52 specimens) from two localities in southern Ethiopia, confirming the published discussion that its original locality is not in Somalia but in southern Ethiopia near these two new localities.

Methods, Material & Abbreviations

Nomenclature and measurements follow Stahnke (1971), Kovařík (2009), and Kovařík & Ojanguren Affilastro (2013), except for trichobothriotaxy (Vachon, 1974), and sternum (Soleglad & Fet, 2003a). Hemispermatophore terminology follows Kovařík et al. (2016c).

We intentionally use here the name Somaliland (Hargeysa) for the northern territory corresponding to the former British colony (British Somaliland), which we distinguish from Somalia (Mogadisho). Somaliland has its own currency, a functional government with representation in several countries, and its officials contributed to our safe visit.

Specimens were found by ultraviolet (UV) detection by night. All collected material was preserved in 80% ethanol. *Specimen Depositories*: FKCP (František Kovařík, private collection, Prague, Czech Republic); MNHN (Muséum National d'Histoire Naturelle, Paris, France); and MZUF (Museo Zoologico de "La Specola", Firenze, Italy). *Morphometrics*: D, depth; L, length; W, width.

Systematics

Family Buthidae C. L. Koch, 1837

Lanzatus Kovařík, 2001

(Figs. 1–40, 123–124, 155, Table 1)

Lanzatus Kovařík, 2001: 41–44, figs. 1–7; Fet & Soleglad, 2005: 11; Fet et al., 2005: 3, 11–12, 20, 22–25, Tab. 1, Fig. 23–25; Prendini & Wheeler, 2005: 462, 481; Dupré, 2007: 7, 13, 16; Kovařík et al., 2007: 207; Kovařík, 2009: 23, 31.

= *Sabinebuthus* Lourenço, 2001a: 16–18, figs. 1–5; Fet & Soleglad, 2005: 4, 11; Fet et al., 2005: 3, 11, 20, 22–23, Tab. 1, Fig. 23; Prendini & Wheeler, 2005: 462, 481; Dupré, 2007: 10, 13, 17; Kovařík, 2009: 23, 31 (syn. by Lourenço, 2001b: 174).

TYPE SPECIES. *Lanzatus somalicus* Kovařík, 2001.

EMENDED DIAGNOSIS. Total length 17.9–27.6 mm. Pedipalps orthobothriotaxic type A (Vachon, 1974); dorsal trichobothria of femur arranged in *β*-configuration (Vachon, 1975); trichobothrium d_2 of femur internal to dorsointernal carina; d_3 of patella internal to dorsomedian carina, when carina present; V_2 on chela manus located behind V_1; *it* on distal fixed finger. Pectines with fulcra. Pectine teeth number 18–24. Basal middle lamella of pectines in females not dilated. Hemispermatophore unknown. Sternum subtriangular. Tibial spurs absent on legs I–IV. Cheliceral fixed finger with one ventral denticle, margins of fingers with standard pattern of buthid dentition (Vachon, 1963). Carapace without distinct carinae, in lateral view with entire dorsal surface horizontal, or nearly so. Lateral eyes number 5 pairs. Pedipalp chela movable finger with distinct granules divided into 7 diagonal rows. Tergites I–VI smooth to finely granulated with one indicated carina or acarinate. Stigmata are narrow slits. Metasomal segments all elongate, smooth, acarinate. Telson elongate, smooth, without subaculear tubercle, aculeus shorter than vesicle.

COMMENTS ABOUT SYNONYMY. Lourenço (2001b: 174) stated that *Lanzatus somalicus* Kovařík, 2001 is a synonym of *Sabinebuthus elegans* Lourenço, 2001. He provided no evidence whatsoever that *S. elegans* and *L. somalicus* are the same species, and instead only told a story about searching for specimens and competing, which the first author perceives very differently. However, this discussion has no place in a technical paper and we therefore refrain from commenting. The published descriptions of these two genera/species include substantial differences that would indicate that they belong to separate genera, distinguishable in a key as follows:

Movable finger of pedipalp with six rows of granules which do not form diagonal rows and lack accessory granules (see fig. 4 in Lourenço, 2001a: 19) ……..…. ..... *Sabinebuthus elegans*

– Movable finger of pedipalp with seven rows of granules which form diagonal rows and have accessory granules (see Fig. 15 and fig. 6 in Kovařík, 2001: 44) .....……..... *Lanzatus*

Since the request of the first author for a loan of the holotype of *Sabinebuthus elegans* was refused, we can only speculate about two possibilities: **a**) fig. 4 in Lourenço, 2001a: 19 is correct and Lourenço, 2001b: 174 is incorrect in claiming that the two taxa are synonyms; **b**) fig. 4 in Lourenço, 2001a: 19, and with it the entire diagnosis of *Sabinebuthus elegans*, are incorrect and these two genera/species are synonyms. To mention one additional detail, Lourenço (2001b: 174) correctly states that the description of *Lanzatus somalicus* was published on 30 March 2001. However, he is incorrect in stating that the description of *Sabinebuthus elegans* was published on 1 March 2001, since the date of the issue is given only as "March 2001". According to the ICZN, if only the month is given then the last day of that month, not the first, is the valid publication date. Consequently, *Sabinebuthus elegans* was described on 31 March 2001.

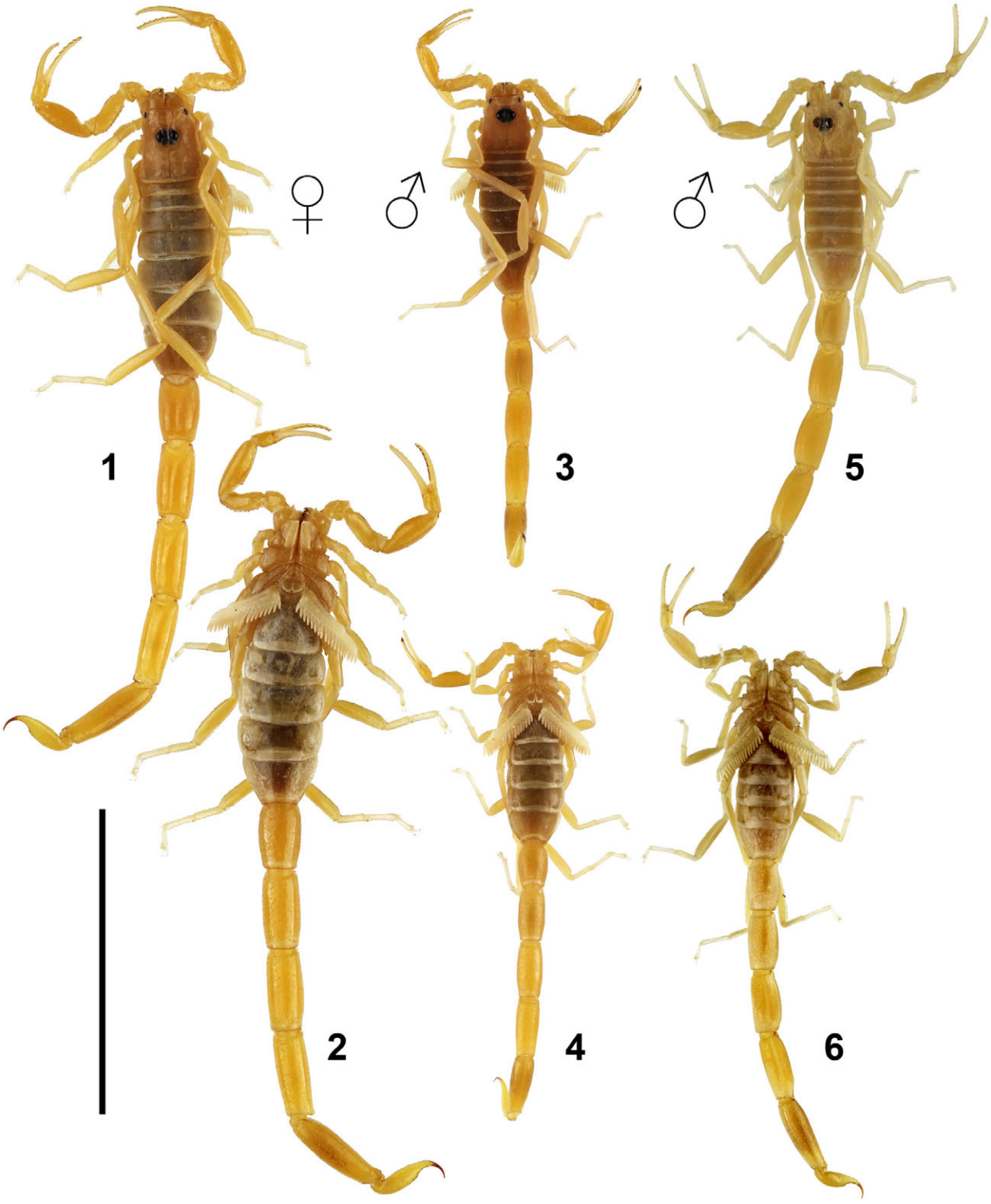
Lanzatus somalicus Kovařík, 2001

(Figs. 5–6, 11–12, 29, 32–34, 155)

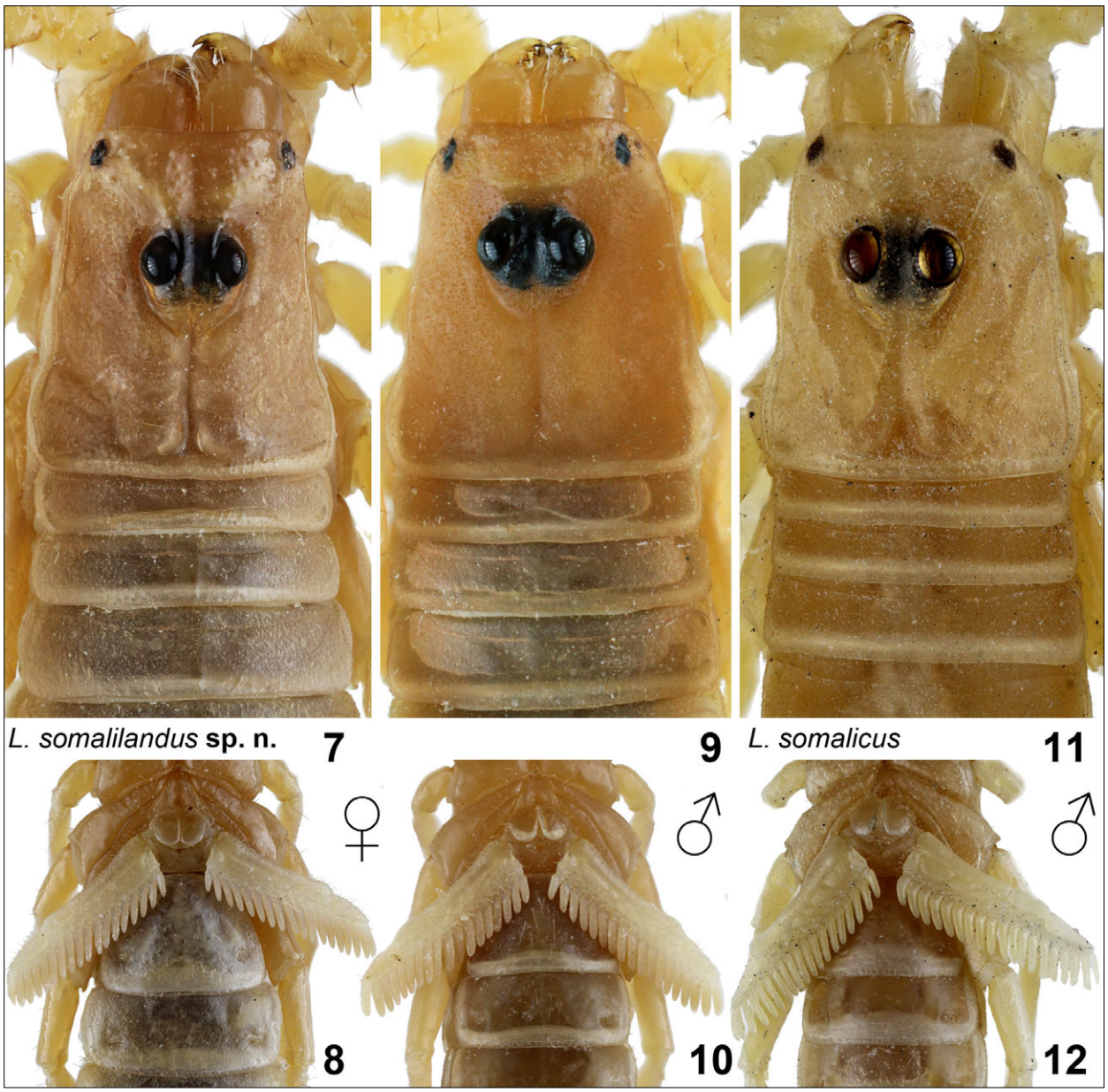
Lanzatus somalicus Kovařík, 2001: 42–44, figs. 1–7; Kovařík, 2003: 135, 141; Fet et al., 2005: 12; Kovařík & Whitman, 2005: 108; Kovařík, 2009: 30.

= *Sabinebuthus elegans* Lourenço, 2001a: 16–20, figs. 1–6 (type locality and type repository: Somalie, région de Brava, entre Modun et Awai, MNHN); Kovařík, 2003: 135 (syn. by Lourenço, 2001b: 174).

TYPE LOCALITY AND TYPE REPOSITORY. Somalia, Geseŕa's mangrove, 01º57'N 45º11'E; MZUF.



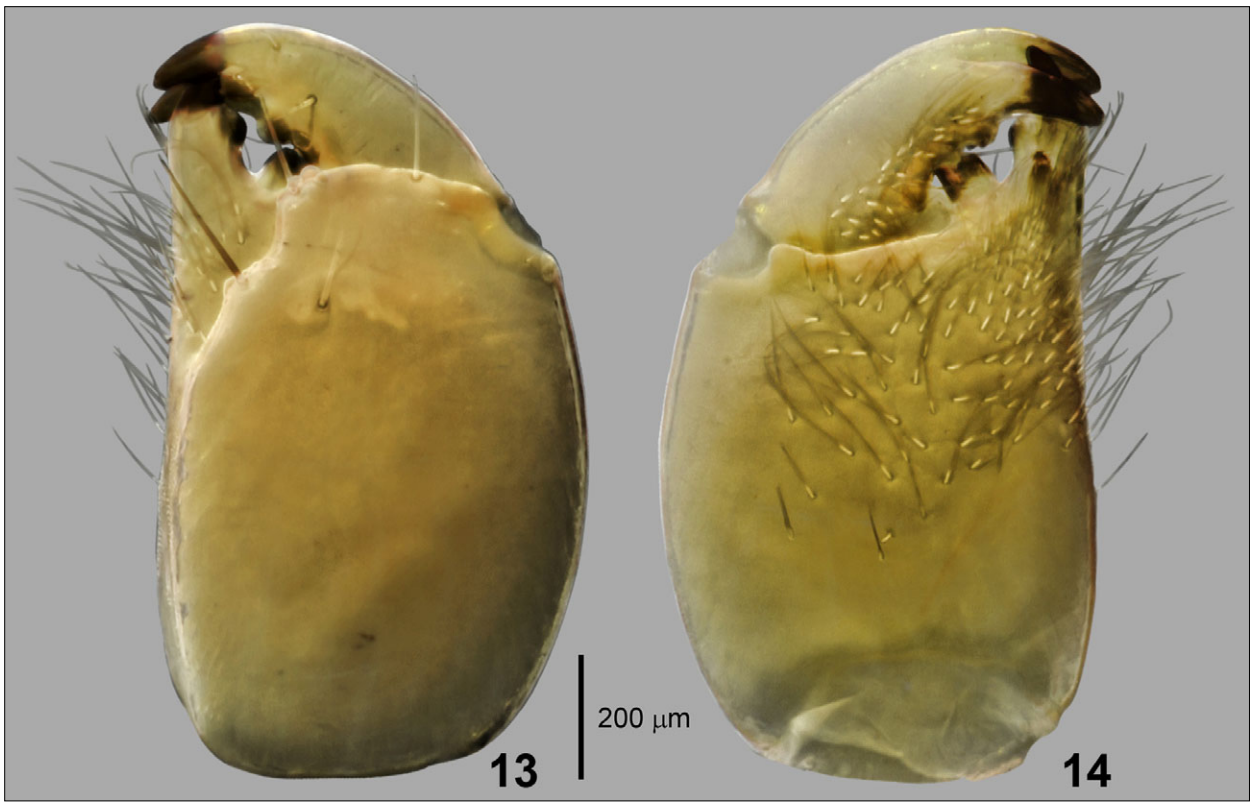
Figures 1–6: *Lanzatus*. **Figures 1–4**. *L. somalilandus* **sp**. **n**. **Figures 1–2**. Female paratype in dorsal (1) and ventral (2) views. **Figures 3–4**. Male holotype in dorsal (3) and ventral (4) views. **Figures 5–6**. *L. somalicus*, male paratype in dorsal (5) and ventral (6) views. Scale bar: 10 mm.



Figures 7–12: *Lanzatus*, carapace and tergites I–III (7, 9, 11), and coxosternal area and sternites III–IV (8, 10, 12). **Figures 7–10**. *L. somalilandus* **sp**. **n**., female paratype (7–8) and male holotype (9–10). **Figures 11–12**. *L. somalicus*, male paratype.

TYPE MATERIAL EXAMINED. Somalia, Geseŕa's mangrove, 01º57'N 45º11'E, 2 m a.s.l., VIII.1975, SBS (Spedizione Biologica Somalia), 1♂ (holotype), MZUF No. 540; Lesňmma, 04º30'N 45º44'E, 268 m a.s.l., 3.VIII.1969, 1♂ (paratype, in original description incorrectly cited as immature, Figs. 5–6, 11–12, 29, 32–34), leg. B. Lanza under a stone in a rainy period, FKCP.

EMENDED DIAGNOSIS. Total length 19.7–27.6 mm in males. Base color uniformly yellow to yellowish brown with black only around the eyes. Fifth metasomal segment marbled grayish black. Pectine teeth number 19–24 in male. Femur and patella of pedipalps bear inconspicuous dorsal carinae. Chela of pedipalp smooth and narrow. No other carinae on pedipalp chela, carapace and tergites. Sternites smooth, without carinae and granules. Metasomal segments smooth, without carinae, and with rounded edges. Dorsal surface of metasomal segments I–IV bear an inconspicuous longitudinal groove. Metasomal segments IV–V densely and very finely granulated. Telson elongated, smooth, with aculear ring well developed in male. Aculeus slightly curved.



Figures 13–14: *L. somalilandus* **sp**. **n**., right chelicera of female paratype, dorsal (13) and ventral (14). Composite white light/ UV fluorescence images. Scale bar: 200 μm.

Lanzatus somalilandus Kovařík et Lowe, **sp**. **n**.
(Figs. 1–4, 7–10, 13–28, 30–31, 35–40, 123–124, 155, Table 1)
http://zoobank.org/urn:lsid:zoobank.org:act:22B29B26-A917-4D0E-BF1F-6D5A1EEB7992

Lanzatus somalicus: Kovařík et al., 2013a: 18.

TYPE LOCALITY AND TYPE REPOSITORY. Somaliland, between Sheikh and Laas Caanood, 09°36'40.1"N 45°29'35.7"E, 1089 m a.s.l., FKCP.

TYPE MATERIAL. **Somaliland**, between Sheikh and Laas Caanood, 09°36'40.1"N 45°29'35.7"E, 1089 m a.s.l. (Locality No. **11SL**, Fig. 40 and fig. 71 in Kovařík et al., 2013a: 17), 10.VII.2011, 2♂ (holotype, Figs. 3–4, 9–10, 28, 30–31 and paratype) 1♀ (paratype, Figs. 1–2, 7–8, 13–27, 35–37, 39, 123–124), leg. F. Kovařík, FKCP.

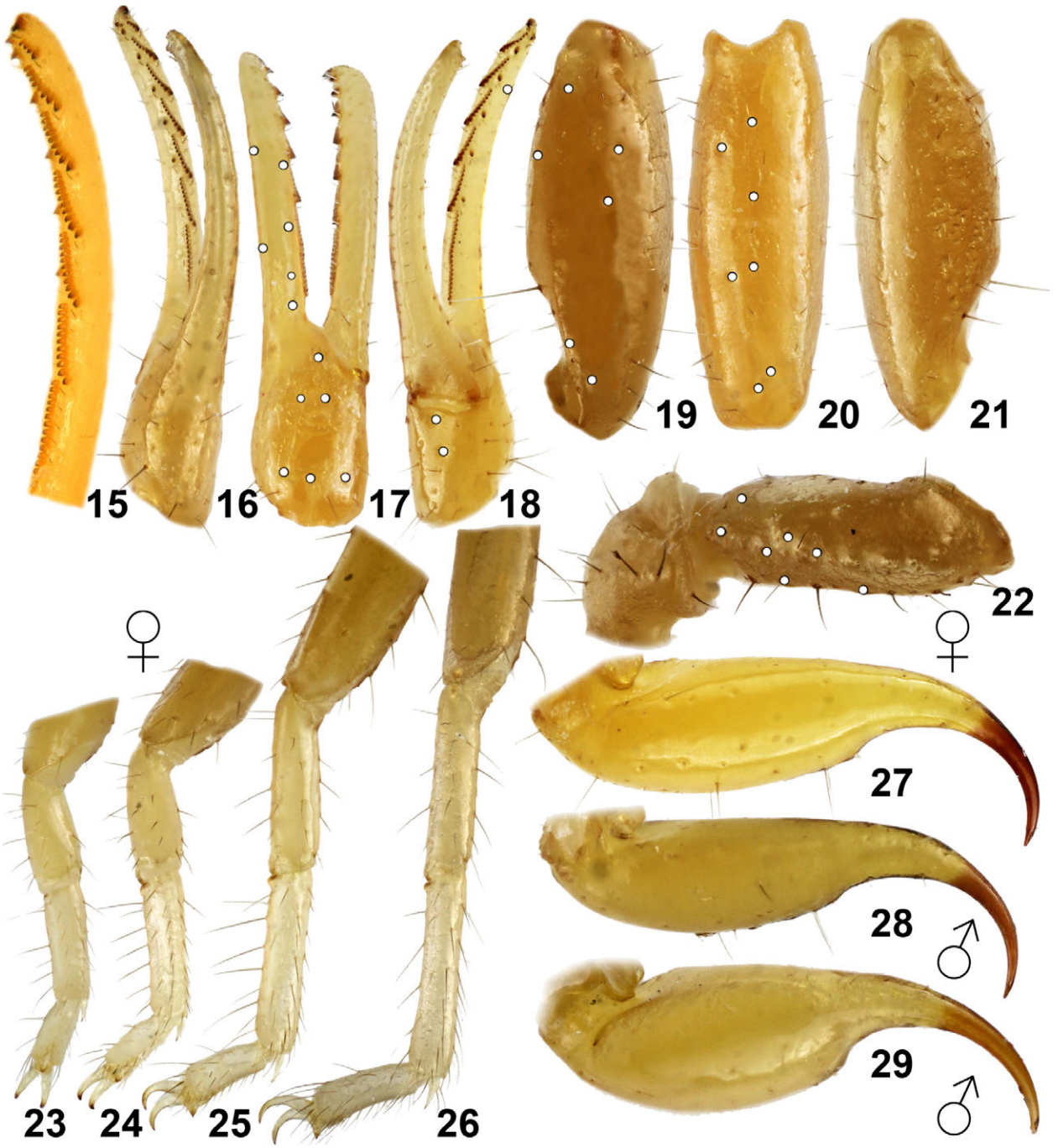
ETYMOLOGY. Named after the country of occurrence.

DIAGNOSIS. Total length 17.9 (male)–26 mm (female). Base color uniformly yellowish orange with black only around the eyes. Fifth metasomal segment slightly marbled in grayish black. Pectine teeth number 18 in both sexes. Pedipalps bear inconspicuous smooth carinae. Pedipalp chela smooth and narrow. Sternites smooth, without carinae and granules. Tergites I–VI finely granulated with one carina present or indicated. Metasomal segments smooth, without carinae, with rounded edges. Dorsal surfaces of metasomal segments I–IV bear an inconspicuous longitudinal groove. Metasomal segments III–V smooth (female) or densely and very finely granulated (males). Telson elongated, smooth, with aculear ring slightly indicated in male. Aculeus strongly curved.

DESCRIPTION. The adults are 17.9 (male)–26 mm (female) long. The habitus is shown in Figs. 1–4. For position and distribution of trichobothria of pedipalps see Figs. 17–20 and 22. Sexual dimorphism: adult male integument matte, female glossy (Figs. 38–39), telson narrower in male (Fig. 28) than in female (Fig. 27), with aculear ring indicated.

Coloration (Figs. 38–39). The base color is uniformly yellowish orange with black only around the eyes, tergites darker. Tarsomeres of legs and telson white. Fifth metasomal segment slightly marbled in grayish black.

Carapace and mesosoma (Figs. 7–10). Entire carapace is finely granulated, with a glossy area only between the posterior and median eyes in the female. Carinae absent. Anterior margin of carapace almost straight. Tergites



Figures 15–29: *Lanzatus*. **Figures 15–28**. *L. somalilandus* **sp**. **n**. **Figures 15–27**. Female paratype. **Figures 15–22**. Pedipalp segments, movable finger dentition (15), chela dorsal (16), external (17) and ventral (18), patella dorsal (19), external (20) and ventral (21), trochanter and femur dorsal (22). Trichobothrial pattern indicated in Figures 17–20 and 22. **Figures 23–26**. Left legs I–IV, retrolateral aspect. **Figures 27–29**. Telson lateral. **Figures 27–28**. *L. somalilandus* **sp**. **n**., female paratype (27) and male holotype (28). **Figure 29**. *L. somalicus*, male paratype.

finely granulated, with one median carina more indicated in female. Pectinal tooth count 18 in both sexes. Pectine marginal tips extend to half of the fourth sternite in the female, to end of the fourth sternite in the male. Pectines with 3 marginal lamellae and 8–9 middle lamellae. All lamellae and fulcra bear numerous pale setae. All sternites smooth.

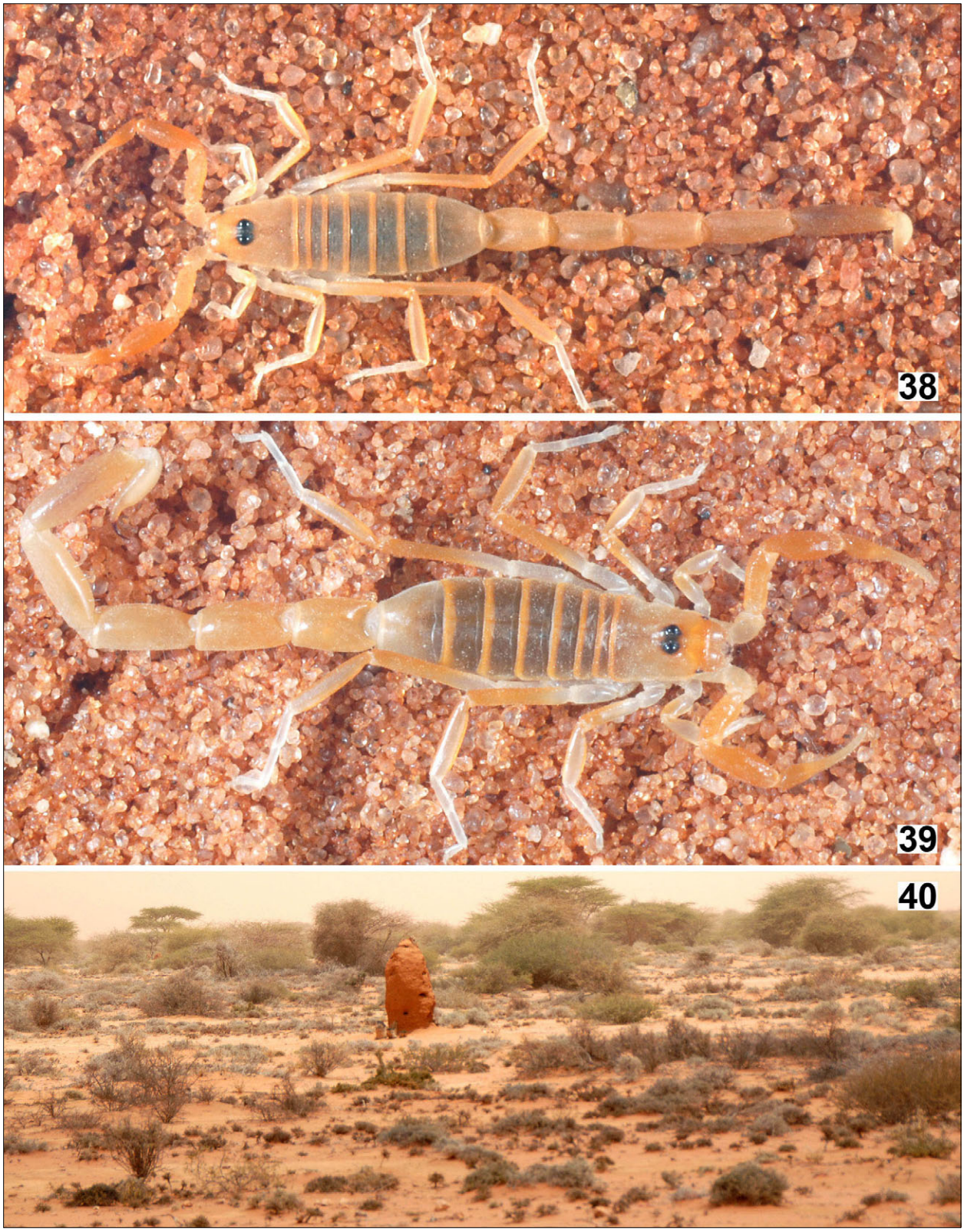
Metasoma and telson (Figs. 27–28, 30–31, 35–37). Metasomal segments smooth and hirsute, without carinae, with rounded edges. Dorsal surface of the first to

Figures 30–37: *Lanzatus*, metasoma and telson. **Figures 30–31**. *L. somalilandus* **sp**. **n**., male holotype, ventral (30), and lateral (31) views. **Figures 32–34**. *L. somalicus*, male paratype, lateral (32), ventral (33), and dorsal (34) views. **Figures 35–37**. *L. somalilandus* **sp**. **n**., female paratype, lateral (35), ventral (36), and dorsal (37) views.

fourth metasomal segments bearing an inconspicuous longitudinal groove. Third to fifth metasomal segments smooth (female) or densely and very finely granulated (males). Telson elongated, smooth, with aculear ring slightly indicated in male. Telson length/ width ratio 3.94 in male, 3.61 in female. Aculeus strongly curved.

Chelicerae (Figs. 13–14, 123–124). Manus 1.4 times longer than wide, dorsal surface smooth with strong anterior marginal and dorsointernal carinae, bearing 3 long pale setae, 2 on anterior marginal carina and 1 submarginal, and 1 long dark macroseta on mid-dorso-internal carina. Dorsal surface of movable finger smooth, with 2 pale microsetae. Dorsal surface of fixed finger with sparse setae with fluorescent bases. Ventral surfaces of manus, fixed and movable fingers bearing numerous medium to long setae with fluorescent bases (Fig. 14), setae on ventral manus well spaced, not very dense, widely distributed. Fingers robust, with typical buthid dentition (Vachon, 1963). Dorsal margin of movable finger armed with 5 teeth: dorsal distal tine, subdistal, median and apparently 2 small basal teeth fused in bicusp. Ventral margin of movable finger with 3 teeth: ventral distal tine, median and basal teeth. Fixed finger margin with 4 teeth: distal tine, subdistal, median and basal teeth fused into bicusp. Ventral surface of fixed finger armed with a single tooth (Fig. 124).

Pedipalps (Figs. 15–22). Pedipalps smooth, sparsely hirsute, with inconspicuous smooth carinae. Pedipalp chela narrow, chela length/ width ratio 5.23 in male, 5.28 in female. Dentate margin of pedipalp chela with distinct granules divided into 7 diagonal rows (including apical row) on movable finger, 6 diagonal rows on fixed finger (of which five have an accessory external granule). Terminal and subterminal granules present.



Figures 38–40: *L. somalilandus* **sp**. **n**., male (38) and female (39) in vivo habitus and the type locality (40).

Legs (Figs. 23–26). Legs I–IV with tibial spurs absent, retrolateral and prolateral pedal spurs present. All legs smooth, without distinct carinae. Tarsomeres bear two rows of macrosetae on the ventral surface, and additional macrosetae on other surfaces. Tarsomeres of legs I–III with 5 to 9 setae.
Measurements. See Table 1.

AFFINITIES. *Lanzatus somalilandus* **sp**. **n**. and *L. somalicus* are differentiated mainly by separate areas of distribution (Fig. 155). They can be separated by morphology of the telson, which is narrower with aculear ring only indicated in *L. somalilandus* **sp**. **n**. (Fig. 28), vs. broader with ring well developed in a male of *L. somalicus* (Fig. 29). The telson length/ width ratio is 3.94 in male and 3.61 in female of *L. somalilandus* **sp**. **n**., vs. 3.45 in male paratype of *L. somalicus*. The aculeus is strongly curved in *L. somalilandus* **sp**. **n**. (Figs. 27–28) vs. slightly curved in *L. somalicus* (Fig. 29). *L. somalicus* has 19–24 pectine teeth in males (19–20 in material examined here, 24 in type of *Sabinebuthus elegans*), vs. 18 teeth in all three types including two males of *L. somalilandus* **sp**. **n**.

COMMENTS ON LOCALITIES AND LIFE STRATEGY. On 10 July 2011 the first author, Tomáš Mazuch and Pavel Novák stopped at the locality **11SL** (c.f. Fig. 40 and fig. 71 in Kovařík et al., 2013a: 17; a sizeable area of windblown sands with sparse shrubs) about one hour after sunset and persuaded the soldiers/ protectors to allow collecting near a road by UV detection at night for at least 15 minutes, a period which yielded all three types of *L. somalilandus* **sp**. **n**., found running on the sand near the shrubs, and a juvenile paratype of *Gint dabakalo* Kovařík et Mazuch, 2015.

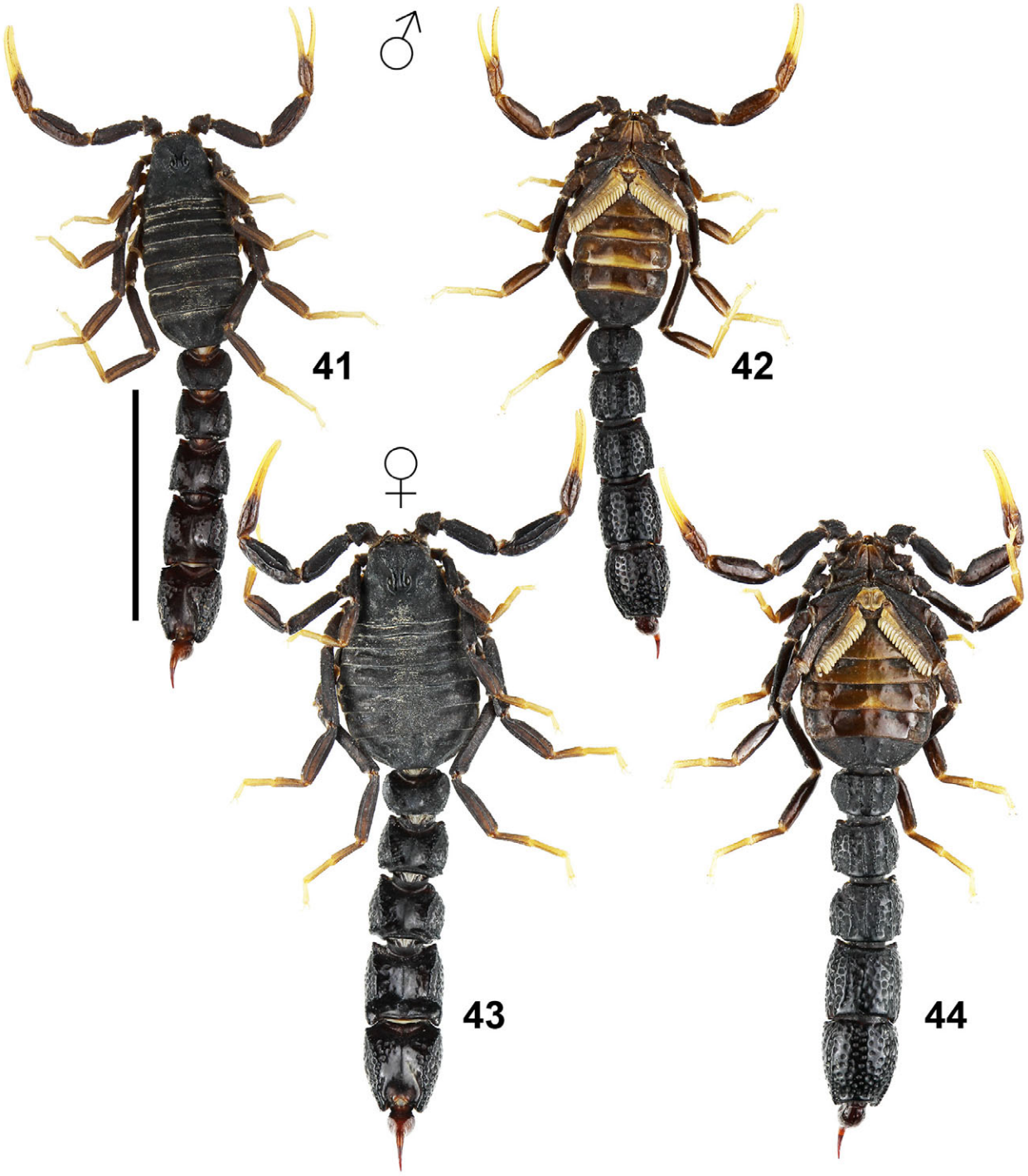
Orthochirus Karsch, 1892
(Figs. 41–77, 155, Table 1)

Orthochirus Karsch, 1892: 306; Fet & Lowe, 2000: 193–199 (complete reference list until 2000); Kovařík, 2004: 4–23, 25–28, figs. 1–8 (complete reference list until 2004); Kovařík & Fet, 2006: 1–10, figs. 1–9; Navidpour et al., 2008: 14–20, figs. 19, 23–31.
= *Orthodactylus* Karsch, 1881: 90, a junior homonym of *Orthodactylus* Hitchcock, 1858 (Reptilia), type species: *Orthodactylus olivaceus* Karsch, 1881 = *Orthochirus scrobiculosus* (Grube, 1873) (syn. by Kraepelin, 1895: 84).
= *Simonoides* Vachon et Farzanpay in Farzanpay, 1987: 162, type species: *Simonoides farzanpayi* Vachon et Farzanpay, 1987 (syn. by Kovařík & Fet, 2006: 1).
= *Afghanorthochirus* Lourenço et Vachon, 1997: 330, type species: *Afghanoorthochirus erardi* Lourenço et Vachon, 1997 (syn. by Kovařík, 2004: 5).
= *Paraorthochirus* Lourenço et Vachon, 1995: 299 (nomen nudum see Fet & Lowe, 2000: 211); Lourenço & Vachon, 1997: 329, type species: *Paraorthochirus stockwelli* Lourenço et Vachon, 1995 (syn. by Navidpour et al., 2008: 17).
Pseudorthochirus [sic]: Lourenço & Vachon, 1995: 304.

TYPE SPECIES. *Orthodactylus olivaceus* Karsch, 1881 = *Orthochirus scrobiculosus* (Grube, 1873).

DIAGNOSIS. Total length under 60 mm. Pedipalps orthobothriotaxic type A (Vachon, 1974); dorsal trichobothria of femur arranged in β-configuration (Vachon, 1975); trichobothrium d_2 of femur present or absent, either internal or external to dorsointernal carina; d_3 of femur internal to dorsomedian carina, when carina present; V_2 on chela manus located behind V_1; *it* on distal fixed finger. Pectines with fulcra, hirsute. Basal middle lamella of pectines in females not dilated. Males with genital papillae. Hemispermatophore flagelliform with lobes of capsule in 3+1 configuration, basal lobe small, median lobe not fused to base of flagellum. Sternum subpentagonal. Tibial spurs present on third and fourth legs. Cheliceral fixed finger with two ventral denticles, margins of fingers with standard pattern of buthid dentition (Vachon, 1963). Carapace without distinct carinae, in lateral view distinctly inclined downward from median eyes to anterior margin. Pedipalp chela movable finger with distinct granules divided into 7–11 rows, with 2–5 subdistal granules. Tergites I–VI smooth to granulated with one indicated carina or acarinate. Stigmata are narrow slits. Metasomal - I–II with carinae. Metasomal segments IV–V ventrally punctate. Telson elongate, smooth, without subaculear tubercle, aculeus as long as, or longer than vesicle.

COMMENTS. Kraepelin (1903: 563) cited one specimen of *Butheolus aristidis* (= *Orthochirus aristidis* (Simon, 1883)) collected in "Somalia, Lasman, Febr. 1900"; Werner (1916: 81) cited a juvenile from Djibouti. These two specimens have not been recently revised and there is a possibility that the specimen from Somalia could be a species of the genus *Orthochiroides* Kovařík, 1998 which in Somalia is represented by the type species *Orthochiroides vachoni* Kovařík, 1998 (Somalia, Sar Uanle, about 20 km south from Chisimaio, 00°29'48"S 42°25'30"E). In contrast, the occurence of the genus *Orthochirus* in Djibouti is expected, but this population is most probably not *O. aristidis*. Lourenço & Leguin (2011: 1–4, 13, 14, 15, figs. 1–4, 22, 27, 33) published a redescription of *O. aristidis* based on the lectotype and paralectotypes from Nubia (Egypt/Sudan), near the Nile, and a topotype female collected in Sudan (Nubia), Wadi Halfa, X/1975. They also published a photo of live female from Djibouti (Lourenço & Leguin, 2011: 4, fig. 5) without information about whether the specimen was

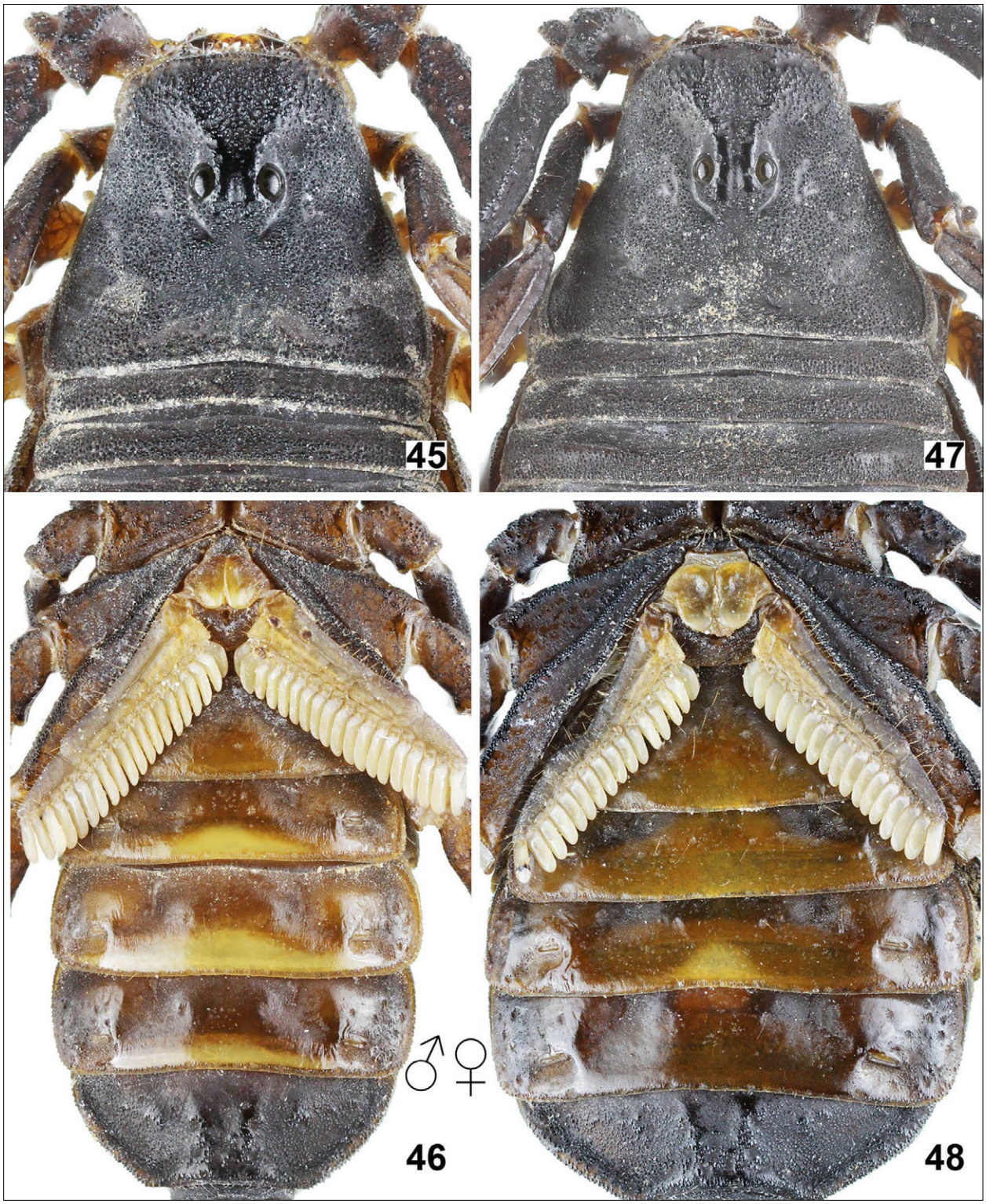


Figures 41–44: *Orthochirus afar* **sp**. **n**. **Figures 41–42**. Male holotype in dorsal (41) and ventral (42) views. **Figures 43–44**. Female paratype in dorsal (43) and ventral (44) views. Scale bar: 10 mm.

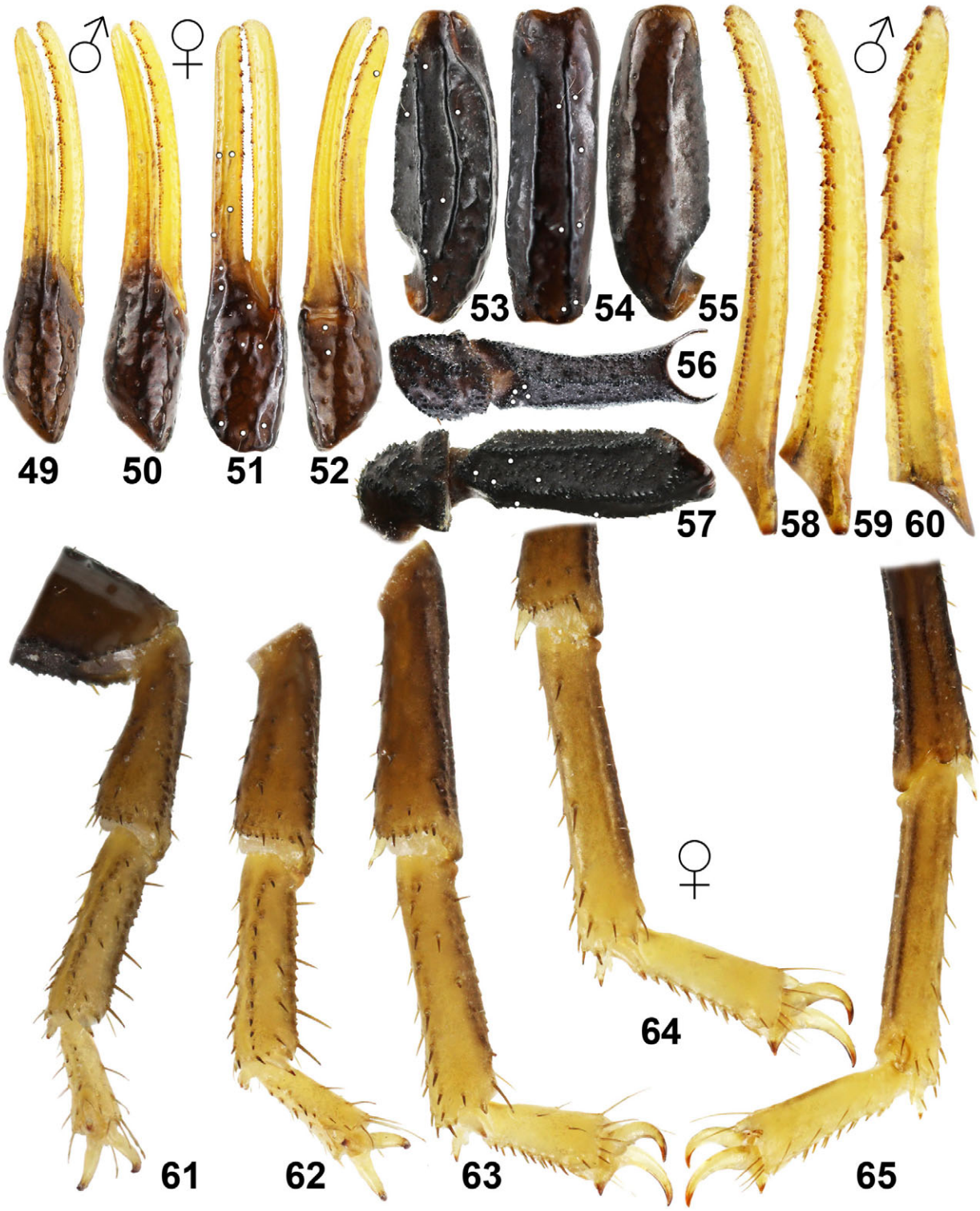
only photographed, or was collected, studied and compared to the types. Lourenço & Leguin (2011: 3) also presumed that *O. aristidis* could occur in Ethiopia although no *Orthochirus* from Ethiopia was cited before this paper (Kovařík, 2003: 135). The types of *O. afar* **sp**. **n**. represent the first verified record of the genus *Orthochirus* from Ethiopia.

Orthochirus afar Kovařík et Lowe, **sp**. **n**.
(Figs. 41–77, 155, Table 1)
http://zoobank.org/urn:lsid:zoobank.org:act:991F421D-D1D9-4ED6-A191-50AE4865FD29

TYPE LOCALITY AND TYPE REPOSITORY. Ethiopia, Afar Region, Gewane, 10°09'38"N 40°39'45"E, 631 m a.s.l., FKCP.



Figures 45–48: *Orthochirus afar* **sp**. **n**. **Figures 45–46**. Male holotype, carapace and tergites I–II (45), and coxosternal area and sternites (46). **Figures 47–48**. Female paratype, carapace and tergites I–III (47), and coxosternal area and sternites (48).



Figures 49–65: *Orthochirus afar* **sp**. **n**. **Figures 49**, **59**, **60**. Male holotype, pedipalp chela dorsal (49), movable (59) and fixed (60) finger dentition. **Figures 50–58**, **61–65**. Female paratype, pedipalp chela dorsal (50), external (51) and ventral (52), patella dorsal (53), external (54) and ventral (55), trochanter and femur internal (56) and dorsal (57), movable finger dentition (58), and right legs I–IV, retrolateral aspect (61–64), and right leg IV, externolateral aspect (65). Trichobothrial pattern indicated in Figures 51–54 and 56–57.

TYPE MATERIAL. **Ethiopia**, Afar Region, Gewane, 10° 09'38"N 40°39'45"E, 631 m a.s.l. (Locality No. **12EO**, Figs. 76–77), 23–24.XI.2012, 1♂ (holotype, Figs. 41–42, 45–46, 49, 59–60, 66–68, 74) 1♂1♀ (paratypes, Figs. 43–44, 47–48, 50–58, 61–65, 69–71, 75) 1♂juv. (paratype), leg. F. Kovařík, FKCP; 11°43'22"N 40°56' 52"E, 457 m a.s.l. (Locality No. **12EM**, Fig. 73), 20. XI.2012, 1♀juv. (paratype, Fig. 72), leg. F. Kovařík, FKCP.

ETYMOLOGY. Named after the Afar (Afar: *Qafár*) people, also known as the Danakil and Adal, an ethnic group inhabiting the Horn of Africa. They reside primarily in the Afar Region of Ethiopia and northern Djibouti, although some also live in the southern end of Eritrea. The Afars speak the Afar language, which is part of the Cushitic branch of the Afro-Asiatic family. Both recorded localities of this species are within their territory.

DIAGNOSIS: Adults from 23 mm (male) to 29 mm (female) long. Base color uniformly black, sternites III–VI brown with yellow zones indicated, pedipalp movable fingers yellow, tarsomeres of legs yellow to white, telson reddish brown. Pectine teeth number 18–20 in males, 16–17 in females. Metasomal segments IV–V ventrally punctate, without median carinae; areas between punctae smooth. Entire metasoma glabrous. Dorsal surface of metasomal segments III–V smooth medially. Pedipalp chela movable finger bear 10 or 11 rows of granules, with internal and external accessory granules. Fixed fingers bear 9 rows of granules, with internal and external accessory granules. Tarsomeres of legs without bristlecombs.

DESCRIPTION. Adults 23 mm (male)–29 mm (female) long. Habitus as shown in Figs. 41–44. For position and distribution of trichobothria of pedipalps see Figs. 51–54 and 56–57. On femur, trichobothrium d_2 missing, distance between d_1 and d_3 shorter that distance between d_3 and d_4, e_1 situated between d_3 and d_4. Only minor sexual dimorphism in pectines (Figs. 46 vs. 48), no difference between sexes in relative lengths or widths of pedipalps and metasomal segments.

Coloration (Figs. 41–48). Base color uniformly black, sternites III–VI brown with yellow zones indicated, seventh sternite black. Chelicerae brown to black, reticulate. Pedipalp movable finger yellow, lighter than manus. Tarsomeres of legs yellow to white. Telson reddish brown.

Carapace and mesosoma (Figs. 45–48). Entire carapace covered by large granules. Carinae absent. Anterior margin of the carapace almost straight, weakly convex medially. Tergites granulated, coarsely so in males. Tergite VII pentacarinate. Pectinal tooth count 18–20 (2x18, 3x19, 1x20) in males, 16–17 (3x16, 1x17) in females. Pectine marginal tips extend to end of fourth sternite in both sexes. The pectines with three marginal lamellae, 6–7 middle lamellae. Lamellae and fulcra bear numerous pale setae. Sternites III–VI smooth without carinae. Sternite VII densely granulated, with one pair of carinae.

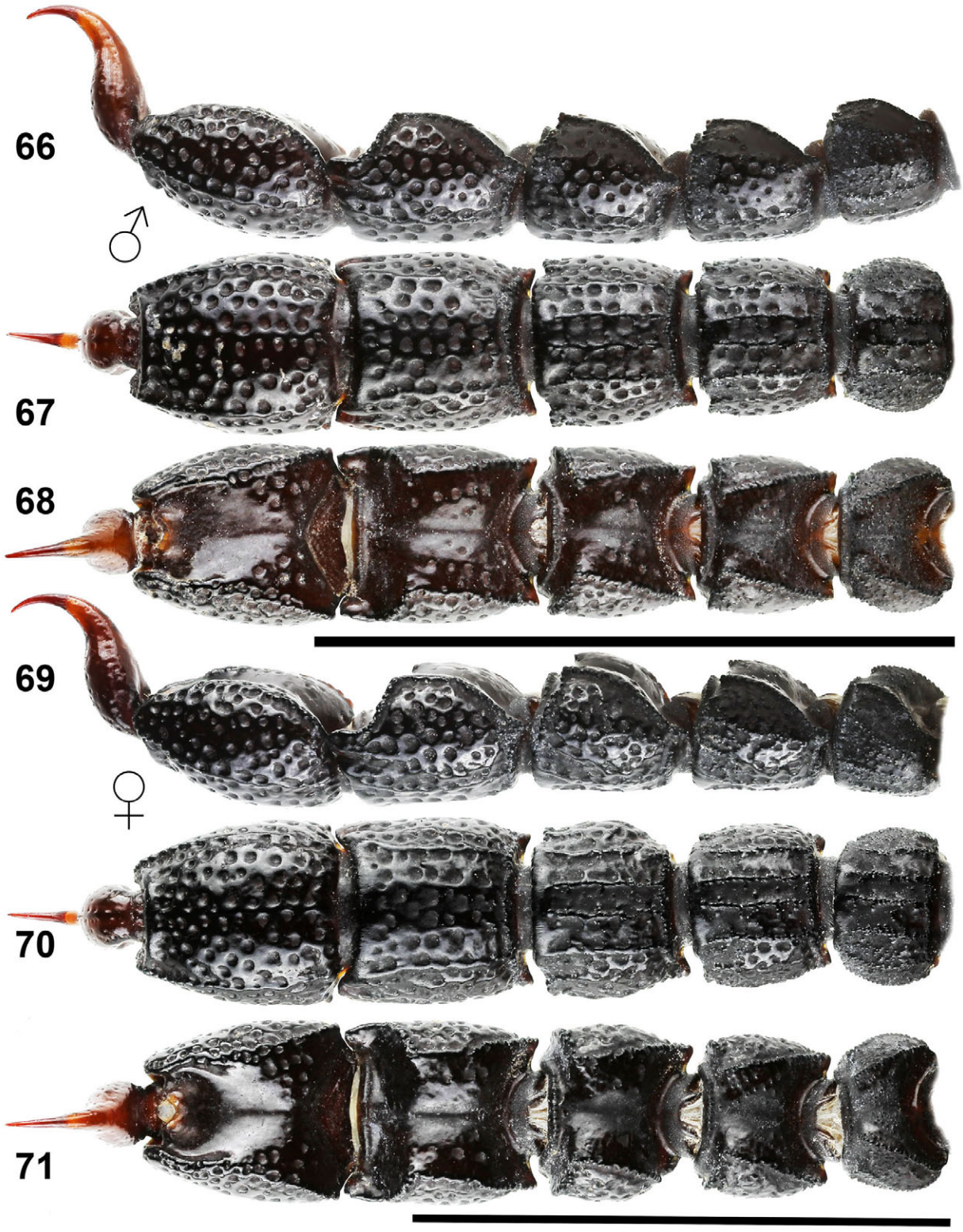
Metasoma and telson (Figs. 66–71). First and second metasomal segments bear a total of 10 granulated carinae. Segments III–V lacking lateral carinae, segments IV and V with only dorsal and ventrolateral carinae, all smooth, sometimes incomplete. First metasomal segment granulated, second segment partly granulated, other segments smooth. All segments punctate. Punctae weak on first segment, stronger on segments II–V. Areas between punctae smooth. Dorsal surface of all metasomal segments smooth medially except for first segment. Entire metasoma and telson glabrous. Short, thin setae may emerge from some punctae. Telson punctate, lacking granules.

Pedipalps (Figs. 49–60). Pedipalp femur granulate, bearing 5 granulate carinae. Patella with 7 smooth, well developed carinae. Chela with smooth carinae which may be discernible throughout length of fixed finger. Movable finger with 10 or 11 rows of granules, flanked by 9 or 10 internal and 8 or 9 external accessory granules, 4 subterminal granules, one terminal granule. Fixed finger with 9 rows of granules, flanked by 8 internal and 8 external accessory granules.

Legs (Figs. 61–65). Legs III and IV with tibial spurs. Retrolateral and prolateral pedal spurs present on all legs. Femur, patella, tibia and partly tarsomere I carinate and smooth. Patella with only a few solitary setae and spines. The tibia with only several spines on the external aspect. Tarsomeres of legs without bristlecombs.

Measurements. See Table 1.

AFFINITIES. The described features distinguish *O. afar* **sp**. **n**. from all other species of the genus. *O. afar* **sp**. **n**. is similar to *O. aristidis* from Egypt and Sudan. These two can be separated unequivocally by: **1**) fixed and movable fingers of pedipalp with 9 and 10–11 rows of granules in *O. afar* **sp**. **n**., vs. 8 and 9 rows of granules in *O. aristidis*; **2**) sternites III–VI brown with yellow zones indicated in *O. afar* **sp**. **n**. (Figs. 46 and 48), vs. black without yellow zones in *O. aristidis* (fig. 4 in Lourenço & Leguin, 2011: 3); **3**) sternite VII densely granulated, bearing one pair of carinae in *O. afar* **sp**. **n**. (Figs. 46 and 48), vs. two pairs of moderate carinae with some minute granulations in *O. aristidis* (Lourenço & Leguin, 2011: 2); **4**) on pedipalp femur, distance between trichobothria d_1 and d_3 shorter than distance between d_3 and d_4, trichobothrium e_1 situated between d_3 and d_4 in *O. afar* **sp**. **n**. (Fig. 57), vs. distance between d_1 and d_3 approximately equal to that between d_3 and d_4, trichobothrium e_1 is situated between d_2 and d_3 in *O. aristidis* (fig. 27 in Lourenço & Leguin, 2011: 14); **5**)



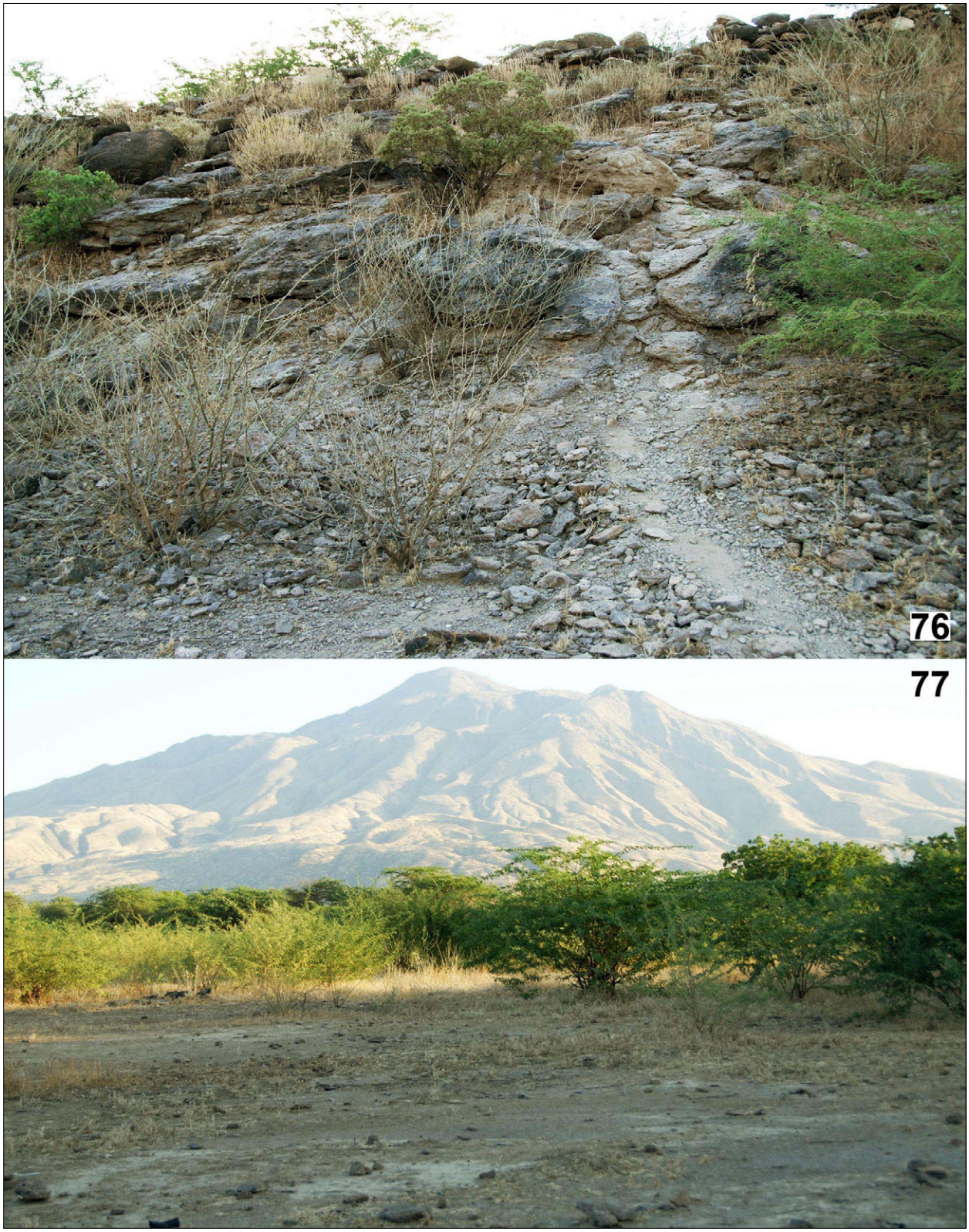
Figures 66–71: *Orthochirus afar* **sp**. **n**., metasoma and telson. **Figures 66–68**. Male holotype, lateral (66), ventral (67), and dorsal (68) views. **Figures 69–71**. Female paratype, lateral (69), ventral (70), and dorsal (71) views. Scale bars: 10 mm.

Figures 72–73: *Orthochirus afar* **sp**. **n**., female juvenile paratype in vivo habitus in Ethiopia at locality 12EM (72) and the locality (73).

pectinal tooth count 18–20 in males, 16–17 in females of *O. afar* **sp**. **n**., vs. 16–18 in males, 13–16 in females of *O. aristidis*.

COMMENTS ON LOCALITIES AND LIFE STRATEGY. The first author visited the type locality **12EO** (Figs. 76–77) on 23–24 November 2012 and collected four type spec-

Figures 74–75: *Orthochirus afar* **sp**. **n**., male holotype (74) and female paratype (75) in vivo habitus in Ethiopia at type locality.



Figures 76–77: *Orthochirus afar* **sp**. **n**., the type locality.

DIMENSIONS (MM)		*Lanzatus somalilandus* **sp. n.** ♂ **holotype**	*Lanzatus somalilandus* **sp. n.** ♀ **paratype**	*Orthochirus afar* **sp. n.** ♂ **holotype**	*Orthochirus afar* **sp. n.** ♀ **paratype**
Carapace	L / W	1.900 / 1.850	2.550 / 2.250	3.025 / 3.750	3.600 / 4.450
Mesosoma	L	4.750	6.850	6.650	6.650
Tergite VII	L / W	1.250 / 1.775	1.925 / 2.600	1.775 / 1.950	1.650 / 5.150
Metasoma & Telson	L	11.250	16.427	16.300	18.700
Segment I	L / W / D	1.550 / 0.990 / 0.875	2.300 / 1.426 / 1.250	1.875 / 2.575 / 1.750	2.000 / 3.050 / 2.300
Segment II	L / W / D	1.725 / 0.925 / 0.850	2.600 / 1.300 / 1.218	2.275 / 2.625 / 1.950	2.525 / 3.150 / 2.450
Segment III	L / W / D	1.900 / 0.887 / 0.825	2.750 / 1.250 / 1.200	2.550 / 2.825 / 2.150	3.025 / 3.400 / 2.675
Segment IV	L / W / D	2.050 / 0.800 / 0.725	3.000 / 1.150 / 1.050	3.250 / 2.950 / 2.200	3.775 / 3.600 / 2.875
Segment V	L / W / D	2.150 / 0.750 / 0.700	3.250 / 1.075 / 1.000	3.325 / 3.000 / 2.075	3.875 / 3.600 / 2.650
Telson	L / W / D	1.875 / 0.475 / 0.450	2.527 / 0.700 / 0.650	3.025 / 1.100 / 0.913	3.500 / 1.300 / 1.063
Pedipalp	L	4.925	6.405	9.625	11.050
Femur	L / W	1.275 / 0.420	1.650 / 0.600	2.575 / 0.800	2.800 / 0.925
Patella	L / W	1.600 / 0.550	2.200 / 0.786	3.000 / 0.986	3.475 / 1.175
Chela	L	2.050	2.775	4.050	4.775
Manus	L / W / D	0.725 / 0.392 / 0.425	0.725 / 0.525 / 0.650	1.175 / 0.750 / 0.788	1.500 / 0.875 / 0.975
Movable Finger	L	1.325	2.050	2.875	3.275
Total	**L**	**17.90**	**25.83**	**25.98**	**28.95**

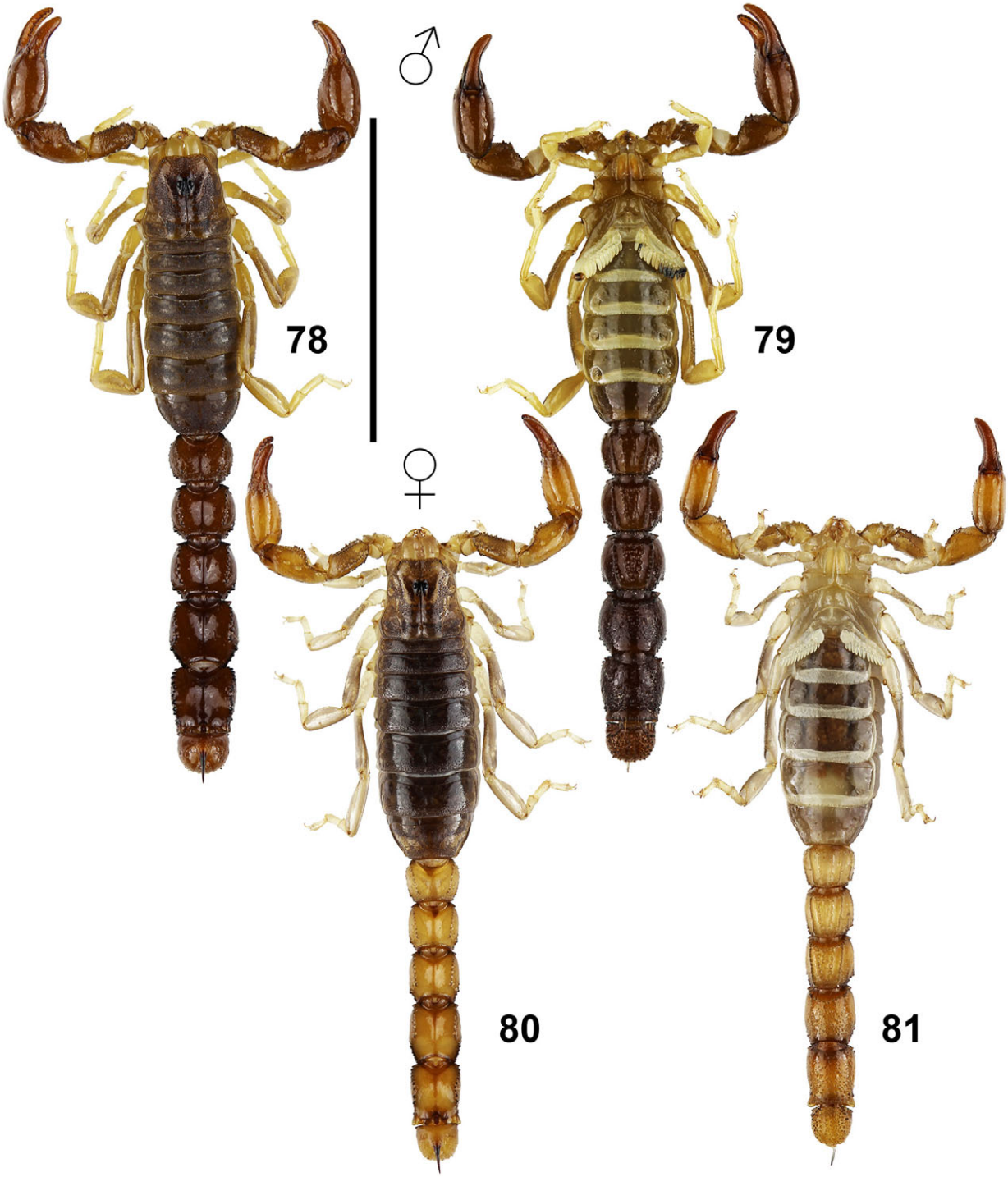
Table 1: Comparative measurements of adults of *Lanzatus somalilandus* **sp**. **n**. and *Orthochirus afar* **sp**. **n**. Abbreviations: length (L), width (W, in carapace it corresponds to posterior width), depth (D).

imens in a narrow area on the margin of a hillside (Fig. 76) by UV detection at night. In addition to *O. afar* **sp**. **n**. which was very rare there, the first author also recorded at this locality *Buthus awashensis* Kovařík, 2011, *Compsobuthus abyssinicus* (Birula, 1903), *Neobuthus awashensis* Kovařík et Lowe, 2012, and *Parabuthus abyssinicus* Pocock, 1901. The first author visited the second locality **12EM** (Fig. 73) on 20 November 2012 shortly after sunset and also recorded at this locality (UV detection) *Buthus awashensis* and *Neobuthus awashensis*.

Somalicharmus Kovařík, 1998
(Figs. 78–122, 125–155, Table 2)

Somalicharmus Kovařík, 1998: 116, 119–122, figs. 9–15; Fet & Lowe, 2000: 224; Soleglad & Fet, 2003b: 88, Tab. 9; Fet & Soleglad, 2005: 11; Fet et al., 2005: 3, 14, 22, Tab. 1, Fig. 23; Prendini & Wheeler, 2005: 481; Dupré, 2007: 10, 13, 16; Kovařík et al., 2007: 201, 205–208, fig. 15; Kovařík, 2009: 21, 31; Mirza et al., 2016: 1.

EMENDED DIAGNOSIS. Total length 18.5–25 mm. Pedipalps orthobothriotaxic type A (Vachon, 1974); dorsal trichobothria of femur arranged in α-configuration (Vachon, 1975) (Fig. 100); trichobothrium d_2 of femur fenced by granules associated with dorsointernal carina, position may appear either dorsal or internal to carina; patella with dorsomedian carina absent, but trichobothrium d_3 located external to d_4; chela manus with V_2 displaced externally relative to V_1; *db* on distal manus, *dt* on base of fixed finger (Fig. 93); *it* on base of fixed finger (Figs. 95, 111). Pectines with fulcra, hirsute (Fig. 112). Pectine teeth number 11–14. Basal middle lamella of pectines extremely dilated and rounded in females (Figs. 116 vs. 115). Males with genital papillae. Hemispermatophore flagelliform with lobes of capsule in 2+1 configuration, basal lobe enlarged, elongate, median lobe not fused to flagellum. Sternum subpentagonal (Figs. 115, 116, 122). Long tibial spurs present on third and fourth legs (Figs. 119–120). Chelicera with reduced dentition, movable finger ventral margin smooth, fixed finger margin with 2 non-distal denticles, lacking bicusp, ventral surface of fixed finger without denticles (Figs. 125–128). Carapace granulated without carinae (Figs. 113–114, 121), in lateral view with entire dorsal surface horizontal or nearly so. Lateral eyes number 2 pairs (type 2A layout, Loria & Prendini, 2014). Movable finger of pedipalp with 8–9 rows and fixed finger with 7–8 rows of granules forming imbricated diagonal rows, with external and internal accessory granules (Figs. 101, 110–111). Tergites densely granulate in males (Fig. 113, 121), more so than in females (Fig. 114); carinae absent or barely indicated by series of more closely spaced granules. Stigmata small, subovoid or hemielliptic slits. Metasoma stout, segments I with 10 carinae, II–III with 8 carinae; segments I–III with ventrosubmedian and ventrolateral carinae strong, the latter posteriorly converging and connecting to form a U-shaped margin carina (Figs. 84, 88); ventral surfaces of segments IV–V coarsely granulated without carinae (Figs. 84, 88, 92). Telson strongly swollen, nearly spherical, with a minute subaculear tubercle, its ventral surface densely hirsute



Figures 78–81: *Somalicharmus whitmanae*. **Figures 78–79**. Male from locality 16EA in dorsal (78) and ventral (79) views. **Figures 80–81**. Female from locality 16EF in dorsal (80) and ventral (81) views. Scale bar: 10 mm.

with long setae, covered with prominent, pointed, dark-brown to black granules, aculeus shorter than vesicle. (Figs. 82, 86, 90–92).

TYPE SPECIES. *Somalicharmus whitmanae* Kovařík, 1998, by monotypy.

Somalicharmus whitmanae Kovařík, 1998
(Figs. 78–122, 125–155, Table 2)

Somalicharmus whitmanae Kovařík, 1998: 116, 119–122, figs. 9–15; Fet & Lowe, 2000: 224; Kovařík, 2003: 135, 145; Fet et al., 2005: 14; Kovařík & Whitman, 2005: 112.

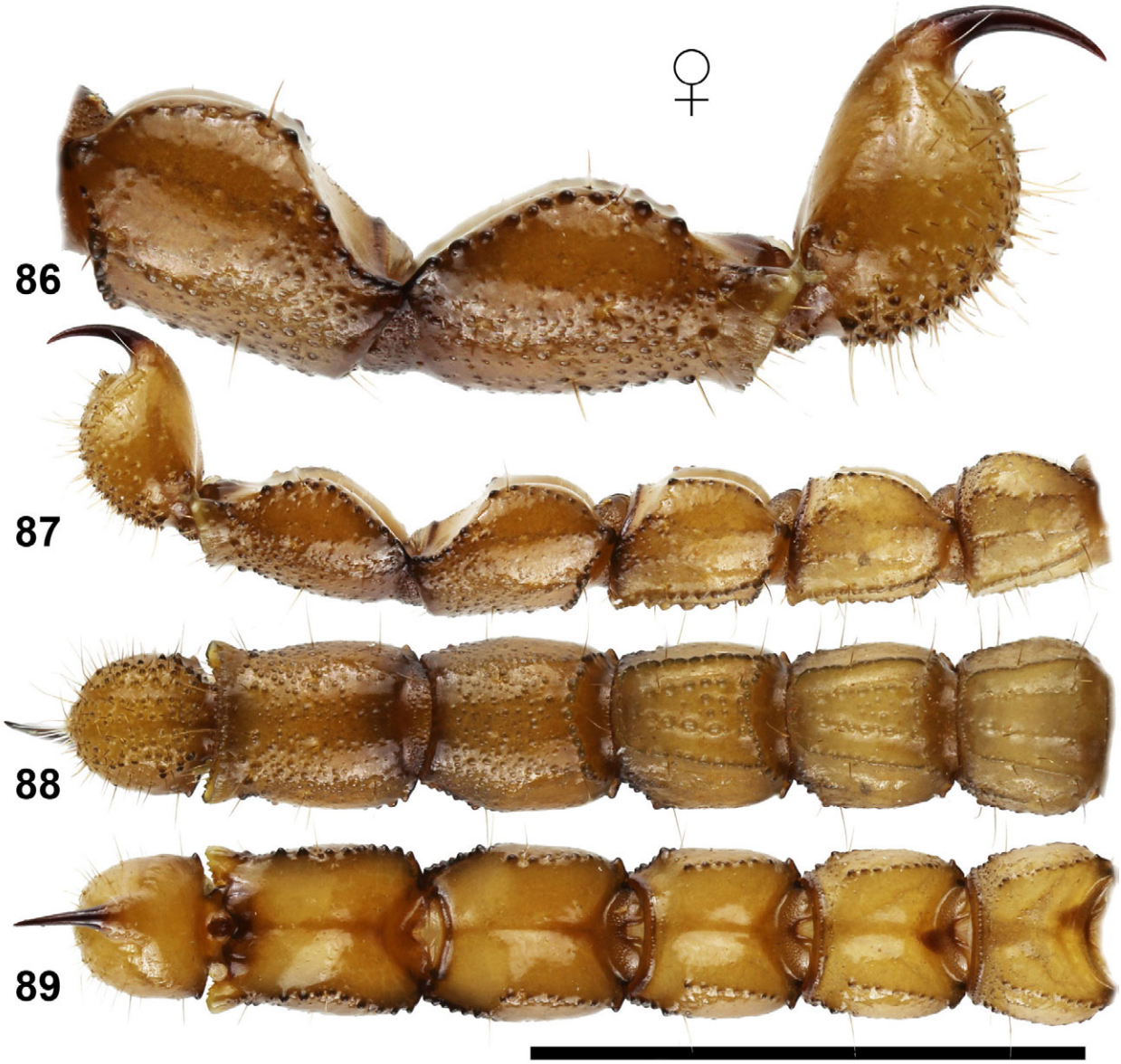
Figures 82–85: *Somalicharmus whitmanae*, male from locality 16EA. **Figure 82**. Metasomal segments IV–V and telson lateral. **Figures 83–85**. Metasoma and telson lateral (83), ventral (84), and dorsal (85) views. Scale bar: 5 mm (83–85).

TYPE LOCALITY AND TYPE REPOSITORY. Ethiopia (see comments below), El Meti; MZUF No. 534.

TYPE MATERIAL EXAMINED. Ethiopia, El Meti, 04°58'N 37°08'E, 1♂ (holotype), 1939, leg. E. Zavattari, MZUF No. 534.

ADDITIONAL MATERIAL EXAMINED. **Ethiopia**, Southern Nationalities and Peoples Region Federal State (SNNPR), Turmi, 04°58'32"N 36°30'53"E, 908 m a.s.l. (Locality No. **16EA**, Fig. 153), 17♂2juvs., 9.-11.IV. 2016, leg. F. Kovařík, FKCP; SNNPR, 20 km SE Konzo, 05°14'33"N 37°32'06"E, 839 m a.s.l. (Locality No. **16EF**, Fig. 154), 14.-15.IV.2016, 29♂2♀ (ecdysis 3.VI.2016) 2juvs., leg. F. Kovařík, FKCP.

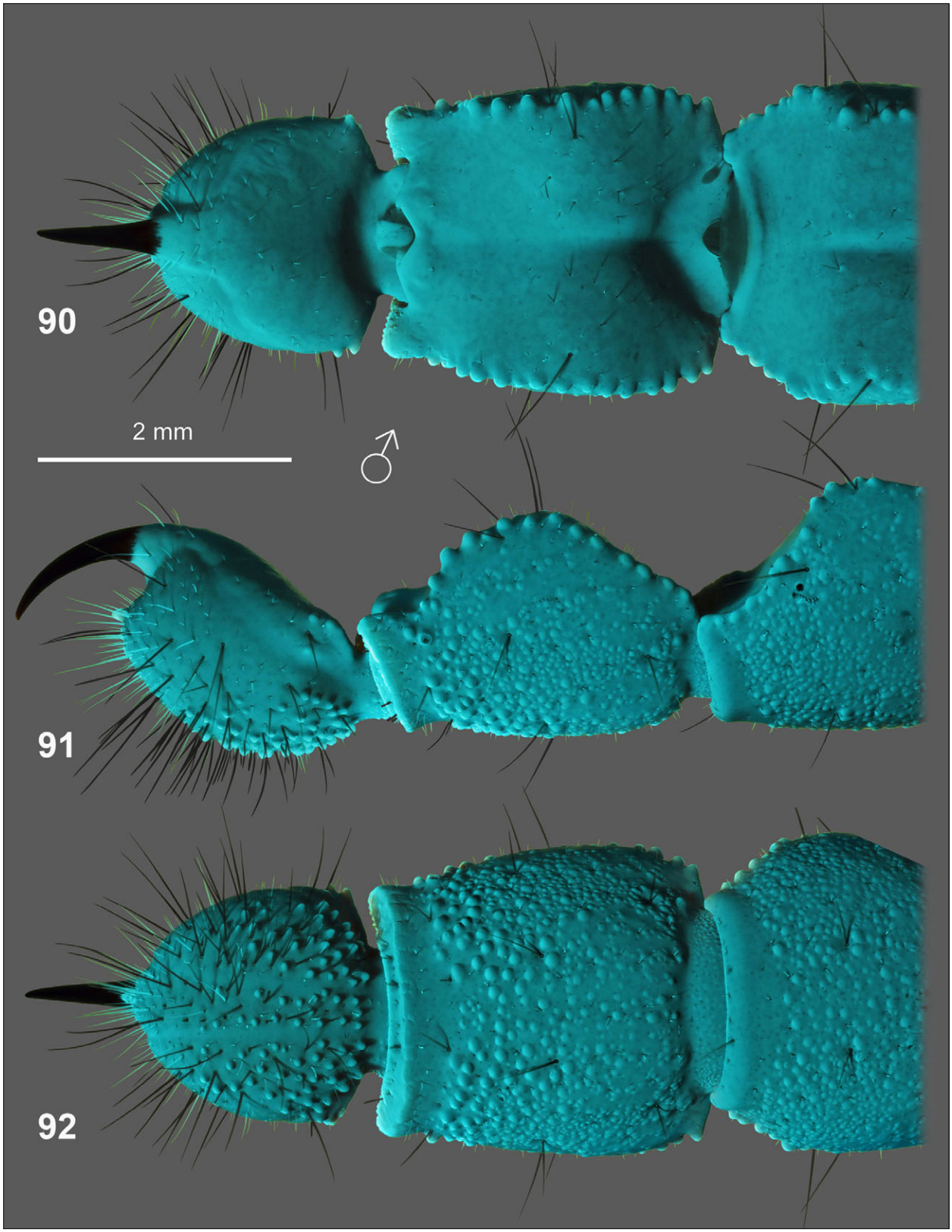
ADDITIONAL DESCRIPTION (BOTH SEXES). Total length of males 18.5–25 mm, females 19–23.5 mm. Pedipalps stout, movable chela finger shorter than manus in both sexes (Figs 94 and 104). Manus of pedipalp chela and metasoma of male broader than in female (Figs. 93–95, 102–105 and 78–81). Sternites smooth (Fig. 122). Pectine teeth number 11–14 (5 x 11, 43 x 12, 36 x 13, 1 x 14) in males and 11–12 (1 x 11, 3 x 12) in females. Metasoma I with lateral carinae present only in females (Fig. 87), and weakly developed or indicated in males



Figures 86–89: *Somalicharmus whitmanae*, female from locality 16EF. **Figure 86**. Metasomal segments IV–V and telson lateral. **Figures 87–89**. Metasoma and telson lateral (87), ventral (88), and dorsal (89) views. Scale bar: 5 mm (87–89).

(Fig. 83). All metasomal segments with dorsal median trough and two lateral carinae composed of several large, non-contiguous, mutually distant granules whose size increases progressively with each consecutive segment.

CHELICERA. (Figs. 125–128). Manus relatively slender, 1.5 times longer than wide, dorsal surface smooth, anterior area with scattered granules and 11 short and long, pale setae, anterior marginal and dorsointernal carinae absent. Dorsal surface of movable finger smooth, with 3 long and 3 short pale setae; dorsal surface of fixed finger with proximal dense brush of long setae with fluorescent bases. Ventral surfaces of manus, fixed and movable fingers bearing dense brush (scopula) of long setae with fluorescent bases (Fig. 128), arranged in distinct wedge-shaped field with V-shaped proximal border on manus. Fingers elongated, with reduced dentition (Figs. 125–126) departing markedly from typical buthid pattern (Vachon, 1963). Movable finger dorsal margin armed with 5 teeth: dorsal distal tine, subdistal, median, and 2 very small basal teeth not fused in bicusp; ventral margin unarmed except for ventral distal tine, which clearly exceeds dorsal distal tine in length. Fixed finger margin armed with 3 teeth: distal tine, subdistal, and basal, bicusp absent; all teeth sharp, conical, non-



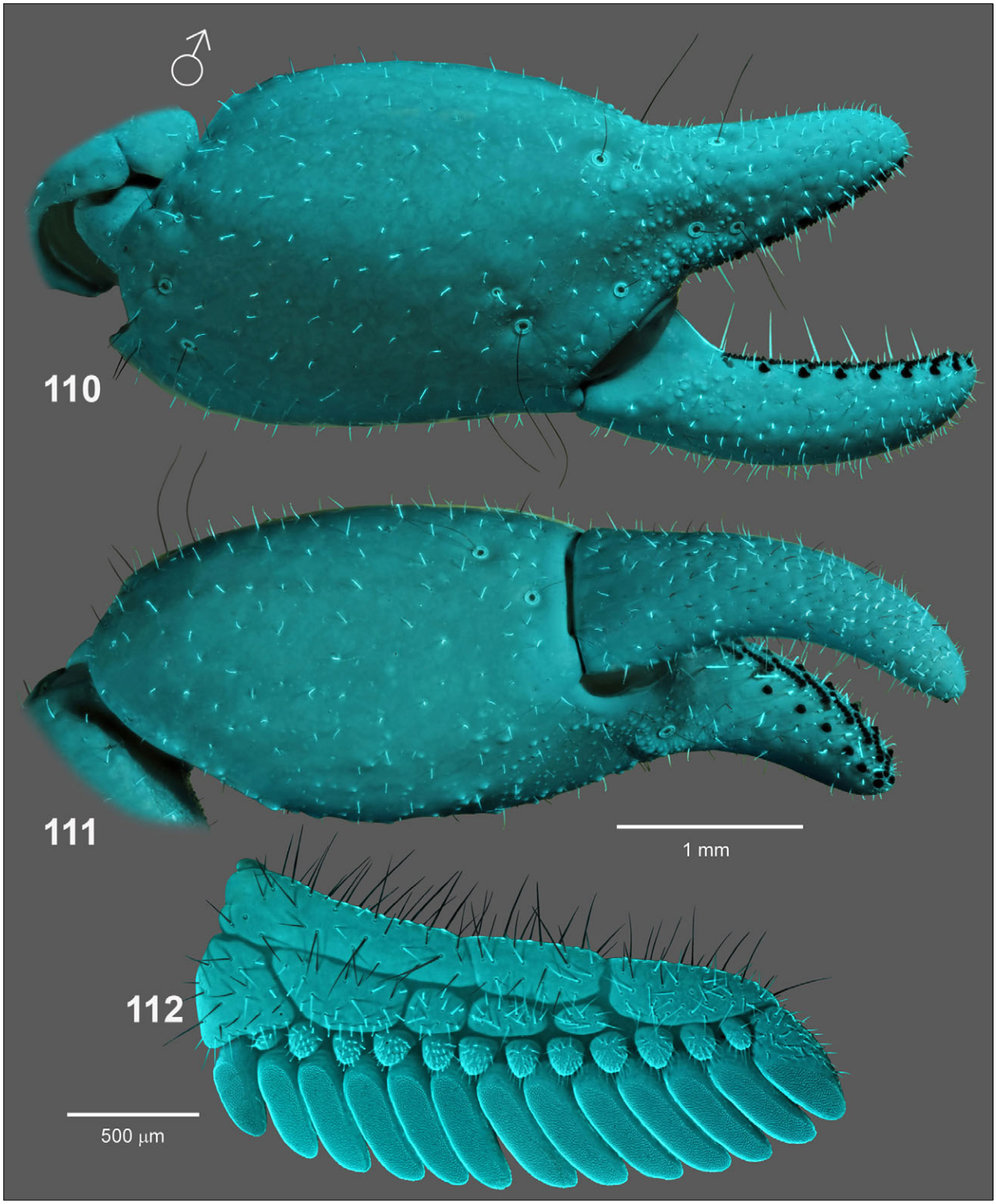
Figures 90–92: *Somalicharmus whitmanae*, posterior metasoma and telson of male from locality 16EA. Dorsal (90), lateral (91) and ventral (92) views. UV fluorescence images. Scale bar: 2 mm.

Figures 93–109: *Somalicharmus whitmanae*, pedipalp segments of male from locality 16EA (93–101) and female from locality 16EF (102–109). Pedipalp chela dorsal (93, 102), external (94, 103) and ventral (95, 104), patella dorsal (96, 105), external (97, 106) and ventral (98, 107), trochanter and femur internal/internodorsal (99, 108) and dorsal (100, 109), and movable finger dentition (101). Trichobothrial pattern indicated in Figures 93–97 and 99–100.

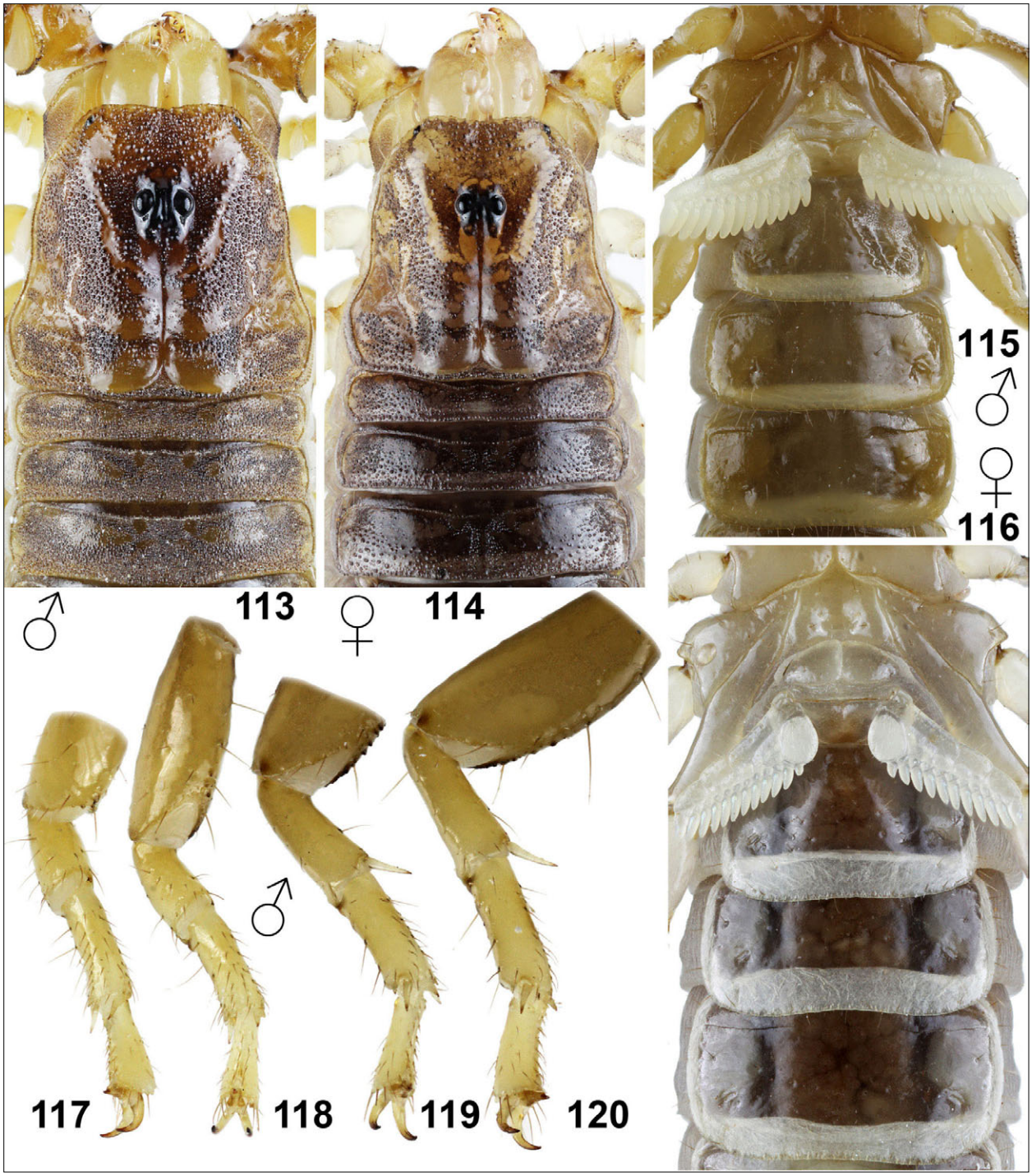
contiguous and well separated from each other. Ventral surface of both fixed and movable fingers unarmed.

HEMISPERMATOPHORE (Figs. 129–133). Flagelliform, extremely long and slender, trunk ca. 18 times length of capsule region. Flagellum relatively short, unfolded length ca. 50% of trunk length, folded into pars recta and pars reflecta, cylindriform, gradually tapering, not distally dilated. Capsule region with 3 lobes at base of flagellum in 2+1 configuration (Kovařík et al., 2016c): median lobe (*ml*) narrow, tapering to sharp apex, with dark reddish-black well-sclerotized carina, well separated from base of flagellum; internal lobe (*il*) smaller, paler brown, deeply split from median lobe and even narrower, also finely tapered to a sharp point; basal lobe (*bl*) greatly enlarged, relatively broad, protruding vertically, sclerotized brown color, apically curled in forward (distal) direction, terminus blunt and rounded; margins of basal lobe stalk also curled forward forming concave scoop, with internal margin extending forward to connect with secondary sclerotized carina along internal margin of median lobe. The peculiar structure of the basal lobe is not an anomaly, as it was confirmed by examination of 10 hemispermatophores extracted from 5 males.

SETATION. *Metasomal segments* with sparse, long, dark macrosetae and short, fluorescent microsetae. *Telson* with numerous long, dark macrosetae, sparse short, fluorescent microsetae, and numerous long, pale, fluo-

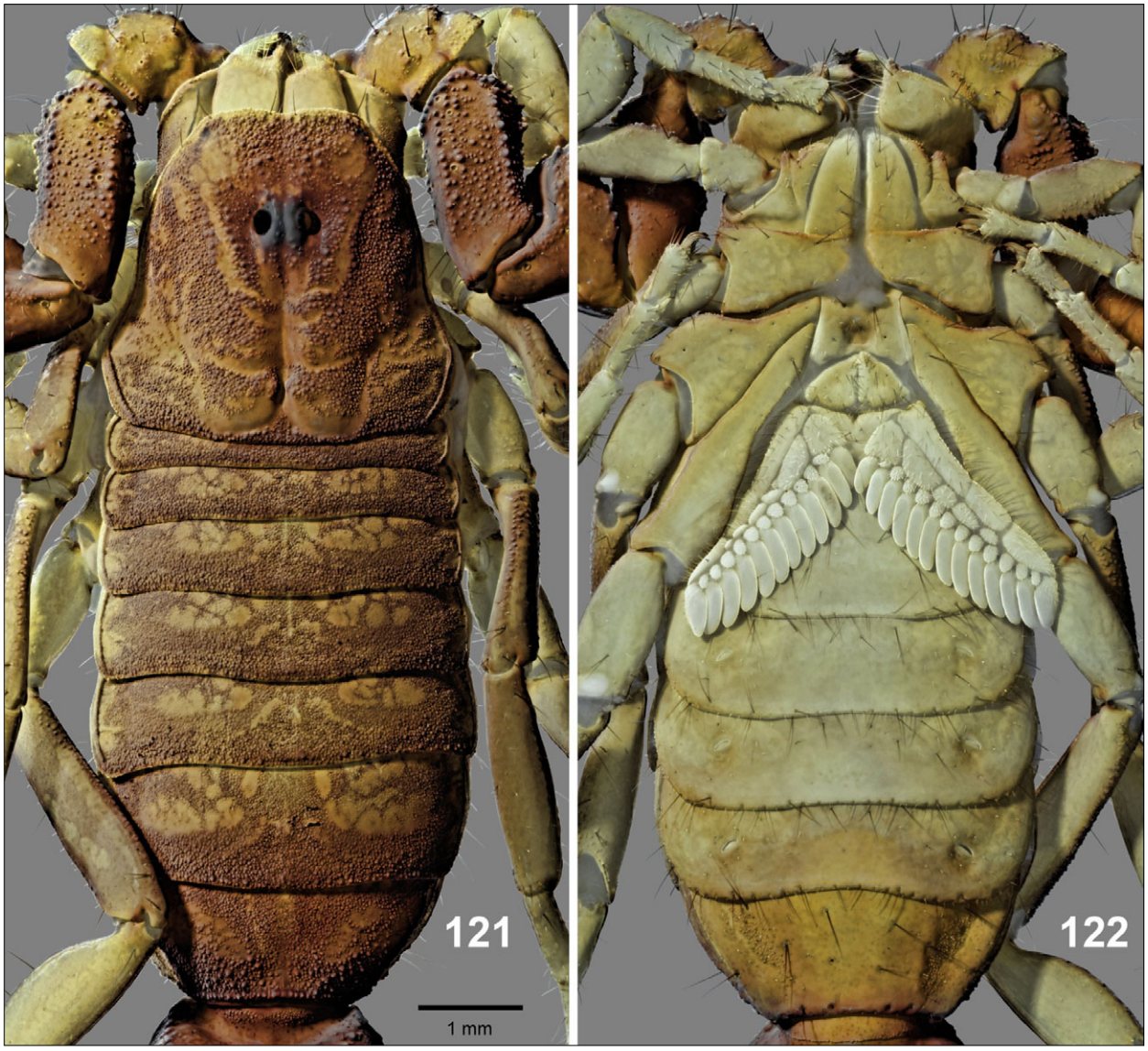


Figures 110–112: *Somalicharmus whitmanae*, male from locality 16EA. Right pedipalp chela, external (110) and ventrointernal (111) views, and left pectine, ventral view (112). UV fluorescence images. Scale bars: 1 mm (110–111) and 500 µm (112).



Figures 113–120: *Somalicharmus whitmanae*. **Figures 113**, **115**, **117–120**. Male from locality 16EA, carapace and tergites I–III (113), coxosternal area and sternites III–V (115) and left legs I–IV, retrolateral aspect (117–120). **Figures 114**, **116**. Female from locality 16EF, carapace and tergites I–III (114), and coxosternal area and sternites III–V (116).

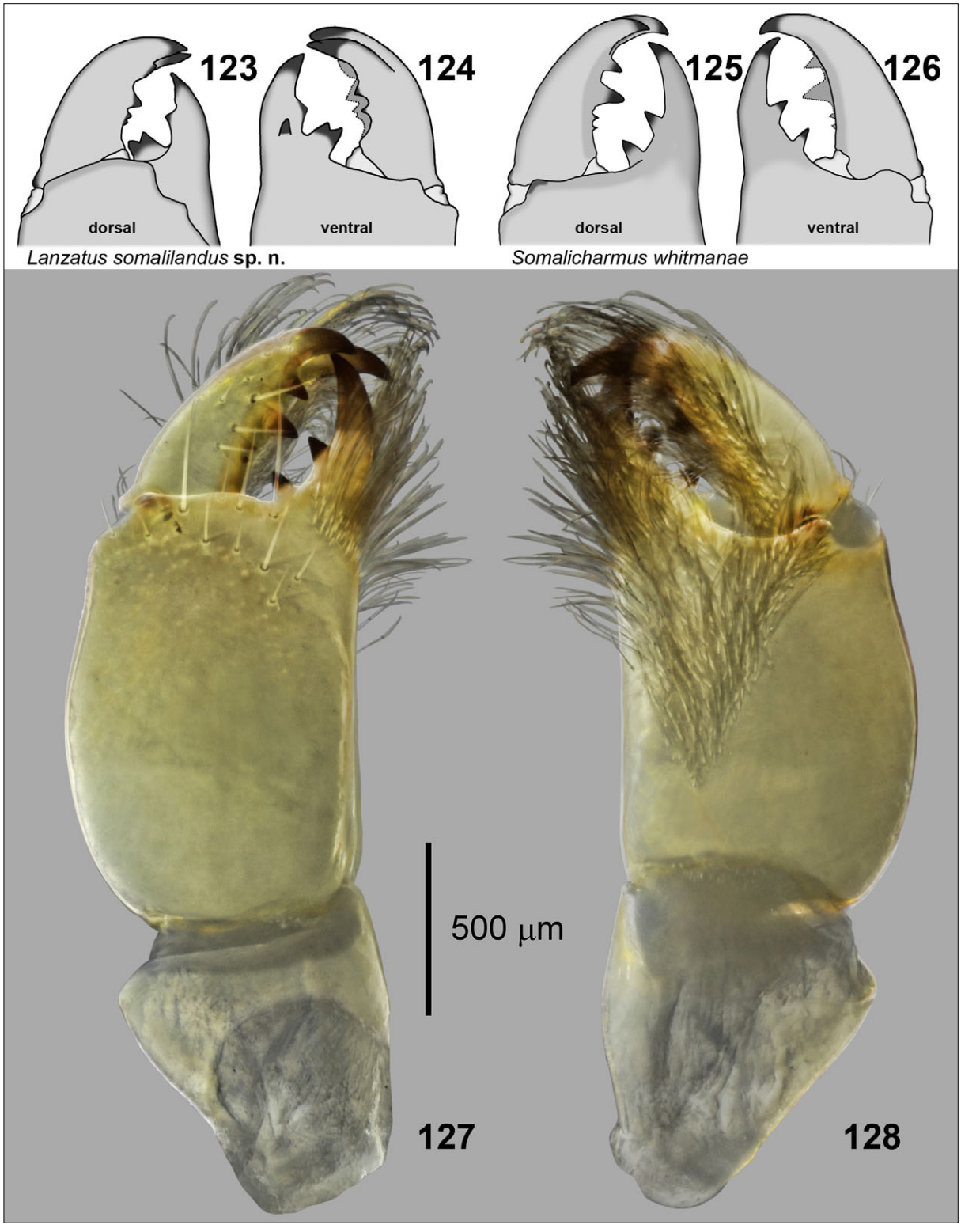
rescent setae concentrated on posterior ventral surface of vesicle (Figs. 90–92). *Pedipalp chela* (Figs. 110–111) with uniformly distributed cover of short fluorescent microsetae over surfaces of manus and fingers. Short dark setae also present but sparse, mostly located on pedipalp fingers. *Pectines* (Fig. 112) with numerous longer, dark macrosetae mostly on marginal and basal middle lamellae. Numerous medium to short fluorescent



Figures 121–122: *Somalicharmus whitmanae*, male from locality 16EA. **Figure 121**. Dorsal view of body showing carapace, tergites, pedipalp trochanter and femur. **Figure 122**. Ventral view of body showing coxosternal area, pectines and sternites. Composite white light/ UV fluorescence images. Scale bar: 1 mm.

setae on middle lamellae and most distal pectine tooth. Fulcra equipped with unusually dense array of ca. 15–30 fluorescent microsetae.

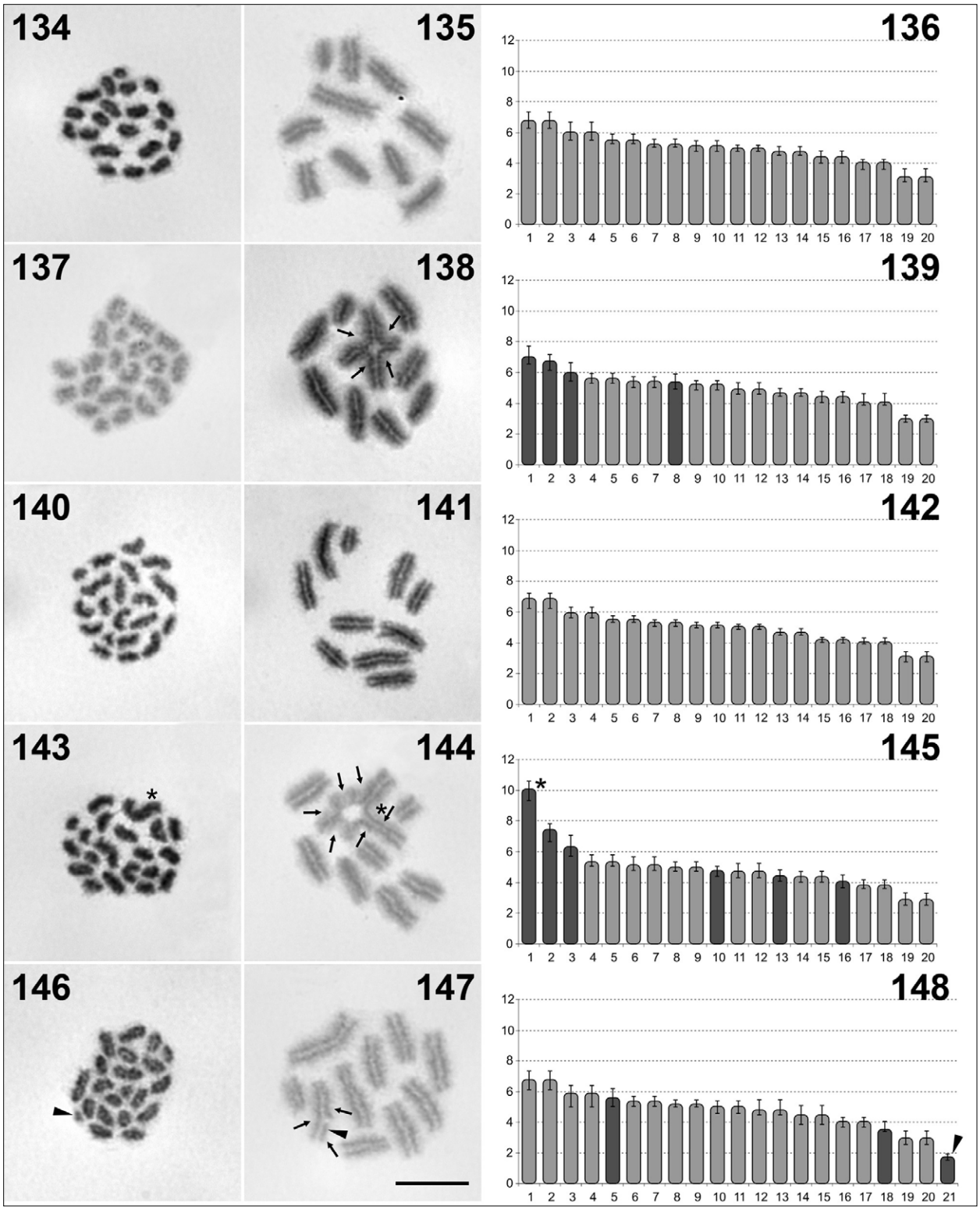
AFFINITIES. The genus name was originally coined to suggest that *Somalicharmus* might have affinities with the Indian genus *Charmus*, and its relative *Thaicharmus* (Kovařík, 1998), which like *Somalicharmus* are small dark scorpions with robust metasoma and subpentagonal sternum. Fet et. al. (2005) grouped these three genera in the "Charmus" group based on dorsal position of femur trichobothrium d_2. However, in our samples we have observed d_2 to also be found internal to the dorsointernal carina, a sufficient criterion for placement in the "Uroplectes" group (Fet et. al., 2005). The telson of *Somalicharmus* differs from that of *Charmus*, but is similar to that of another small buthid in the "Uroplectes" group, *Butheoloides*, both being bulbous with a small, knob-like subaculear tubercle (but a similar tubercle occurs in *Thaicharmus*). However, *Somalicharmus* differs from *Butheoloides* in other characters (e.g. cheliceral finger dentition, placement of trichobothria *db*, *dt* and *it* on pedipalp fixed finger, form of pedipalps and metasoma). Also, unlike *Somalicharmus*, both *Charmus* and *Butheoloides* have a hemispermatophore median lobe that is fused to the base of the flagellum (Vachon, 1952; Kovařík et. al., 2016c). The absence of teeth on the ventral side of the cheliceral



Figures 123–128: **Figures 123–126:** Diagrams of cheliceral finger dentition. **Figures 123–124**. *Lanzatus somalilandus* **sp**. **n**., female paratype, dorsal (123) and ventral (124) views, showing typical pattern of buthid dentition. Reconstructed from specimen with worn teeth (Figs. 13–14). **Figures 125–125**. *Somalicharmus whitmanae*, male from locality 16EA, dorsal (125) and ventral (126) views, showing pattern of dentition highly aberrant for a buthid. **Figures 127–128**. *Somalicharmus whitmanae*, left chelicera of male from locality 16EA, dorsal (127) and ventral (128) views. Composite white light/ UV fluorescence images. Scale bar: 500 μm.

Figures 129–133: *Somalicharmus whitmanae*, right hemispermatophore of male from locality 16EA. Whole hemispermatophore in ventroexternal view (129), and magnified views showing capsule region, flagellum and distal trunk in internal (130), dorsal (131), external (132) and ventral (133) views. Abbreviations: *bl*, basal lobe; *il*, internal lobe; *ml*, median lobe. Scale bars: 1 mm (129) and 500 µm (130–133).

fixed finger of *Somalicharmus* is shared with other buthid genera *Nanobuthus*, *Uroplectes* and *Karasbergia*. The genus *Nanobuthus* needs revision, but if, as some authors have presumed, it is close to *Neobuthus*, then it would have femur trichobothria in the *β*-configuration and belong to the "Buthus" group (Fet et. al., 2005) which excludes *Somalicharmus*. On the other hand, *Somalicharmus* is similar to *Uroplectes* and *Karasbergia* in having femur trichobothria in *α*-configuration and femur d_2 displaced internally (= "Uroplectes" group), and a 2+1 layout of lobes of the hemispermatophore capsule, with the median lobe not fused to the base of the flagellum (Kovařík et. al., 2016; Lamoral, 1979). *Uroplectes* differs from *Somalicharmus* in its subtriangular sternum shape, trichobothrial pattern, pedipalp and metasomal structure. In *Uroplectes*, it is the basal tooth of the female pectine that is enlarged, not the basal middle lamella. *Karasbergia* shares several characters with *Somalicharmus*: both have a subpentagonal sternum, pedipalp fixed finger with trichobothrium *it* at a non-distal location (near mid-finger in *Karasbergia*) and *db* and *dt* in proximal positions, and metasoma I–III with ventrolateral carinae joined to form a U-shaped posterior marginal carina (Hewitt, 1913; Lamoral, 1979; Prendini 2004). *Karasbergia* differs in having 3 pairs of lateral eyes, pedipalp chela manus with trichobothrium V_2 internal to V_1, pedipalp fingers without external accessory granules, genital papillae absent in males, and chelicera with standard buthid pattern of carination and dentition (Lamoral, 1979; Vachon, 1963). The strongly dilated basal middle lamella of female pectines in *Somalicharmus* is an unusual condition also found in



Figures 134–148: *Somalicharmus whitmanae*. Mitotic metaphases (134, 137, 140, 143, 146), postpachytenes (135, 138, 141, 144, 147), and ideograms (136, 139, 142, 145, 148) (y axis - % of the chromosome length of the diploid set, dark grey indicates chromosomes of multivalents) of males. **Figures 134–136**. Male from locality 16EA, 2n=20, 10II. **Figures 137–139**. Male from locality 16EA, 2n=20, 8II+CIV. Arrows indicate chromosomes of quadrivalent. **Figures 140–142**. Male from locality 16EF, 2n=16, 10II. **Figures 143–145**. Male from locality 16EF, 2n=20, 7II+CVI. Arrows indicate chromosomes of hexavalent and asterisk indicates extra large chromosome. **Figures 146–148**. Male from locality 16EF, 2n=21, 9II+CIII. Arrows indicate chromosomes of trivalent and arrowheads indicates extra small chromosome. Scale bar = 10 μm.

Species	Sex	2n	Chromosome Length	Ppt Configuration	Locality
Somalicharmus whitmanae	male	20	2x 6.76 - 2x 4.04, 2x 3.12	10II	16EA
	male	20	2x 6.70 - 2x 3.94, 2x 3.03	10II	16EA
	male	20	2x 7.08 - 2x 4.06, 2x 3.14	10II	16EA
	male	20	2x 7.03 - 2x 4.01, 2x 3.09	10II	16EA
	male	20	7.05 - 2x 4.09, 2x 2.99	8II+CIV	16EA
	male	20	2x 6.87 - 2x 4.28, 2x 3.34	10II	16EF
	male	20	10.09, 7.47, 6.33, 2x 5.35 - 2x 3.85, 2x 2.89	7II+CVI	16EF
	male	21	2x 6.79 - 3.53, 2x 2.96, 1.76	9II+CIII	16EF

Table 2: The diploid numbers, the relative lengths of chromosomes of the diploid set, postpachytene (Ppt) configuration (after Mattos et al., 2013) and the localities of analyzed *Somalicharmus whitmanae* from Ethiopia.

Isometrus (fig. 558 in Kovařík et al., 2016c), *Parabuthus* (fig. 62 in Kovařík et al., 2016b), *Tityopsis* (fig. 49 in Teruel et Kovařík, 2012), and "*Tityus asthenes*" complex (fig. 14 in Kovařík et al., 2013b), but these taxa are not closely related and this is probably a convergent character.

Unique traits of *Somalicharmus* not known in any other extant buthids include: (i) absence of dentition on ventral margin of the cheliceral movable finger; (ii) absence of bicuspid dentition on base of cheliceral fixed finger; (iii) cheliceral manus without anterior marginal or dorsointernal carinae; (iv) pedipalp chela with trichobothrium *it* located at base of fixed finger (as far as has been documented; many species descriptions failed to map the location of *it*); (v) hemispermatophore capsule with tall, vertical, scoop-like basal lobe which is as long as the median lobe.

REMARKS ON THE KARYOTYPES (Figs. 134–148). Altogether we analyzed karyotypes of eight males of *Somalicharmus whitmanae* from the two localities 16EA and 16EF (Table 2). For chromosome preparations we used the "plate spreading" method already used for scorpions (e.g. Kovařík et al., 2009). The chromosomes were stained by 5% Giemsa solution in Sörensen phosphate buffer for 20 min. The relative length of the chromosomes of the diploid set was measured for each specimen using the software Image J 1.45r (http://rsbweb.nih.gov/ij) with the plugin Levan (Sakamoto & Zacaro, 2009) based on 10 postpachytene.

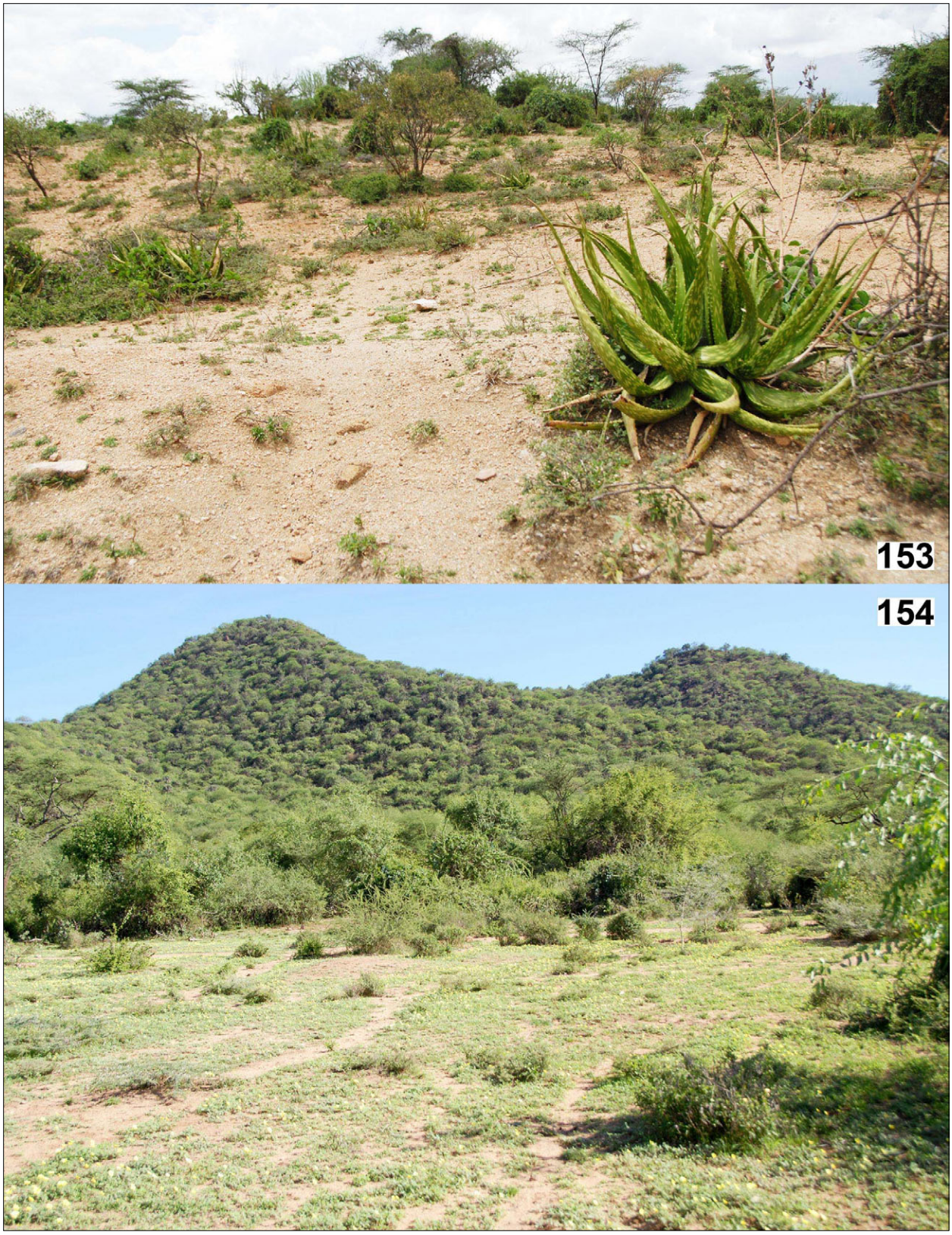
Seven males analyzed from both localities displayed 2n=20 (Figs. 134–145). We also detected fission of one chromosome in one male from locality 16EF (Fig. 147). This chromosomal aberration causes an increase in diploid number (2n=21) and the presence of a distinct small chromosome (Figs. 146–148). The chromosomes form bivalents during pachytene and postpachytene in the majority of males (Figs. 135 and 141). These chromosomes gradually decrease in length with the exception only of the last chromosome pair that is distinctively shorter than the previous one (Fig. 136, Table 2). This shorter pair of chromosomes is also evident in karyotypes of all other males with detected chromosomal rearrangements. In one male from 16EA, we observed a quadrivalent during postpachytene (Fig. 138). This is probably the result of reciprocal translocation between two chromosome pairs of larger length (Fig. 139). In one male from locality 16EF, we observed a hexavalent during postpachytene (Fig. 144), probably the result of several rearrangements. In the karyotype of this specimen, the rearrangements form one extra large chromosome (Figs 143–145). The karyotypes of *S. whitmanae* show holocentric chromosomes, achiasmatic meiosis in males, and a lower number of chromosomes. These are attributes typical for scorpions of the family Buthidae (e.g. Mattos et al., 2013).

COMMENTS ON LOCALITIES AND LIFE STRATEGY. The type locality has been confirmed to be in Ethiopia, thanks to Sarah Whitman who found that the label "Somalia: El Meti" is incorrect (Kovařík & Whitman, 2005: 112). The male holotype was collected by the Missione Biologica Sagan-Omo led by Edoardo Zavattari, which in 1939 explored the Borana region from Dolo westwards to Lake Stephanie and the Omo River (Largen, 2001). According to Largen (2001), El Meti is located at 04°58'N 37°08'E, midway between localities 16EA and 16EF (Fig. 155).

The first author visited locality **16EA** (Fig. 153) on 9–11 April 2016 and collected 17 males and 2 juveniles by UV detection. Here, the maximum recorded daytime temperature was 33.8 ºC, and the nighttime temperature shortly after sunset was 27.1 ºC, dropping to 24.3 ºC (minimum temperature) before sunrise, and the humidity varied at night between 55% and 72%. The minimum daytime humidity was 40%. In addition to *S. whitmanae*,

Figures 149–150: *Somalicharmus whitmanae* in vivo habitus. Male from locality 16EA (149), and female from locality 16EF (150).

Figures 151–152: *Somalicharmus whitmanae*, female from locality 16EF with 13 newborns (151) and the same female with juveniles after first ecdysis (152).



Figures 153–154: *Somalicharmus whitmanae*, localities 16EA (153), Ethiopia, Turmi, and 16EF (154), Ethiopia, 20 km SE Konzo.

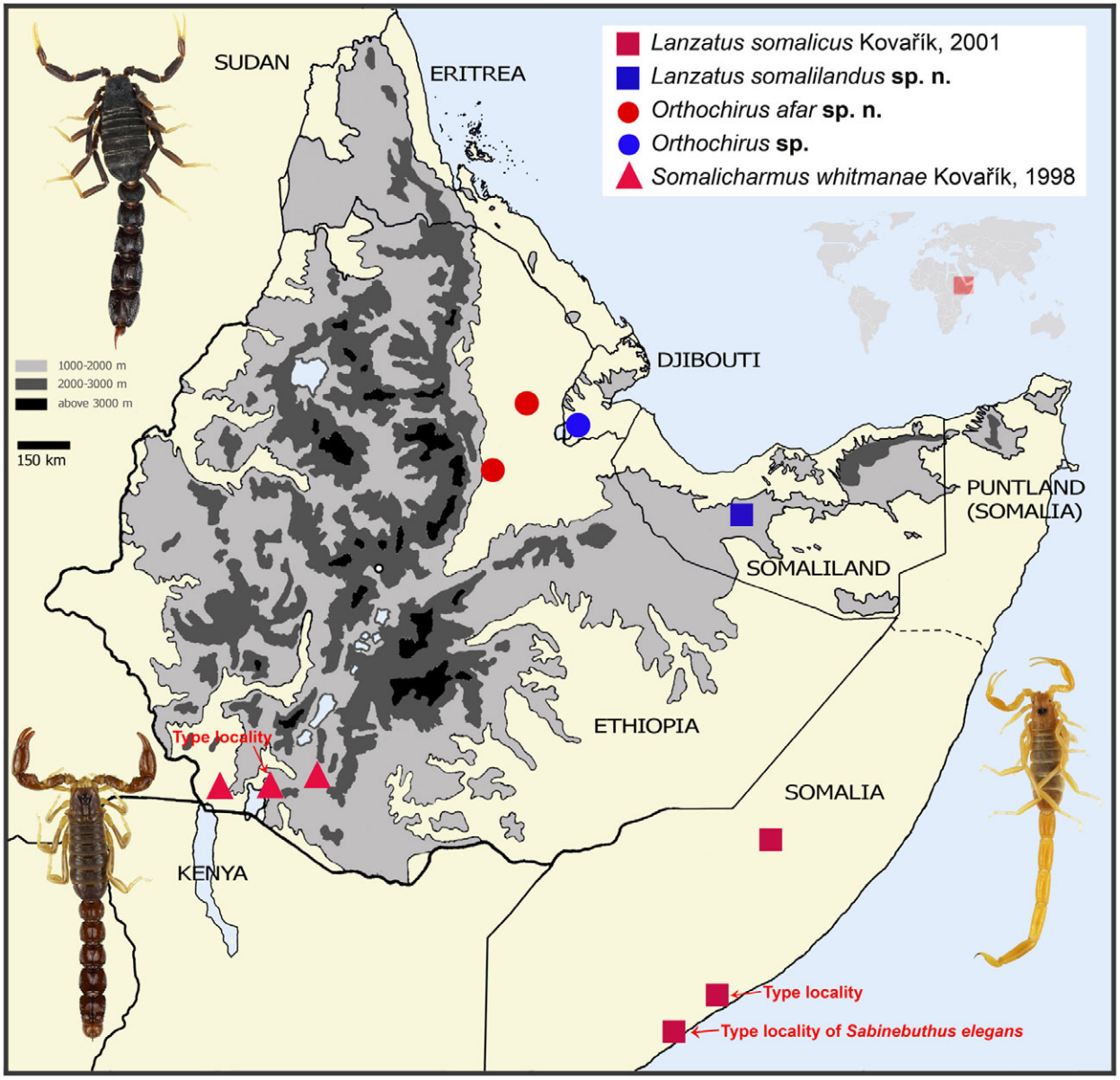


Figure 155: Map showing confirmed distribution of *Lanzatus*, *Orthochirus*, and *Somalicharmus* in Horn of Africa. Most points indicate sites sampled during 2011–2016 expeditions, except for the localities of *Lanzatus somalicus* in Somalia, and of *Orthochirus* sp. in Djibouti (the map indicates with arbitrary plotted symbol for two citations: a juvenile cited by Werner (1916: 81) with imprecise coordinates, and of a specimen cited by Lourenço & Leguin (2011: 4, 15, figs. 5, 39); see also comments under *Orthochirus* in Systematics section.

The first author also recorded at this locality *Hottentotta trilineatus* (Peters, 1862), *Lychas obsti* Kraepelin, 1913, *Parabuthus pallidus* Pocock, 1895, *Uroplectes fischeri* (Karsch, 1879), and *Pandinurus exitialis* (Pocock, 1888).

The first author visited locality **16EF** (Fig. 154) on 14–15 April 2016 and collected by UV detection 29 males, one gravid female which gave birth to 13 newborns on 9 July 2016 (Figs. 151–152, these newborns completed their first ecdysis on 17 July 2016), and 3 juveniles of which one completed final ecdysis to a sexually mature female on 3 June 2016. At this locality, the maximum recorded daytime temperature was 34.7 ºC, and the nighttime temperature was 27.4 ºC shortly after sunset, dropping to 21.7 ºC (minimum temperature) before sunrise, and the humidity varied between 55% and 65%. In addition to *S. whitmanae* the first author also recorded at this locality *Hottentotta trilineatus*, *Lychas obsti*, *Parabuthus hamar* Kovařík et al., 2016 (type locality), and *P. pallidus*.

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References

DUPRÉ, G. 2007. Conspectus genericus scorpionorum 1758–2006 (Arachnida: Scorpiones). *Euscorpius*, 50: 1–31.

FARZANPAY, R. 1987 (1366). [*Knowing Scorpions*]. Teheran: Central University Publications, No. 312, Biology 4, 1–231(in Farsi, with Latin index).

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.

FET, V. & M. E. SOLEGLAD. 2005. Contributions to scorpion systematics. I. On recent changes in high-level taxonomy. *Euscorpius*, 31: 1–13.

FET, V., M. E. SOLEGLAD & G. LOWE. 2005. A new trichobothrial character for the high–level systematics of Buthoidea (Scorpiones: Buthida). *Euscorpius*, 23: 1–40.

HEWITT, J. 1913. The Percy Sladen Memorial Expedition to Great Namaqualand 1912-13. Records and descriptions of the Arachnida of the collection. Order Scorpiones. *Annals of the Transvaal Museum*, 4(3): 146–159.

KARSCH, F. 1881. Uebersicht der europäischen Skorpione. *Berliner Entomologische Zeitschrift*, 25: 89–91.

KARSCH, F. 1892. Arachniden von Ceylon und von Minikoy, gesammelt von den Herren Doctoren P. und F. Sarasin. *Berliner Entomologische Zeitschrift*, 36(1891): 267–310.

KOVAŘÍK, F. 1998. Three new genera and species of Scorpiones (Buthidae) from Somalia. *Acta Societatis Zoologicae Bohemicae*, 62: 115–124.

KOVAŘÍK, F. 2001. *Lanzatus somalicus* gen. et sp. n. (Scorpiones: Buthidae) from Somalia. *Acta Societatis Zoologicae Bohemicae*, 65: 41–44.

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. Revision and taxonomic position of genera *Afghanorthochirus* Lourenço & Vachon, *Baloorthochirus* Kovařík, *Butheolus* Simon, *Nanobuthus* Pocock, *Orthochiroides* Kovařík, *Pakistanorthochirus* Lourenço, and Asian *Orthochirus* Karsch, with descriptions of twelve new species (Scorpiones, Buthidae). *Euscorpius*, 16: 1–33.

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. 2011a. *Buthus awashensis* sp. n. from Ethiopia (Scorpiones, Buthidae). *Euscorpius*, 128: 1–6.

KOVAŘÍK, F. 2011b. A review of the subgenus *Pandinus* Thorell, 1876 with descriptions of two new species from Uganda and Ethiopia (Scorpiones, Scorpionidae). *Euscorpius*, 129: 1–18.

KOVAŘÍK, F. 2012. Review of the subgenus *Pandinurus* Fet, 1997 with descriptions of three new species (Scorpiones, Scorpionidae, *Pandinus*). *Euscorpius*, 141: 1–22.

KOVAŘÍK, F. 2013. *Pandinus* (*Pandinus*) *trailini* sp. n. from Ethiopia (Scorpiones, Scorpionidae) with data on localities and life strategy. *Euscorpius*, 163: 1−14.

KOVAŘÍK, F. 2015. Scorpions of Ethiopia (Arachnida, Scorpiones). Part I. Genus *Butheoloides* Hirst, 1925 (Buthidae) with description of a new species. *Euscorpius*, 195: 1−10.

KOVAŘÍK, F. 2016. Scorpions of the Horn of Africa (Arachnida, Scorpiones). Part VIII. *Pandinops* Birula, 1913 (Scorpionidae) with description of two new species. *Euscorpius*, 229: 1–20.

KOVAŘÍK, F. & V. FET. 2006. Taxonomic position of the genus *Simonoides* Vachon et Farzanpay, 1987, and description of a new species of *Orthochirus* Karsch from Iran (Scorpiones, Buthidae). *Euscorpius*, 38: 1–10.

KOVAŘÍK, F. & G. LOWE. 2012. Review of the genus *Neobuthus* Hirst, 1911 with description of a new species from Ethiopia (Scorpiones, Buthidae). *Euscorpius*, 138: 1–25.

KOVAŘÍK, F., G. LOWE, D. HOFEREK, J. PLÍŠKOVÁ & F. ŠŤÁHLAVSKÝ. 2016. Scorpions of Ethiopia. Part IV. Genus *Uroplectes* Peters, 1861 (Scorpiones: Buthidae). *Euscorpius*, 217: 1–14.

KOVAŘÍK, F., G. LOWE, J. PLÍŠKOVÁ & F. ŠŤÁHLAVSKÝ. 2013a. A new scorpion genus, *Gint* gen. n., from the Horn of Africa (Scorpiones, Buthidae). *Euscorpius*, 173: 1–19.

KOVAŘÍK, F., G. LOWE, J. PLÍŠKOVÁ & F. ŠŤÁHLAVSKÝ. 2016a. Scorpions of the Horn of Africa (Arachnida, Scorpiones). Part VI. *Compsobuthus* Vachon, 1949 (Buthidae) with description of *C. eritreaensis* sp. n. *Euscorpius*, 226: 1–21.

KOVAŘÍK, F., G. LOWE, J. PLÍŠKOVÁ & F. ŠŤÁHLAVSKÝ. 2016b. 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., G. LOWE, K. B. RANAWANA, D. HOFEREK, V. A. SANJEEWA JAYARATHNE, J. PLÍŠKOVÁ & F. ŠŤÁHLAVSKÝ. 2016c. Scorpions of Sri Lanka (Arachnida, Scorpiones: Buthidae, Chaerilidae, Scorpionidae) with description of four new species of the genera *Charmus* Karsch, 1879 and *Reddyanus* Vachon, 1972 stat. n.. *Euscorpius*, 220: 1–133.

KOVAŘÍK, F., G. LOWE, M. SEITER, J. PLÍŠKOVÁ & F. ŠŤÁHLAVSKÝ. 2015. Scorpions of Ethiopia (Arachnida, Scorpiones). Part II. Genus *Babycurus* Karsch, 1886 (Buthidae) with description of two new species. *Euscorpius*, 196: 1–31.

KOVAŘÍK, F. & T. MAZUCH. 2011. *Hemiscorpius novaki* sp. n. from Somaliland (Scorpiones: Hemiscorpiidae). *Euscorpius*, 126: 1–9.

KOVAŘÍK, F. & T. MAZUCH. 2015. Scorpions of Ethiopia (Arachnida, Scorpiones). Part III. Genus *Hottentotta* Birula, 1908 (Buthidae), with description of three new species. *Euscorpius*, 202: 1−37.

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., M. E. SOLEGLAD & V. FET. 2007. A new species of scorpion in the "*Charmus*" group from India (Scorpiones: Buthidae). *Boletín Sociedad Entomológica Aragonesa*, 40: 201–209.

KOVAŘÍK, F., F. ŠŤÁHLAVSKÝ, 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., R. TERUEL, M. A. C. COZIJN & M. SEITER. 2013b. *Tityus carolinae* sp. n. from Suriname and Guyana (Scorpiones: Buthidae). *Euscorpius*, 178: 1−9.

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. 1895. Nachtrag zu Theil I der Revision der Skorpione. *Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten*, 12 (1894): 73–96.

KRAEPELIN, K. 1903. Scorpione und Solifugen Nordost-Afrikas, gesammelt 1900 und 1901 von Carlo Freiherrn von Erlanger und Oscar Neumann. *Zoologische Jahrbücher*, *Abtheilung für Systematik*, 18(4–5): 557–578.

LAMORAL, B. H. 1979. The scorpions of Namibia (Arachnida: Scorpionida). *Annals of the Natal Museum*, 23 (3): 497–784.

LARGEN, M. J. 2001. Catalogue of the amphibians of Ethiopia, including a key for their identification. *Tropical Zoology*, 14: 307–402.

LORIA, S. & L. PRENDINI. 2014. Homology of the lateral eyes of scorpiones: a six-ocellus model. *PLoS ONE* 9(12): e112913. doi:10.1371/journal.pone.0112913.

LOURENÇO, W. R. 2001a. Un nouveau genre de Buthidae, probable vicariant geographique d´ *Anomalobuthus* Kraepelin (Chelicerata, Scorpiones). *Biogeographica*, 77(1): 15–20.

LOURENÇO, W. R. 2001b. A propos de quelques decisions taxonomiques concernant des scorpions des families Buthidae, Chaerilidae et Scorpiopidae. *Biogeographica*, 77(4): 173–175.

LOURENÇO, W. R. & E.-A. LEGUIN. 2011. Further considerations on the species of the genus *Orthochirus* Karsch, 1891 from Africa, with description of three new species (Scorpiones: Buthidae). *Euscorpius*, 123: 1–19.

LOURENÇO, W. R. & M. VACHON. 1995. Un nouveau genre et deux nouvelles espéces de scorpions Buthidae d'Iran. *Bulletin du Muséum National d'Histoire Naturelle Paris*, 17: 297–305.

LOURENÇO, W. R. & M. VACHON. 1997. Un nouveau genre et quatre nouvelles espéces de scorpions (Buthidae) du Moyen-Orient. *Zoosystema*, 19(2–3): 327–336.

LOWE, G. & F. KOVAŘÍK. 2016. Scorpions of the Horn of Africa (Arachnida, Scorpiones). Part V. Two new species of *Neobuthus* Hirst, 1911 (Buthidae), from Ethiopia and Eritrea. *Euscorpius*, 224: 1–46.

MATTOS, V. F., D. M. CELLA, L. S. CARVALHO, D. M. CANDIDO & M. C. SCHNEIDER. 2013. High chromosome variability and the presence of multivalent associations in buthid scorpions. *Chromosome Research*, 21: 121–136.

MIRZA, Z. A., R. V. SANAP & K. KUNTE. 2016. A new species of the genus *Thaicharmus* Kovařík, 1995 (Scorpiones: Buthidae) from northeast India. *Euscorpius*, 215: 1–11.

NAVIDPOUR, S., F. KOVAŘIK, M. E. SOLEGLAD & V. FET. 2008. Scorpions of Iran (Arachnida, Scorpiones). Part I. Khoozestan Province. *Euscorpius*, 65: 1–41.

PRENDINI, L. 2004. Revision of *Karasbergia* Hewitt (Scorpiones; Buthidae), a monotypic genus endemic to southern Africa. *Journal of Afrotropical Zoology*, 1: 77–93.

PRENDINI, L. & W. WHEELER. 2005. Scorpion higher phylogeny and classification, taxonomic anarchy, and standards for peer review in online publishing. *Cladistics*, 21: 446–494.

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.

SOLEGLAD, M. E. & V. FET. 2003a. The scorpion sternum: structure and phylogeny (Scorpiones: Orthosterni). *Euscorpius*, 5: 1–34.

SOLEGLAD, M. E. & V. FET. 2003b. High-level systematics and phylogeny of the extant scorpions (Scorpiones: Orthosterni). *Euscorpius*, 11: 1–175.

STAHNKE, H. L. 1971. Scorpion nomenclature and mensuration. *Entomological News*, 81: 297–316.

TERUEL, R. & F. KOVAŘÍK. 2012. Scorpions of Cuba. *Clairon Production*, 232 pp.

VACHON, M. 1952. Études sur les scorpions. *Institut Pasteur d'Algérie*, *Alger*, 1–482. (published 1948–1951 in *Archives de l'Institut Pasteur d'Algérie*, 1948, 26: 25–90, 162–208, 288–316, 441–481.

1949, 27: 66–100, 134–169, 281–288, 334–396. 1950, 28: 152–216, 383–413. 1951, 29: 46–104).

VACHON, M. 1963. De l'utilité, en systématique, d'une nomenclature des dents de chélicères chez les scorpions. *Bulletin du Musèum National d'Histoire Naturelle*, *Paris*, (2), 35 (2): 161–166.

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.

VACHON, M. 1975. Sur l'utilisation de la trichobothriotaxie du bras des pédipalpes des Scorpions (Arachnides) dans le classement des genres de famille des Buthidae Simon. *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences*, (D), 281(21): 1597–1599.

WERNER, F. 1916. Über einige Skorpione und Gliederspinnen des Naturhistorischen Museum in Wiesbaden. *Jahrbücher des Nassauischen Verein für Naturkunde*, 69: 79–97.

YANG, X., Y. NORMA-RASHID, W. R. LOURENÇO & M. ZHU. 2013. True lateral eye numbers for extant buthids: a new dis-covery on an old character. *PLoS ONE* 8 (1): e55125. doi:10.1371 /journal. pone. 005 5125.