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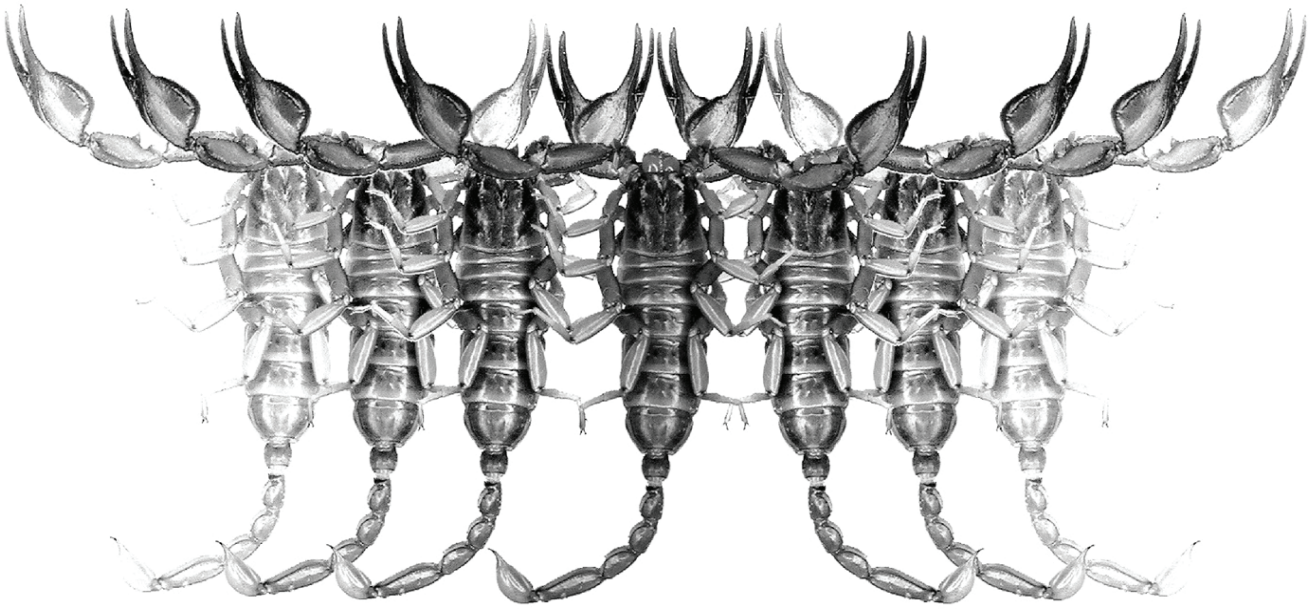

Scorpions of the Horn of Africa (Arachnida: Scorpiones). Part XXIV. *Leiurus* (Buthidae), with description of *Leiurus gubanensis* sp. n.

František Kovařík & Graeme Lowe

May 2020 — No. 309

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Occasional Publications in Scorpiology

EDITOR: **Victor Fet**, Marshall University, **'fet@marshall.edu'**

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Euscorpius — Occasional Publications in Scorpiology. 2020, No. 309

Scorpions of the Horn of Africa (Arachnida: Scorpiones). Part XXIV. *Leiurus* (Buthidae), with description of *Leiurus gubanensis* sp. n.

František Kovařík [1] & Graeme Lowe [2]

[1] P. O. Box 27, CZ-145 01 Praha 45, Czech Republic; http://www.scorpio.cz
[2] Monell Chemical Senses Center, 3500 Market St., Philadelphia, PA 19104-3308, USA

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Summary

New data are presented on the distribution of the genus *Leiurus* Ehrenberg, 1828 in the Horn of Africa, Somaliland, acquired during expeditions in 2011–2019. *Leiurus gubanensis* **sp**. **n**. is described from the Guban area, an extremely warm and dry place. The description is fully complemented with color photographs of live and preserved specimens, as well as of their habitats. This increases the known diversity of the genus to 14 species.

Introduction

In 2011–2019, the first author had the opportunity to participate in expeditions to the Horn of Africa, to study scorpions at 141 localities, and to publish several articles (23 in this series). One species in the genus *Leiurus* Ehrenberg, 1828 was found, *Leiurus gubanensis* **sp**. **n**., with occurrence limited to the central and eastern part of the Guban area ("guban" in Somali language means "burnt land"). This is a zone of hot, arid terrain stretching along the sea between Djibouti and Puntland (Somalia) with daytime temperatures of ca 50°C. The first author also made repeated visits to the western part of the Guban area (Gerissa and Zeyla), but did not collect any *Leiurus* there. The new species is herein described and illustrated in detail, and diagnostic characters are proposed to differentiate it from each of the 13 other known species in the genus.

Methods, Material & Abbreviations

Nomenclature and measurements follow Stahnke (1971), Kovařík (2009), and Kovařík & Ojanguren Affilastro (2013), except for trichobothriotaxy (Vachon, 1974, 1975) and chelicerae (Vachon, 1963). External morphology was studied and recorded under both white light and UV fluorescence imaging (Prendini, 2003; Volschenk, 2005).
Specimen depositories: All studied specimens are deposited in FKCP (František Kovařík, private collection; will in future be merged with the collections of the National Museum of Natural History, Prague, Czech Republic).
Morphometrics: D, depth; L, length; W, width.

Systematics

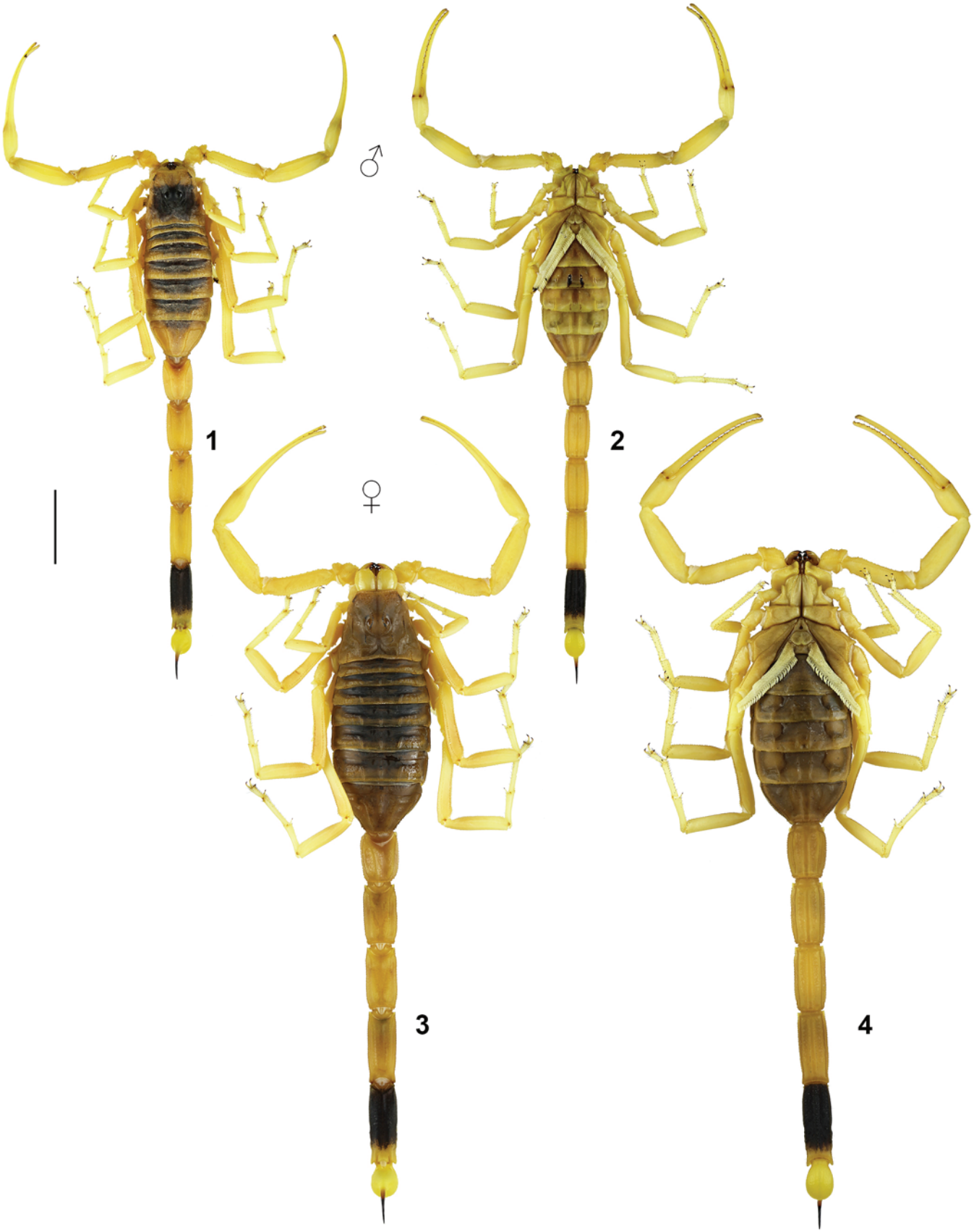
Family Buthidae C. L. Koch, 1837

Genus ***Leiurus*** Ehrenberg, 1828
(Figures 1–91, Table 1)

Androctonus (*Leiurus*) Ehrenberg in Hemprich & Ehrenberg, 1828, pl. I, fig. 5; Hemprich & Ehrenberg, 1829: 353 (in part).
Leiurus: Vachon, 1949: 83–88 (1952: 203–208); Fet & Lowe, 2000: 155–157; Lowe et al., 2014: 1–129, figs. 1–100 (complete reference list).

Type species. *Androctonus* (*Leiurus*) *quinquestriatus* Ehrenberg, 1828.

Diagnosis. Medium to large sized buthid scorpions, total length 50–115 mm. The carapace is almost flat, weakly or moderately trapezoidal, with anterior margin straight or slightly concave, and 5 lateral eyes in 'type 5' pattern (Loria & Prendini, 2014). Both carapace and tergites bear granulated carinae. The carapace bears distinct anterior, superciliary, central median, central lateral, posterior median and posterior lateral carinae. The central lateral and posterior median carinae are fused into a lyre configuration. Tergites I–II, VII bear 5 carinae, and III–VI bear 3 carinae. Tergites lack macrosetae. The metasoma is elongate, metasoma I–III bear 10 carinae, with median lateral carinae complete on I, and reduced on II–III. Metasoma IV bears 8 carinae, and metasoma V bears 7 carinae of which the dorsolateral carinae are weak, and ventrolateral carinae are strong with serrate or lobate dentition. The telson has a relatively



Figures 1–**4**: *Leiurus gubanensis* **sp**. **n**., 18SF. **Figures 1**–**2**. Male holotype in dorsal (1) and ventral (2) views. **Figures 3**–**4**. Female paratopotype in dorsal (3) and ventral (4) views. Scale bar: 10 mm.

Dimensions (mm)		*Leiurus gubanensis* sp. n. ♂ holotype	*Leiurus gubanensis* sp. n. ♀ paratype
Carapace	L / W	8.01 / 8.14	10.41 / 12.13
Mesosoma	L	19.25	25.03
Tergite VII	L / W	5.09 / 7.56	7.19 / 11.95
Pectine	L	10.60	11.79
Mid-pectine sensillar margin	L	0.85	0.73
Metasoma + telson	L	43.74	56.67
Segment I	L / W / D	5.57 / 4.14 / 4.00	7.11 / 5.53 / 5.20
Segment II	L / W / D	6.65 / 3.52 / 3.58	8.42 / 4.69 / 4.77
Segment III	L / W / D	6.85 / 3.21 / 3.40	8.65 / 4.38 / 4.43
Segment IV	L / W / D	7.81 / 3.01 / 3.03	10.44 / 3.95 / 4.10
Segment V	L / W / D	8.94 / 2.88 / 2.77	11.61 / 4.01 / 3.71
Telson	L / W / D	7.92 / 2.79 / 2.69	10.44 / 3.88 / 3.73
Pedipalp	L	35.63	44.23
Femur	L / W	8.73 / 1.98	10.79 / 2.63
Patella	L / W	9.95 / 2.45	12.04 / 3.30
Chela	L	16.95	21.40
Manus	W / D	1.99 / 2.30	2.97 / 2.86
Movable finger	L	12.70	15.83
Total	**L**	**71**	**92.11**

Table 1. Comparative measurements of adults of *Leiurus gubanensis* **sp. n.** Abbreviations: length (L), width (W, in carapace it corresponds to posterior width), depth (D).

bulbous vesicle lacking a subaculear spine or tubercle. Pectines bear fulcra. Pectinal tooth count ranges are ♂ 28–43, ♀ 25–38. The hemispermatophore is flagelliform, the capsule having 3 sperm hemiduct lobes well separated from the flagellum, and a strong hook-like basal lobe. The chelicerae exhibit characteristic buthid dentition (Vachon, 1963), with two denticles on the ventral aspect of the fixed finger. The pedipalp chela is slender with long fingers, the surface smooth with carinae reduced or obsolete, and the dentate margins of the fingers are armed with linear, non-imbricated subrows of primary denticles, flanked by internal and external accessory denticles. The movable finger bears two enlarged subdistal internal denticles. The pedipalps are orthobothriotaxic, pattern type Aβ (Vachon 1974, 1975), the femur with trichobothrium d_2 on its dorsal surface, and the patella with d_3 internal to the dorsomedian carina. The chela manus has Eb_1-Eb_2 angled proximally, and Eb_1-Eb_2-Eb_3 acute angle opening in the distal direction (δ-configuration). Tibial spurs are present on legs III–IV, and basitarsi I–III bear regular series of macrosetae on retrosuperior, retroinferior and inferior margins. On the ventral surfaces of telotarsi are paired rows of macrosetae, and prolateral and retrolateral tarsal spurs are present on all legs. *Sexual dimorphism*: compared to females, males have a narrower mesosoma, more robust carination on tergites and sternites III–V, more slender pedipalps and metasoma, longer pectines with larger teeth, and weaker dentition or granulation on ventromedian carinae of metasoma II–III. Males are similar to females in lacking undulate dentate margins at the base of the pedipalp fingers.

Leiurus gubanensis sp. n.

(Figures 1–91, Table 1)

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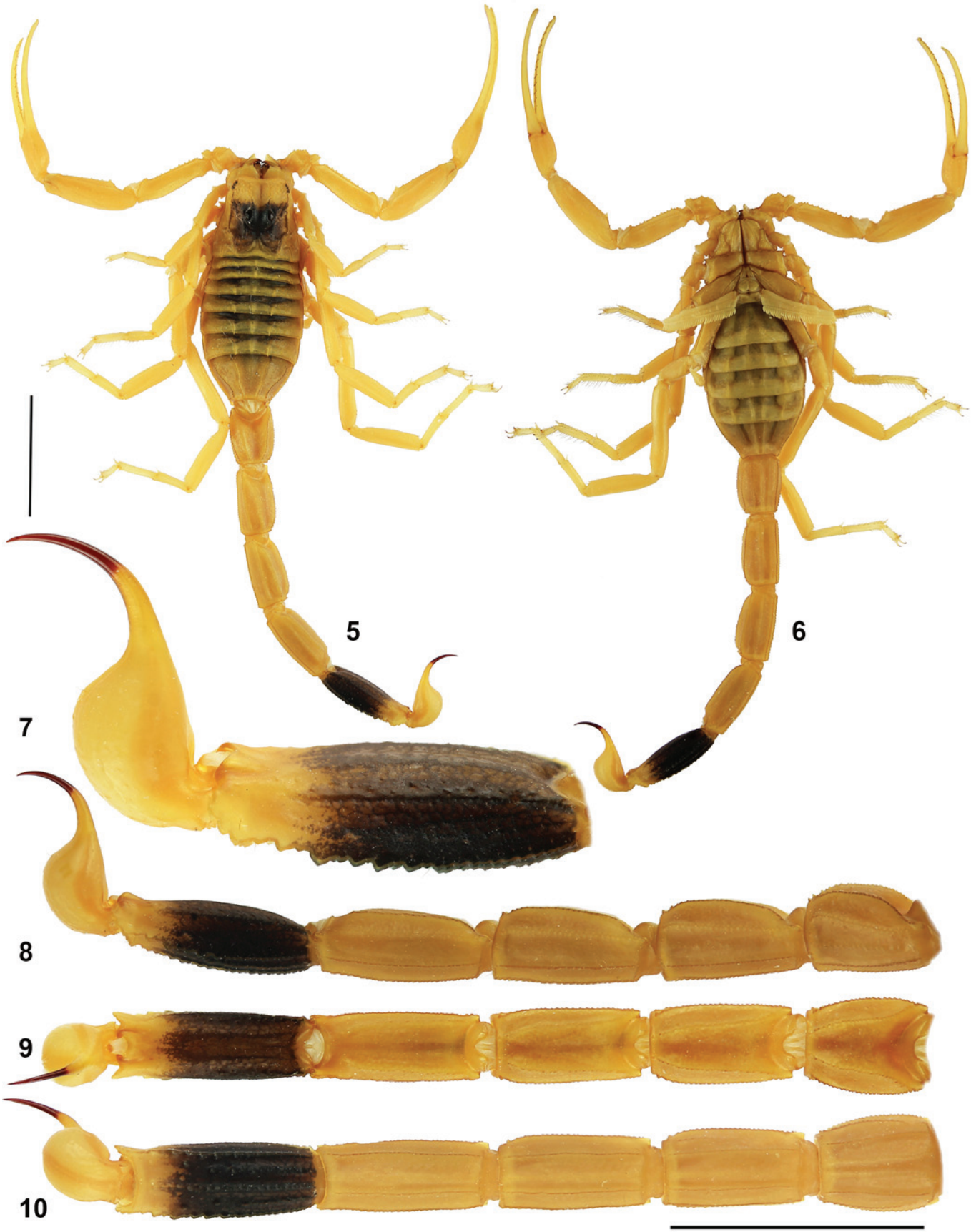
Type locality and type repository. Somaliland, 5 km S of Maid, 10°59'46"N 47°08'14"E, 182 m a. s. l. (Locality No. 18SF); FKCP.

Type material (FKCP). **Somaliland**, 5 km S of Maid, 10°59'46"N 47°08'14"E, 182 m a. s. l. (Locality No. **18SF**), 25.VIII.2018, 1♂ (holotype) 1♀1juv. (paratypes), leg. F. Kovařík; Maid, 11°00'03"N 47°06'30"E, 52 m a. s. l. (Locality No. **17SN**), 3.-4.IX.2017, 1juv. (paratype), leg. F. Kovařík; near Berbera, 10°16'01"N 45°06'21.3"E, 367 m a. s. l. (Locality **11SG**), 10.VII.2011, 1♂juv.2♀juvs.(paratypes) 1♀ (paratype, pedipalps only), leg. F. Kovařík et T. Mazuch.

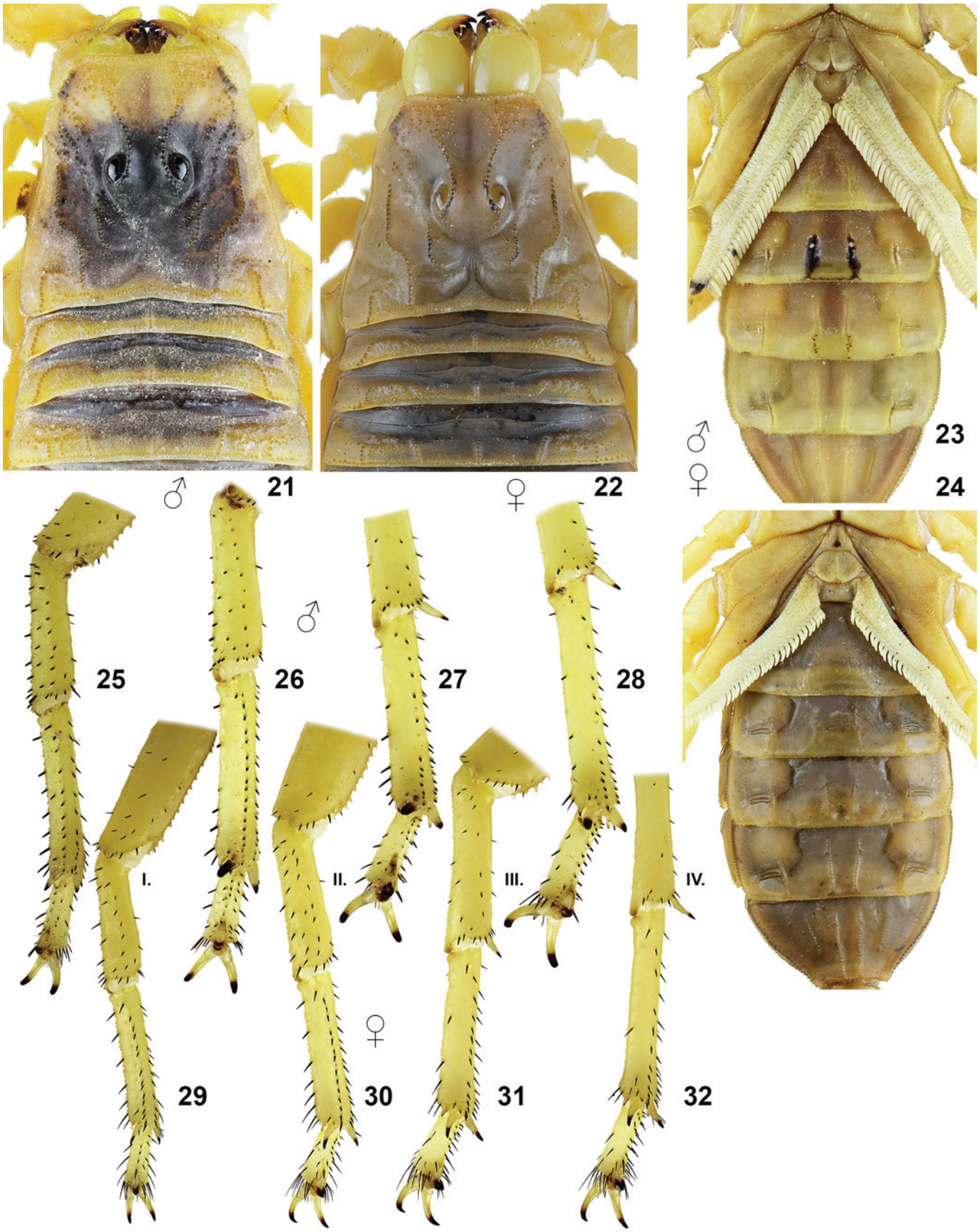
Etymology. Named after the Guban area ("guban" in Somali language means "burnt land"), a zone of hot, arid land along the sea between Djibouti and Puntland (Somalia). Both Maid and Berbera belong to the Guban area.

Diagnosis. Total length is 71 mm (male) – 92 mm (female), carapace length is 8.0–10.4 mm. The base color is yellow, including legs, pedipalps, metasoma I–IV and telson. The carapace, tergites and metasoma V have dark pigment, and the chelicerae are pale yellow without reticulation. The anterior

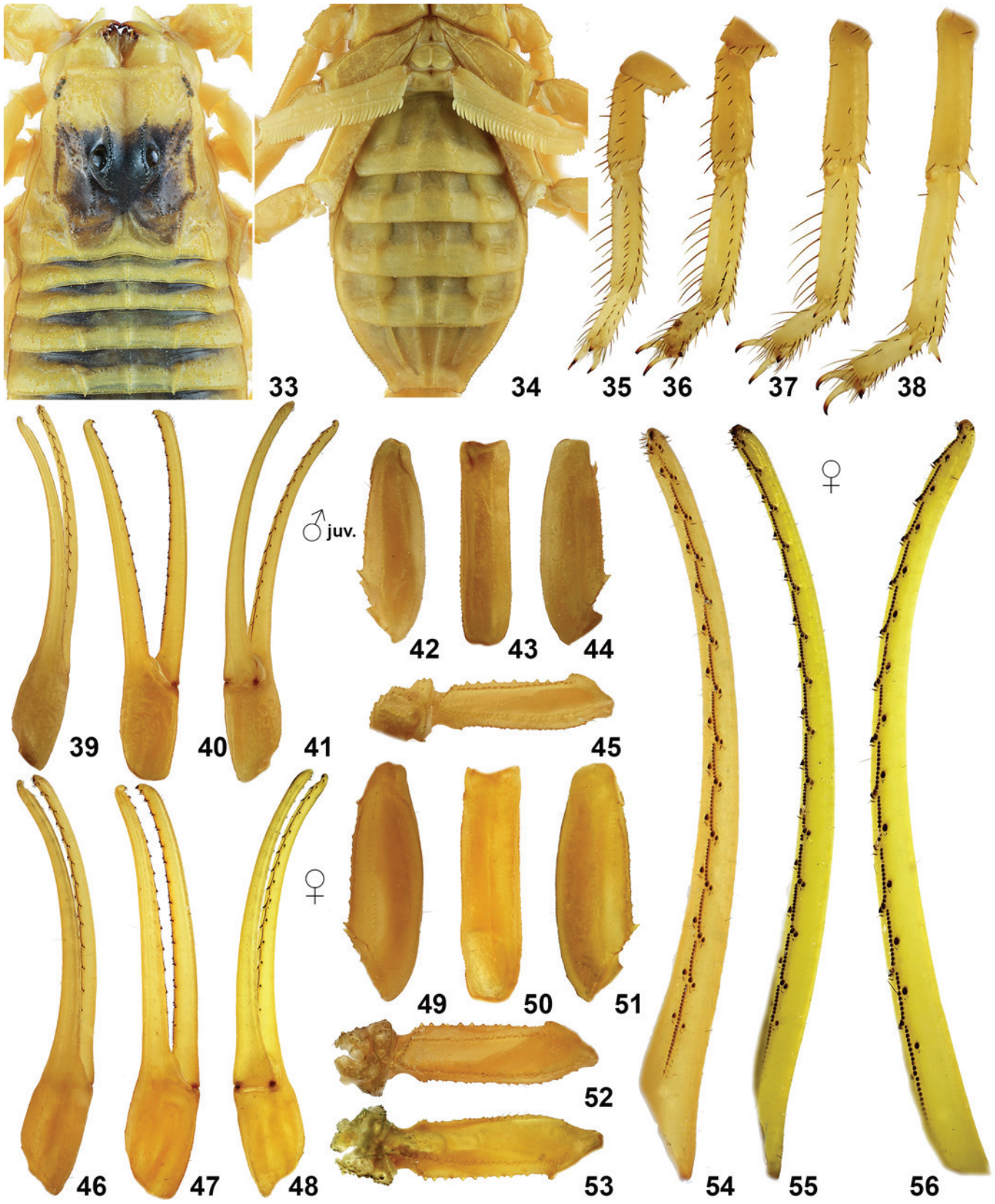


Figures 5–**10**: *Leiurus gubanensis* **sp**. **n**., male subadult paratype, 11SG. **Figures 5**–**6**. Dorsal (5) and ventral (6) views. **Figures 7**–**10**. Telson and metasoma V lateral (7), and metasoma and telson lateral (8), dorsal (9), and ventral (10) views. Scale bars: 10 mm (5–6, 8–10).

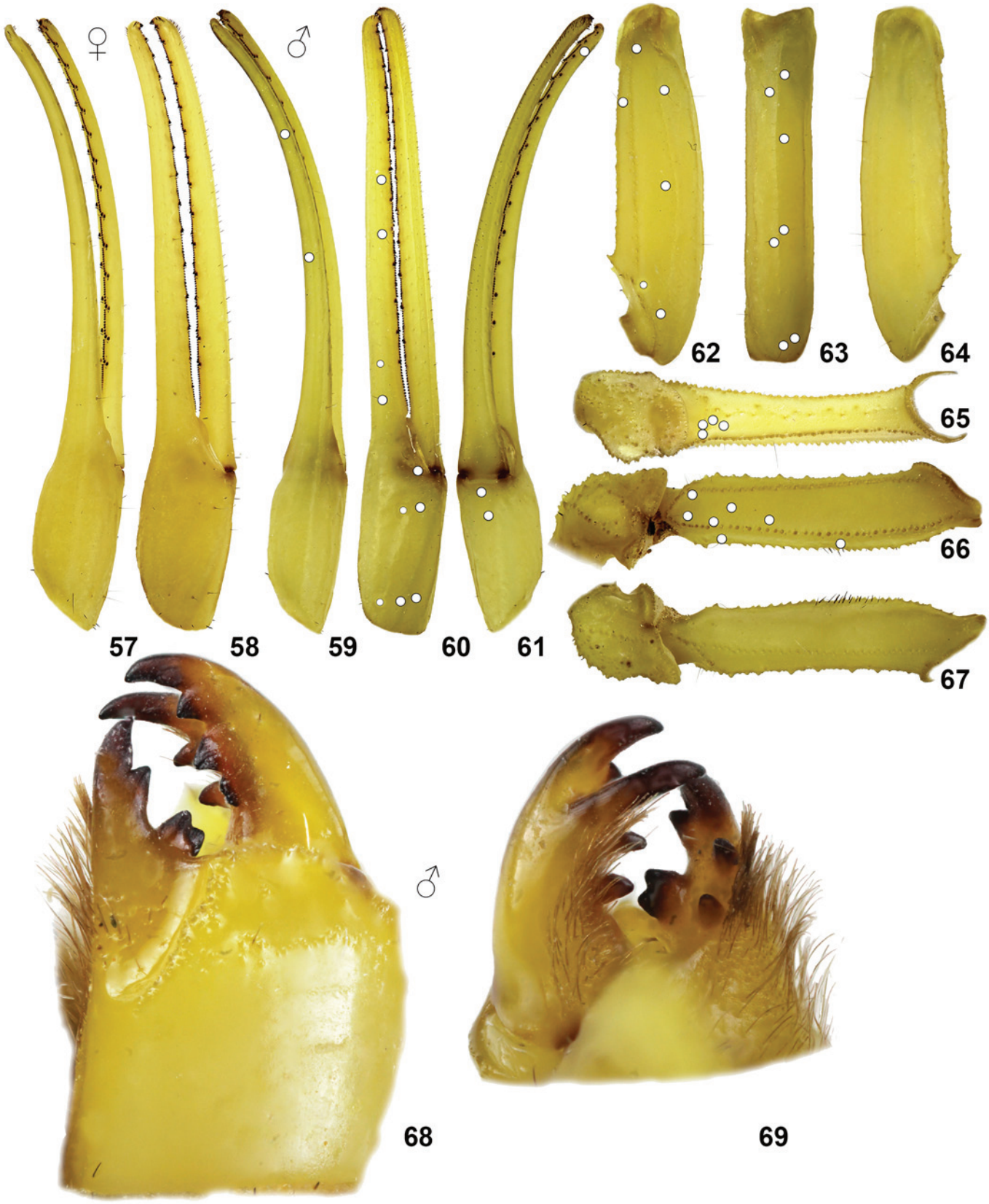
Figures 11–**20**: *Leiurus gubanensis* **sp**. **n**., 18SF. **Figures 12–13**, **15**–**17**. Male holotype, metasoma V and telson ventral (12) and lateral (13), and metasoma and telson lateral (15), dorsal (16), and ventral (17) views. **Figures 11**, **14**, **18**–**20**. Female paratopotype, metasoma V and telson ventral (11) and lateral (14), and metasoma and telson lateral (18), dorsal (19), and ventral (20) views. Scale bars: 10 mm (15–17, 18–20).



Figures 21–**32**: *Leiurus gubanensis* **sp**. **n**., 18SF. **Figures 21**, **23**, **25**–**28**. Male holotype, carapace and tergites I–III (21), coxosternal area and sternites (23), left legs I–IV, retrolateral aspect (25–28 respectively). **Figures 22**, **24**, **29**–**32**. Female paratopotype, carapace and tergites I–III (22), coxosternal area and sternites (24), left legs I–IV, retrolateral aspect (29–32 respectively).



Figures 33–**56**: *Leiurus gubanensis* **sp**. **n**., 11SG. **Figures 33**–**45**, **54**. Male subadult paratype, carapace and tergites I–IV (33), coxosternal area and sternites (34), left legs I–IV, retrolateral aspect (35–38 respectively), chela dorsal (39), external (40) and ventral (41) views, patella dorsal (42), external (43) and ventral (44) views, trochanter and femur dorsal (45), and movable finger dentition (54). **Figures 46**–**53**, **55**–**56**. Female adult paratype, chela dorsal (46), external (47) and ventral (48) views, patella dorsal (49), external (50) and ventral (51) views, trochanter and femur dorsal (52) and ventral (53) views, and movable (55) and fixed (56) finger dentition.



Figures 57–**69**: *Leiurus gubanensis* **sp**. **n**., 18SF. **Figures 57**–**58**. Female paratopotype, chela dorsal (57) and external (58) views. **Figures 59**–**69**. Male holotype, chela dorsal (59), external (60) and ventral (61) views, patella dorsal (62), external (63) and ventral (64) views, trochanter and femur internal (65), dorsaloexternal (66) and ventral (67) views, and right chelicera in dorsal (68) and ventral (69) views. Trichobothrial pattern is indicated by white circles (59–63, 65–66).

median carinae of the carapace do not extend to the anterior marginal granule row, and the area between the anterior median carinae bears sparse, fine granules. The area between posterior median carinae is depressed with a shallow furrow. The median ocular tubercle is very large, its width measured between outer margins of median eyes is over 0.35 times the midline carapace length. Tergites II–III bear dense, coarse to fine granulation on the medial intercarinal surfaces. The metasoma is slender, with morphometric ratios: segment II L/W 1.79–1.88, III L/W 1.97–2.13, and IV L/W 2.59–2.64. The ventromedian carinae of metasoma II and III bear 23–26 denticles. The pedipalps are slender, with morphometric ratios: chela L/W ♂ 8.52, ♀ 7.21, patella L/W ♂ 4.06, ♀ 3.65. The movable and fixed fingers of the pedipalps bear 13 rows of granules (including proximal row), the movable finger has 15 outer and inner denticles, and the fixed finger 15 outer and 14 inner denticles. Fixed finger trichobothrium *db* is proximal to *est*. Pectinal teeth number 35–39 in the males and 28–32 in the females. The ratio of mid-pectine sensillar margin L/ metasoma I W is: ♂ 0.205, ♀ 0.132. The legs are slender, leg III patella L/D 4.11 in female. Leg III basitarsus has 5–10 retrosuperior setae.

Description. The adults are 71 mm (male) – 92 mm (female) long. The habitus is shown in Figs. 1–6. For position and distribution of trichobothria of pedipalps see Figs. 59–63, 65–66.

Coloration (Figs. 1–6, 84–86). The base color is pale yellow, and melanic pigmentation is confined to patches around the median ocular tubercle and carinae of the interocular triangle. The ventromedian carinae of metasoma II–IV lack pigmentation, and metasoma V is darkened except for the most posterior portion of segment. The chelicerae are pale yellow without reticulation.

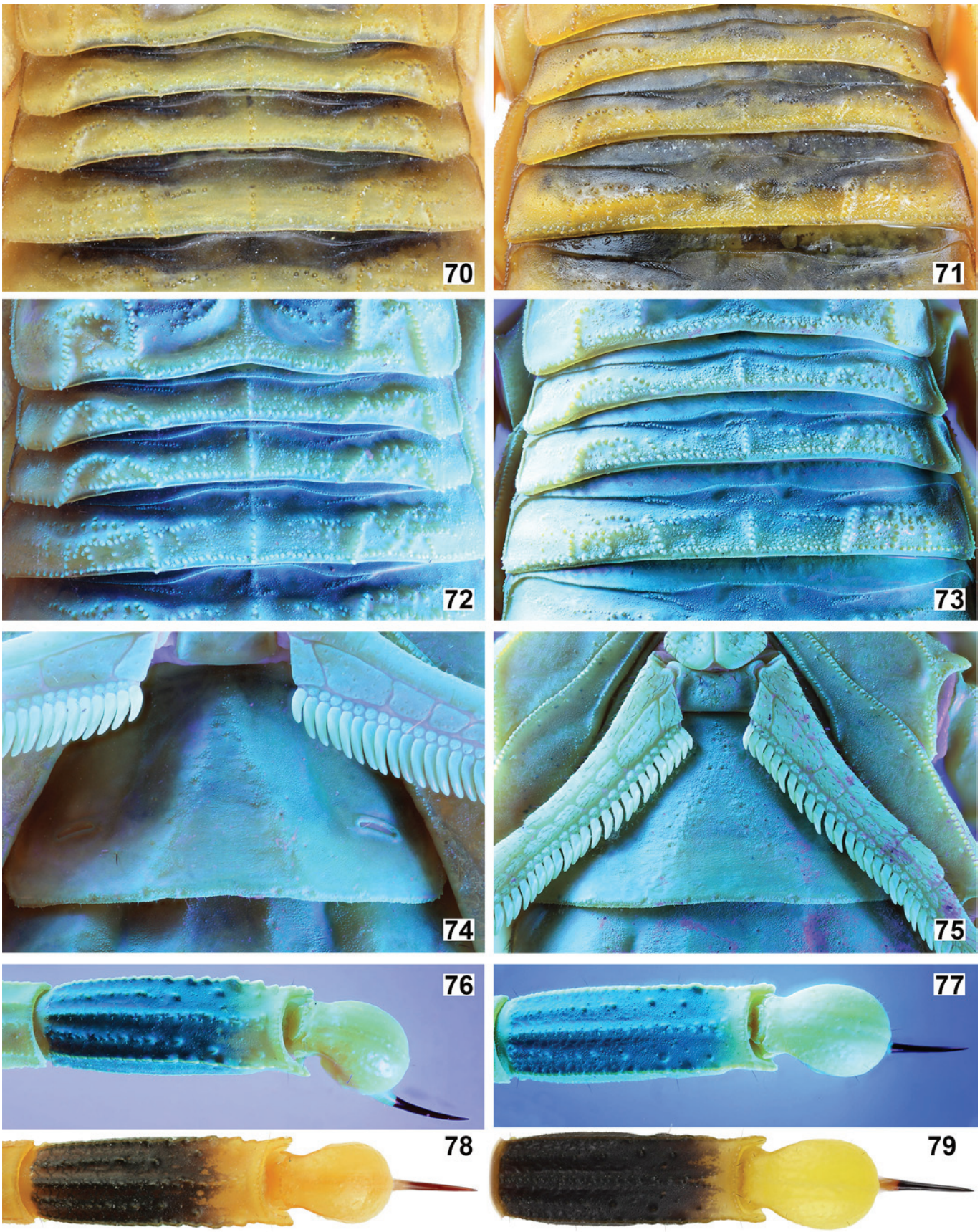
Carapace and mesosoma (Figs. 21–24, 33–34, 70–75). The carapace is subrectangular, with steeply sloped lateral flanks. The interocular triangle is convex laterally, depressed medially. The anterior margin of the carapace is almost straight, with fine granules or denticles across its width, and is bordered by a row of large granules. The median ocular tubercle is conspicuously large compared to the overall size of the carapace, the ratio of tubercle width (measured across outer ocular margins)/ mid-line carapace length is 0.35 in the holotype male, and 0.34 in the topoparatype female. Five lateral eyes (3 large, 2 small) are present on each side. The carinae are typical for the genus *Leiurus*, with anterior median, superciliary, central lateral, posterior median and posterior lateral carinae strong and coarsely granular. The anterior median carinae do not extend to the anterior marginal granule row, and the area between them has sparse, fine granules. The area between the posterior median carinae is depressed with a shallow median furrow. Tergites I–II bear 5 granular carinae, the median and inner lateral carinae being linear with medium to coarse granules, and the outer lateral carinae are aligned with the posterior lateral carinae of the carapace. Tergites III–VI bear 3 coarsely granulated carinae. The medial intercarinal surfaces of tergites II–III have dense, coarse to fine granulation. Tergite VII is pentacarinate, with all carinae strong and granular, and inner and outer lateral carinae are joined anteriorly by transverse granule rows. The sternites are finely shagreened. Sternite III–IV has median carinae well developed and finely granular in the male, rather reduced in females. Sternites V–VI bear moderate to strong, granulated lateral and median carinae, sternite VII strong, crenulate-granulate median and lateral carinae. The medial intercarinal surface of sternite VII is densely, finely shagreened. The pectinal tooth count is 35–39 in the males and 28–32 in the females. The pectinal marginal tips extend to half of the length of sternite V in the adult male, and a quarter of the length in females. The pectines have three marginal lamellae and 9–10 middle lamellae. The lamellae bear numerous fine, dark macrosetae, and each fulcrum has 3 – 6 fine, dark macrosetae. The pectine basal piece is lightly shagreened in both sexes.

Metasoma and telson (Figs. 7–20, 76–79). The first metasomal segment bears 10 complete carinae, the second through fourth segments eight complete carinae. The lateral surfaces of the second and third segments bear several granules in place of missing median lateral carinae. The fifth segment bears seven carinae. Carinae on segments I–IV are crenulate or have denticulate granulation. The intercarinal surfaces on segments I–IV are smooth, and segment V is smooth dorsally, and is sparsely finely shagreened laterally and ventrally. All segments are sparsely setose. The telson is smooth, bulbous, with aculeus slightly shorter than the vesicle.

Pedipalps (Figs. 39–67). The pedipalps are smooth or very finely granulated. The femur bears four to five carinae. The dorsoexternal, dorsointernal and ventrointernal carinae are strong with coarse, closely spaced dentate granules. The internal carina is incomplete, with irregular large sparse granules. A linear group of 10–16 accessory macrosetae is present on the lower distal external surface. The patella bears seven coarsely granular carinae. The dorsointernal carina is strong with coarse granulation, the dorsomedian carina moderate with fine granulation, and the dorsoexternal carina is weak, almost smooth. The external and ventroexternal carinae are smooth, the ventromedian carina is weak with fine granules, and the ventrointernal carina is strong, with well spaced medium-sized granules and a ventral patellar spur. The internal carina is strong with large dentate granules. The chela bears five weak to obsolete carinae, which may be incomplete. The pedipalp movable and fixed fingers bear 13 rows of granules, the movable finger has 15 outer and inner denticles, and the fixed finger 15 outer and 14 inner denticles.

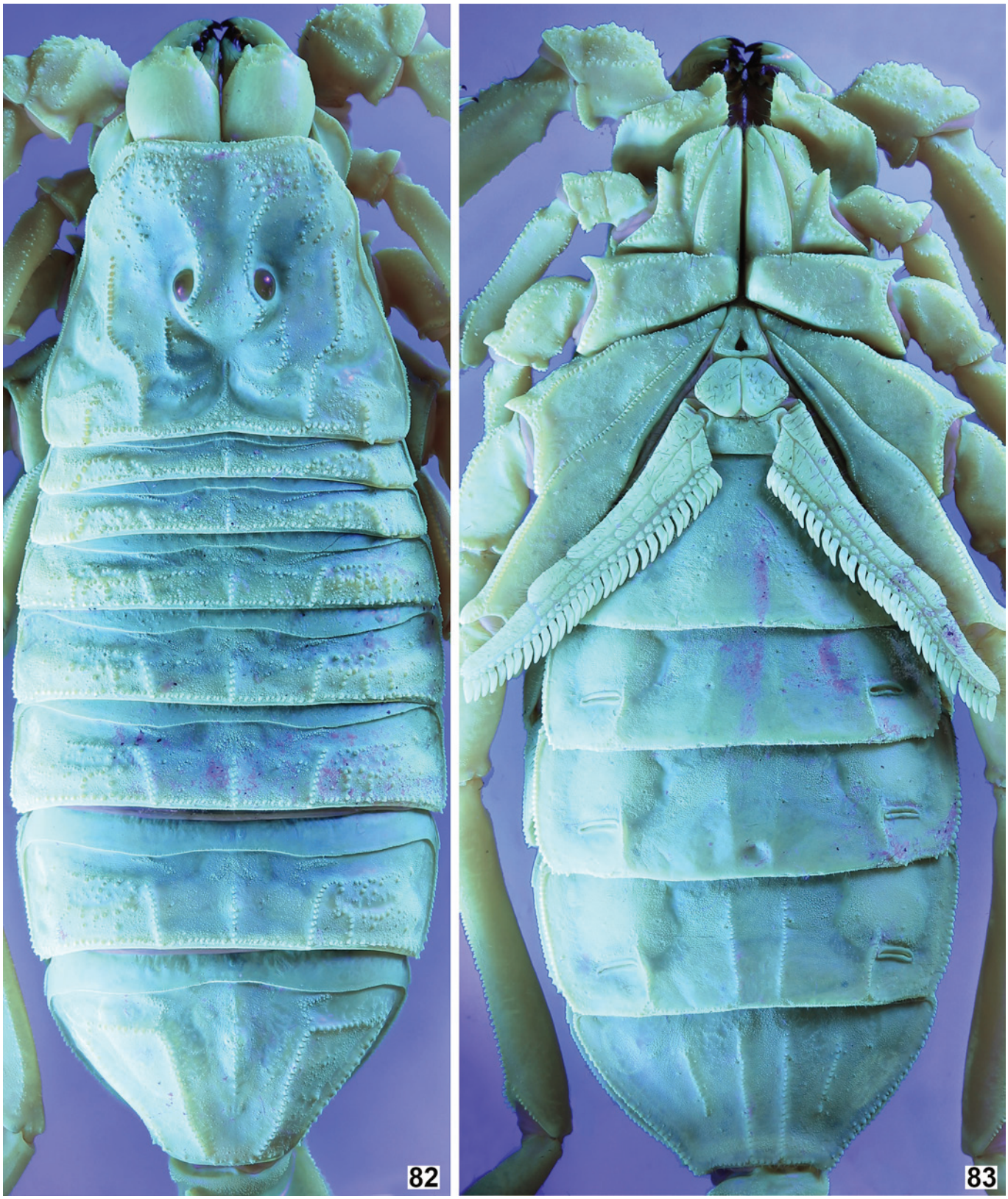
Legs (Figs. 25–32, 35–38). Leg pairs III and IV bear long tibial spurs. Retrolateral tarsal spurs are simple, non-setose, and prolateral tarsal spurs basally bifurcate, bearing 1–3 macrosetae. The telotarsi bear two rows of spiniform macrosetae on their ventral surfaces. Basitarsi I–III bear bristle-combs, and basitarsus III has 5–10 retrosuperior macrosetae.

Measurements. See Table 1.



Figures 70–79: *Leiurus gubanensis* **sp. n.**, comparison of key characters of male subadult paratype from 11SG (70, 72, 74, 76, 78) and female paratopotype from 18SF (71, 73, 75, 77, 79). **Figures 70–73**. Tergites I–III under white light (70–71) and UV fluorescence (72–73). **Figures 74–75**. Sternite III under UV fluorescence. **Figures 76–79**. Metasoma V and telson ventral under UV fluorescence (76–77) and white light (78–79).

Figures 80–81: *Leiurus gubanensis* **sp. n.**, 18SF, male holotype, carapace and tergites (80) and coxosternal area and sternites (81) under UV fluorescence.



Figures 82–83: *Leiurus gubanensis* **sp. n.**, 18SF, female paratopotype, carapace and tergites (82) and coxosternal area and sternites (83) under UV fluorescence.

Affinities. The described features distinguish *L. gubanensis* **sp**. **n**. from all other species of the genus. The key of Lowe et al. (2014: 4) would place *L. gubanensis* **sp**. **n**. closest to *L. brachycentrus* Ehrenberg, 1829 from Yemen and Saudi Arabia. Both have densely shagreened or finely granulated medial intercarinal surfaces on tergites II-III, and males have relatively long pectine teeth, a character also shared with *L. macroctenus* Lowe, Yagmur & Kovařík, 2014. They differ from *L. macroctenus* in that females have relatively short pectine teeth. Another character shared between *L. gubanensis* **sp**. **n**. and *L. brachycentrus* is proximal position of trichobothrium *db* relative to *est* on the pedipalp fixed finger. However, *L. brachycentrus* differs from *L. gubanensis* **sp**. **n**. in the following characters: metasoma V lightly pigmented (vs. dark); less slender pedipalps, legs and metasoma, as indicated by lower L/W and L/D morphometric ratios cited in Lowe et al. (2014: 105, tab. 3B) (vs. the ranges cited above in the diagnosis).

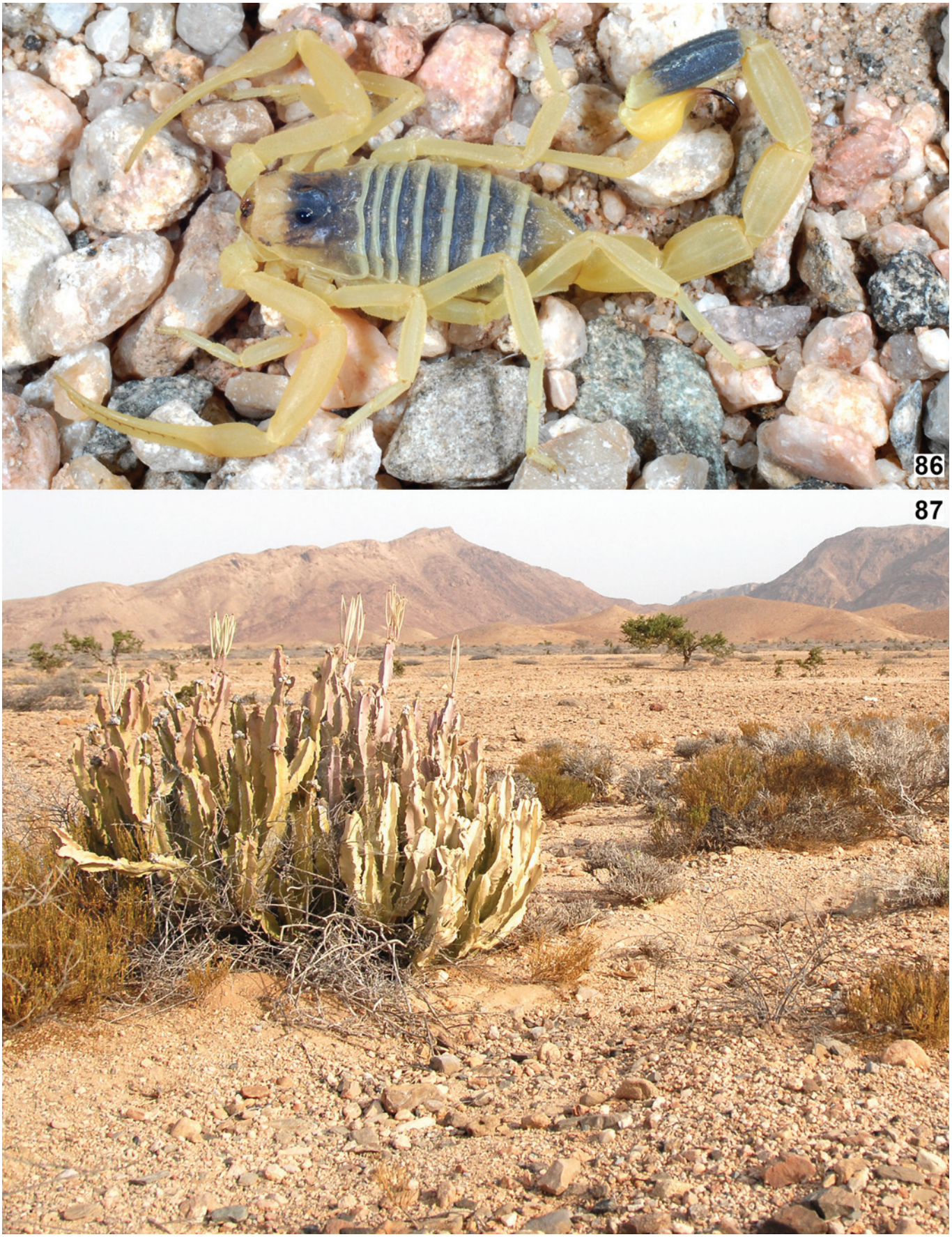
Two geographically closer species on the African continent are *L. quinquestriatus* Ehrenberg, 1828 from Sudan and Egypt, and *L. somalicus* Lourenço & Rossi, 2016, from Somalia (see Fig. 88). Together with *L. gubanensis* **sp**. **n**., all three have rather elongated, slender pedipalps, legs and metasoma. However: (i) *L. quinquestriatus* differs from *L. gubanensis* **sp**. **n**. in the following characters: in females, sternite III has median carinae strongly developed (cf. figs. 78B, 92J in Lowe et al., 2014) (vs. weak or obsolete; Figs. 75, 83); higher numbers of retrosuperior macrosetae on basitarsus III (8–16 vs. 5–10); and carapace posteromedian granule arcs reduced or absent (vs. well developed); (ii) *L. somalicus* differs from *L. gubanensis* **sp**. **n**. in the following characters: melanic pigment on carapace confined centrally, not extending to posterior margin; less elongated metasoma, metasoma II L/W 1.68–1.72, II L/W 1.86–2.00, IV L/W 2.31–2.32 (vs. ranges cited above in the diagnosis). Moreover, in both *L. quinquestriatus* and *L. somalicus*, trichobothrium *db* is distal to *est* on the pedipalp fixed finger (vs. proximal).

While several characters are proposed here to differentiate *L. somalicus*, from *L. gubanensis* **sp**. **n**., a number of other key characters previously useful in *Leiurus* taxonomy (Lowe et al., 2014) remain unscored. They were omitted from the description of Lourenço & Rossi (2016), which listed mostly genus-level and buthid family-level characters. For species diagnosis, the authors relied on coloration, pectinal tooth count, number of granule rows on pedipalp fingers, and sternite carination and granulation. The latter have indeed proven useful in differentiating some *Leiurus* species (Lowe et al., 2014), but other characters may vary intraspecifically, or have overlapping ranges interspecifically. The authors suggested that *L. somalicus* has an affinity with *L. haenggii* without specifying which shared characters supported this view. They further wrote that the two differ by "distinct morphometric values", again without details. If there is such an affinity, then it is worth noting that *L. gubanensis* **sp**. **n**. is clearly separable from *L. haenggii* by having dense granulation on tergites II–III, longer pectine teeth (as quantified by sensillar margin ratios) and fewer basitarsal retrosuperior macrosetae. Lourenço & Rossi (2016) dismissed some characters in the dichotomous key of Lowe et al. (2014) as being "rather difficult to be used" and "sometimes ambiguous and not easy to be interpreted". They did not elaborate on the problems to help improve the key in future work. We point out that diagnostic characters in that paper were fully defined in the text, including biometrics, and the granulation and carination characters extensively illustrated by UV fluorescence imaging (Prendini, 2003; Volschenk, 2005). A taxonomic key is applicable to those species or populations that were examined to construct the key, but new species or different populations may lie outside its scope.

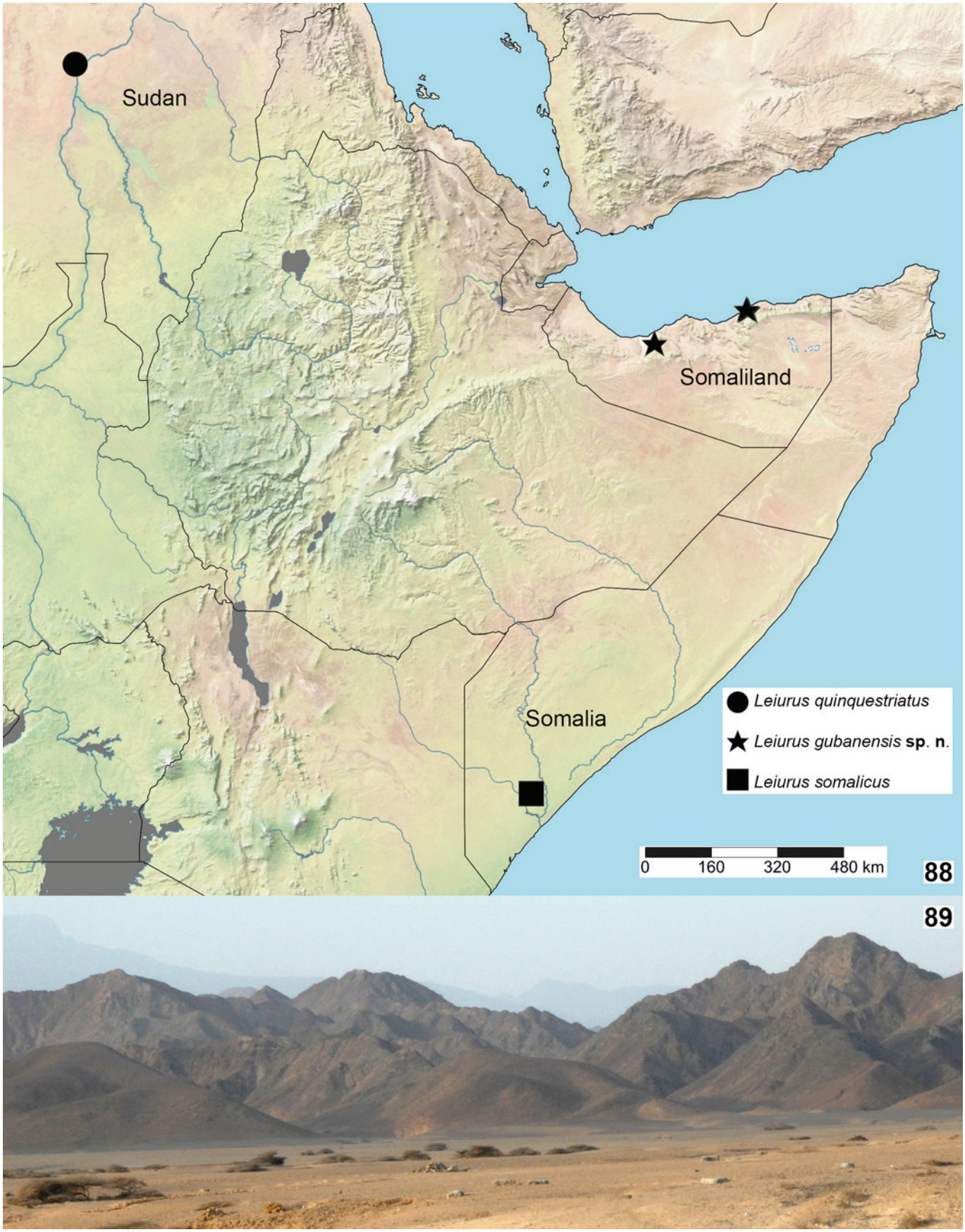
L. gubanensis **sp**. **n**. can also be distinguished from other *Leiurus* spp. by characters utilized in Lowe et al. (2014). *L. haenggii* Lowe et al., 2014, *L. arabicus* Lowe et al., 2014 and *L. heberti* Lowe et al., 2014 collectively differ in having medial intercarinal surfaces of tergites II–III smooth or sparsely shagreened, without dense granulation. *L. hebraeus* (Birula, 1908) and *L. abdullahbayrami* Yagmur, Koc & Kunt, 2009, both differ in having less slender pedipalps, legs and metasoma, and smaller numbers of denticles (i.e., 7–19) on ventromedian carinae of metasoma II–III. Ventromedian denticle counts on II–III were first utilized by Levy et al. (1970) in their quantitative study of *Leiurus*, and can separate species with more elongate vs. more stout metasomal segments. *L. jordanensis* Lourenço, Modrý & Amr, 2002, is similar to *L. gubanensis* **sp**. **n**. in having elongated appendages and metasoma, but differs markedly in its overall dark coloration, higher numbers of retrosuperior macrosetae on basitarsus III (18–20) and ventromedian denticles on metasoma II (31–36), and in having pedipalp chela fixed finger *db* distal to *est*.

Three other species described from Africa also have slender appendages and metasoma comparable to those of *L. gubanensis* **sp**. **n**. They can be distinguished as follows: (i) *L. savanicola* Lourenço, Qi & Cloudsley-Thompson, 2006, from Cameroon, known only from the holotype male (https://science.mnhn.fr/institution/mnhn/collection/rs/item/rs8979), differs in having the telson vesicle less bulbous with shallower posterior slope; in several morphometric ratios, e.g., metasoma V L/D 3.6 (vs. 3.2), metasoma V L/ carapace L 1.2 (vs. 1.1), pedipalp femur L/W 4.01 (vs. 4.41), pedipalp patella L/W 3.77 (vs. 4.01); in having pedipalp fixed finger *db* distal to *est*; and shorter male pectine teeth (♂ mid-pectine sensillar margin L/metasoma I W ca. 0.13, vs. 0.205); (ii) *L. hoggarensis* Lourenço, Kourim & Sadine, 2018, from Algeria differs in its carapace color pattern; having pedipalp fixed finger *db* distal to *est* (vs. proximal); 11–12 granule rows on pedipalp fingers (vs. 13); and lower pectinal tooth counts (♂ 26–29, ♀ 32–34); (iii) *L. ater* Lourenço, 2019, from Chad, differs in its uniformly dark coloration, and in having the telson vesicle less bulbous with shallower posterior slope and longer aculeus. Another potential difference for *L. ater* is the positioning of pedipalp fixed finger *db* distal to *est*, illustrated in Lourenço (2019: 137, fig. 9). However, we find the trichobothrial map in that figure surprising and peculiar because it places *db* at

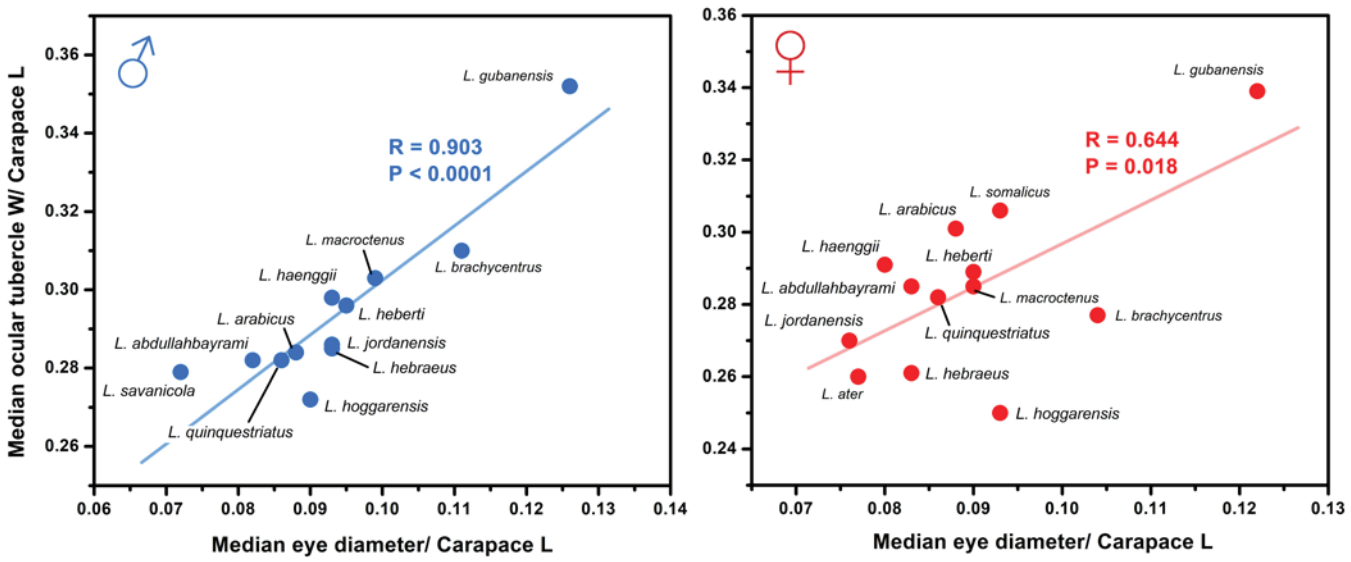
Figures 84–85: *Leiurus gubanensis* **sp. n.**, 18SF, male holotype (84) and female paratopotype (85) in vivo habitus.



Figures 86–87: *Leiurus gubanensis* **sp. n.**, 11SG, male subadult paratype (86) in vivo habitus and its locality (87).



Figures 88–89: **Figure 88**. Distribution of *Leiurus gubanensis* **sp**. **n**., *L. quinquestriatus* and *L. somalicus* in the region. **Figure 89**. Type locality (18SF) of *L. gubanensis* **sp**. **n**.



Figures 90–91: Scaling of relative size of median ocular tubercle with relative size of median eyes in the genus *Leiurus*. Ordinates of **s**catter plots are the ratio median ocular tubercle width/ carapace L, and abscissas are the ratio median eye diameter/ carapace L, in males (90) and females (91). Plotted symbols represent measurements from a single sample of each species, extracted or estimated from published images and data, or from our own material. Lines are least squares regression fits, and the corresponding correlation coeeficients R, and P-values are indicated. In both sexes, *L. gubanensis* **sp. n.** is well separated from other species in having the largest eyes in the genus.

a very distal position, some distance distal even to *et* (*db* is shown at ca. 77% of the distance from base to tip of fixed finger). This condition is an extreme deviation from all other known species of *Leiurus*, which have *db* not far from mid-finger (range ca. 33–60% of the distance from base to tip) and invariably proximal to *et*. As a rule, the majority of members of the Old World 'Buthus' group (including *Leiurus*) have *db* proximal to *et*. We find that *db* attains a position level with, or scarcely distal to *et*, in only a few cases (e. g. certain *Hottentotta* sp. with more elongated fingers). In fact, the fixed finger configuration shown in Lourenço (2019: fig. 9) is characteristic of New World genera *Tityus* and *Centruroides*, not of Palaearctid buthids. We prefer to leave this character unscored until it can be independently confirmed.

An additional, new character that sets *L. gubanensis* **sp. n.** apart from other known species of *Leiurus* is the prominently large size of both the median ocular tubercle and the median eyes. In relative terms, the ratio of median eye diameter (*D*)/ midline carapace L was ♂ 0.126, ♀ 0.122, which exceeded the corresponding ratios of all other species (range 0.72–0.111, both sexes). Remarkably, absolute diameters of adult *L. gubanensis* **sp. n.** (*D* = 0.96 mm ♂, 1.19 mm ♀) were also greater than in all other species, even though many of the others have larger body sizes and longer carapace lengths. Eye sensitivity is proportional to the square of the entrance pupil diameter (Land, 1981), which in scorpion median eyes is determined by eye diameter. In *L. gubanensis* **sp. n.**, the value of D^2 surpasses that of other *Leiurus* spp. by factors of: ♂ 1.37–2.95, ♀ 1.56–3.39. At a given focal length, a wider aperture means the lens f-number (focal length/ *D*) is proportionately decreased, which improves light collection. In *Androctonus australis*, *D* ~ 0.5 mm and f-number is estimated to be < 0.5, which contributes to high sensitivity (Fleissner & Fleissner, 1985). At the same focal length, the aperture of ca. 1 mm in *L. gubanensis* **sp. n.** could theoretically yield an f-number < 0.25. However, focal length may vary across species. In *L. gubanensis* **sp. n.** the relative size of the median ocular tubercle, measured by the ratio of its width/ midline carapace L, was ♂ 0.352, ♀ 0.339, and this was greater than in other species which varied over a range of 0.250–0.310 (both sexes). Median ocular tubercle relative width was interspecifically correlated with eye diameter *D* in both males (R = 0.903, P < 0.0001) and females (R = 0.644, P = 0.018) (Figs. 90–91). This suggests that spheroidal eye volume within the tubercle, and probably also focal length, scales up with increasing eye diameter across different taxa, to maintain a roughly constant f-number. Retinal area would scale up accordingly, as would eye sensitivity if the retinular units or their component photoreceptors increased in size. Alternatively, if retinular units are of fixed size, then their number must increase and this will enhance spatial resolution. Endowed with median eyes having superior light sensitivity and/ or image acuity, *L. gubanensis* **sp. n.** may be unique in possessing the best nocturnal vision in the genus.

Comments on localities and life strategy. The type locality, 18SF is at foothills, bordering between sandy semidesert and rocky terrain (Fig. 89). Type specimens were recorded at night during UV collecting on rocks together with *Compsobuthus maidensis* Kovařík, 2018 and *Orthochiroides* cf. *vachoni* Kovařík, 1998. The morphological characters of *L. gubanensis* **sp. n.**, including long slender pedipalps, legs and metasoma, and low numbers of basitarsal macrosetae, are consistent with lithophile ecomorphotypes characteristic of

rocky habitats. However, the species was also found in sandy semidesert on the sea shore ca 5 km from the type locality (locality No. 17SN, fig. 38 in Kovařík, 2018: 8) at night during UV collecting, together with *Gint maidensis* Kovařík et al., 2018 (type locality), *Compsobuthus maidensis* Kovařík, 2018 (type locality), *Neobuthus maidensis* Kovařík et al., 2018 (type locality), *Parabuthus granimanus* Pocock, 1895, and *Hottentotta* sp. Both of these sites are very hot with daytime temperatures around 50 ºC. We (FK) visited both localities only at night. At 21:00 h the air temperature was 38.6 ºC and the humidity 52%. Minimum nighttime temperature of 31.9 ºC and humidity of 46% were recorded in the early morning. The locality 11SG (Fig. 87) is sandy to rocky desert in the vicinity of Berbera in northwestern Somaliland, also in the Guban area, whose southern edge lies in close proximity to the Goolis and Ogo Mountain Range. This low-lying area is extremely warm and dry. July temperatures at the locality were ca 50°C during the day and 35–40°C at night. We collected in this locality during the day and recorded from there a paratype of *Hemiscorpius novaki* Kovařík & Mazuch, 2011 (fig. 11 in Kovařík & Mazuch, 2011: 3), as well as the species *Parabuthus granimanus* Pocock, 1895, *Hottentotta polystictus* (Pocock, 1896), and *Neobuthus berberensis* Hirst, 1911.

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