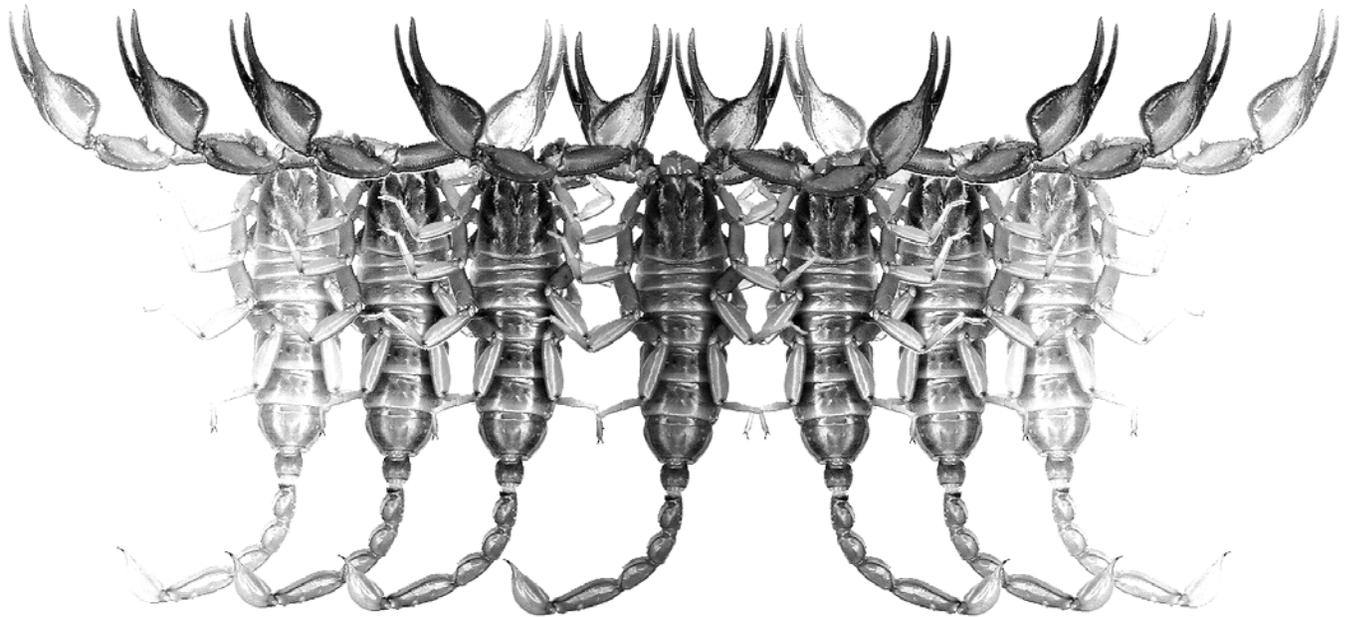


Euscorpius

Occasional Publications in Scorpiology



**Two New Species of *Hottentotta* Birula, 1908
(Scorpiones: Buthidae) from Northern Oman**

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Euscorpius

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Two new species of *Hottentotta* Birula, 1908 (Scorpiones: Buthidae) from northern Oman

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Summary

Two new endemic species of *Hottentotta* Birula, 1908, are described from the Al Hajar Mountains of northern Oman: *H. pellucidus* **sp. nov.**, from the Shir Plateau of Jabal Bani Jabir in the eastern Al Hajar, characterized by: medium size, uniform yellow color, dense cover of long and short macrosetae on pedipalps, legs and metasoma, only two macrosetae on tergite posterior margins, and slender male pedipalp chelae with very weakly scalloped fingers; and *H. saxinatans* **sp. nov.**, from Jabal Akhdar in the western Al Hajar, characterized by: medium size, uniform yellow color with faint fuscosity on metasomal carinae, nearly bare body and appendages with few short macrosetae, and slender male pedipalp chelae with unscalloped fingers. Both are lapidicolous or lithophilic scorpions, inhabiting very rocky terrain. Their disjunct distribution in high altitude refugia suggests that they are relict species, descendants of a more widespread fauna adapted to temperate climates in the Pleistocene or post-glacial times.

Introduction

The genus *Hottentotta* Birula, 1908 encompasses a heterogeneous assemblage of medium to large sized buthid scorpions with a vast geographic distribution in northern and southern Africa, the Middle East and Asia (Vachon & Stockmann, 1968; Lamoral, 1979; Levy & Amitai, 1980; Fet & Lowe, 2000; Kovařík, 2007). Individual species however, have more restricted ranges, and in the southern Arabian Peninsula only three species have been recorded: *H. scaber* (Ehrenberg, 1828) from Yemen, *H. jayakari* (Pocock, 1895) from the Al Hajar Mountains of northern Oman, and *H. salei* (Vachon, 1980) from the Dhofar Mountains of southern Oman and Yemen (Vachon 1977, 1980; Kovařík, 2007). These species appear to be closely related, and the latter two were originally classified as subspecies of *H. jayakari*. Many *Hottentotta* are well adapted to rocky substrates, and additional species might be expected to occur in mountainous habitats of Oman. During a survey of scorpion fauna by ultraviolet detection, two distinctive new species were found inhabiting high altitude refugia of the Al Hajar Mountains. These discoveries significantly increase the known diversity of this genus in southern Arabia.

Methods

Scorpions were collected by ultraviolet (UV) detection at night and preserved in the field by standard methods (Williams, 1968; Stahnke, 1972; Sissom, Polis & Watt, 1990). Locality data were recorded using

portable GPS units (Garmin). Specimens were examined under a dissecting microscope, either air dried or submerged in 70% isopropyl alcohol, under white light illumination or UV epifluorescence (Prendini, 2003; Volschenk, 2005). Measurements were made with an ocular reticule or digital calipers, following biometric definitions in Lamoral (1979) and Sissom, Polis & Watt (1990) with the following modifications: carapace anterior width taken between medial pair of lateral eyes; telson and vesicle lengths taken from anterior limit of vesicle to tip of aculeus, and to inflexion point on posterior slope of vesicle, respectively, with dorsal surface of vesicle level; pedipalp chela length taken as chord length from external proximal limit of manus to apex of fixed finger; pedipalp chela manus width and depth measured with articular condyles level. The preocular length is defined as the distance from the center of the median ocular tubercle to the anterior margin of the carapace. Carinal terminology follows Stahnke (1970), with metasomal amendments by Prendini (2001b, 2004), with paired dorsal carinae on metasoma V termed 'dorsolateral', and pedipalp chela amendments by Soleglad & Sissom (2001). Trichobothrial notation follows Vachon (1974, 1975). Hemispermaphore terminology follows Lamoral (1979).

Abbreviations

Specimen depositories: BMNH, Natural History Museum, London, United Kingdom; MNHN, Muséum National d'Histoire Naturelle, Paris, France; NHMB, Naturhistorisches Museum Basel, Basel, Switzerland;

ONHM, Oman Natural History Museum, Muscat, Oman. *Private collections*: FKCP, František Kovařík, Prague, Czech Republic; GL, collection of the author. *Biometrics*: L, length; W, width; D, depth.

Systematics

Hottentotta pellucidus, sp. nov.

Figs. 1–26, 53–54, 57–59, 65–66, Tab. 1

Holotype: adult ♂, Oman, Jabal Bani Jabir, UV detection on rocky terrain, rock strewn plateau with small wadis, on bare rock, 22°49.76'N 59°01.47'E, 1620 m a.s.l., 14 September 1995, 23:10 h, leg. G. Lowe, M.D. Gallagher & J. Dundon, NHMB.

Paratypes: Oman: 1 ♂, Jabal Bani Jabir, under stone, limestone plateau, 22°50'N 59°02'E, 1650 m a.s.l., 6 November 1992, leg. A.S. Gardner, SQU41, NHMB; 2 ♂, Jabal Bani Jabir, UV detection, 22°49'N 59°02'E, 1800 m a.s.l., September 1995, leg. A. François & C. Delise, ONHM; 9 ♂, 10 ♀, 7 juveniles, Jabal Bani Jabir, UV detection, stationary on rocks and ground under rocks, loose rock strewn plateau with small wadis, sparse vegetation, few bushes, grass, region of burial towers, 22°49.6'N 59°01.59'E, 1640 m a.s.l., 14 September 1995, 19:40 h, leg. G. Lowe, M.D. Gallagher & J. Dundon, NHMB, GL, ONHM; 15 ♂, 7 ♀, 10 juveniles, same locality as holotype, NHMB, MNHN, BMNH, FKCP; 1 ♀, Ras Al Hamra, 23°38'N 58°30'E, May 1998, leg. C. Rose, NHMB; 1 ♀, Jabal Bani Jabir, UV detection, rocky slope, 22°49.86'N 59°01.36'E, 1686 m a.s.l., 14 December 2001, 15:30–17:30 h, leg. A. Winkler, NHMB; Jabal Bani Jabir, UV detection, rocky slope, between rocks, 22°49.6'N 59°01.36'E, 1695 m a.s.l., 12 December 2001, 18:30–21:30 h, leg. A. Winkler & B. Winkler, NHMB.

Diagnosis. Medium sized *Hottentotta* (Sissom, 1990; Kovařík, 2007; Sun, Zhu & Lourenço, 2010), adults 56–70 mm; color uniform pale yellow without contrasting markings; carapace and tergites with strong, granular carinae; anterior margin of carapace with coarse granules; tergites tricarinate, posterior margins with carinae protruding in short spiniform processes; pedipalp femur, pedipalp patella, legs, metasoma and telson conspicuously hirsute, with numerous long and short macrosetae; metasoma with numerous intercarinal macrosetae; genital opercula densely setose; pedipalp chela finely hirsute with mostly short macrosetae; posterior margin of tergites I–VI mostly bare, usually with just one pair of short macrosetae internal to lateral carinae; pedipalps slender, femur L/W 3.6–4.4, patella L/W 3.0–3.5, chela L/W 5.9–6.5; pedipalp chela without carinae; pedipalp fixed finger primary denticles divided into 13–14 subrows (98 % of cases), movable finger

primary denticles divided into 14–15 subrows (98 % of cases); male pedipalp fingers without strong basal scalloping; metasoma moderately robust, segment L/W ratios: metasoma I 1.01–1.15, metasoma II 1.24–1.40, metasoma III 1.29–1.48, metasoma IV 1.50–1.85, metasoma V 2.02–2.40; metasoma I–III with 10 carinae, median lateral carinae complete but weak on segment III; lateral surfaces of metasoma I–IV coarsely granulated; pectine teeth in males 29–35, in females 25–33.

Etymology. The specific epithet refers to the uniform, pale yellow, semi-translucent body, which contrasts with the varied dark coloration of many other members of the genus.

Comparisons. Other species of *Hottentotta* with pedipalps bearing numerous long macrosetae are differentiated as follows: *H. franzwerneri* (Birula, 1914), *H. gentili* (Pallary, 1924), *H. saulcyi* (Simon, 1880) and *H. schach* (Birula, 1905): larger scorpions (70–130 mm), dark color on carapace or body, tergites with numerous macrosetae, male with more swollen pedipalp chela manus; *H. zagrosensis* Kovařík, 1997 and *H. lorestanus* Navidpour et al., 2010: larger scorpions (> 100 mm), body entirely black, tergites with numerous macrosetae; *H. jabalpurensis* Kovařík, 2007: male with more swollen pedipalp chela manus, tergites with numerous macrosetae; *H. scaber* (Ehrenberg, 1828): light and dark color pattern, metasoma with sparse setation, metasoma I–III more stout; *H. flavidulus* Teruel et Rein, 2010: similar to *H. pellucidus* in being a smaller *Hottentotta* with uniform yellow coloration, but metasoma is more stout and lacks dense setation.

In Oman, the hirsute species *H. jayakari* (Pocock, 1895) and *H. salei* (Vachon, 1980) differ as follows: larger species (60–90 mm), dark pigmentation on body and pedipalps; denser pilosity on legs and pedipalps; numerous macrosetae on entire posterior margins of tergites I–VI; metasomal segments of adults more robust, with more sparse intercarinal setation (*H. salei*) or bare, lacking macrosetae (*H. jayakari*); lateral intercarinal surfaces of metasoma I–IV smooth, not granulated; male pedipalp chelae with more swollen manus and distinct scalloping at base of fingers.

Description (holotype male unless otherwise specified).

Coloration (Figs. 1–4). Base color pale translucent yellow; without contrasting markings; melanic pigmentation confined to median and lateral eyes; denticles of chelicerae and pedipalp fingers, articular condyles of pedipalp movable fingers, tarsal unguis and aculeus of telson castaneous.



Figures 1–4: *H. pellucidus*, sp. nov., habitus, 1–2, holotype male; 3–4, paratype female. 1, 3. Dorsal aspect. 2, 4. Ventral aspect. Scale bar: 10 mm.

Carapace (Figs. 1, 5). Subquadrate, only slightly wider than long, dorsoventrally compressed, lateral flanks moderately sloped; median eyes slightly raised; lateral eyes with 5 ocelli (3 large, 2 small); anterior margin concave, smooth except for weak median denticulations, bordered by coarse granules; *carination*: anterior median, central median and posterior median carinae strongly developed, coarsely granular; central lateral and lateral ocular carinae less distinct, granular; central median and posterior median carinae not collinear, but connected by short transverse series of 4–6 granules; supraocular part of superciliary carinae smooth, post-ocular part with enlarged granule; other carinae indistinct; *chaetotaxy*: short macrosetae present on anterior part of carapace, 12 along anterior margin, 7 among anterior bordering granules, 1–2 behind lateral eyes, 2 on anterior median carinae; *granulation*: group of coarse granules on anterior interocular triangle behind lateral eyes; lateral flanks with coarse granulation; posterior median intercarinal area mostly smooth, with scattered fine granules; area between anterior median carinae smooth; posterior margin of carapace bordered by row of fine granules between posterior median carinae.

Chelicera (paratype male) (Figs. 6–7). Dorsal surface of manus smooth, glabrous, with transverse row of coarse, subdistal granules; base of fixed finger with prominent dorsointernal carina bearing coarse granules; *chaetotaxy*: manus with pair of short pale microsetae on apical border; long reddish macroseta on dorsointernal carina, shorter reddish macroseta medially located on subdistal granule row; dorsal surface of movable finger with 5 short pale microsetae in distal half; manus ventrally smooth, bearing numerous long, fine microsetae, sparser medially, denser on medio-internal aspect, merging with dense setal brush on ventral aspect of fixed finger; dense fine setae extend to medial and dorsomedial surfaces at base of fixed finger; ventral surface of movable finger densely setose; *dentition*: fingers with normal buthid dentition (Vachon, 1963; Sissom, 1990); fixed finger with large distal tine, subdistal denticle and large proximal bicuspid, two prominent denticles on ventral surface; movable finger with large dorsal and ventral distal tines; dorsal margin of movable finger with two large triangulate denticles and small proximal bicuspid, ventral margin with two robust denticles.

Coxosternal area (Fig. 2). Coxae smooth; posterior margins of coxae III–IV finely granulated proximally; coxa I with 8–9 macrosetae, endite I of coxa I with 9–12 macrosetae, endite II with 3–6 macrosetae; coxa II with 8–10 macrosetae on anterior and distal margins; coxa III with 5–6 macrosetae on anterior margin; coxa IV with single basal macroseta; sternum subtriangular, smooth anteriorly, finely granulated on posterior margin, with

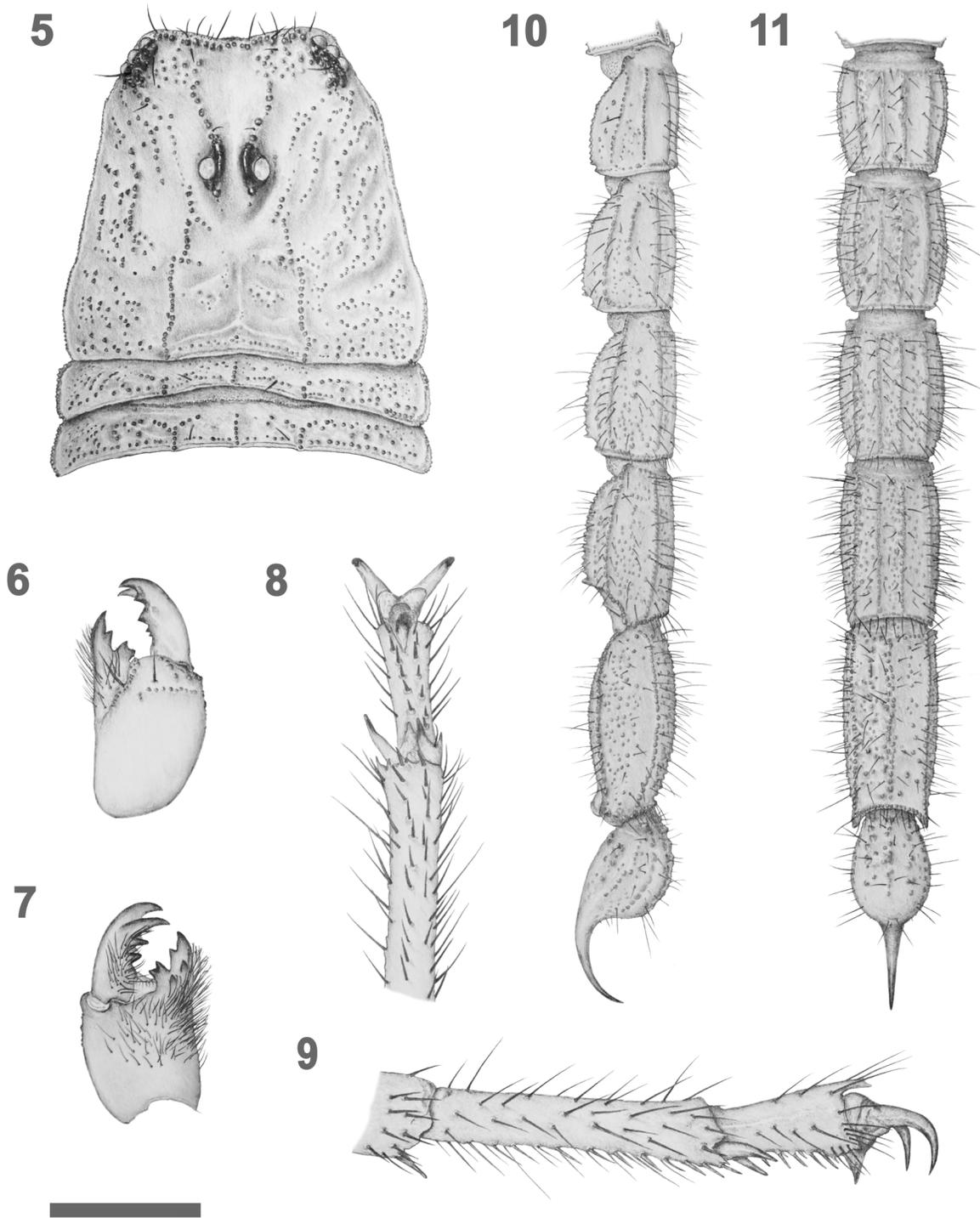
deep posteromedian excavation; genital opercula smooth, each with 20 short macrosetae; genital papillae present.

Pectines (Figs. 2, 19). Basal piece with deep anteromedian incision, surface smooth; 2 short macrosetae on left half; distal tips of pectines extending slightly past middle of trochanter IV; pectines with 3 marginal lamellae, 9 or 10 middle lamellae, plus small intermediate lamella at distal end of basal marginal lamella, 31–33 teeth; marginal lamellae, middle lamellae and fulcra with numerous short reddish macrosetae, 2–5 on fulcra; when anterior margins of both pectines are aligned with posterior margins of coxae IV, basal 3 teeth overlap with gap between basal middle lamellae.

Mesosoma (Figs. 1–2, 5). *Tergites*: pretergites smooth; tergites I–VI with 3 granulose, moderately strong carinae; median carinae of III–VI and lateral carinae of I–VI with terminal spinoid granule projecting slightly beyond posterior margins of tergites; lateral carinae of tergite I short, reduced to terminal projection; tergite VII with two pairs of coarsely granular lateral carinae, and granulated median hump; margins of all tergites with well-spaced small granules; lateral flanks of all tergites moderately sloped, with numerous coarse granules; median intercarinal surfaces mostly smooth, with sparse fine and coarse granules; tergites mostly bare with less than 4 macrosetae; tergites I–VI with paired marginal macrosetae on medial side of lateral carinae; additional small marginal macrosetae on lateral sides of lateral carinae on tergites III and VI; tergite VII devoid of macrosetae. *Sternites*: all sternites smooth, sternite III without carinae, sternites IV–VI with smooth, weak lateral carinae; sternite VII with 4 carinae, medial pair weak, smooth, lateral pair moderate, weakly granular; macrosetal counts on medial and lateral surfaces + posterior margin: III 29+15, IV 11+17, V 16+15, VI 19+7, VII 21+3; lateral margins shagreened on sternite III, denticulate on IV–VII, posterior margins microdenticulate on III–VI, granular on VIII.

Hemispermaphore (paratype male) (Figs. 17–18). Flagelliform, trunk elongate, slender; flagellum filiform, relatively short, pars recta 0.2 times length of trunk, pars reflecta 0.4 times length of trunk; inner lobe a broad untapered lamina with truncate rounded apex; median lobe wide, triangulate with curved inner edge, outer lobe tapered, apically bent; basal lobe a stout blunt hook. Measurements (paratype): trunk L (to base of flagellum) 11.5 mm, pars recta 2.1 mm, pars reflecta 4.6 mm, inner lobe (from base of flagellum) 860 μ m, median lobe 530 μ m, outer lobe 400 μ m, basal lobe 330 μ m.

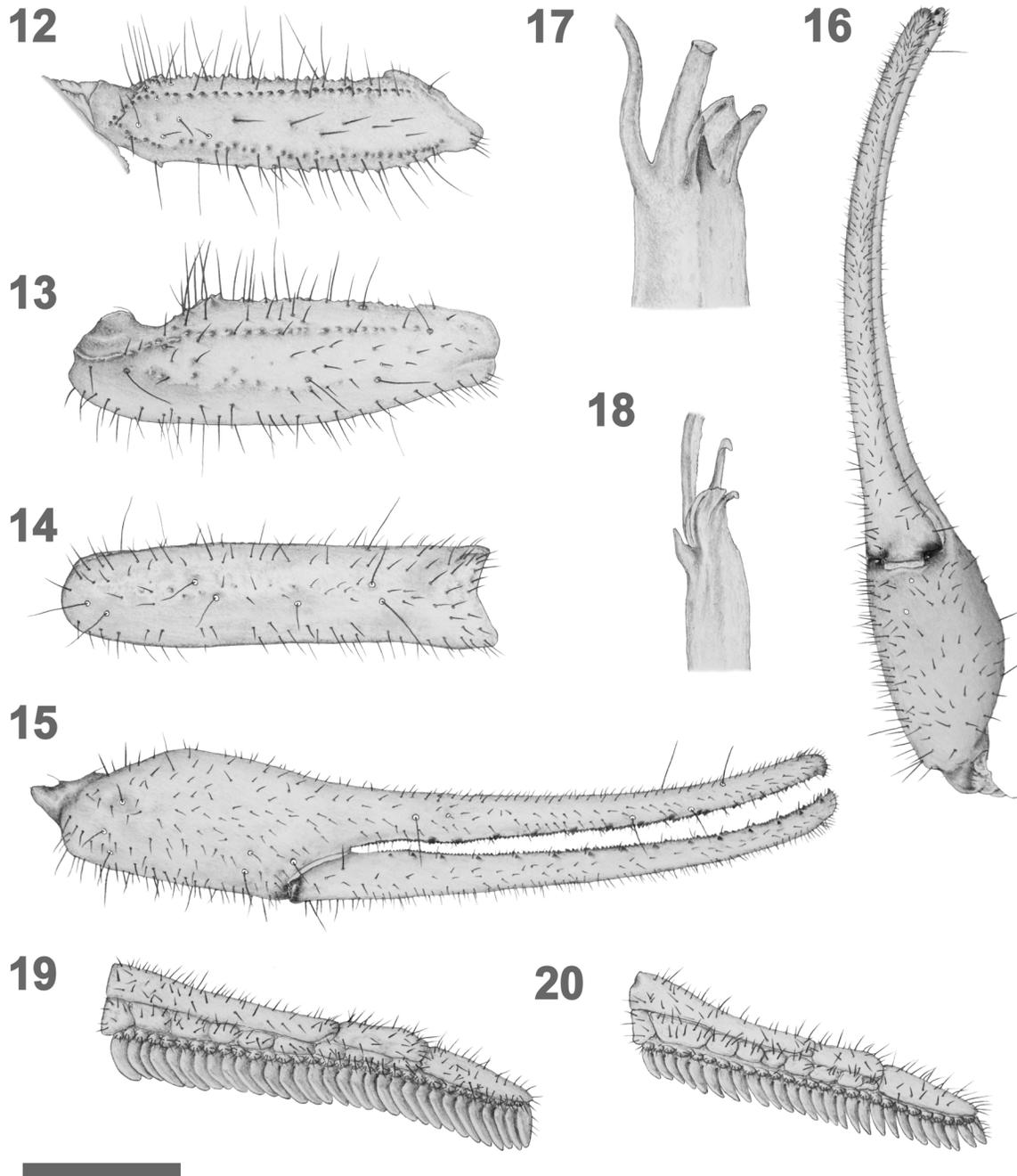
Metasoma (Figs. 1–2, 10–11). Moderately elongate, total length plus telson length 5.4 times carapace length;



Figures 5–11: *H. pellucidus*, sp. nov. 5, 8–11, holotype male; 6–7, paratype male (Jabal Bani Jabir). 5. Carapace and tergites I–II, dorsal aspect. 6–7, right chelicera. 6. Dorsal aspect. 7. Ventral aspect. 8–9, right basitarsus and telotarsus III. 8. Ventral aspect. 9. Retrolateral aspect. 10–11, metasoma and telson. 10. Right lateral aspect. 11. Ventral aspect. Scale bar: 5: 3.19 mm; 6–7: 2.125 mm; 8–9: 1.5 mm; 10–11: 6.22 mm.

segments I–III with 10 carinae, segment IV with 8 carinae; segment V with 5 complete carinae; dorso-submedian carinae strong, coarsely granular on I–VI; dorsolateral carinae strong, on I–IV, weak on V,

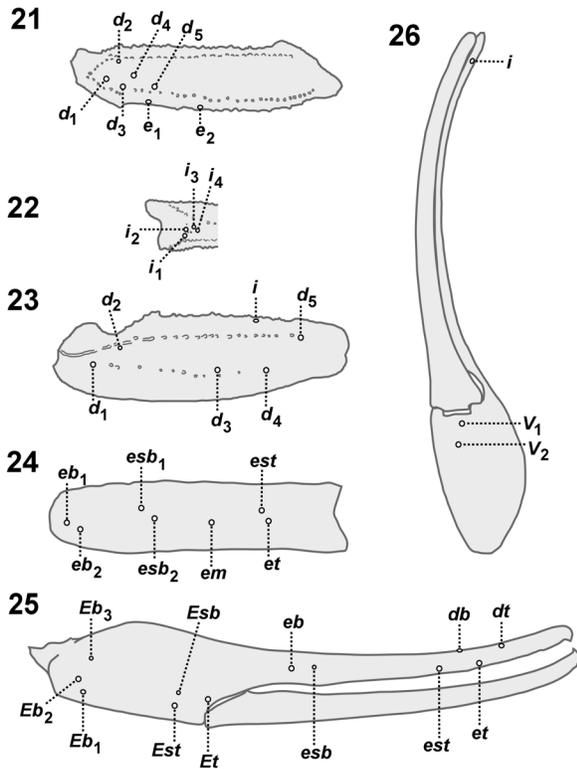
coarsely granular on all segments; median lateral carinae strong, complete on segment I–II, weak, indistinct on anterior 1/4 of segment III, coarsely granulate on I–III; ventrolateral carinae strong, granulose on I–III, granulo-



Figures 12–20: *H. pellucidus*, sp.nov., 12–16, 19, holotype male; 17–18, paratype male; 20, paratype female. 12. Right pedipalp femur, dorsal aspect. 13. Right pedipalp patella, dorsal aspect. 14. Right pedipalp patella, external aspect. 15. Right pedipalp chela, external aspect. 16. Right pedipalp chela, ventral aspect. 17–18. Right hemispermatophore, lobes at base of flagellum. 17. Convex aspect. 18. Inner aspect. 19. Left male pectine, ventral aspect. 20. Left female pectine ventral aspect. Scale bar: 12–16, 19–20: 4.1 mm; 17–18: 1.06 mm.

crenulate on IV–V; ventrosubmedian carinae moderate, smooth on I–II, moderate to strong, granulose on III–IV; ventromedian carina strong, broadly granulated on V; ventrosubmedian carinae on V weak, nearly obsolete,

only discernible on anterior 1/3 of segment, marked by linear series of coarse dentate granules; dorsal intercarinal surfaces smooth on segments I–IV, smooth medially and weakly granular laterally on V; dorso-



Figures 21–26: *H. pellucidus*, sp. nov., trichobothrial map, holotype male. **21.** Right pedipalp femur, dorsal aspect. **22.** Right pedipalp femur, proximal internal aspect. **23.** Right pedipalp patella, dorsal aspect. **24.** Right pedipalp patella, external aspect. **25.** Right pedipalp chela, external aspect. **26.** Right pedipalp chela, ventral aspect. Trichobothrial notation after Vachon (1974).

lateral intercarinal surfaces weakly granular on I, strongly, coarsely granular on II–IV; segment I granulated on lateral surface above median lateral carina, ventrolateral and ventral intercarinal surfaces smooth; segments II–V with coarse granulation on lateral and ventral intercarinal surfaces; lateral anal lobes not dissected; ventral anal arc with 26 crenulations; *chaetotaxy*: ventrolateral and ventral surfaces on all segments with numerous long macrosetae on carinae and intercarinal surfaces; dorso-lateral intercarinal surfaces with macrosetae absent on I–III, present on IV; dorsosubmedian carinae with macrosetae absent on I, present on II–IV; dorsal intercarinal surfaces of all segments lacking macrosetae; segment V with macrosetae around dorsolateral carinae.

Telson (Figs. 10–11). Vesicle bulbous, steeply sloped posteriorly; dorsal surface of vesicle smooth, without setae, lateral and ventral surfaces studded with coarse granules, bearing numerous long macrosetae; aculeus robust, curved, slightly shorter than vesicle.

Pedipalp (Figs. 12–16, 21–26, 53–54). *Femur* (Fig. 12): slender, 4.03 times longer than wide; dorsoexternal, dor-

sointernal and ventrointernal carinae moderate, with regular small dentate granules; other carinae obsolete; dorsal surface flat, external surface convex, ventral surface concave, all smooth; internal surface convex, with scattered enlarged dentate granules; distal external macrosetae arranged in two longitudinal rows on distal half of femur (16–20 shorter ventral setae, 9–11 longer dorsal setae); numerous long and short macrosetae on dorsoexternal, dorsointernal and ventrointernal carinae, and dorsal and internal surfaces; ventral surface without setae. *Patella* (Figs. 13–14): elongate, 3.14 times longer than wide; dorsointernal carina moderate, weakly granulose; dorsomedian and ventromedian carinae weak, smooth to weakly granular; internal carina weak, marked by widely spaced granules; other carinae obsolete; all intercarinal surfaces smooth; external, dorsal and internal surfaces with numerous long and short macrosetae, ventral surface without setae. *Chela* (Figs. 15–16, 53–54): slender with tenuous fingers, 6.12 times longer than wide; movable finger 2.45 times manus ventral length; manus smooth, carinae obsolete; fixed and movable fingers smooth, lacking scalloping of proximal dentate margins; short macrosetae dense on dorsal, external and ventral surfaces of manus and fingers, sparse or absent on internal surfaces; 14 primary denticle subrows on both fixed and movable fingers (Figs. 53–54); all denticle subrows flanked by internal and external accessory denticles, except for most proximal subrow of fixed finger; movable finger with 4 enlarged subdistal denticles. *Trichobothrial pattern* (Figs. 21–26): orthobothriotaxic, type A β (Vachon, 1974; 1975); femur d_2 , patella d_2 , chela Eb_3 , Esb and esb petite; patella with d_3 internal to dorsomedian carina (Fet, Sogleglad & Lowe, 2005); db positioned on fixed finger midway between est and et (Kovařík, 2007); line joining V_1 and V_2 on manus oblique, not perpendicular to axis of movable finger articulation (Sun, Zhu & Lourenço, 2010).

Legs (Figs. 1–2, 8–9). Slender; ventral carinae prominently denticulate on femora, weakly crenulate on tibiae; legs III–IV with tibial spurs; retrolateral pedal spurs simple, non-setose; prolateral pedal spurs basally bifurcate, bearing 0 (I) or 1 (II–IV) macrosetae; prolateral and retrolateral surfaces of basitarsi and telotarsi with numerous macrosetae, not arranged into wide bristle-combs; ventral aspect of basitarsi I–III with single row of short, stout macrosetae; ventral aspect of telotarsi I–IV paired rows of stout spiniform macrosetae; unguis stout.

Measurements of holotype male (mm). Total L 60.00; metasoma and telson L 37.50; carapace L 6.97, anterior W 3.57, posterior W 7.37, preocular L 2.79; metasomal segments (L/D/W) I 4.68/3.51/4.37, II 5.42/3.43/4.30, III 5.89/3.52/4.23, IV 6.84/3.61/4.05, V 8.00/3.41/3.72; telson L 7.47; vesicle L 4.44, D 3.12, W 3.11; pedipalp

chela L 14.38, manus ventral L 4.26, chela W 2.35, D 2.42, fixed finger L 9.05, movable finger L 10.42; pedipalp femur L 7.62, W 1.89, patella L 8.03, W 2.56; pectine L 8.44; leg III patella L 6.33, D 1.58, sternite VII L 4.43, W 7.27.

Adult female (paratype, Jabal Bani Jabir) (Figs. 3–4, 20, 59). Similar to male, but differs as follows: a larger scorpion, coarser granules on carapace and tergites; pectines shorter, distal tips extending to proximal 1/4 of trochanter IV, with 7–8 middle lamellae; pectine teeth smaller, shorter; when anterior margins of both pectines are aligned with posterior margins of coxae IV, basal teeth do not overlap; basal piece with more shallow anteromedian incision; lateral carinae obsolete on sternite IV.

Measurements of paratype female (mm). Total L 64.00; metasoma and telson L 36.50; carapace L 7.40, anterior W 3.52, posterior W 7.66, preocular L 2.91; metasomal segments (L/D/W) I 4.48/3.58/4.51, II 5.22/3.55/4.33, III 5.54/3.58/4.16, IV 6.51/3.56/3.96, V 8.00/3.39/3.73; telson L 7.37; vesicle L 4.50, D 2.91, W 3.12; pedipalp chela L 14.16, manus ventral L 4.00, chela W 2.43, D 2.43, fixed finger L 9.05, movable finger L 10.18; pedipalp femur L 6.90, W 1.77, patella L 8.22, W 2.69; pectine L 7.31; leg III patella L 6.19, D 1.65; sternite VII L 4.12, W 7.48.

Variation. *Juveniles*: differed from adults as follows: carapace and tergites with weaker carination, intercarinal surfaces smooth; metasoma I–IV with weaker, finely granulated carinae, intercarinal surfaces smooth; metasoma V smooth except for granules on ventral surface; metasomal setation more sparse, most setae located on carinae; setation on pedipalps, basitarsi and telotarsi more sparse; metasoma V with faint fuscous markings on lateral and ventral surfaces.

Sexual dimorphism: Morphometric data for adults of both sexes are summarized in Table 1. Males had on average significantly longer (relative to carapace) and more slender metasomal segments, pedipalps, legs, pectines and sternite VII than females. Pectine teeth: males 29–35 (mode 33, 62/68 = 91.2% of combs with 31–34 teeth), females 25–33 (mode 29, 60/78 = 76.9% of combs with 27–30 teeth). The number of denticle subrows on the pedipalp fingers of males was not significantly different from that of females. The mean number of subrows for movable fingers was significantly higher than that for fixed fingers ($P < 0.001$, paired t-test, $n = 142$). In 143 fixed fingers (sexes pooled), there were 39/143 (27.3 %) with 13 subrows, 101/143 (70.6 %) with 14 subrows, and 3/143 (2.1 %) with 10 or 12 subrows; in 143 movable fingers (sexes pooled), there were 107/143 (74.8 %) with 14 subrows,

33/143 (23.1 %) with 15 subrows, and 3/143 (2.1 %) with 6 or 13 subrows.

Reproduction. An adult female from Jabal Bani Jabir, collected on 14 September 1995, was held in isolated captivity, and on 21 August 1998 was observed after parturition with a live second instar juvenile and 4 dead embryos. This suggests that this species is capable of storing viable spermatozoa for up to 3 years (Kovoor, Lourenço & Muñoz-Cuevas, 1987). The abundance of males implies that this is not a parthenogenetic population (Matthiesen, 1962; Lourenço, 2002).

Distribution (Figs. 65–66). This species is found on Jabal Bani Jabir in the eastern Al Hajar Mountains (Al Hajar Ash Sharqi) of Oman, where all specimens were collected at high elevation (> 1,600 m a.s.l.). A single isolated specimen from Ras al Hamra, along the edge of the sea near Muscat, may be a spurious record due to human transport. There were no other specimens of this species in a large sample of scorpions (2,048) collected from lower elevations (< 1,500 m a.s.l.), including the heavily populated coastal areas in the vicinity of Muscat. The lack of records from the western Al Hajar ranges suggests that this species does not cross the Sumail Gap dividing the eastern and western ranges, and may be confined to higher elevations in the eastern Al Hajar.

Ecology. Ultraviolet detection on Jabal Bani Jabir revealed a dense population of *H. pellucidus* on the remote high plateau of Shir (1,600–1,800 m a.s.l.). At the collection sites the terrain was open, very dry, sparsely vegetated and littered with abundant loose rock broken into blocks and slabs (Figs. 61–63). The scorpions were found at night sitting stationary, some clinging to rocks, others on the ground under the edges of loose rocks. Many males were wandering out in the open. Other less common lithophilic or lapidicolous scorpions collected in the same area included *Compsobothus maindroni* (Kraepelin, 1900), *Hemiscorpium flagelliraptor* Lowe, 2010, *Nebo omanensis* Francke, 1980 and *Microbothus gardneri* Lowe, 2010. The Shir Plateau is an important archaeological site where prehistoric residents of the 3rd millennium BC utilized the same broken rock that provides so much scorpion microhabitat to construct tower tombs that still stand as memorials to respected members of their society (Fig. 63) (Yule & Weisgerber, 1998; Seibert et al., 2005).

***Hottentotta saxinatans*, sp. nov.**

Figs. 27–52, 55–56, 60, 65–66, Tab. 1

Holotype: adult ♂, Oman, Jabal Shams, Jabal Akhdar, UV detection, rocky wadi, vegetated boulder strewn slopes, resting on boulders or tree trunks,

23°14.31'N 57°11.64'E, 1900 m a.s.l., 14 October 1993, 21:12 h, leg. G. Lowe & M.D. Gallagher, NHMB.

Paratypes: Oman: 1 ♀, 11 October 1993, leg. A.S. Gardner, FKCP; 3 ♂, 5 ♀, 3 juveniles, same locality as holotype, GL, NHMB, BMNH; 1 ♀, 1 juvenile, Jabal Shams, Jabal Akhdar, UV detection on slope around wadi, narrow rock-bottomed wadi, with boulders, 23°14.27'N 57°11.68'E, 1870 m a.s.l., 2 October 1994, 19:00–20:00 h, leg. G. Lowe & M.D. Gallagher, ONHM; 5 ♀, 3 juveniles, Jabal Shams, UV detection on boulders on slopes above gravelly wadi, with trees, boulder slopes on sides, 23°14.29'N 57°11.62'E, 1855 m a.s.l., 2 October 1994, leg. G. Lowe & M.D. Gallagher, GL, NHMB, MNHN; 1 ♂, 3 ♀, 3 juveniles, Qayut, Jabal Akhdar, 23°09.74'N 57°27.84'E, 2150 m a.s.l., 11 May 1995, leg. A.S. Gardner, ONHM; 1 ♂, Jabal Shams, in crevice in tree at 1.5 m above ground, 23°13.65'N 57°12.22'E, 1850 m a.s.l., 19 October 1995, 22:00 h, leg. M.D. Gallagher, ONHM.

Diagnosis. Medium sized *Hottentotta* (Sissom, 1990; Kovařík, 2007; Sun, Zhu & Lourenço, 2010), adults 54–69 mm; color uniform bright yellow, with faint fuscosity on ventrolateral and ventrosubmedian carinae of metasoma II–IV, and ventrolateral, ventrosubmedian and ventromedian carinae of metasoma V; carapace and tergites with moderate, finely granular carinae; anterior margin of carapace with fine granules; posterior margins of tergites with carinae protruding in short spiniform processes; carapace, tergite, mesosoma and pedipalps finely granulated or shagreened; carapace, tergites, sternites, pedipalps, legs, metasoma and telson sparsely setose, nearly bare, macrosetae short, fine; genital opercula moderately to sparsely setose; posterior margin of tergites I–VI with few short macrosetae or bare; pedipalps slender, femur L/W 3.4–3.8, patella L/W 3.0–3.4, chela L/W 6.1–7.3; pedipalp chela without carinae; pedipalp fixed finger primary denticles divided into 13–14 subrows (92 % of cases), movable finger primary denticles divided into 13–14 subrows (97 % of cases); male pedipalp fingers without basal scalloping; metasoma moderately elongate, segment L/W ratios: metasoma I 1.0–1.25, metasoma II 1.3–1.5, metasoma III 1.5–1.7, metasoma IV 1.8–2.1, metasoma V 2.1–2.4; metasoma I–III with 10 carinae, median lateral carinae strong, complete on I–II, weak and incomplete on III; lateral surfaces of metasoma I–IV finely granulated or shagreened; pectine teeth in males 27–29, in females 23–27.

Comparisons. The sparse setation differentiates this species from those *Hottentotta* whose pedipalps bear a dense cover of long macrosetae or dense fine pubescence. Among those without dense pilosity on pedipalps, the following are separated by having more stout metasomal segments: *H. arenaceus* (Purcell, 1902),

H. conspersus (Thorell, 1876), *H. finneganae* Kovařík, 2007, *H. hottentotta* (Fabricius, 1787), *H. jalalabadensis* Kovařík, 2007, *H. minax* (L. Koch, 1875), *H. niloticus* (Birula, 1927), *H. pachyurus* (Pocock, 1897), *H. polystictus* (Pocock, 1896), *H. rugiscutus* (Pocock, 1897), *H. stockwelli* Kovařík, 2007 and *H. trilineatus* (Peters, 1861); the Asian species *H. alticola* (Pocock, 1895), *H. buchariensis* (Birula, 1897) and *H. penjabensis* (Birula, 1897) differ in having more elongate metasomal segments (male L/D ratio: metasoma IV > 2.1, metasoma V > 2.4), greater numbers of subrows of primary denticles on pedipalp fixed and movable fingers (14–16), and varying degrees of fuscous pigmentation on the carapace pedipalps, tergites and metasoma; *H. judaicus* (Simon, 1872) differs in its uniform black coloration and more stout pedipalps (pedipalp patella L/W < 3.0); *H. socotrensensis* (Pocock, 1889) has a more elongate carapace with anterior fuscosity, pedipalps with shorter fingers, and broader manus, and black chelicerae; *H. khoozestanus* Navidpour et al., 2008 is mostly yellow in color, but is much larger (120 mm), has 16 subrows of primary denticles on the pedipalp fingers, and more slender metasomal segments.

In Oman, *H. jayakari* (Pocock, 1895), *H. salei* (Vachon, 1980) and *H. pellucidus* **sp. nov.**, are differentiated by: dense pilosity on the pedipalps, stronger carinae and coarser granulation on carapace, tergites and metasoma; *H. jayakari* and *H. salei* also differ in their dark pigmentation, and strong scalloping at the base of the male pedipalp fingers.

Etymology. The specific epithet refers to the rapid, fluid movement of this species in rocky habitats, giving the impression of effortlessly floating or swimming over a sea of rocks and boulders.

Description (holotype male unless otherwise specified).

Coloration (Figs. 27–28). Entire body uniform pale yellow (bright ochraceous yellow in life); without contrasting markings; melanic pigmentation confined to median and lateral eyes; denticles of chelicerae and pedipalp fingers, articular condyles of pedipalp movable fingers, tarsal ungues and aculeus of telson castaneous.

Carapace (Figs. 27, 31). Subquadrate, slightly wider than long, dorsoventrally compressed, lateral flanks shallowly sloped; median eyes slightly raised; lateral eyes with 5 ocelli (3 large, 2 small); anterior margin concave, microgranular, bordered by coarser granules; *carination*: anterior median, central median and posterior median carinae moderate, finely granular; other carinae indistinct; central median and posterior median carinae not collinear, incompletely joined; supraocular and postocular parts of superciliary carinae finely gran-



Figures 27–30: *H. saxinatans*, sp. nov., habitus, 27–28, holotype male; 29–30, paratype female. 27, 29. Dorsal aspect. 28, 30. Ventral aspect. Scale bar: 10 mm.

ular, 9 short macrosetae on anterior margin of carapace; *granulation*: coarse granules on anterior interocular triangle behind lateral eyes; lateral flanks with coarse to fine granulation; posterior median intercarinal area smooth with few fine granules; area between anterior median carinae mostly smooth with sparse fine granules; posterior margin of carapace with strip of fine granules between posterior median carinae.

Chelicera (Figs. 32–33). Dorsal surface of manus smooth, glabrous, with transverse row of coarse and fine, subdistal granules; dorsointernal carina at base of fixed finger with coarse granules; *chaetotaxy*: manus with pair of short pale microsetae on apical border; long reddish macroseta on dorsointernal carina; dorsal surface of movable finger with 4 short pale microsetae in distal 2/3; manus ventrally smooth, bearing numerous long, fine microsetae, sparser medially, denser on medio-internal aspect, merging into dense setal brush on ventral aspect of fixed finger; dense fine setae extend to medial surface, more sparse on dorsomedial area at base of fixed finger; ventral surface of movable finger densely setose; *dentition*: fingers with normal buthid dentition (Vachon, 1963; Sissom, 1990); fixed finger with large distal tine, subdistal denticle and large proximal bicus, two prominent denticles on ventral surface; movable finger with large dorsal and ventral distal tines; dorsal margin of movable finger with two large triangulate denticles and small proximal bicus, ventral margin with two large robust denticles.

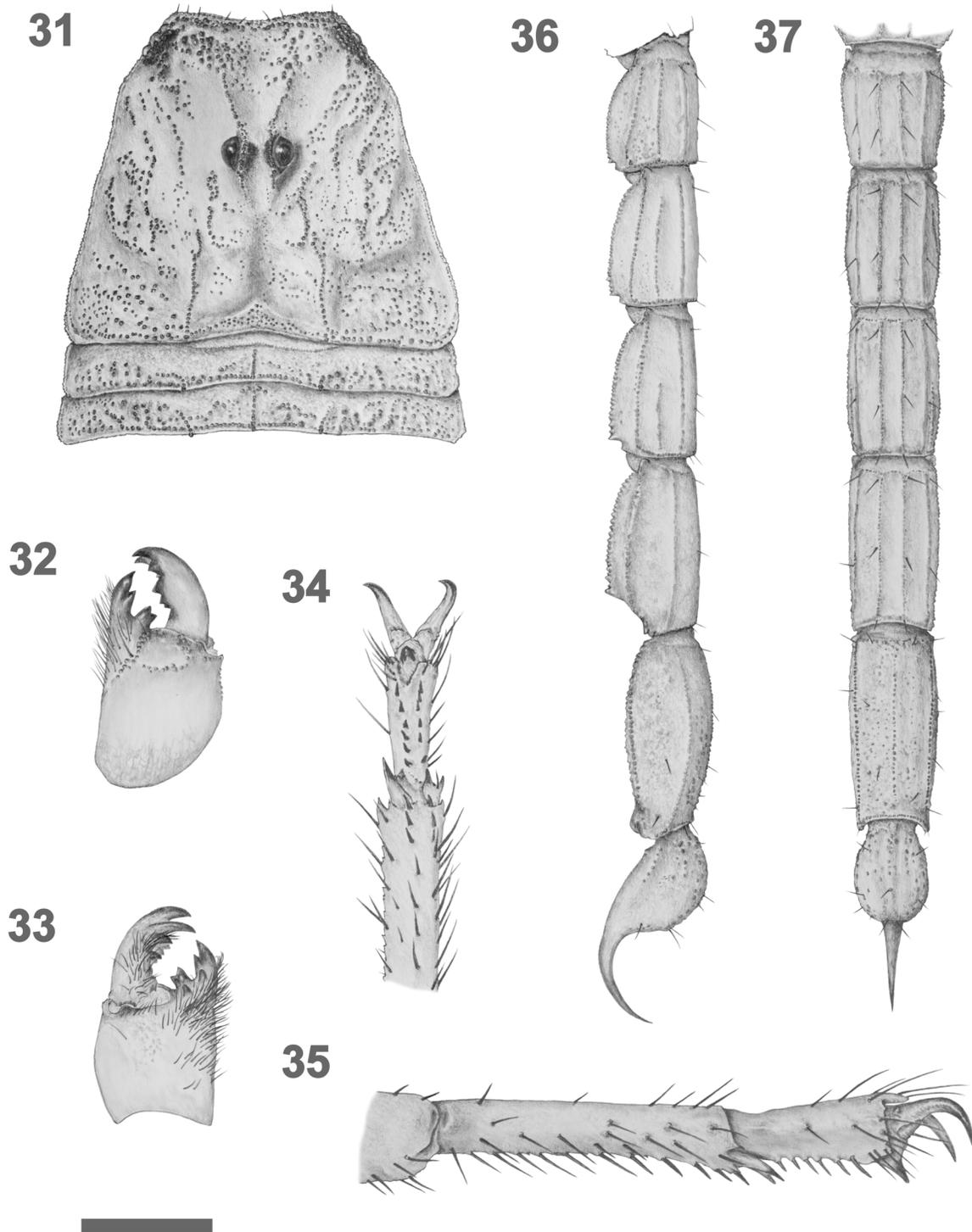
Coxosternal area (Fig. 28). Coxae minutely shagreened or smooth; fine granulation on anterior margins of coxae II–III, proximal anterior margins of coxa IV, posterior margin of coxae III, proximal posterior margin of coxa IV, posterodistal margins of coxae I–III, and surface of coxa I endite; coxa and endite I with 5–9 macrosetae, endite II with 3 macrosetae; coxa II with 3 anterior marginal macrosetae; coxa III with 4 anterior marginal macrosetae; coxa IV with single basal macroseta; sternum subtriangular, smooth, with deep posteromedian excavation flanked by a pair of macrosetae; genital opercula smooth, each with 4 short macrosetae; genital papillae present.

Pectines (Figs. 28, 45). Basal piece smooth with deep anteromedian incision, bearing one short macroseta; distal tips of pectines extending to middle of trochanter IV; pectines with 3 marginal lamellae, 9 middle lamellae, plus small intermediate lamella at distal end of basal marginal lamella, 28–28 teeth; marginal lamellae, middle lamellae and fulcra with moderate cover of short reddish macrosetae, 2–5 on fulcra; when anterior margins of both pectines are aligned with posterior margins edges of coxae IV, basal 3 teeth overlap with gap between basal middle lamellae.

Mesosoma (Figs. 27–28, 31). *Tergites*: pretergites smooth; tergites I–VI with 3 granulose, moderately strong carinae; median carinae of III–VI and lateral carinae of I–VI with terminal granule projecting slightly beyond posterior margins of tergites; lateral carinae short on tergite I, longer and curved on II–VI; tergite VII with two pairs of granular lateral carinae, and granulated narrow median hump; lateral flanks of all tergites shallowly sloped, with numerous granules; tergites III–V with transverse anterolateral series of granules contiguous with lateral carinae; median intercarinal surfaces with scattered fine and coarse granules; tergites nearly bare with at most one pair of short marginal macrosetae on medial sides of lateral carinae; tergite VII devoid of macrosetae. *Sternites*: all sternites smooth, lustrous; sternite III without carinae, lateral carinae smooth, weak on sternites IV–V, smooth, moderate on VI; sternite VII with 4 granular carinae, medial pair moderate, lateral pair strong; macroseta counts on medial and lateral surfaces + posterior margin: III 26+12, IV 6+10, V 7+11, VI 6+6, VII 6+2; lateral margins of sternites denticulate, more strongly so on VI–VII, posterior margins microdenticulate on III–VI, granular on VIII.

Hemispermaphore (Figs. 43–44). Flagelliform, trunk elongate, slender; flagellum filiform, long, pars recta 0.34 times length of trunk, pars reflecta 0.6 times length of trunk; inner lobe a broad slightly tapered lamina with truncate apex; median lobe wide, triangulate, outer lobe tapered, apically bent; basal lobe short, uniformly narrow, apically truncate. Measurements (paratype): trunk L (to base of flagellum) 6.1 mm, pars recta 2.1 mm, pars reflecta 3.7 mm, inner lobe (from base of flagellum) 715 μ m, median lobe 400 μ m, outer lobe 360 μ m, basal lobe 160 μ m.

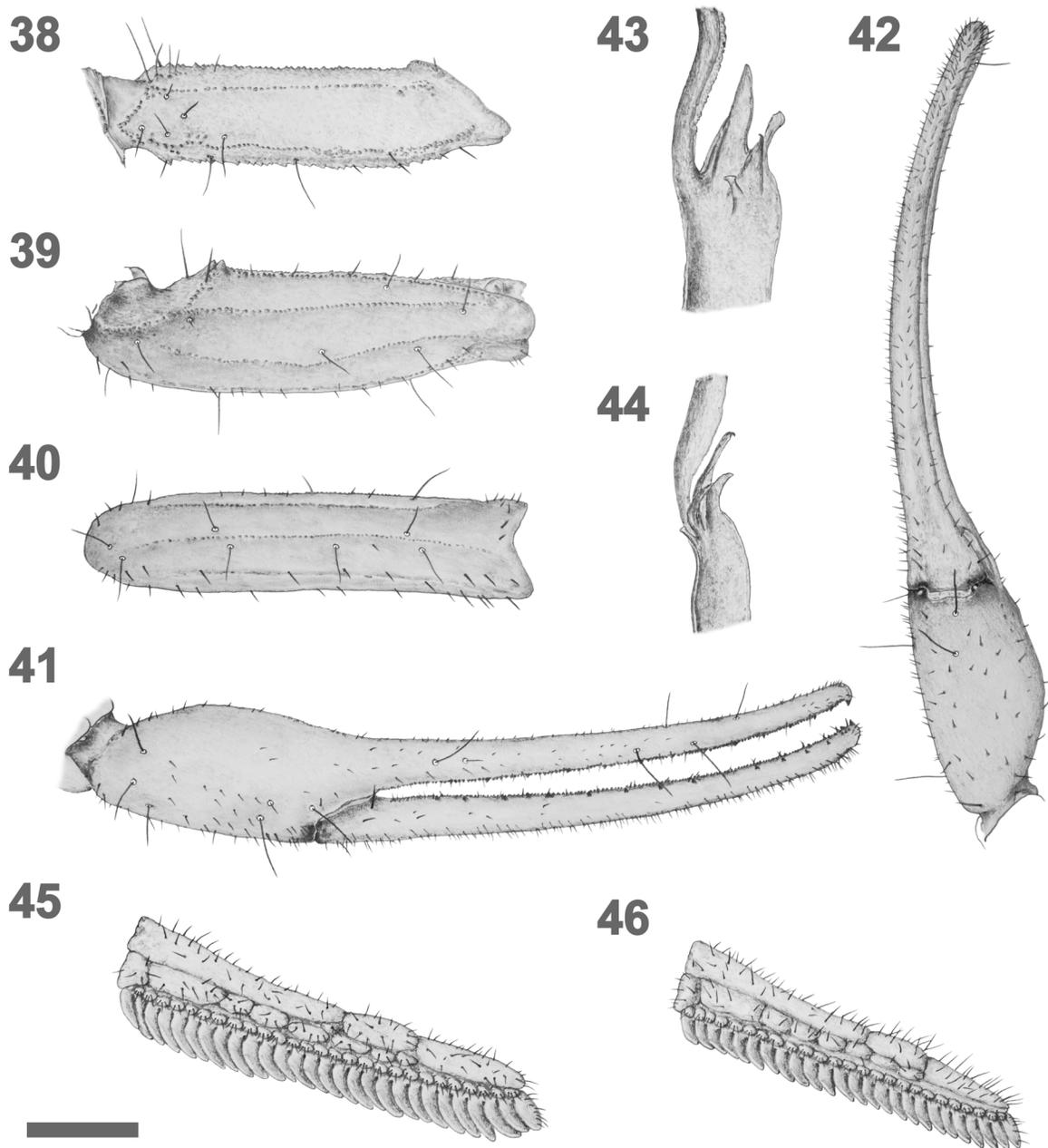
Metasoma (Figs. 27–28, 36–37). Moderately elongate, total length plus telson length 5.4 times carapace length; segments I–III with 10 carinae, segment IV with 8 carinae; segment V with 5 complete carinae; dorso-submedian carinae strong, moderately to finely granular on I–VI; dorsolateral carinae strong on I–IV, weak on V, granular on all segments, with granulation weaker on VI–V; median lateral carinae granular, strong, complete on metasoma I–II, weak, indistinct on anterior 1/3 of segment III; ventrolateral and ventrosubmedian carinae strong, weakly granulate, almost smooth on I–II, moderately granulate on IV–V; ventromedian carina moderate, finely granulate on V; ventrosubmedian carinae on V weak, finely granulate, confined to anterior 1/3 of segment; dorsal intercarinal surfaces smooth to minutely shagreened on segments I–IV, smooth medially and finely granular laterally on V; dorsolateral intercarinal surfaces moderately granulate on I, finely granulate on II, shagreened in III–IV; lateral, ventrolateral and ventral intercarinal surfaces of all segments



Figures 31–37: *H. saxinatans*, sp. nov., holotype male. **31.** Carapace and tergites I–II, dorsal aspect. **32–33,** right chelicera. **32.** Dorsal aspect. **33.** Ventral aspect. **34–35,** right basitarsus and telotarsus III. **34.** Ventral aspect. **35.** Retrolateral aspect. **36–37,** metasoma and telson. **36.** Right lateral aspect. **37.** Ventral aspect. Scale bar: 31: 2.75 mm; 32–33: 2 mm; 34–35: 1.3 mm; 36–37: 5.5 mm.

finely granulated or shagreened; ventral surface of metasoma V with additional scattered medium sized granules on posterior half of segment; lateral anal lobes

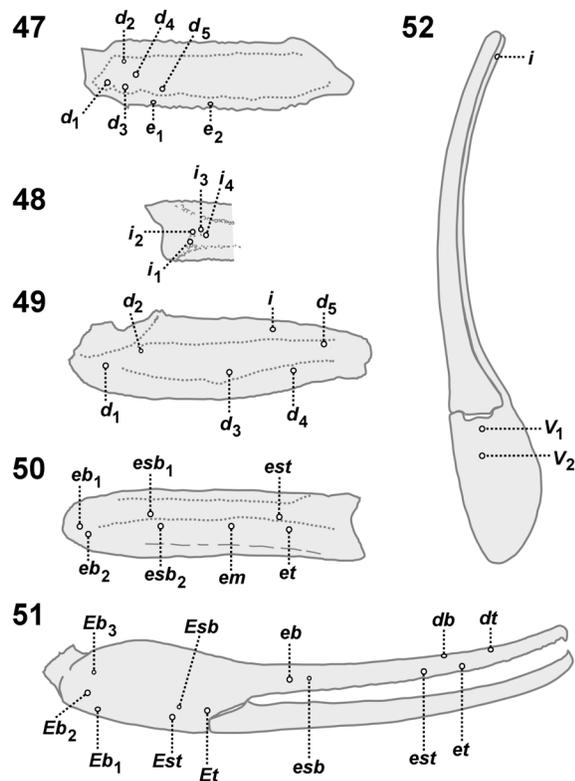
smooth, rounded, not dissected; ventral anal arc with 26 fine ventral granules and 7 coarse ventrolateral granules; *chaetotaxy*: carinae with small numbers of short macro-



Figures 38–46: *H. saxinatans*, sp. nov., 38–45, holotype male; 46, paratype female. 38. Right pedipalp femur, dorsal aspect. 39. Right pedipalp patella, dorsal aspect. 40. Right pedipalp patella, external aspect. 41. Right pedipalp chela, external aspect. 42. Right pedipalp chela, ventral aspect. 43–44. Right hemispermatophore, lobes at base of flagellum. 43. Convex aspect. 44. Inner aspect. 45. Left male pectine, ventral aspect. 46. Left female pectine ventral aspect. Scale bar: 38–42, 45–46: 2 mm; 43–44: 0.68 mm.

setae, intercarinal macrosetae absent; dorsal and lateral surfaces of metasoma I–IV lacking macrosetae, ventrolateral carinae with 1–2 macrosetae, ventrosubmedian carinae with 3 macrosetae including posterior marginal; segment V with 4 lateral macrosetae, and 4 pairs on ventral surface; 4 macrosetae on ventral anal arc.

Telson (Figs. 36–37). Vesicle ovoid, moderately sloped posteriorly; vesicle with dorsal surface smooth, lateral surface smooth with single longitudinal series of fine granules; ventrolateral and ventral surfaces studded with fine granules, bearing 11 short and long macrosetae; aculeus slender, curved, shorter than vesicle.



Figures 47–52: *H. saxinatans*, sp. nov., trichobothrial map, holotype male. **47.** Right pedipalp femur, dorsal aspect. **48.** Right pedipalp femur, proximal internal aspect. **49.** Right pedipalp patella, dorsal aspect. **50.** Right pedipalp patella, external aspect. **51.** Right pedipalp chela, external aspect. **52.** Right pedipalp chela, ventral aspect. Trichobothrial notation after Vachon (1974).

Pedipalp (Figs. 38–42, 47–52, 55–56). *Femur* (Fig. 38): slender, 3.83 times longer than wide, with 5 moderate, finely granulated carinae; dorsoexternal, dorsointernal and ventrointernal carinae with regular, closely spaced medium to small granules; external and internal carinae with more irregular, widely spaced, larger dentate granules; intercarinal surfaces with scattered fine granules, ventral surface sparsely granulate, nearly smooth; distal external macrosetae sparse, 8–10 setae in ventral row, 3 in dorsal row, carinal setation sparse, intercarinal surfaces lacking macrosetae. *Patella* (Figs. 39–40): elongate, 3.35 times longer than wide, with 7 granulate carinae; dorsointernal and dorsomedian carinae moderate, finely granulate; dorsoexternal, ventroexternal and ventral carinae weak, finely granulate; external carinae moderate, with weak, fine granulation; ventrointernal carina obsolete; internal carina moderate, with small to medium granules; intercarinal surfaces with sparse fine granules or sparsely shagreened, ventral surfaces nearly smooth; macrosetae sparse. *Chela* (Figs. 41–42, 55–56): slender with tenuous fingers, 7.3 times longer than wide; movable finger 2.62 times manus ventral length;

external and ventral surfaces of manus smooth, internal and dorsal surfaces with weak, fine granulation; digital carinae weak, other carinae obsolete; fixed and movable fingers smooth, except for internal patch of fine granules at base of fixed finger, dentate margins of fingers without proximal scalloping; manus and fingers with numerous short macrosetae; dense brush of setae on ventral apical area of movable finger; 13 primary denticle subrows on right fixed and movable fingers (Figs. 55–56) and left fixed finger, 11 on left movable finger (anomalous fusion of apical subrows); all denticle subrows flanked by internal and external accessory denticles; movable finger with 4 enlarged subdistal denticles. *Trichobothrial pattern* (Figs. 47–52): ortho-bothriotaxic, type A β (Vachon, 1974; 1975); femur d_2 , patella d_2 , chela Eb_3 , Esb and esb petite; patella with d_3 internal to dorsomedian carina (Fet, Soleglad & Lowe, 2005); db positioned on fixed finger between est and et (Kovařík, 2007); line joining V_1 and V_2 on manus oblique, not perpendicular to axis of movable finger articulation (Sun, Zhu & Lourenço, 2010).

Legs (Figs. 27–28, 34–35). Slender; ventral carinae finely denticulate on femora, weakly crenulate on tibiae; legs III–IV with tibial spurs; retrolateral pedal spurs simple, non-setose; prolateral pedal spurs basally bifurcate, bearing single macroseta; prolateral and retrolateral surfaces of basitarsi and telotarsi with numerous short macrosetae, not arranged into bristle-combs; retroventral aspect of basitarsi I–III with row of short, stout macrosetae; ventral aspect of telotarsi I–IV with paired rows of stout spiniform macrosetae; ungues stout, strongly curved.

Measurements of holotype male (mm). Total L 58.00; metasoma and telson L 37.00; carapace L 6.79, anterior W 3.34, posterior W 7.45, preocular L 2.80; metasomal segments (L/D/W) I 5.06/3.47/4.09, II 5.47/3.36/3.60, III 5.85/3.24/3.51, IV 6.73/3.30/3.37, V 7.67/3.21/3.28; telson L 6.95; vesicle L 4.25, D 2.86, W 2.74; pedipalp chela L 14.09, manus ventral L 3.95, chela W 1.93, D 2.08, fixed finger L 9.55, movable finger L 10.33; pedipalp femur L 7.12, W 1.86, patella L 8.05, W 2.40; pectine L 7.92; leg III patella L 6.19, D 1.54, sternite VII L 3.92, W 6.79.

Adult female (same locality as holotype) (Figs. 29–30, 46, 60). Differs from male as follows: a larger scorpion, coarser granules on carapace and tergites; pectines shorter, distal tips only extending to end of coxa IV, with 7–8 middle lamellae; pectine teeth smaller, shorter; when anterior margins of both pectines are aligned with posterior margins of coxae IV, basal teeth do not overlap; basal piece with more shallow anteromedian incision; sternite IV with weaker lateral carinae, sternite VII with strong medial carinae.

	<i>Hottentotta pellucidus</i>		<i>Hottentotta saxinatans</i>	
	males	females	males	females
Carapace W/ L	0.99 – 1.14 1.05 ± 0.04 (17)	1.04 – 1.15 1.09 ± 0.03 (18)	1.00 – 1.15 1.09 ± 0.05 (9)	
Pedipalp femur L/W	3.65 – 4.39 4.04 ± 0.21 (17)	3.34 – 4.12 3.73 ± 0.18 (18)	3.42 – 3.83 3.63 ± 0.13 (9)	
Pedipalp patella L/W	3.07 – 3.45 3.29 ± 0.12 (17)	2.82 – 3.35 3.02 ± 0.11 (18)	3.35 – 3.35 3.35 ± 0.01 (2)	3.00 – 3.33 3.16 ± 0.10 (7)
Pedipalp chela L/manus W	5.96 – 6.49 6.21 ± 0.17 (17)	5.47 – 6.34 5.93 ± 0.24 (18)	6.09 – 7.30 6.53 ± 0.36 (9)	
Pedipalp femur L/ carapace L	0.97 – 1.10 1.04 ± 0.04 (17)	0.90 – 0.99 0.96 ± 0.02 (18)	0.96 – 1.05 1.00 ± 0.03 (9)	
Pedipalp patella L/ carapace L	1.14 – 1.25 1.20 ± 0.03 (17)	1.08 – 1.16 1.12 ± 0.02 (18)	1.19 – 1.21 1.20 ± 0.02 (2)	1.11 – 1.17 1.15 ± 0.02 (7)
Pedipalp chela L/ carapace L	1.97 – 2.16 2.04 ± 0.05 (17)	1.88 – 2.02 1.95 ± 0.04 (18)	1.90 – 2.08 1.96 ± 0.06 (9)	
Pedipalp movable finger L/ manus ventral L	2.17 – 2.55 2.38 ± 0.09 (35)		2.36 – 2.62 2.51 ± 0.09 (9)	
Pedipalp movable finger L/ carapace L	1.41 – 1.53 1.46 ± 0.04 (17)	1.35 – 1.46 1.40 ± 0.03 (18)	1.34 – 1.52 1.42 ± 0.05 (9)	
Pedipalp chela manus W/ carapace L	0.31 – 0.35 0.33 ± 0.01 (35)		0.28 – 0.32 0.30 ± 0.01 (9)	
Leg III patella L/D	3.49 – 4.47 3.94 ± 0.20 (16)	3.24 – 3.85 3.66 ± 0.15 (17)	3.73 – 4.07 3.87 ± 0.15 (7)	
Leg III patella L/ carapace L	0.78 – 0.95 0.91 ± 0.04 (16)	0.82 – 0.88 0.85 ± 0.02 (17)	0.84 – 0.91 0.86 ± 0.03 (7)	
Sternite VII W/ L	1.57 – 1.93 1.73 ± 0.10 (17)	1.67 – 2.23 1.93 ± 0.14 (18)	1.73 – 2.07 1.88 ± 0.12 (7)	
Metasoma I L/W	1.01 – 1.14 1.07 ± 0.04 (17)	0.92 – 1.08 0.98 ± 0.03 (18)	1.18 – 1.24 1.21 ± 0.04 (2)	0.99 – 1.11 1.05 ± 0.05 (7)
Metasoma II L/W	1.24 – 1.39 1.30 ± 0.05 (17)	0.97 – 1.23 1.18 ± 0.06 (18)	1.48 – 1.52 1.50 ± 0.03 (2)	1.32 – 1.45 1.38 ± 0.04 (7)
Metasoma III L/W	1.29 – 1.48 1.39 ± 0.05 (17)	1.25 – 1.35 1.31 ± 0.03 (18)	1.67 – 1.70 1.68 ± 0.02 (2)	1.49 – 1.59 1.54 ± 0.04 (7)
Metasoma IV L/W	1.50 – 1.85 1.71 ± 0.08 (17)	1.53 – 1.69 1.61 ± 0.04 (18)	2.00 – 2.07 2.03 ± 0.05 (2)	1.81 – 1.99 1.90 ± 0.05 (7)
Metasoma V L/W	2.02 – 2.40 2.21 ± 0.09 (17)	1.96 – 2.24 2.08 ± 0.08 (18)	2.34 – 2.37 2.35 ± 0.02 (2)	2.10 – 2.24 2.19 ± 0.05 (7)
Vesicle L/ telson L	0.58 – 0.65 0.62 ± 0.02 (34)		0.57 – 0.64 0.60 ± 0.03 (7)	
Metasoma I L/ carapace L	0.63 – 0.71 0.67 ± 0.02 (17)	0.58 – 0.65 0.61 ± 0.02 (18)	0.69 – 0.75 0.72 ± 0.04 (2)	0.61 – 0.69 0.63 ± 0.03 (7)
Metasoma II L/ carapace L	0.76 – 0.84 0.80 ± 0.02 (17)	0.70 – 0.75 0.73 ± 0.02 (18)	0.81 – 0.82 0.81 ± 0.01 (2)	0.72 – 0.79 0.75 ± 0.02 (7)
Metasoma III L/ carapace L	0.78 – 0.89 0.85 ± 0.03 (17)	0.74 – 0.81 0.78 ± 0.02 (18)	0.86 0.86 ± 0.00 (2)	0.78 – 0.82 0.80 ± 0.02 (7)
Metasoma IV L/ carapace L	0.87 – 1.04 0.98 ± 0.04 (17)	0.87 – 0.94 0.90 ± 0.02 (18)	0.98 – 0.99 0.98 ± 0.01 (2)	0.89 – 0.96 0.91 ± 0.02 (7)
Metasoma V L/ carapace L	1.06 – 1.21 1.17 ± 0.04 (17)	1.03 – 1.13 1.08 ± 0.03 (18)	1.12 – 1.13 1.12 ± 0.01 (2)	0.99 – 1.09 1.04 ± 0.03 (7)
Pedipalp fixed finger denticle subrows	10 – 14 13.67 ± 0.58 (143)		2 – 14 12.79 ± 1.79 (62)	
Pedipalp movable finger denticle subrows	6 – 15 14.16 ± 0.82 (143)		11 – 14 13.47 ± 0.62 (62)	
Pectine L/ carapace L	1.14 – 1.27 1.22 ± 0.04 (17)	0.90 – 1.04 0.98 ± 0.04 (18)	0.81 – 1.17 0.93 ± 0.10 (9)	
Pectine teeth	29 – 35 32.63 ± 1.22 (68)	25 – 33 29.17 ± 1.80 (78)	27 – 29 28.09 ± 0.68 (22)	18 – 27 24.83 ± 1.60 (40)

Table 1: Variation in meristics and selected morphometric ratios for *Hottentotta pellucidus*, **sp.nov.** and *Hottentotta saxinatans*, **sp.nov.** Indicated are ranges, mean ± standard deviation with sample sizes in parentheses. All samples are from adults except pedipalp denticle subrow counts and pectinal tooth counts, which also include measurements from immatures and from both left and right appendages. Values of variables significantly different between the two sexes ($P < 0.01$ for *H. pellucidus*, $P < 0.05$ for *H. saxinatans*; Mann Whitney test) are cited separately for males and females, and those not significantly different are pooled for both sexes.



Figures 53–56: Pedipalp finger dentition of new *Hottentotta* species. **53–54**, *H. pellucidus*, **sp. nov.**, holotype male. **55–56**, *H. saxinatus*, **sp. nov.**, holotype male. **53, 55:** right fixed finger, ventral aspect. **54, 56:** right movable finger, dorsal aspect. Scale bar: 1 mm. Images acquired under UV fluorescence.

Measurements of paratype female (mm): total L 68.50; metasoma and telson L 40.00; carapace L 7.42, anterior W 3.84, posterior W 8.55, preocular L 3.09; metasomal segments (L/D/W) I 5.13/3.87/4.62, II 5.88/3.68/4.26, III 6.05/3.72/3.92, IV 7.13/3.61/3.72, V 8.08/3.50/3.70; telson L 7.77; vesicle L 4.56, D 3.26, W 3.29; pedipalp chela L 15.02, manus ventral L 4.16, chela W 2.37, D 2.36, fixed finger L 9.74, movable finger L 10.90; pedipalp femur L 7.61, W 2.03, patella L 8.64, W 2.79; pectine L 7.01; leg III patella L 6.54, D 1.75; sternite VII L 4.43, W 8.55.

Variation. Juveniles: differed from adults as follows: carapace and tergites with weaker carinae, intercarinal surfaces with weaker granulation or smooth; metasoma I–V with weaker, finely granulated carinae, intercarinal surfaces smooth; telson vesicle more elongate, with more prominent granules on ventral surface; aculeus more stout. Juveniles and sub-adults have contrasting dark pigmentation on ventrosubmedian and ventrolateral carinae of metasoma I–V, and ventromedian carinae of V. In adults, these carinal markings are not as dark, and may be difficult to discern in some individuals.

Sexual dimorphism: males were smaller than females: carapace L 6.19–6.79 (6.49 ± 0.42 , $n = 2$) for adult males, 7.31–7.75 (7.52 ± 0.17 , $n = 7$) for adult females. Morphometric data for adults of both sexes are summarized in Table 1. The limited sample of adult males ($n = 2$) may account for there being fewer adult morphometric ratios with statistically significant sexual dimorphism. Males had on average significantly longer (relative to carapace) and more slender metasomal segments and pedipalp patellae than females. Pectine teeth: males 27–29 (mode 28): of 22 combs, 4 had 27 teeth, 12 had 28 and 6 had 22; females 18–27 (mode 25): of 40 combs 1 had 18 teeth (malformed), 1 had 21, 2 had 22, 8 had 24, 14 had 25, 12 had 26, and 2 had 27 (85 % of combs with 24–26 teeth). The number of denticle subrows on the pedipalp fingers of males was not significantly different from that of females. The mean subrow count for movable fingers was significantly higher than that for fixed fingers ($P = 0.005$, paired t-test, $n = 62$). Of 62 fixed fingers (sexes pooled), there were 1/62 (1.6 %) with 2, 6 and 9 subrows each (anomalous fusions), 2/62 (3.2 %) with 12, 46/62 (74.2 %) with 13 subrows, and 11/62 (17.7 %) with 14; of 62

movable fingers (sexes pooled), there were 1/62 (1.6 %) with 11 and 12 subrows each, 28/62 (45 %) with 13 subrows, and 32/62 (51.6 %) with 14 subrows.

Distribution (Figs. 65–66). All documented records are from the limestone massif of Jabal Akhdar (Fig. 64), at high elevation (> 1,850 m a.s.l.) in the eastern section of the western Al Hajar mountain ranges (Al Hajar Al Gharbi) of northern Oman. Several collections were made from Jabal Shams, the highest peak of Jabal Akhdar. The species may be endemic to these mountains.

Ecology. This is a rupicolous species, found at night by ultraviolet detection in rocky wadis and steep slopes of ravines littered with massive boulders on Jabal Akhdar. The areas where scorpions were observed were relatively sheltered, and none were taken from the open, exposed plateau. The terrain was well vegetated with trees and shrubs (Fig. 64). The elevation range of the collections (1,850–2,150 m) places this species in the upper *Sideroxylon–Olea–Dodonaea* zone of vegetation (Mandaville, 1977; Ghazanfar, 1991; Brinkmann et al., 2009), just below the transition to *Juniperus excelsa* woodland (Gardner & Fisher, 1996). Adult *H. saxinatans* were observed in ambush positions resting inverted on overhanging surfaces of boulders. Some occupied more protected sites in fissures of cracked boulders, and younger individuals were also found perched on tree trunks. At rest, the metasoma was held coiled to one side, and the pedipalps were retracted in a triangular stance with finger tips touching or intersecting. When disturbed, the animals escaped by gliding swiftly over rock surfaces. Other scorpion species collected from the same areas were *Compsobuthus maindroni* (Kraepelin, 1900), *Babycurus exquisitus* Lowe, 2000, *Hottentotta jayakari* (Pocock, 1895), *Nebo omanensis* Francke, 1980, and *Orthochirus glabrifrons* (Kraepelin, 1903).

Discussion

The Al Hajar Mountains of northern Oman comprise a biogeographic ‘island’ in southeast Arabia, isolated from other montane environments by sea and desert. They are separated from the southwestern mountains of Dhofar and Yemen by the arid steppes of central Oman, and from the Zagros and Makran Ranges of Iran and Pakistan by the Arabian Gulf and Gulf of Oman. Due to their isolation, the Al Hajar Mountains are inhabited by a number of endemic animals, for example geckoes (*Asaccus montanus*, *A. platyrhynchus*, *A. caudivolvulus*, *A. gallagheri*, *Pristurus celerrimus*) (Arnold, 1972, 1977; Arnold & Gardner, 1994; Gardner, 1994), other reptiles (*Omanosaura jayakari*, *O. cyanura*, *Echis omanensis*) (Arnold & Gallagher, 1977; Babocsay,

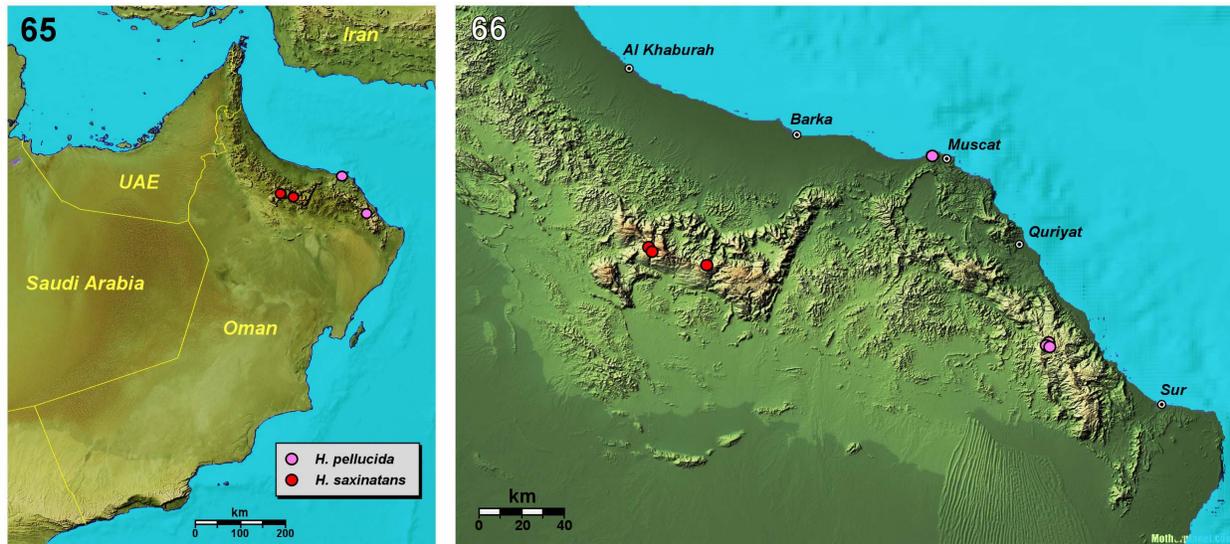
2004; Gardner, 2009), a tenebrionid beetle (*Prochoma margolateralis*) (Carl, 2004) and the Arabian Tahr (*Arabitragus jayakari*) (Thomas, 1894; Insall, 1999; Ropiquet & Hassanin, 2005); and at least 14 endemic taxa of vascular plants (Brinkmann et al., 2009).

There is a considerable list of scorpions that are likely to be endemic to the Al Hajar Mountains and adjacent Batinah coastal plain: *Babycurus exquisitus* Lowe, 2000, *Buthacus williamsi* Lourenço et Leguin, 2009, *Compsobuthus maindroni* (Kraepelin, 1900), *C. nematodactylus* Lowe, 2009, *Hottentotta jayakari* (Pocock, 1895), *Hemiscorpius flagelliraptor* Lowe, 2010, *Hemiscorpius falcifer* Lowe, 2010, *Hemiscorpius maindroni* (Kraepelin, 1900), *Nebo omanensis* Francke, 1980, *Microbuthus gardneri* Lowe, 2010, *Odontobuthus brevidigitus* Lowe, 2010, *Orthochirus glabrifrons* (Kraepelin, 1903) and *Vachoniolus batinahensis* Lowe 2010. The addition of two new species, *Hottentotta pellucidus* sp. nov. and *H. saxinatans* sp. nov., raises the total count of endemic scorpion species to 15, a remarkable number for a relatively small arachnid order. Two other species in northern Oman, *Androctonus crassicauda* (Olivier, 1807) and *Orthochirus innesi* Simon, 1910 are widely distributed elsewhere, so the endemic fraction is $15/17 = 88.2\%$. This high level of endemism might be explained by the low vagility of scorpions which makes them susceptible to vicariant speciation over the long history of these ancient mountains. After uplift of the mountains in the late Miocene, there have been multiple opportunities for dispersal and colonization by faunal elements from Africa or Asia during mesic phases of climatic cycles in the Pleistocene. Interchange of terrestrial faunas would have been impeded by marine barriers during pluvial periods, and by xeric barriers during glacial periods (most recently ~20 kYa). The last mesic or humid period occurred around 9–6.5 kYa (the ‘Climatic Optimum’), after which increasingly hot, arid conditions developed over much of the Arabian Peninsula. The wide altitudinal range and diversity of substrates in the Al Hajar region would have promoted local speciation by differential adaptation of lithophilic, lapidicolous or fossorial scorpions to different microhabitats (Williams, 1970; Prendini, 2001a; Lowe, 2009).

Among the endemic scorpions, *Babycurus exquisitus* and *Hottentotta saxinatans* from Jabal Akhdar, and *H. pellucidus* from Jabal Bani Jabir, appear to be restricted to higher elevations (> 1,600 m). They have not been found in extensive samples obtained by UV detection at lower elevations, and they do not cross the Sumail Gap dividing the western and eastern Al Hajar. They may be descendents of a relict mesic fauna that retreated to high altitude refugia during one of the Pleistocene glaciations. The mountains would have become semi-arid or arid during the late Holocene transition to hyper-arid conditions in Arabia. Current



Figures 57–64: In vivo habitus and habitats of new *Hottentotta* species in Oman. 57–59. *H. pellucidus*, **sp. nov.** 57–58. Paratype male. 59. Paratype female. 60. *H. saxinatans*, **sp. nov.**, paratype female. 61–63. Shir Plateau, Jabal Bani Jabir, type locality of *H. pellucidus*. 61–62. Terrain photos showing extensive fields of loose rock. 63. Prehistoric tower tomb constructed from broken rock. 64. Jabal Shams, type locality of *H. saxinatans*.



Figures 65–66: Maps showing collection sites of new species of *Hottentotta* in northern Oman. **65.** Records plotted on larger scale terrain and elevation map of southeast Arabia with geopolitical borders. **66.** Records plotted on color topographic map of northern Oman showing locations in the Al Hajar mountain ranges. Magenta circles: *H. pellucida*, sp. nov.; red circles: *H. saxinatans*, sp. nov. The isolated record of *H. pellucida* at Muscat may be spurious.

mean annual rainfall is 350 mm on Jabal Akhdar (Gardner & Fisher, 1996) which is on the higher end for Oman. In contrast, it is a mere 75 mm on Jabal Bani Jabir (Siebert et al., 2005). Although these montane scorpions were able to adapt to more xeric environments, they may be confined to the cooler mountain tops by competition from other presumably more recent species, e.g. *Hottentotta jayakari*, that have successfully occupied niches at lower elevations.

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