A new Hemiscorpius Peters, 1861 (Scorpiones: Hemiscorpiidae) from southwestern Iran

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Abstract: A new Hemiscorpius species, H. kashkayi sp. nov., is described from the Khuzestan and Ahwaz region in southwestern Iran. H. kashkayi is related to H. persicus Birula, 1903, known from Baluchestan in eastern Iran, which does not show sexual dimorphism between males and females, like H. kashkayi. These 2 species differ from all other Iranian Hemiscorpiidae species in having no sexual dimorphism. H. kashkayi is distinguished from H. persicus by its relatively short and well-developed stout metasoma and pedipalp segments, less developed patellar process, and carapacial and mesosomal carination.

Key words: Scorpiones, Hemiscorpiidae, Iran, Hemiscorpius, new species

1. Introduction
The family Hemiscorpiidae is distributed in East Africa, the Arabian Peninsula, Iraq, and Iran (Fet, 2000; Soleglad et al., 2005). Iranian species were reviewed by Monod and Lourenço (2005), who synonymized the genus Habibiella Vachon, 1974 with Hemiscorpius Peters, 1861 and gave revised diagnoses of Hemiscorpius gaillardi (Vachon, 1974), H. lepturus Peters, 1861, and H. persicus Birula, 1903, and also described H. enishochelea Monod and Lourenço, 2005 and H. acanthocercus Monod and Lourenço, 2005 from Bandar-Abbas, Hormozgan Province, in southeastern Iran. Hemiscorpius lepturus is known for serious scorpionism problems in southern Iran. This dangerous scorpion has highly cytotoxic venom that can cause deep skin necrosis and severe systemic pathology (Radmanesh, 1998; Shahbahzadeh et al., 2003; Pipelzadeh et al., 2007). Monod and Lourenço (2005) suggested that H. lepturus is not the only species causing all envenomations and that other Hemiscorpius species may cause similar dermonecrotic ulcers. Hence, elucidating the taxonomy of Hemiscorpius is important for understanding scorpionism in Iran. Here, we describe a new species of Hemiscorpius that has been overlooked in previous work on the fauna of Khuzestan Province. With the description of this new species, the number of known Iranian members of the genus Hemiscorpius is raised to 6, and the number of scorpion species known from Khuzestan Province is raised to 18.

2. Materials and methods
Scorpions were collected under stones during the day time and placed into 70% ethanol for preservation. Specimens were deposited in the scorpion collection of the Zoology Department of Niğde University (ZDNU) and the Biology Department of Zanjan University (BDZU).

Measurements were taken with a micrometric eyepiece of >0.1 mm accuracy and drawings were made using an Olympus SZX9 stereomicroscope with a drawing tube. All measurements are in millimeters. Trichobothrial notations and terminology of metasomal carination follow those of Vachon (1974). Measurements follow those of Stahnke (1970) and Sissom et al. (1990), except for the anterior width of the carapace, which was taken between the most medial pair of lateral eyes. Lengths of telson and vesicle were taken from the anterior limit of the vesicle, and pedipalp chela length was measured as the chord length from the external proximal limit of the manus to the edge of the fixed finger. The width and depth of the pedipalp manus were measured with the articular condyles level. Finally, the width of the pedipalp was measured including the dorsal patellar process (Soleglad and Fet, 2003). The preocular length was defined as the distance from the median ocular tubercle to the anterior margin of the carapace. The carinal terminology used is according to that of Stahnke (1970). The terminology of the pedipalp finger proximal scalloping (“recess” and “hump”) is according to Levy and Amitai (1980), and the hemispermatophore terminology follows Lamoral (1979). The formulae for telotarsal spiniform setae follow Francke (1975, 1977), i.e. Pr1/Rr1 PI1/R1 : Pr2/Rr2 PI2/R2 : Pr3/Rr3 PI3/R3 : Pr4/Rr4 PI4/R4, where P = prolateral or anterior, R = retrolateral or posterior, r = right tarsus, l = left tarsus, and 1–4 denote legs I–IV. Biometric conventions for macrosetal
counts for metasomal carinae listed in order for segments I, II, III, and IV follow Lowe (2010).

3. Results
3.1. Hemiscorpius kashkayi sp. nov.
Figures 1–9.

3.1.1. Type material

Etymology: The name “kashkayi” is given in honor of the nomadic Kashkay (Qashqai) Turks living in southern and southwestern Iran.

Diagnosis: A member of the genus Hemiscorpius, it is differentiated as follows: adults up to 40 mm in length; color dark tan yellow with blackish brown pedipalp fingers (Figures 1a–1d); (1) carapace longer than wide, shagreened and finely granular except small smooth compartments; superciliary carinae finely granular anteriorly, granules become coarser toward the median eyes and below median eyes, lateral margins with small blunt granules below lateral ocular tubercles, sternite VII with 2 granulose carinae in male (Figure 2b) and female; (2) pedipalps stout, chela fingers longer than manus; (3) internal protuberance of pedipalpal patella with internodorsal carina bearing 2 strong spiniform granules; (4) pedipalp patella orthobothriotaxic, external side with 13 trichobothria (1 est and 2 esb; also em1 basal to em2) (Figure 3f), ventral side with 3 trichobothria, pedipalp patella with external and ventromedian carina (Figure 2e); (5) metasoma I

Figure 1. Habitus of the holotype male (a and b) and paratype female (c and d) of Hemiscorpius kashkayi sp. nov.: a) dorsal, b) ventral, c) dorsal, d) ventral aspect.
with ventral median carina obsolete; only dorsal carinæ of segments II–IV and ventral and ventrolateral carinæ of segment V bearing spiniform granules; (7) metasoma and telson not greatly elongated, and without strong sexual dimorphism (Figures 4a and 4b); adult metasomal segment L/W ratios: male: I 1.64, II 2.14, III 2.30, IV 2.53, V 3.16; female: I 1.37, II 1.64, III 1.71, IV 2.16, V 2.58; telson with slightly elongated, bulbous vesicle, slightly curved aculeus (Figures 4a and 4b); (8) metasoma of females with dorsal carinæ of segments II–IV and ventral and ventrolateral carinæ of segments II–V bearing moderately spiniform granules; pedipalp chela (Figure 3d) with manus strongly flattened, moderately broadened, with ventroexternal carina consisting of fused and flattened granules; chela fingers slender, elongated, curved; fixed finger length equal to or greater than manus length; proximal margins of pedipalp fingers not scalloped in males; dentate margin of movable finger of adults armed with single linear row of denticles basally, 2 linear rows apically, internal accessory denticles numerous, irregularly spaced; orthobothriotaxic type C (Figures 2d, 2e, and 3a–3f), chela manus with V internal to V as to ventroexternal carina, Dt on base of fixed finger, eb slightly basal or equal to db on fixed finger; legs slender, leg III patella L/W 3.0–3.2.

**Hemispermatophore:** Lamelliform with complex capsule, distal lamina slender, slightly pointed apically; with double lamellar hook; capsular region complex has distinct lamella with strong apical hook; distal and

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**Figure 2.** *Hemiscorpius kashkayi* sp. nov. holotype male: a) carapace, b) sternite VII, c) right chelicera dorsal aspect, d) right femur dorsal aspect, e) right patella ventral aspect (scale bar: 1 mm).
accessory lobes well developed while basal and posterior lobes not well developed (Figure 8).

Comparisons: This species is distinguished from all other known members of the genus by the form of the pedipalp chela, with no recess on the long pedipalp chela fingers in males (Figures 6a and 6b). *H. kashkayi* sp. nov. is closely related to *H. persicus* from eastern Iran and *H. somalicus* Lourenço, 2011 and *H. novaki* Kovarík and Mazuch, 2011 from Somali. All of them have stout orthobothriotaxic pedipalps and have no pronounced sexual dimorphism between males and females. However, males of *H. kashkayi* sp. nov. and *H. persicus* can be more readily distinguished from each other than females based on: (1) carapace granulation, (2) relatively short and thick metasoma and thick and well-developed pedipalp segments, (3) morphology of telson, (4) pedipalp carination and shape, (5) trichobothria. The carapace of *H. kashkayi* sp. nov. has a dark colored line on the edge of the carapace anteriorly and posteriorly. These dark stripes are also present on the posterior edges of all tergites, except

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**Figure 3.** *Hemiscorpius kashkayi* sp. nov. holotype male (a–c, e, f) and paratype female (d): a) right chela dorsal aspect, b) right chela external aspect, c) right chela ventral aspect, d) right chela dorsal aspect, e) right patella dorsal aspect, f) right patella external aspect (scale bar: 1 mm).
The stripes are observed under UV light as cuticular foldings, while under white light they are observed as small blackish granules on posterior edges of tergites. The carapace of *H. persicus* is more granulose, while the surface of the carapace of *H. kashkayi* sp. nov. is smooth and brighter, but is finely granulated in dark colored areas and has a pair of dark colored 2–3 granules posteriorly situated on the inner side of the posteromedian furrows. The superciliary carinae are more granulose in *H. persicus* while they are nearly smooth with granules only below the median eyes in *H. kashkayi* sp. nov. *H. persicus* has metasomal dorsal carinae with numerous strong spiniform granules on metasomal segments I–V while in *H. kashkayi* sp. nov. the dorsal carinae of metasomal segments II–IV bear much reduced and weaker spiniform granules. The ventral and ventrolateral carinae of the metasomal segments are furnished with weak spiniform granules in males of *H. kashkayi* sp. nov., but are well developed with spiniform granules in males of *H. persicus*. The mediolateral carinae of metasomal segment V are present in almost the entire segment in *H. kashkayi* sp. nov., while they are present only on the anterior half of the segment in *H. persicus*. In *H. kashkayi* sp. nov. the telson is more ovoid and the aculeus is less curved than in *H. persicus*. *H. kashkayi* sp. nov. has lateral surfaces of telson, which are almost completely smooth with very small granules only scattered, while the lateral surfaces are more granular in *H. persicus*. The pedipalp chela manus in *H. kashkayi* sp. nov. is slightly thicker and with longer fingers than in *H. persicus*. The scalloping structure of the pedipalp fingers is not present in the males of *H. kashkayi* sp. nov. but is moderately developed in *H. persicus*. *H. kashkayi* has internodorsal carina of the patellar prominence with only 2 moderately strong spiniform granules, while *H. persicus*, in addition to having 2 strong spiniform granules, has several additional spiniform granules. Although they have the same orthobothriotaxic pedipalp patella, on the external side with 13 trichobothria, em1 is basal to em2 in the male *H. kashkayi* sp. nov., while em2 is basal to em1 in the male *H. persicus*. *H. kashkayi* sp. nov. differs from

Figure 4. *Hemiscorpius kashkayi* sp. nov. holotype male: a) metasoma and telson, ventral aspect, b) metasoma and telson, lateral aspect (scale bar: 2 mm).

Figure 5. *Hemiscorpius kashkayi* sp. nov. holotype male: a) right telotarsus III, ventrolateral aspect, b) right telotarsus III, ventral aspect (scale bar: 0.5 mm).

*H. somalicus* in its larger size; metasomal segment I longer than wide; dorsal carinae of metasomal segments I–IV moderately developed; differs from *H. novaki* in having less developed metasomal segments of the carinae. Ratios of the male pedipalp chela length to movable finger lengths are 2.90 for *H. somalicus*, 2.47 for *H. novaki*, and 3.33 for *H. kashkayi* sp. nov.

3.1.2. Description of holotype male (adult): Description based on the holotype (ZDNU 2007/66).

**Coloration:** Base color dark, yellowish brown with blackish underlyng pattern of dusky markings on chelicerae, carapace, and tergites I–V; pedipalp fingers, articular condyles of leg segments and aculeus of telson blackish dark brown; black pigmentation found around median and lateral eyes, anterior and posterior edge of carapace, also on posterior edge of tergites (Figures 1a and 1b).

**Carapace:** Mostly dark yellow to medium brown in color; posterior and anterior edges of carapace and granulated areas blackish; median and lateral ocular tubercles black. Carapace dorsoventrally flattened, a little longer than wide, slightly elongated, length 4.9 mm, posterior width 4.1 mm; lateral margins nearly parallel, median ocular tubercle weakly developed, surface shagreened, densely, finely granulated except for sulci and small smooth areas; anterior margin with deep median emargination; preocular length (Figures 2a and 6) 0.40 times length of carapace; 3 lateral eyes on each side, the posterior eye smaller than the 2 anterior; median ocular tubercle recessed, eyes only slightly raised above the surface of the carapace; sulci less developed except for well-developed posterior lateral sulci and posterolateral sulcus deeply excavated near posterior margin of carapace.
Chelicerae: Pale yellowish in color, manus and fingers with dark reticular pigmentation; teeth of fingers reddish brown; movable finger with 4 external denticles: distal, subdistal, medial, and basal; Chaetotaxy: manus with 3 macrosetae near apical border; movable finger with 2 macrosetae (Figure 2c).

Coxosternal area: Granulated on anterior margins; sternum wide and pentagonal with deep posteromedian sulcus; genital opercula divided, triangular; genital papillae present (Figure 7b).

Mesosoma: Tergite coloration dark yellow to medium brown anteriorly, becoming dark yellow posteriorly; tergites I–VI with series of coarse blackish granules along posterior margins, which appear as cuticular folds under UV light; each tergite bears a medial pair of marginal macrosetae. Tergites I–VI surfaces shagreened with very fine lateral granulation, tergite VII moderately granulated on lateral sides of its lateral carinae. Tergites I–VI have a shallow median depression divided anteriorly by a weak ridge, which becomes more pronounced in tergites IV–VI. Median carina reduced to a very weak ridge on tergites I–VI, but present on the posterior 4/5 of tergite VII as ridges with small blunt granules. Median border straight on pretergite I, convex on pretergites II–VI, and straight on pretergite VII; all pretergites smooth and minutely pitted. Sternite coloration dark yellow to light brown. Sternites III–VI smooth and minutely pitted, without granulation or carinae; sternite III with a pair of large, very finely and densely granular depressions, covered by the pectines; sternites IV–VI with a pair of shallow median furrows. Sternite VII shagreened finely and densely granular; a pair of lateral carinae developed as elongated granular ridges; median carina absent (Figure 2b). Spiracles of book lungs crescent-shaped. Tergites and sternites VII wider than long. Pectines (Figure 7b): tips extending to medial section of trochanter IV; pectine teeth, left 18, right 16; combs with 3 marginal lamellae, extended basal middle lamella, and 4 smaller elongate ovoid and 3 smaller rounded middle lamellae; basal middle lamella with medial border nearly twice as long as width of basal marginal lamella; basal piece of pectines longer than wide, with wide, V-shaped anterolateral deep invagination, bearing a pair of macrosetae; posterior border straight.

Chaetotaxy of carapace and tergites: Carapace with 2 macrosetae near posterior border and all tergites with 2 macrosetae medially near its posterior edges.

Metasoma: Metasoma not elongated and slender, color dark yellow to medium brown (Figures 1a, 1b, 4a, and 4b). Segment I with 6 carinae, ventromedian carina obsolete; segments II–IV with 7 carinae; dorsosubmedian carinae on segments I–IV strongly developed and crenulate, dorsolateral carinae strongly developed, crenulate on segments I–III; moderately crenulate on IV. Ventrolateral carinae strong, smooth to weakly granulate on I, strongly crenulated on segments II–IV; ventromedian carina obsolete on segment I, very weakly developed with flattened granules only posteriorly and nearly smooth anteriorly.

Figure 6. a) Hemiscorpius kashkayi sp. nov. holotype male chela external aspect, b) H. persicus male chela external view (photo by G. Lowe).

Figure 7. a) Hemiscorpius acanthocercus male, coxosternal area, b) Hemiscorpius kashkayi sp. nov. holotype male, coxosternal area.
on segment II, moderately crenulate on segments III–IV; metasoma V with 5 carinae: median lateral carinae weakly crenulate with 18–20 granules along 4/5 on segment V, ventromedian carina and ventrolateral carinae strong, crenulate; intercarinal surfaces of all segments concave, very finely granulate, matte; dorsal with lateral surface having few scattered posterior granules especially on all segments; lower lateral surface of segment V very finely granulate, nearly smooth, upper lateral surface more granulate with small scattered granules.

**Chaetotaxy of metasoma:** Long, reddish macrosetae are found on all metasomal segments; I–II with 2 pairs of macrosetae on dorsosubmedian carinae, with 3 pairs on III–V; I–II with 2 pairs of macrosetae on dorsolateral carinae, with 3 pairs on III–IV; ventrolateral carinae with 3 pairs of macrosetae on I–IV, 4 pairs on V; ventromedian carina flanked by paired macrosetae: 3 pairs on I–III, 4 pairs on IV; metasoma V with 3 pairs of macrosetae on dorsolateral carinae, 2 macrosetae on lateral row of granules, 4 pairs on ventrolateral carinae, 5 pairs on ventromedian carinae, and 2 on ventral intercarinal surface; 3 additional long macrosetae on ventral anal arc.

**Telson** (Figures 4a and 4b): Vesicle prolonged ovoid, moderately bulbous, a little wider than metasoma V; vesicle smooth dorsally, with 8–10 very small granules anteromedially; weakly convex lateral surfaces separated by a shallow median trough; telson bearing 3 pairs of macrosetae on dorsal surface; 3 pairs on lateral surface, 3 pairs on ventral surface, and 1 pair on base of aculeus. Aculeus with thick basal section and slightly curved.

**Pedipalp** (Figures 2d, 2e, and 3a–f):

**Femur** (Figure 2d). Femur 2.6 times longer than wide; dorsoexternal, dorsointernal, and ventrointernal carinae well developed with large blunt granules; external carinae moderately granular proximally, as a ridge with flattened moderate granules distally; dorsal and ventral surface densely and finely granulate, external surface with irregularly arranged large granules. Internal surface includes 3–4 enlarged reddish granules.

**Patella** (Figures 2e, 3e, and 3f). Patella 2.25 times longer than wide, with only dorsointernal carina coarsely granular, dorsoexternal carina smooth to weakly granular; ventroexternal carina moderately granular basally, weakly granular apically; ventrointernal carina moderately developed with large blunt granules, external carina a ridge with small flattened granules; dorsal and ventral surfaces moderately and finely granulated, external surface shagreened and less granulated. Dorsal and ventral patellar processes distinct with 2 strong spiniform granules; lacking additional granules on dorsal patellar process.

**Chela** (Figures 3a–3c and 6a). Relatively long, flattened with slightly expanded manus, chela length more than 3.5 times its width; relatively long fingers, movable finger 1.26 times longer than manus; pedipalp finger slender, slightly curved and fixed finger, with no basal concavity, and movable finger has no scallop at base (Figure 3a). Dorsoexternal and ventroexternal carina strongly developed on manus, like a ridge with moderately developed, prolonged, and flattened small granules; digital carina moderately granular at least at the base of the tibia, but more like a ridge along the length of the rest of the tibia. Ventoexternal and inner accessory carinae marked by series of enlarged granules; dorsointernal aspect of manus with scattered coarse granules; all intercarinal surfaces granular, on dorsal surface granules creating a networklike appearance; pedipalp fingers slender, not scoloped at base, 2 rows of denticles along the edge of movable fingers, immovable fingers with 2 rows of denticles at base becoming a single fused row toward the tip of the fingers. Linear row resolved into subrows, separated by slightly enlarged primary denticles and external accessory denticles; 5 external accessory denticles on movable finger and 4 on fixed finger.

**Trichobothrial pattern** (Figures 2d, 2e, and 3a–f). Orthobothriotaxic, type C (Vachon, 1974); patella with trichobothria d2 and i settled close together along dorsointernal carina; external surface of patella esb1 aligned with esb2; em1 rather proximal to em2; chela manus with V2 internal to V1 relative to axis of ventroexternal carina and distance between V3 and V4 more than 2.5 times the distance between V1 and V2; Dt positioned on
the base of the fixed finger at the articulating level of fixed and movable finger; db at the same level as eb; ib and it on median 2/3 of the fixed finger, and dt positioned medially but also slightly proximally on fixed finger.

Legs (Figures 5a and b): Thin and moderately elongate, laterigrade; basitarsi with series of several long reddish macrosetae on dorsal and ventral edges; dorsal, prolateral, and retrolateral surfaces of all telotarsi with long setae; basis of telotarsi with 2 parallel ventral rows of long, thickened, reddish spiniform setae, with setation formula 5/7 5/6: 6/7 6/6: 6/7 7/7; unguis stout and curved.

Measurements of holotype male (mm; L: length, W: width, D: depth): Total L 40.00; carapace L 4.9, W 4.1; preocular L 1.8; pectine L 2.9; metasoma and telson L 2.1; metasoma, segment I L 2.8, W 1.7, D 1.45; segment II L 3, W 1.4, D 1.5; segment III L 3, W 1.3, D 1.45; segment IV L 3.3, W 1.3 D 1.45; segment V L 3.8, W 1.2, D 1.4; telson L 3.5, vesicle W 1.4, D 1.4; aculeus L 0.7; femur L 4.2, W 1.7; patella L 4.2, W 1.8; pedipalp chela L 8.0, chela manus ventral L 3.6, manus L 3.9, chela W 2.4, chela D 2.7, fixed finger L 3.3, movable finger L 4.3.

Selected morphometric ratios: carapace W/L 0.83, pedipalp femur L/carapace L 0.85, pedipalp femur L/W 2.47, pedipalp patella L/W 2.33; pedipalp movable finger L/chela manus ventral L 1.19, pedipalp movable finger L/carapace L 0.87, pedipalp chela L/W 3.33, pedipalp chela manus ventral L/chela W 1.5, manus L/W 1.62, patella III L/W 3.0, metasomal segment L/W: I 1.64, II 2.17, III 2.30, IV 2.53, V 3.16.

3.1.3. Paratype female (adult) (Figures 1c, 1d, and 3d): Similar to holotype male, but differs as follows: carapace and tergites slightly less elongated; carapace and lateral carinae of tergite VII less crenulated; sternite VII lustrous, a pair of lateral carinae developed as elongated granular ridges and 3–4 granules on the external side of lateral carinae; pectines smaller, shorter and marginal tips extending only to basal 1/3 of trochanter IV; pectine teeth: left 11, right 10; combs with extended basal middle lamella, 6 small, round middle lamella; basal middle lamella with medial border over 3 times as long as the width of basal marginal lamella; genital opercula fused and without median suture; metasomal segments slightly less elongate, telson vesicle slightly more elongate; vesicle with small lateral granulation arranged as a pair of ventromedian rows bearing macrosetae; pedipalps with slightly less carination, chela with manus less expanded; telotarsal spiniform seta formula 5/7 5/6: 6/7 6/6: 6/7 7/7; unguis stout and curved.

Measurements of paratype female (mm): Total L 35; carapace L 4.5, W 3.9; preocular L 1.4; pectine L 2.4; metasoma I L 2.2, W 1.6; metasoma II L 2.3, W 1.4;
metasoma III L 2.4, W 1.4; metasoma IV L 2.6, W 1.2; metasoma V L 3.1, W 1.2; telson L 3.4, vesicle W 1.5, D 1.4; pedipalp femur L 3.7, W 1.5; pedipalp patella L 3.8, W 1.6; pedipalp chela L 7.2, chela manus ventral L 3.3, chela W 2.3, chela L/chela manus ventral L 2.18, pedipalp movable finger L 3.9, fixed finger L 2.9.

**Variations:** Two paratype females with 10–11, 1 female with 9–10, 1 female with 10–10 pectinal teeth; 2 paratype males with 16–16, 2 of paratype males with 15–15, 1 male with 16–18, 1 male with 15–16, and 1 male with 14–14 pectinal teeth.

**Distribution:** It is only known from Andimeshk, Omidiyeh, and Masdjjed Soliman of Khuzestan Province in Iran (Figure 9).

**4. Discussion**

Lowe (2010: 17) showed a plot of chela morphometric ratios for relative elongation of pedipalp fingers (movable finger L/carapace L; movable finger L/chela manus ventral L) for females of 10 species of *Hemiscorpius*. The mentioned measurements were taken from 3 females of *H. kashkayi*. The mean value for the 3 females of the movable finger L/carapace L ratio was 0.86, and that for the movable finger L/chela manus ventral L ratio was 1.25. With these chela ratios, females of *H. kashkayi* are clustered in the least specialized species of *Hemiscorpius* for lithophilic habitats, and with regard to the mean value of movable finger L/manus ventral L measurements they are clustered with females of *H. acanthocercus* and *H. socotranus* Pocock, 1899 according to Lowe (2010: 17).

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