

1 **Report of a rare anomaly in the telson of *Hemiscorpius jiroftensis***
2 **(Scorpiones: Hemiscorpiidae)**

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23 **Abstract**

24 **Introduction:** This study reports and describes a rare morphological anomaly observed in the
25 telson of *Hemiscorpius jiroftensis* collected from Khuzestan Province, Iran. This represents
26 the first documentation of such an abnormality in this species.

27 **Materials & Methods:** Systematic field surveys were carried out in Baghmalek, Khuzestan
28 Province, southwest Iran, in December 2025. A morphologically unusual specimen of *H.*
29 *jiroftensis* was collected and identified using standard morphological keys. The specimen was
30 examined under a Leica MZ 7.5 stereomicroscope, and morphometric measurements were
31 taken using a Guanglu digital caliper. High-resolution photographs of the external
32 morphology and abnormal structures were captured using a Canon digital imaging system.

Results: A rare anomaly present exclusively on the telson of the scorpion is described and illustrated. Morphological measurements of the specimen are also presented. This constitutes the first documented case of telson anomaly in *H. jiroftensis*. The causes of such anomalies in scorpions remains unclear.

Conclusion: This study provides the first report of a telson anomaly in *H. jiroftensis*. The detailed morphological documentation and measurements of this rare specimen enhance our understanding of developmental anomalies in scorpions and serve as a foundation for future research on teratology in the genus *Hemiscorpius*.

Keywords: Abnormality; *Hemiscorpius jiroftensis*; Telson; Morphological measurements.

1. Introduction

Among arthropods, scorpions possess one of the most highly specialized venom delivery systems, consisting of a pair of venom glands situated bilaterally within the telson and a stinger (aculeus) for venom injection [1]. The venom apparatus is essential for immobilizing prey, defending against threats, and adapting to ecological niches [1, 2]. Typically, venom glands are paired and symmetrically arranged inside the telson, separated by muscular tissue, and connected distally to the aculeus via venom ducts [3, 4]. This structural arrangement is highly conserved across different scorpion groups, underscoring the evolutionary significance of an efficient venom delivery system [4].

The genus *Hemiscorpius* Peters, 1861, includes 22 described species distributed from northeastern Africa to Iran and represents the only genus within the family Hemiscorpiidae Pocock, 1893, which is sister to *Hormuridae* Laurie, 1896 [5]. In Iran, Nine species of this medically significant genus have been recorded, three of which are responsible for the most severe clinical cases of human envenomation [5-8]. Species of *Hemiscorpius* are lithophilous, inhabiting arid to semi-arid environments ranging from low-lying coastal areas to foothills and mountains, regions characterized by considerable climatic variation [9].

Iran is one of the countries most heavily impacted by scorpionism, with an estimated 40,000–50,000 envenomation cases and approximately 20 deaths reported annually [10]. Epidemiological data indicate that 10–15% of envenomations in southwestern Iran are attributed to *H. lepturus*, which accounts for 89% of fatalities [5]. Southern Iran, especially the coastal regions along the Persian Gulf and Gulf of Oman, is a diversity hotspot for *Hemiscorpius*. Topographical features such as the Jebal Barez, Makkoran, and Zagros Mountain ranges have facilitated isolation and speciation, resulting in high levels of endemism within the genus [5].

H. jiroftensis, formerly referred to as *H. lepturus*, is one of the most medically important scorpion species in the Middle East, particularly in Iran and Iraq [5-10]. Its venom is predominantly cytotoxic and hemolytic rather than strongly neurotoxic, leading to dermonecrosis, hemolysis, inflammation, and, in severe cases, renal failure and systemic complications [9]. Transcriptomic and structural analyses have further elucidated the venom composition, including phospholipase A₂ coding sequences, phospholipase D proteins, and venom-associated metabolic pathways [5-10].

Morphological anomalies have been extensively documented in arthropods, affecting either the entire body plan or individual segments. Such anomalies have been observed in insects [11], spiders [12], chelicerates [13], and ticks [14]. Scorpions also display developmental anomalies in various body regions, including the metasoma, mesosoma, telson, pedipalps, and pectines [15,16]. Various non-sexual anomalies have been documented, including metasomal and telsonal duplication [17], mesosoma abnormalities [18], telson deformities [3, 18], and pedipalp malformations [19]. In a previous study, we documented a rare anomaly affecting the venom vesicle and metasomal structure of *Hottentotta zagrosensis* from Khuzestan Province, Iran, suggesting that both genetic and environmental factors may be involved [3].

However, anomalies involving the duplication or structural separation of venom glands remain exceedingly rare. Such abnormalities may arise from developmental disturbances or genetic mutations, potentially impacting venom synthesis, storage, and delivery. Examining these anomalies in *H. jiroftensis* offers valuable insights into venom gland development, evolutionary adaptation, and functional diversity. Therefore, the present study aims to describe a rare anatomical anomaly characterized by two distinct venom glands in *H. jiroftensis* and to discuss its potential developmental and evolutionary significance.

2. Materials and methods

Systematic field surveys of scorpions were conducted in Baghmalek, Khuzestan Province, southwest Iran, in December 2025 (Figure 1), by the Veterinary Service of the Razi Vaccine and Serum Research Institute. During these surveys, a morphologically unusual specimen of *Hemiscorpius jiroftensis* was identified. The specimen was collected from Baghmalek County, an area characterized by a hot, arid climate with pronounced seasonal temperature fluctuations. Species identification was performed using standard morphological taxonomic keys provided by Dehghan et al [5]. Following identification, the specimen was transported

to the laboratory and maintained in ventilated plastic containers under controlled conditions. The scorpion was provided with continuous access to water and was periodically fed live crickets. Venom extraction was carried out using controlled electrical stimulation applied to the telson, following the protocol described by Salabi et al. [3].

General morphology was assessed following the framework of Lourenço [20], and morphological measurements are reported in millimeters (mm). Morphometric measurements were obtained using a Guanglu digital caliper in accordance with the standard measurement criteria established by Sissom et al. [21]. Each specimen was examined under a Leica MZ 7.5 stereomicroscope, with detailed assessment of coloration, pedipalp morphology and prosoma/metasoma features. Six meristic traits and 18 morphometric ratios were measured using digital calipers (Table 1). For a detailed morphological examination, the specimen was preserved in 95% ethanol to prevent tissue degradation and structural distortion. Measurements included the dimensions of the carapace, metasomal segments, telson, and appendages. High-resolution photographs of the external morphology and abnormal structures were captured using a Canon digital imaging system to document the diagnostic features and observed anomalies.

2-1. Abbreviations of Morphometric Ratios

CL: Carapace length; CPW: Carapace posterior wide; CAW: Carapace anterior wide; CHL: Manus+ fixed finger length; ML: Manus length; MFL: Movable finger length; No.MFT: Number of Movable fig teeth (L: left; R: right); No.FFT: Number of fixed finger teeth (L: left; R: right); No.PT: Number of Pectinal teeth (L: left; R: right); Body Length: BL; Mt(I-V)L: Metasomal segment I-V length; Mt(I-V)W: Metasomal segment I-V wide; RVSRI: Razi Vaccine and Serum Research Institute; VAMRVSRI: Venomous Animals Museum of Razi Vaccine and Serum Research Institute, Karaj, Alborz, Iran; ZMCHUA: Zoological Museum of Shahid Chamran University of Ahvaz, Ahvaz, Khuzestan, Iran.

3. Results

Field surveys conducted in Baghmalek County, Khuzestan Province, yielded multiple scorpion specimens, including one adult *Hemiscorpius jiroftensis* individual exhibiting a rare morphological anomaly affecting the posterior metasomal region (Figure 1A,B). Close visual inspection and morphological analysis revealed that all five metasomal segments maintained normal morphology without detectable structural deformities. However, the terminal venom apparatus displayed a distinct abnormality: two separate telsons, each bearing an independent

aculeus, were attached to the fifth metasomal segment (Figure 2). Venom extraction confirmed the full functionality of both telsons, as venom was successfully secreted from each gland. Both telson structures exhibited standard anatomical organization, indicating two distinct venom storage compartments. Morphological evaluation suggests that this condition may reflect partial duplication or segmentation within the venom gland complex. All other body regions, including the prosoma, mesosoma, pedipalps, and walking legs, were structurally normal and symmetrical, with no visible deformities. Morphometric measurements of this adult specimen are presented in Table 1. The total body length was 59.89 mm, and detailed morphometrics revealed standard proportions in the carapace and metasomal segments, consistent with typical adult *H. jiroftensis* specimens.

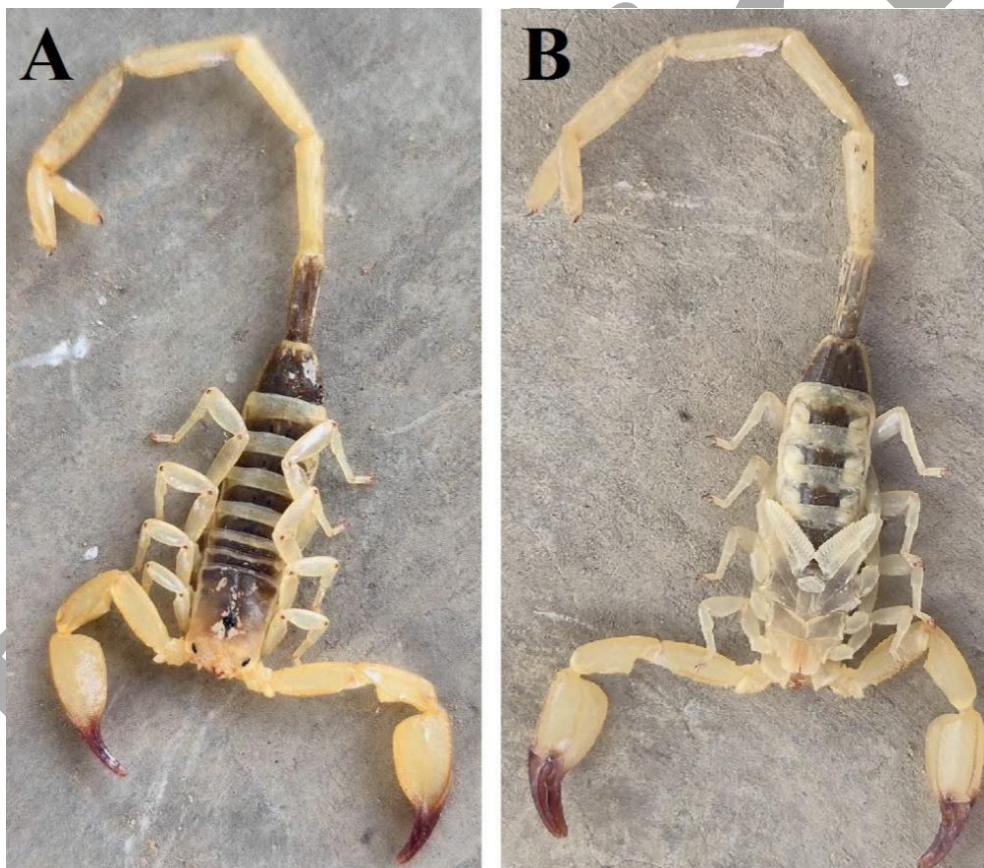


Figure 1. Anomalous adult specimen of *Hemiscorpius jiroftensis*. (A) Dorsal view. (B) Ventral view.

These measurements confirmed that the anomaly was restricted to the telson and venom gland region, without affecting overall body proportions or segmental morphology. The presence of two fully functional telsons is unprecedented in *H. jiroftensis* and represents a rare developmental irregularity in the venom apparatus.

Table I. Measurements (mm) of the abnormal *Hemiscorpius jiroftensis* specimen. Abbreviations: L/W/H= length/width/height; PW/AW= posterior width/anterior width. L = length; W = width (for carapace, it corresponds to posterior width); D = depth.

Character	♂	
CL	5.71	
CPW	5.04	
CAW	3.72	
CL/CPW	1.13	
CL/CAW	1.53	
CHL	8.65	
ML	4.66	
MFL	5.24	
Mt(I)L/W/D	5.30/1.84/1.77	
Mt(II)L/W/D	6.57/1.54/1.83	
Mt(III)L/W/D	6.64/1.46/1.69	
Mt(IV)L/W/D	6.86/1.42/1.62	
Mt(V)L/W/D	7.31/1.59/1.83	
Mt(I)L/W	2.88	
Mt(I)L/D	2.99	
Mt(II)L/W	4.27	
Mt(IV)L/D	4.23	
Mt(V)L/D	3.99	
No.PT	16	
Met L	34.52	
Total body L	59.89	
Telson L/W/H	5.60/1.33/1.47	5.53/1.29/1.51
TL/W	4.2	4.31
TL/D	3.81	3.68



Figure 2. Ventral view of the venom glands of *Hemiscorpius jiroftensis* with abnormal telson collected from Khuzestan province, Iran.

4. Discussion

This study reports a unique developmental anomaly in an adult *Hemiscorpius jiroftensis* specimen, characterized by the presence of two separate telsons, each bearing an independent aculeus and a fully functional venom gland. Such an observation is exceedingly rare in scorpions, as most previously documented anomalies involve duplication or malformation of metasomal segments, pedipalps, or telson shape, rather than structural duplication of the venom apparatus itself [22]. In the examined specimen, all five metasomal segments retained normal morphology, and other body regions—including the prosoma, mesosoma, pedipalps, and walking legs—were symmetrical and structurally intact. This suggests that the anomaly was highly localized to the terminal venom apparatus without broader developmental disruption. Morphometric measurements confirmed that overall body proportions corresponded to typical adult *H. jiroftensis*, further emphasizing that this was a specific and isolated morphological irregularity.

Functional evaluation through venom milking demonstrated active secretion from both telsons, indicating that the two venom glands were fully developed and capable of independent venom delivery. The structural and functional integrity of these glands suggests that the anomaly represents genuine partial duplication or compartmentalization within the venom gland complex rather than a non-functional vestigial structure. This functional

179 symmetry contrasts with many previously reported telson anomalies, where venom secretion
180 is often reduced or restricted to a single aculeus [23, 24].

181 The origin of this anomaly remains unclear. Developmental abnormalities in scorpions may
182 result from a combination of genetic factors, chromosomal mutations, or environmental
183 influences such as temperature extremes, humidity variation, and chemical exposure during
184 embryogenesis [18, 25]. Similar anomalies have been documented in other scorpion species
185 collected from natural habitats, including our previous report of aculeus duplication in
186 *Hottentotta zagrosensis*[3]. The occurrence of this rare anomaly in *H. jiroftensis* within the
187 same geographic region suggests that local environmental or genetic factors may underlie
188 developmental irregularities in the scorpion populations. From a functional perspective, the
189 presence of two independent venom-producing telsons may carry ecological and evolutionary
190 significance. This structural modification could enhance envenomation capability, potentially
191 improving prey capture or defense. Nevertheless, further studies incorporating histological
192 examination and molecular analysis of venom composition are required to determine whether
193 these structural changes also affect venom potency, biochemical profile, or delivery
194 mechanics. This case constitutes the first documented instance of two fully functional telsons
195 in *H. jiroftensis*. Reporting such anomalies broadens our understanding of scorpion
196 morphological diversity and offers insights into the developmental plasticity and potential
197 evolutionary pathways of venom apparatus specialization in scorpions.

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202 **Data availability**

203 All data analyzed during this study are included in this article.

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207 **Authors' contributions**

208 Study concept and design: Fatemeh Salabi; Gathering and coding the data: Fatemeh Salabi,
209 and Seyed Mahdi Kazemi. Analysis and interpretation of data: Fatemeh Salabi. Photography:
210 Fatemeh Salabi. Drafting of the manuscript: Fatemeh Salabi, and Seyed Mahdi Kazemi.
211 Revision of the manuscript: Fatemeh Salabi, and Seyed Mahdi Kazemi.

212 **Conflict of interest**

213 The authors declare no conflict of interest.

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