



Morphological Study of *Hemiscorpius* Peters, 1861 (Scorpiones: Hemiscorpidae) in Hormozgan Province, Southern Iran

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ABSTRACT

Hemiscorpius species are distributed in Africa and Asia. Seven species of this genus have been identified in Iran of which six species have been reported from Hormozgan province. Members of this genus are the most dangerous scorpions in Iran. Scorpions were collected by moving stones during the day and searching at night using portable UV lights from 2011 to 2022 from different areas in Hormozgan province. Three species were identified from Hormozgan province including *Hemiscorpius acanthocercus*, *H. enischnocela* and *H. shahii* which are endemic to Iran. These species have limited distribution and were reported only from the south of Iran. The number of trichobothria are 3, 10-12 and 15-17 in *H. acanthocercus*, *H. enischnochela* and *H. shahii*, respectively. The measured values showed that *H. Shahii* is larger than *H. enischnochela* and *H. acanthocercus*. Specimens of *H. acanthocercus* are brown to dark brown samples with dark metasomal segment V. There have been reports of death from biting this species. Members of *H. enischnochela* are light brown to yellow samples. Members of *H. Shahii* are large brown samples. All three species have sexual dimorphism. Although these three species can be distinguished based on their morphological characters, the molecular investigation is needed to confirm the validity of all species of this genus. Identifying species and determining their distribution range is very useful in facilitating education and treatment management.

Keywords: *Hemiscorpius*, Hemiscorpidae, Iran, Morphology, Sexual dimorphism

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1. Introduction

Hemiscorpiinae was a subfamily belonging to Scorpionidae Latreille, 1802 (1). It was first transferred from Scorpionidae to Ischnuridae by Stockwell (2) and then elevated to the family by Lourenço (3) and Prendini (4).

Hemiscorpiidae Pocock, 1893 included two genera consisting of *Hemiscorpius* Peters, 1861 and *Habibiella* Vachon, 1974. *Habibiella* is synonymized with *Hemiscorpius* by Monod & Lourenço (5). This family consists of a small group of Old World scorpions that occur in Africa (Eritrea, Somalia, and Egypt) and Asia (Iran, Iraq, Oman, Pakistan, Saudi Arabia, Socotra Island, United Arab Emirates, and Yemen) (6, 7). Members of this family can be recognized by the following characteristics: Patella of pedipalps with ventral trichobothria, femur of pedipalps with 3-4 trichobothria (one on dorsal part), movable finger of chelicerae with two denticles, sternum pentagonal, metasomal segments I-IV with an axial carina in ventral part, and lateroapical margins of tarsi of legs straight (5, 8-10).

By the end of 2022, the number of *Hemiscorpius* species had increased to 17 species (11). Currently, seven species of this genus have been recorded in Iran, including: *H. acanthocercus* (5, 9, 12-16), *H. enischnochela* (5, 9, 13, 16, 17), *H. gaillardi* (5, 18-20), *H. kashkayi* (8), *H. lepturus* (5, 9, 12, 13, 18, 20-51), *H. persicus* (5, 16-18, 23-25, 53), and *H. shahii* (10). The highest species diversity of the genus *Hemiscorpius* is reported from Hormozgan Province, Iran (17). Six species of this genus have been reported from Hormozgan Province (all except *H. kashkayi*), of which, five species are endemic to Iran and *H. shahii* is endemic to Hormozgan Province.

In southern Iran, about 500 cases of scorpion stings per 100,000 people occur annually. *Hemiscorpius lepturus*, *H. acanthocercus*, and *Androctonus crassicauda* have the highest rate of scorpion stings resulting in death in the southern part of Iran (30, 54, 55), with all three species reported from Hormozgan Province (17). To date, numerous cases of severe

kidney complications and deaths resulting from stings by scorpions of the family Hemiscorpidae have been reported from Hormozgan Province (15, 16, 56, 57). Therefore, it is highly important to identify dangerous species and determine their distribution area because this is very important for producing specific antivenoms when treating patients.

Due to the limited distribution range in Iran, very little information is available on these scorpions. This study aimed to determine the morphometric values of *Hemiscorpius* species to facilitate the identification of species of this genus in Hormozgan Province based on morphological characteristics.

2. Materials and methods

2.1. Study area

Hormozgan Province is located between 25°23' and 28°57' N and 52°41' and 59°15' E in the southern part of Iran. The province has a 900 km long border with the Persian Gulf and the Sea of Oman. The province consists of two distinct areas, the coastal area in the south and the mountainous area in the north. Most of the province is mountainous, with the southern part of the Zagros Mountains stretching from northwest to southeast (hormozgan.doe.ir). The total annual precipitation is 100-150 mm, and the mean annual relative humidity is 59.5%. The maximum and minimum annual mean temperatures are 49°C and 6°C, respectively (hormozganmet.ir).

2.2. Sampling of scorpions

Scorpions were collected from 2011 to 2022 from different areas of Hormozgan Province by moving stones during the day and searching with portable ultraviolet lamps at night (Fig. 1). Samples were preserved in 80% ethanol. Samples were also sent from two hospitals, namely Children's Hospital and Shahid Mohammadi Hospital, Bandar Abbas, Iran. These samples were provided to these centers by individuals who had been bitten by scorpions. The specimens were deposited in the medical entomology collection of Bandar Abbas Health School, Hormozgan University of Medical Science,

Hormozgan, Iran, and in the collection of the Research Institute of Zabol, Zabol, Iran.

2.3. Morphology and morphometry

Samples were identified by valid keys of *Hemiscorpius* species (5, 10, 17) using a Nikon XN stereomicroscope (Japan). Morphometric measurements (based on Stahnke, (58) and Sissom,

(59)) of the scorpion were made as follows: 1) carapace length and width, 2) mesosoma length and width, 3) metasoma segment length and width (I-V), 4) telson length, 5) patellar length and width, 6) tibial length and width, 7) movable finger length, and 8) total length of adult male and female specimens (Tables 1, 2, 3).

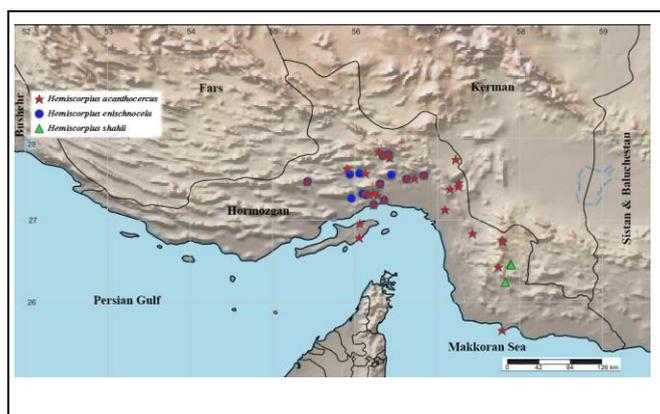


Figure 1. Distribution map of *Hemiscorpius* specimens, collected from Hormozgan province

Table 1: Measurements (min & max) of adult males and females of *Hemiscorpius acanthocercus*

| Parameter | | | ♂ Min (mm) | ♂ Max (mm) | ♀ Min (mm) | ♀ Max (mm) |
|--------------------|-----------------------|------------|------------|------------|------------|------------|
| | | | N=19 | | N=15 | |
| Pedipalp | Femur | Length | 4.6 | 6.5 | 4.3 | 5.5 |
| | | Width | 1.6 | 2 | 1.6 | 2 |
| | Patella | Length | 4.6 | 6.3 | 4.4 | 5.6 |
| | | Width | 1.9 | 2.4 | 1.8 | 2.3 |
| | Manus | Length | 9 | 12.3 | 8.8 | 11.4 |
| Width | | 3.3 | 3.9 | 3.4 | 4.5 | |
| | Movable Finger Length | 3.6 | 4 | 3.8 | 5.2 | |
| Carapace | Length | 5.1 | 6.7 | 5.4 | 6.7 | |
| | Width | 4.3 | 5.7 | 4.5 | 5.4 | |
| Mesosoma | Length | 12.3 | 15.9 | 11.8 | 16.1 | |
| | Width | 4.3 | 5.9 | 4.8 | 6.3 | |
| Metasomal Segments | Length I | Length I | 4.6 | 7 | 2.6 | 3.4 |
| | | Width I | 1.5 | 2 | 1.8 | 2.3 |
| | Length II | Length II | 4.9 | 6.7 | 3 | 3.8 |
| | | Width II | 1.3 | 1.8 | 1.6 | 2 |
| | Length III | Length III | 5.4 | 7.9 | 3 | 4.1 |
| | | Width III | 1.2 | 1.6 | 1.5 | 1.9 |
| | Length IV | Length IV | 5.5 | 8.3 | 3.4 | 4.4 |
| | | Width IV | 1.1 | 1.5 | 1.4 | 1.7 |
| | Length V | Length V | 6.4 | 8.6 | 4.2 | 5.6 |
| | | Width V | 1.2 | 1.6 | 1.4 | 1.9 |
| Telson | Length | 4.9 | 6.1 | 3.1 | 5.2 | |
| Pectin | Length | 3.7 | 5.1 | 2.9 | 5.6 | |
| Total Length | | | 49.1 | 67.2 | 36.5 | 49.3 |

Table 2: Measurements (min & max) of adult males and females of *Hemiscorpius enischnochela*

| Parameter | | | ♂ Min (mm) | ♂ Max (mm) | ♀ Min (mm) | ♀ Max (mm) |
|--------------------|-----------------------|------------|------------|------------|------------|------------|
| | | | N=17 | | N=13 | |
| Pedipalp | Femur | Length | 7.5 | 8.7 | 6.3 | 8 |
| | | Width | 2.2 | 2.5 | 2.1 | 2.7 |
| | Patella | Length | 7.2 | 8.3 | 6.2 | 8 |
| | | Width | 2.7 | 3.3 | 2.5 | 3.3 |
| | Manus | Length | 13.6 | 15.5 | 11.9 | 15.6 |
| | | Width | 4.2 | 4.6 | 3.8 | 5 |
| | Movable Finger Length | 5.8 | 6.9 | 5.9 | 7 | |
| Carapace | Length | 7.5 | 8.5 | 7.2 | 8.7 | |
| | Width | 6.3 | 7.7 | 6.1 | 7.3 | |
| Mesosoma | Length | 17.5 | 21.5 | 15.6 | 20.2 | |
| | Width | 6.4 | 7.2 | 6.7 | 11.2 | |
| Metasomal Segments | Length I | Length I | 8 | 9.4 | 4 | 5 |
| | | Width I | 2 | 2.4 | 2.1 | 2.7 |
| | Length II | Length II | 8.7 | 10.8 | 4.5 | 5.8 |
| | | Width II | 1.7 | 1.9 | 1.8 | 2.2 |
| | Length III | Length III | 9.2 | 11.2 | 4.4 | 6.1 |
| | | Width III | 1.6 | 1.8 | 1.7 | 2.1 |
| | Length IV | Length IV | 9.6 | 11.4 | 5.1 | 6.6 |
| | | Width IV | 1.5 | 1.8 | 1.6 | 2 |
| | Length V | Length V | 9.8 | 11.7 | 5.8 | 7.5 |
| | | Width V | 1.6 | 1.9 | 1.7 | 2.1 |
| Telson | Length | 6.5 | 7.9 | 5.4 | 6.7 | |
| Pectin | Length | 5.4 | 6.4 | 3.7 | 4.6 | |
| Total Length | | | 76.8 | 92.4 | 52 | 66.6 |

Table 3: Measurements (min & max) of adult male and females of *Hemiscorpius shahii*

| Parameter | | | ♂ (mm) | ♀ Min (mm) | ♀ Max (mm) |
|--------------------|-----------------------|------------|--------|------------|------------|
| | | | N=1 | N=4 | |
| Pedipalp | Femur | Length | 10.8 | 10.8 | 11.4 |
| | | Width | 2.6 | 2.6 | 2.9 |
| | Patella | Length | 10.6 | 10 | 11.1 |
| | | Width | 3 | 3.2 | 3.7 |
| | Manus | Length | 9.2 | 8.9 | 10.5 |
| | | Width | 4 | 4.1 | 4.9 |
| | Movable Finger Length | 11 | 11.6 | 12.2 | |
| Carapace | Length | 9.2 | 9.5 | 10 | |
| | Width | 8.2 | 5 | 8.5 | |
| Mesosoma | Length | 24.8 | 22.4 | 30.1 | |
| | Width | 8 | 7.8 | 9 | |
| Metasomal Segments | Length I | Length I | 10.8 | 6.5 | 8 |
| | | Width I | 2.2 | 2.5 | 2.7 |
| | Length II | Length II | 12.3 | 7 | 8.8 |
| | | Width II | 1.8 | 2.1 | 2.4 |
| | Length III | Length III | 12.5 | 7.4 | 9.2 |
| | | Width III | 1.6 | 1.9 | 2.2 |
| | Length IV | Length IV | 13.3 | 8 | 10 |
| | | Width IV | 1.6 | 1.8 | 2 |
| | Length V | Length V | 13.5 | 8.4 | 11 |
| | | Width V | 1.5 | 1.8 | 2 |
| Telson | Length | 7.6 | 7.4 | 8.1 | |
| Pectin | Length | 6.3 | 4.6 | 5.6 | |
| Total Length | | | 10.4 | 76.6 | 95.2 |

3. Results

3.1. Systematics

Family Hemiscorpiidae Pocock, 1893

Genus *Hemiscorpius* Peters 1861

Hemiscorpius acanthocercus (Figs. 2, 3, 7A)

Material examined. Iran, Hormozgan Province: 2 males, district Bandar Abbas, 27°14'N, 56°21'E, 2013, leg. M. H. Speed; 1 female, 29 August 2013, leg. H. Hasanpour; 8 females, 3 subadult females, 12 males, 2014, leg. M. Shahi; 1 female, 14 March 2015, leg. M.

Rahimi; 1 male, October 14, 2017, leg. E. Arman; 2 males, 2019, leg. F. Afghanpour; 1 female, 2020, leg. N. Bagheri; 1 male, May 25, 2020, leg. R. Speed; 1 male, June 21, 2020, leg. M. Reyhani; 1 female, April



Figure 2. Adult male of *Hemiscorpius acanthocercus*: A) Dorsal view, B) Ventral view

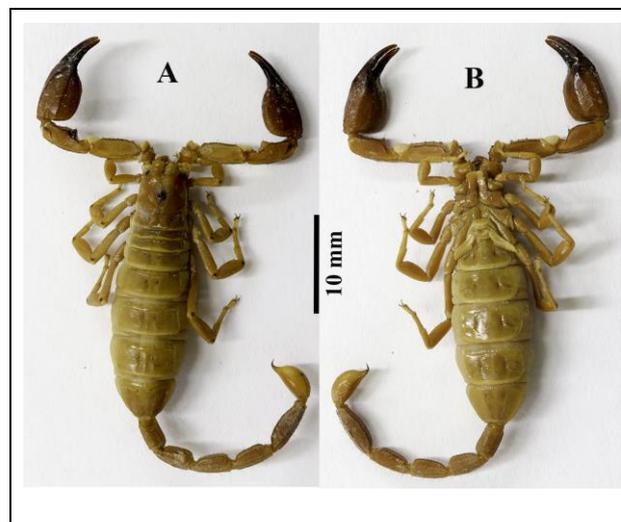


Figure 3. Adult female of *Hemiscorpius acanthocercus*: A) Dorsal view, B) Ventral view

30, 2021, leg. M. Shahi; 1 female, Chahestan, 27°30'N, 56°43'E, 2013, leg. M. Gorji; 1 female, 2014, leg. M. Darvishi; 1 female, May 10, 2021, leg. Salari; 1 female, Dargir, 27°19'N, 56°13'E, 2014, leg. M. Shahi; 1 female (Fig. 7A), village of Dargaz,

27°50'N, 56°17'E, October 08, 2022, leg. O. Jafari; 1 female, 1 male, Fin, 27°37'N, 55°54'E, 2013, leg. M. J. Rostami; 1 male, 2019, leg. S. Aflaki; 2 females, August 05, 2021, leg. M. Shahi; 1 female, Fur Khorj, 27°45'N, 56°25'E, 2020, leg. A. Abbaspour; 1

subadult male, village of Genow , 27°26'N, 56°18'E, 2014; 1 male, June 18, 2022, leg. M. Shahi; 1 female, Isin, 27°18'N, 56°16'E, September 17, 2021, leg. M. Shahi; 1 female, Mohamad Abad, 2013, 27°19'N, 56°07'E, leg. S. Behzadipour; 2 males, Sarzeh, 27°34'N, 56°07'E, October 16, 2013, leg. Gh. Mirannejad; 1 female, Shamil, 27°32'N, 56°50'E, 30 December 2012, leg. M. Ghasemi; 1 male, 2013, leg. A. Pirayesh; 1 male, Siyahu, 27°47'N, 56°20'E, 2013, leg. Z. Hamzehei; 1 male, Tazian, 27°18'N, 56°10'E, April 19, 2014, leg. M. Shahi; 1 female (Fig. 3), Takht, 27°30'N, 56°37'E, April 22, 2011, leg. O. Jafari; 1 female, 1 male, 2014, leg. M. Shahi; 3 females, Bandar Abbas Roudan road, 27°14'N, 56°21'E, December 03, 2021, leg. M. Shahi; 1 female, Bashagard County, 26°27'N, 57°53'E, October 16, 2013, leg. Gh. Mirannezhad; 1 female, April 05, 2014, leg. E. Sayyadi; 2 males, May 31, 2014, leg. H. Eidzadeh; 1 female, June 13, 2014, leg. A. Shanbehzadeh; 1 male (Fig. 2), 03 August 2014, leg. H. Eidzadeh; 1 male, August 30, 2014, leg. H. Gangozari; 1 female, October 22, 2014, leg. K. Heydari; 8 females, 8 males, August 06, 2022, leg. M. Shahi; 3 females, 2 subadult females, 3 males, Bashagard County, Beshno village, 26°45'42.0"N, 57°47'24.5"E, September 27, 2014, leg. A. Eidzadeh; 1 male, Darang Madu village, 26°30'N, 58°09'E, October 15, 2013, leg. M. Karami; 1 male, Jakdan village, 26°25'N, 57°44'E, May 05, 2013, leg. A. Hashemi; 26°25'N, 57°44'E, May 29, 2014, leg. A. Shanbehzadeh; 1 male, Owghan village, 26°44'N, 57°47'E, July 20, 2014, leg. H. Eidzadeh; 1 female, Bandar-e Jask, 25°39'N, 57°47'E, May 11, 2021, leg. Mojahedi; 1 female, Khamir County, Ruydar, 27°28'N, 55°25'E, 2014, leg. Sh. Jahanbani; 1 male, August 02, 2021, leg. Z. Ghahramani; 1 male, Minab County, 27°07'N, 57°05'E, 2013, leg. H. Ghaderi; 2 males, July 12, 2020, leg. M. Shahi; 1 female, Senderk, 26°50'N, 57°25'E, September 29, 2018, leg.

A. Askari; 1 female, Rudan County, Abnama, 27°27'N, 57°15'E, May 01, 2013, leg. R. Habibi; 1 male, Eslamabad, 27°22'N, 57°09'E, May 25, 2013, leg. A. Ranjbari; 6 females, 2 males, Faryab, 27°49'N, 57°17'E, April 20, 2012, leg. R. Habibi; 1 Female, 27°49'N, 57°17'E, August 06, 2013, leg. Mahdavi; 2 females, 1 male, Kharaji, 27°24'N, 57°15'E, June 03, 2014, leg. R. Habibi; 3 females, 2 males, Ziaratali, 27°44'N, 57°13'E, July 03, 2013, leg. Bahramshahi; 1 male, Qeshm Island, Dargahan, 26°57'N, 56°03'E, 2013, leg. A. Mirshekari; 1 male, Qeshm Island, 26°47'N, 56°03'E, 2020, leg. M. Shahi.

Diagnosis. Maximum total length in male and female 67.2 and 49.3 mm, respectively (Table 1); base color of body brown, median and lateral eyes, fingers of pedipalps, and aculeus black (Figs. 2, 3, 7A); patella of pedipalps with 3 ventral trichobothria; carapace dark brown, longer than wide with fine granules (Figs. 2A, 3A); sternites dark yellow, sternum pentagonal (Figs. 2B, 3B); pectinal teeth 13-16 in males (Fig. 2B) and 9-10 in females (Fig. 3B); metasomal segments in males (Fig. 2) very elongate and more slender in females (Figs. 3, 7A); segment V in most specimens black (Figs. 2, 3, 7A); telson pale yellow, long in males (Fig. 2) and oval in females (Fig. 3), aculeus short and curved (Figs. 2, 3). Measurements are given in Table 1.

Hemiscorpius enischnochela Monod & Lourenço, 2005 (Figs. 4-6, 7B)

Material examined. Iran, Hormozgan Province: 1 male, Bandar Abbas district, 27°14'N, 56°21'E, 2013, leg. M. Heydaripour; 2 females, 3 males, 2014, leg. M. Shahi; 2 females, 2019, leg. N. Karimi; 1 female, July 17, 2020, leg. A. Ahmar; 1 female, May 31, 2021, leg. S. Khadir; 2 females, 4 males, 2 juveniles, Fin, Tal-e Gerdu village, 27°48'N, 56°24'E, 2013, leg. M. Dehghan; 1 female, Genow village, 27°26'N, 56°18'E, April 25, 2014, leg. M. Shahi; 2 females (Fig. 7B), October 27, 2022, leg. H. Barahoei and M.

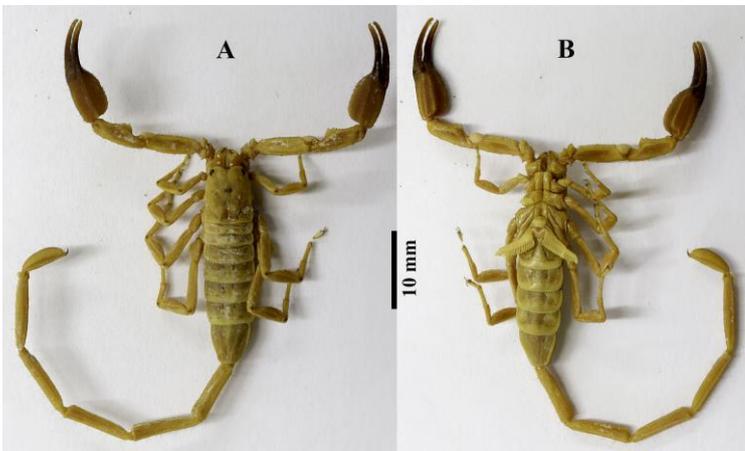


Figure 4. Adult male of *Hemiscorpius enischnochela*: A) Dorsal view, B) Ventral view

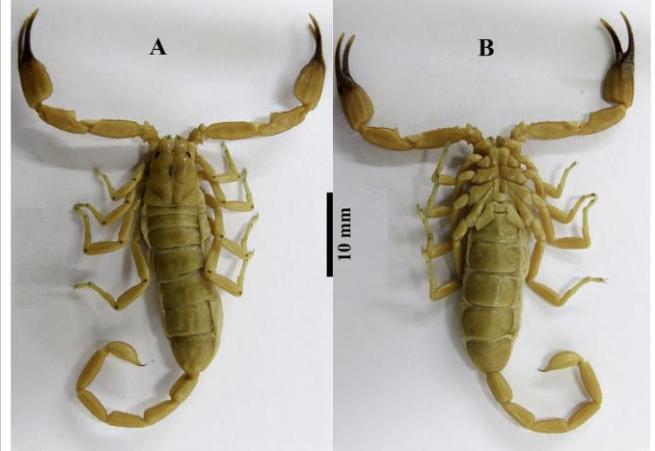


Figure 5. Adult female of *Hemiscorpius enischnochela*: A) Dorsal view, B) Ventral view



Figure 6. Alive samples of male (A) and female (B) of *Hemiscorpius enischnochela*



Figure 7. Alive specimens of females of *Hemiscorpius acanthocercus* (A) and *H. enischnochela* (B)

Shahi; 1 male, Keshar-e Oliya, 27°16'N, 55°57'E, 2013, leg. K. Karjou; 1 female, Khorgo village, 27°33'N, 56°26'E, leg. Behrouzi; 1 male, October 03, 2022, 2 females, Konaru, 27°18'39.9"N, 56°08'16.4"E, 2013, leg. A. Mahyari; 1 female, Qalate Bala, 27°19'N, 56°05'E, June 03, 2015, M. Shahi; 1 male, Rezvan, 27°34'N, 56°03'E, 2013, leg. A. Dastpak; 1 male, Shamil, 27°32'N, 56°50'E, 2013, leg. Sh. Speed; 1 female, 1 male, Siyahu, 27°47'N, 56°20'E, 2013, leg. S. Kamali; 1 female, May 17,

2018, leg. M. Shahi; 1 female, Takht, 27°30'N, 56°37'E, 2013, leg. M. A. Khodajouyan; 1 female, Bandar Abbas, Roudan road, 27°14'N, 56°21'E, December 03, 2021, leg. M. Shahi; 1 male, Khamir County, Ruydar, 27°28'N, 55°25'E, 2011, leg. M. Mirkarimi; 1 female, 8 males (Fig. 4), 2013, leg. H. Jahanbani; 1 female, 1 male, October 01, 2014, leg. M. Shahi; 1 female, July 20, 2014, leg. A. Foroutan; 2 females, 2 males, 2014, leg. F. Nikanpour; 1 female, 1 male, May 07, 2020, 2 males, September 10, 2021,

leg. Z. Ghahramani; 1 female, 1 male (Fig. 6), December 01, 2022, leg. Sh. Jahanbani; 1 female (Fig. 5), Lavar; 27°33'N, 55°56'E, 2014, leg. Z. Fatr.

Diagnosis. Maximum total length in adult male and female 92.4 and 66.6 mm, respectively (Table 2); base color of body bright yellow, median and lateral eyes, fingers of pedipalps and aculeus black (Figs. 4-6, 7B); patella of pedipalps with 10-12 ventral trichobothria; carapace longer than broad and finely granular (Figs. 4A, 5A, 6, 7B); tergites slightly granular; sternites pale yellow, sternum pentagonal (Figs. 4B, 5B); pectinal teeth 16-17 in male (Fig. 4B) and 8-10 in female (Fig. 5B); metasoma in male (Figs. 4, 6A) very elongate and more slender than in females (Figs. 5, 6B, 7B); telson oval in females (Figs. 5, 7B) and long in males (Figs. 4, 6A), aculeus short and curved (Figs. 4-6, 7B). Measurements are given in Table 2.

Hemiscorpius shahii (Figs. 8, 9)

Material examined. Iran, Hormozgan province: 1 female (Fig. 9), Bashagard district, leg. Jaqard village, 26°14'N, 57°49'E, May 26, 2014, J. Barazideh; 2 females, 1 subadult male, 6 juveniles, Bashagard district, 26°27'N, 57°53'E, April 05, 2014, leg. E. Sayyadi; 1 male (Fig. 8), 2013, leg. Gh. Aghili; 1 female, October 18, 2013, leg. M. Vatankhah.

Diagnosis. Maximum total length in male and female 10.4 and 95.2 mm, respectively (Table 3); base color of body brown, median and lateral eyes, fingers of pedipalps and aculeus black (Figs. 8, 9); patella of pedipalps with 14-17 ventral trichobothria; carapace dark brown, longer than wide with fine granules (Figs. 8A, 9A); sternites brown, sternum pentagonal (Figs. 8B, 9B); pectinal teeth 14-15 in males (Fig. 8B) and 9-10 in females (Fig. 9B); metasomal segments in males (Fig. 8B) very elongate and more slender than in females (Fig. 9B); telson pale yellow, long in males (Fig. 8) and oval in females (Fig. 9), aculeus short and curved (Figs. 8, 9). Measurements are given in Table

3.

3.2. Identification key for the *Hemiscorpius* species occurring in Iran

1. Pedipalp patella with 14-17 ventral trichobothria, large samples..... *H. shahii*
 - Pedipalp patella with 10-12 or 3 ventral trichobothria, small to medium samples2
- 2(1). Pedipalp patella with 10-12 ventral trichobothria3
 - Patella of pedipalps with 3 ventral trichobothria ..4
- 3(2). Patella of pedipalps with 1 trichobothria on outer side; patellar processes with interodorsal carinae bearing 3 strong spiny granules..... *H. enischnochela*
 - Patella of pedipalps with 2 trichobothria on outer surface; patellar processes with interodorsal carinae bearing 6 spiny granules..... *H. gaillardii*
- 4(2). Total length of adult less than 40 mm; metasoma and telson not greatly elongated; without strong sexual dimorphism5
 - Total adult length more than 50 mm; metasoma and telson greatly elongated; with strong sexual dimorphism..... 6
- 5(4). Male without recess on long pedipalp chela fingers; carapace almost smooth with granules only below median eyes; lateral surfaces of telson almost completely smooth with very small granules only scattered*H. kashkayi*
 - Male with a recess on long pedipalp chela fingers; carapace more granulate; lateral surfaces of telson more granulate*H. persicus*
- 6(4). Metasomal dorsal carinae with numerous strong spiny granules; lateral carapace margins with small spiny granules below lateral eyes*H. acanthocercus*
 - Metasomal dorsal carinae with sparse, very reduced, and weaker spiny granules, especially on anterior segments; lateral carapace margins completely smooth*H. lepturus*



Figure 8. Adult male of *Hemiscorpius shahii*: A) Dorsal view, B) Ventral view

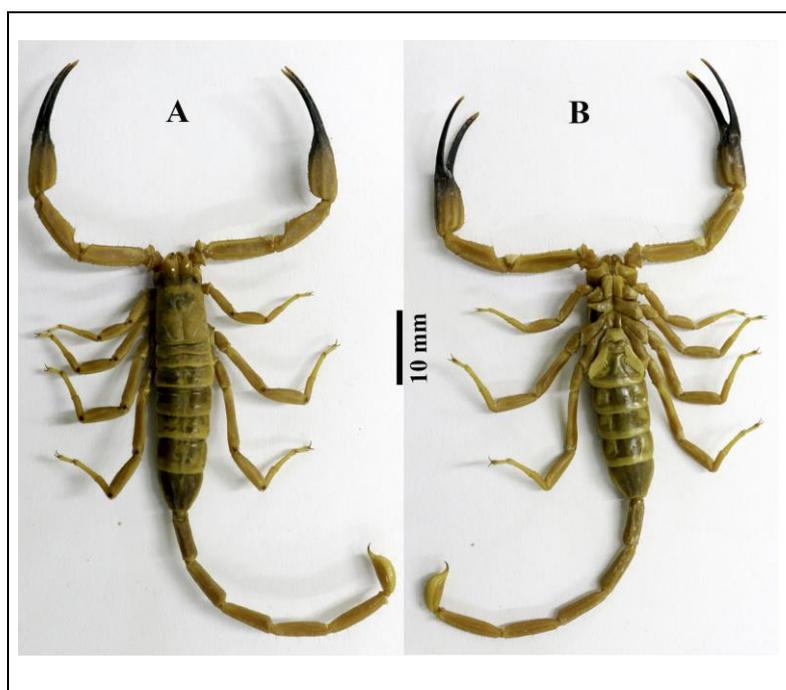


Figure 9. Adult female of *Hemiscorpius shahii*: A) Dorsal view, B) Ventral view

4. Discussion

Hemiscorpius Peters, 1861 has the greatest species diversity in southern Iran, compared to other parts of Iran. *Hemiscorpius enischnocela*, *H. acanthocercus*, and *H. shahii* are endemic to Iran. These species have a restricted range and have been reported only from the south of Iran (5, 10, 13,

16).

Very few studies have been conducted on this genus so far. Hormozgan Province is highly rich in scorpion species due to suitable climatic conditions. The highest species diversity of *Hemiscorpius* has been reported from this province (5, 9, 17).

Hemiscorpius acanthocercus and *H. enischnochela* have been described from Hormozgan province (5) and reported

by other researchers from different parts of this province (9, 14-16). *Hemiscorpius acanthocercus* has caused human deaths due to severe complications (56). The report of *H. gaillardi* (17) from Hormozgan province was the result of misidentification and was corrected by Barahoei and Shahi (60). In this study, we were unable to identify any specimens of *H. lepturus*, and it appears that previous reports (9, 32, 39, 52) were the result of misidentification. The specimens reported as *H. persicus* from Hormozgan Province (18, 24, 25, 52) are *H. acanthocercus*. *Hemiscorpius shahii* is distributed only in the Bashagard region in the eastern part of Hormozgan (10). Bashagard is the junction between the Zagros and Makoran Mountains (61). It seems that the presence of these complications caused the separation of *H. Shahii* from other species in its vicinity. Probably, the type of soil and the habitat conditions in this region have caused the particular morphological characteristics of this species. Therefore, only three species are distributed in Hormozgan province, namely *H. acanthocercus*, *H. enischnochela*, and *H. shahii*.

The measurements showed that *H. shahii* was larger than *H. enischnochela* and *H. acanthocercus*. The body length was larger in males than in females (Tables 1-3). The telson shape was similar in all species. They were ovate in females and elongate in males. The results obtained in this study were in agreement with the descriptive study of Monod and Lourenço (5).

Specimens of *H. acanthocercus* were brown to dark brown specimens with dark metasomal segment V (Figs. 2, 3, 7A). The members of *H. enischnochela* were light brown to yellow specimens (Figs. 4-6, 7B). Members of *H. shahii* were large brown specimens (Figs. 8, 9). The number of trichobothria was 3, 10-12, and 15-17 in *H. acanthocercus*, *H. enischnochela*, and *H. shahii*, respectively, and all three species exhibited strong sexual dimorphism (Tables 1-3). The metasomal segments of adult males were narrow and very long (5, 10, 17), making males easy to distinguish from females.

Because of the morphological similarity of some species to each other, molecular study is urgently needed to confirm the validity of all species in this genus. On the other hand, different populations in regions with different weather conditions have different venom compositions; therefore, existing antivenoms do not have the right effect for treating patients. Considering this, it is necessary to identify different species in each region for the management of reconnaissance and treatment.

Authors' Contribution

Collecting samples, first identification and measurements of specimens and drafting the manuscript: Mehran Shahi. Final identification of specimens, providing of pictures, confirmation of the records and revising the manuscript and correspondence: Hossein Barahoei. All authors read and approved the final version of the manuscript.

Ethics

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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