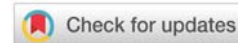


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## Research Article

# Psammophilic scorpions in deserts of Iran

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## Abstract

In this study totally 3453 scorpions belonged buthidae family collected from different localities in south and southwestern provinces of Iran. The six psammophilic scorpions were identified in this research: *Kraepelinia palpator*, *Polisius persicus*, *Apistobuthus susanae*, *Buthacus macrocentrus*, *Vachoniolus iranus* and *Compsobuthus jakesi*.

## Introduction

The psammophilus scorpions are liked to life on desert area and this group of scorpions are stenotopes, maladapted to life outside of this environments, and are unviable to burrow soil [1-3].

Long tarsal claws and enlarged macrochaete setae arranged into "sand combs" increase the effective surface area in contact with the ground. This allows scorpions to walk on loose sand without sinking or loss of traction. Such leg morphology also allows efficient movement of sand during burrow construction [2,3].

Psammophilic scorpions generally burrow to a depth of 0.3-1.0m below the surface [3]. Some psammophiles (e.g., *Vejovoidus longiunguis*) have streamlined metasomas and telsons, which may aid in escape when animals become buried in the sand. Scorpions that encounter only sandy substates (ultrapsammophiles) may have greatly reduced pectines (Newlands 1972) [4]. Since pectines function in substrate discrimination during spermatophore deposition, such hypotrophy may reflect their relative uselessness for scorpions that are in extremely homogeneous environments [4].

Farzanpay [5] and Fet, et al. [1,6] reported psammophilus genus *Apistobuthus* and *Buthacus* from sandy regions of Khoozestan province and, *Polisius persicus*, from Sistan & Bluchestan province (East of Iran) .

The study was conducted for the first time in the Iranian desert scorpions and It shows the species diversity in the desert regions of Iran.

## Material and methods

During this study from 2006 to 2012 specimens collected from different localities of six provinces of Iran: Khoozestan, Kerman, Fars, Ilam, Hormozgan and Boushehr. The specimens collected by night catch and UV light lamps.

## Results

A total 3453 scorpions were collected during this study from different provinces of south and southwestern area in Iran which is from the highest to the minimum number of scorpions cached, as follows:

*Apistobuthus susanae* 1982 (57.40%)

*Buthacus macrocentrus* 935 (27%)

*Compsobuthus jakesi* 351 (10.16 %)

*Vachoniolus iranus* 165 (4.8%)

*Polisius persicus* 11 (3.2%)

*Kraepelinia palpator* 9 (0.26%)

## *Kraepelinia palpator* (Figures 1-4)

**Distribution:** Iran, Kerman Province [7]; Turkmenistan.



Figure 1,2: Kraepelinia palpator [8], ventral and dorsal views, ♂ (32 mm), Iran, Kerman Province, Jupar road, 30°07'25"N 57°11'26"E, 1819 m a.s.l. (Locality No. KE-29),

Figures 3,4: Kraepelinia palpator [8], dorsal and ventral views, ♀ (30 mm), Iran, Kerman Province, Jupar-Kerman road, 30°10'48"N 57°03'02"E, 1788 m a.s.l. (Locality No. KE-110).

**kerman province material examined:** Iran, Kerman Province, Kerman Province, Jupar road, 30°07'25"N 57°11'26"E, 1819 m a.s.l. (Locality No. KE-29), V.2009, 3♂1♀ (RRLS), 1♂ (FKCP), leg. Koohpaye, Jamalizadeh and Ebrahimi; Shahdad, Dehghan abad vil., 30°27'20"N 57°49'01"E, 334 m a.s.l. (Locality No. KE-63), V.2009, 1♂2♀ (RRLS), leg. Koohpaye, Jamalizadeh and Ebrahimi; Ravar-Mashhad road, 31°21'44"N 56°50'08"E, 1100 m a.s.l. (Locality No. KE-84), V.2009, 1♂ (RRLS), leg. Koohpaye, Jamalizadeh and Ebrahimi; Ravar-Mashhad road, Yusef abad vil., 31°20'51"N 56°48'21"E, 1139 m a.s.l. (Locality No. KE-90), V.2009, 1juv. (RRLS), leg. Koohpaye, Jamalizadeh and Ebrahimi; Jupar-Kerman road, 30°11'56"N 57°03'18"E, 1778 m a.s.l. (Locality No. KE-109), VI.2009, 1♂ (RRLS), leg. Koohpaye, Jamalizadeh and Ebrahimi; Jupar-Kerman road, 30°10'48"N 57°03'02"E, 1788 m a.s.l. (Locality No. KE-110), VI.2009, 1♀ (FKCP), leg. Koohpaye, Jamalizadeh and Ebrahimi; Jupar-Kerman road, 30°07'25"N 57°11'26"E, 1819m a.s.l. (Locality No. KE-134), VI.2009, 1♂2♀ (RRLS), leg. Koohpaye, Jamalizadeh and Ebrahimi.

### Polisius persicus (Figures 5-8)

**Distribution:**Iran, Sistan & Baluchistan Province [6], Esfahan Province [9], Ilam Province [10], Kerman Province [7].

**kerman province material examined:** Iran, Kerman Province, Zehkaloot-Jazmuriyan, 27°47'18"N 58°35'07"E, 378 m a.s.l. (Locality No. KE-19), IV.2009, 1♂2♀ (RRLS), leg. Koohpaye, Jamalizadeh and Ebrahimi; Zarand, 30°47'42"N 56°35'19"E, 1678 m a.s.l. (Locality No. KE-36), V.2009, 1♂ (RRLS), leg. Koohpaye, Jamalizadeh and Ebrahimi; Rafsanjan road, Zarand, 30°32'22"N 56°04'42"E, 1547 m a.s.l. (Locality No. KE-46), V.2009, 1♂ (RRLS), leg. Koohpaye, Jamalizadeh and Ebrahimi; Shahre babak, Marza, 30°01'43"N 55°05'41"E, 1789 m a.s.l. (Locality No. KE-54), V.2009, 1♀ (RRLS), 1♀ im. (FKCP), leg. Koohpaye, Jamalizadeh and Ebrahimi.

**Ilam province material examined:** Iran, Ilam Prov., Dashte Abbas, Ein Saleh village, 32°25.24'N 47°43.86'E, 182 m a.s.l. (Locality No. IL-828), X.2007, 1♀ im. FKCP, leg. Navidpour, Masihpour & Bahrani.

### Apistobuthus susanae (Figures 9-12)

**Distribution:**Iran, Khoozestan Province [11,12], Ilam Province [10].

**kerman province material examined:** Iran, Khoozestan Province, Hamidiyeh, 31°27'57"N 48°29'18"E, 13 m a.s.l. (Locality No. A-Ham-812-1), IX.2007, 18♂11♀ 11juvs RRLS, 1♂1juv. FKCP, leg. Masihpour & Navidpour; Ahvaz-Masjedsoleyman road, 31°35'44"N 48°57'19"E, 35m a.s.l. (Locality No. A-Ma-810), IX.2007, 23♂18♀ RRLS, 2ims. (♂♀) FKCP leg. Navidpour & Masihpour; Ramhormoz road (20 km to Ramhormoz), 31°13'55"N 49°14'26"E, 50m a.s.l., V.2007, 8♂10♀ RRLS, leg. Masihpour & Tofigh; Dagh Mishan-Abdelkhan road, Razihassan village, 31°51'16"N 48°19'07"E, 42 m a.s.l., 2007, 10♂18♀ RRLS, leg. Habibzadeh, Hayader & Bahrani; Albaji, Ahvaz-Andimeshk road, 20 km to Ahvaz, 31°20'44"N 48°38'36"E, 16m a.s.l., 2007, 6♂3♀ RRLS, leg. Masihpour, Behani & Hayader; Ahvaz-Haftgel road (40 km to Haftgel), 31°16'17"N 49°14'07"E, 44m a.s.l., 2007, 9♂2♀ RRLS, leg. Habibzadeh, Hayader & Bahrani; Ahvaz-Masjedsoleyman road Zoveyer village, 31°35'20"N 48°57'01"E, 34.5m a.s.l., 2007, 15♂♂

**Ilam province material examined:** Iran, Ilam Prov., Ein Khosh, 32°24.76'N 47°37.48'E, 130m a.s.l. (Locality No. IL-

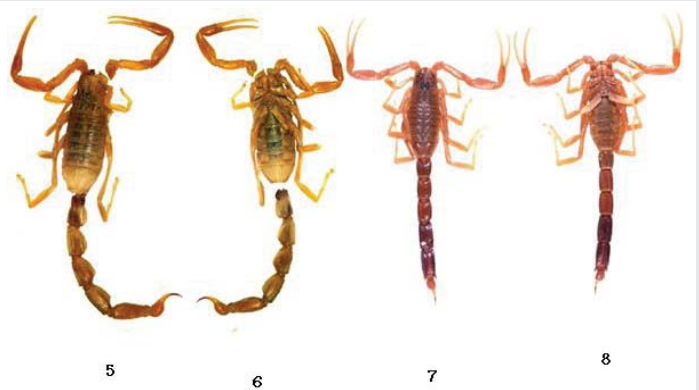


Figure 5,6: Polisius persicus, ventral and dorsal views, ♀ (41 mm), Iran, Sistan & Baluchistan Province.

Figures 7,8: Polisius persicus Fet, Capes & Sissom, 2001 ventral and dorsal views, ♂ im. (22 mm), Iran, Ilam Province.



Figure 9,10: Apistobuthus susanae, ventral and dorsal views, ♂ (76 mm), Iran, Ilam Province.

Figures 11,12: Apistobuthus susanae Lourenço, 1998, dorsal and ventral views, ♀ (69 mm), Iran, Khoozestan Province.

826), X.2007, 1♂1♀ FKCP 8♂3♀ RRLS, leg. Hayader, Mashipour & Bahrani.

### **Buthacus macrocentrus (Figures 13-16)**

**Distribution:**Iran, Bushehr, Hormozgan, Ilam [7,13], and Khoozestan [12] Provinces; Iraq, Israel [14], Jordan [15], Syria [16], Turkey [17].

**Khoozestan province material examined:** Iran, Khoozestan Province, Ahvaz–Omidiyeh road (40 km to Omidiyeh), 30°37'49"N 49°31'47"E (Locality No. 812), V.2007, 1juv. FKCP, leg. Mashipour & Bahrani; Hamidiyeh, 31°27'57"N 48°29'18"E, 13 m a.s.l. (Locality No. A-Ham-812-2), IX.2007, 3♀ RRLS, 1♂1♀ FKCP, leg. Mashipour & Navidpour; Ahvaz–Masjedsoleyman road, 31°49'34"N 49°05'00"E, 53 m a.s.l. (Locality No. A-Ma-816), X.2007, 4ims. 3juvs. RRLS, leg. Mashipour & Hayader; Ahvaz–Omidiyeh road (20 km to Omidiyeh), 30°56'12"N 49°34'00"E, 53m a.s.l., 2007, 3♂5♀ 1juv. RRLS, leg. Bahrani, Mashipour & Jahanifard; Chogha Zambil (zikkurat), 32°00'55"N 48°31'04"E, 68.5 m a.s.l., 2007, 4♂1♀ RRLS, leg. Mashipour, Navidpour & Hayader; Ahvaz–Haftgel road (40km to Haftgel), 31°16'17"N 49°14'07"E, 44 m a.s.l., 2007, 3♂ RRLS, leg. Habibzadeh, Hayader & Bahrani; Ahvaz–Omidiyeh road, Chombeh village, 31°11'54"N 49°11'41"E, 44 m a.s.l., 2007, 3♂3♀ RRLS, leg. Mashipour, Navidpour & Tofigh; Shush (Apadana Palace), 32°10'55"N 48°15'39"E, 75 m a.s.l., X.2007, 1♂5♀3 juvs. RRLS, leg. Navidpour, Mashipour & Bahrani.

**Ilam province material examined:** Iran, Ilam Prov., Dashte Abbas, Ein saleh Village, 32°25.24'N 47°43.86'E, 182 m a.s.l. (Locality No. IL-828), X.2007, 2♂3♀ RRLS 1♀ FKCP, leg. Navidpour; Dashte Abbas, Seyed Falhi Village, 32°24.105'N 47°36.922'E, 115m a.s.l. (Locality No.IL-829), II.2008, 3♂1♀ RRLS, leg. Navidpour, Bahrani & Hayader.

**Bushehr province material examined:** Iran, Bushehr Prov., cca 17 km NW. Bandar-e Genaveh, 10m a.s.l., 29°38'32"N 50°26'56"E, 1♂ FKCP, 13–14.X.1998, leg. P. Kabátek; Bandar-e Genaveh env., X.2000, 2♂ FKCP, leg. R. Perlík; Delvar,



**Figure 13,14:** *Buthacus macrocentrus*, dorsal and ventral views, ♂ (69 mm), Iran, Khoozestan Province, Hamidiyeh, 31°27'57"N 48°29'18"E, 13 m a.s.l. (Locality No. A-Ham-812-2), FKCP.

**Figures 15,16:** *Buthacus macrocentrus* (Ehrenberg, 1828), dorsal and ventral views, ♀ (58 mm), Iran, Khoozestan Province, Hamidiyeh, same locality as in Fig. 56–57, FKCP.

28°42'59"N 51°04'52"E, 4m a.s.l. (Locality No. Bu-20), XI.2007, 18♂22♀10juvs. RRLS 4juvs. FKCP, leg. Mashipour & Hayader; Dayer, 27°49'35"N 52°04'44"E, 4 m a.s.l. (Locality No. Bu-25), XI.2007, 1juv. RRLS, leg. Mashipour, Bahrani & Habibzadeh; Bushehr to Dayer road, Dero Ahmad village, 27°53'47"N 51°35'51"E, 4 m a.s.l. (Locality No. Bu-27), XI.2007, 3♂1♀1juv. RRLS, leg. Mashipour, Hayader & Habibzadeh; Bushehr to Dayer road, Golestan, 29°13'46"N 51°19'33"E, 3 m a.s.l. (Locality No. Bu-28), XI.2007, 15♂3♀8juvs. RRLS, 1♂2♀ FKCP, leg. Mashipour, Hayder & Bahrani; Omidiyeh to Genaveh road, 30°13'42"N 50°12'01"E, 128 m a.s.l. (Locality No. Bi 805), VI.2007, 11♂18♀22juvs. RRLS, leg. Navidpour & Mashipour; Dailam road, Khite Amareh village, 30°42'52"N 49°44'59"E, 41 m a.s.l. (Locality No. OM-801), VII.2007, 1♂2♀ RRLS, leg. Navidpour, Mashipour & Habibzadeh.

**Hormozgan province material examined:** Iran, Hormozgan Province, 26°45'57.3"N 54°46'31.4"E, 18 m a.s.l., XI.2008, 4♂4♀ (RRLS) , leg. Mashipour & Hayader; 26°45'14.9"N 54°31'44.3"E, 30 m a.s.l. (Locality No. HO-149), XI.2008, 2♂2ims. (RRLS), leg. Mashipour, Bahrani & Habibzadeh; 26°46'36.6"N 55°13'59.2"E, 5 m a.s.l. (Locality No. HO-152), XI.2008, 1♂ (FKCP) 3ims. (RRLS), leg. Mashipour, Hayader & Habibzadeh; 45 km. to Khamir Port (Bandare Khamir), 26°50'41.2"N 55°22'06.9"E, 17 m a.s.l. (Locality No. HO-153), XI.2008, 4♀4ims. (RRLS) 1♀ (FKCP), leg. Mashipour, Hayder & Bahrani.

### **Vachoniolus iranus (Figures 17-20)**

**Distribution:** Iran, Khoozestan Province [12], Ilam Province [10].

**Ilam province material examined:** Iran, Ilam Prov., Ein Khosh, 32°24.76'N 47°37.48'E, 130 m a.s.l. (Locality No. IL-826), X.2007, 1♀1im. FKCP, 1♀im. RRLS, leg. Hayader, Mashipour & Bahrani.

**Khoozestan province material examined:** Iran, Khoozestan Province,, near Mas- djedsoleyman, 31°38'40"N 48°56'41"E, 53 m a.s.l. (Locality No. A-Ma 806-1), VIII.2007, 8♂25♀13juvs (holotype and paratypes), leg. Navidpour & Mashipour; Ahvaz–Masjedsoleyman road, 31°35'44"N 48°57'19"E, 35 m a.s.l. (Locality No. A-Ma-810), IX.2007, 12♂27♀7juvs (paratypes), leg. Navidpour & Mashipour.

### **Compsobothus jakesi (Figures 21-24)**

**Distribution:**Iran, Bushehr Province [13], Khoozestan Province [12], Ilam Province [10]; Iraq (Kovarik 2003).

**Ilam province material examined:** Iran, Ilam Prov., Ein Khosh, 32°24.76'N 47°37.48'E, 130 m a.s.l. (Locality No. IL-826), X.2007, 1♂1♀ FKCP, leg. Hay- ader, Mashipour & Bahrani; Dashte Abbas, Ein Saleh Village, 32°25.24'N 47°43.68'E, 182 m a.s.l. (Locality No. IL-828), X.2007, 1♂2♀ RRLS, leg. Mashipour, Bahrani & Hayader; Dashte Abbas, Seyed Falhi Village, 32°24.105'N 47°36.922'E, 115 m a.s.l. (Locality No. IL-829), X.2007, 2♀ RRLS, leg. Mashipour, Habibzadeh & Hayader; Dehloran, 32° 36.36'N 47°20.26'E, 146 m a.s.l. (Locality No. IL-825), X.2007, 1♀im. RRLS, leg. Mashipour, Hayader, Habibzadeh & Bahrani.



Figure 17,18: *Vachoniolus iranus* ventral and dorsal views, ♂ (42 mm) holotype, Iran, Khoozestan Province.

Figures 19,20: *Vachoniolus iranus*, ventral and dorsal views, ♂ (40 mm) allotype, Iran, Khoozestan Province.



Figure 21,22: *Compsobuthus jakesi*, dorsal and ventral views, ♂ (28 mm) paratype, Iraq, Najaf Province, Ash-Shabakah (Shabachah, Shabicha), 262 m, 31°06'N 43°95'E.

Figures 23,24: *Compsobuthus jakesi* Kovařík, 2003 [18], dorsal and ventral views, ♂ (27 mm), Iran, Khoozestan Province.

and approximately 20% of deserts surfaces are covered by sand (Seely, 1991). Widespread In many deserts (e.g. Namib, Sahara, Karakum), sandy substrates from 64% of the Sahara, 41% of the Libyan Desert, 52% of the Arabian Desert.

Iran in term of climate is part of the Afro-Asian belt of deserts that stretch from the Cape Verde islands off West Africa all the way to Mongolia near Beijing, China.

The geography of Iran consists of a plateau surrounded by mountains and divided into drainage basins. Dasht-e Lut is the largest desert of Iran, 485 kilometers long and 327 kilometers wide, and is considered to be one of the driest places on Earth.

The Dasht-e Kavir or Kavir-e Namak also known as is a extensive desert lying in the middle of the Iranian plateau. It is about 820 kilometers long and 320 kilometers wide making it the Earth's 23rd largest desert. This desert stretches from the Alborz mountains in the north-west to the Dasht-e Lut in the south-east .

A combination between physiological, behavioral and morphological adaptations enable scorpions to tolerate environmental stresses in desert habitats. Scorpions live in sand deserts worldwide. Of 140 known scorpion genera [6], 29 are recorded from sand habitats. Of these, 11 genera exclusively inhabit sand. While some species live exclusively on sand, others have a broader nich that includes other substrates. A four-point scale can be adopted in considering scorpions found only in sandy deserts [4,19-28]:

- 1) Ultrapsammophiles: species found only in sand habitats with little vegetation.
- 2) Psammophiles: species found in vegetated sandy areas.
- 3) Fossorial psammophiles: species that spend almost all their time in burrows.
- 4) Facultative psammophiles: species that inhabit sand and other substrates, generally these do not possess a highly modified morphology.

Iran has various habitats. Studies showed that over 60 different species in three families (Buthidea, Scorpionidae and Hemiscorpiidae) exists in Iran [7,10,12,13,20-23]. Distribution of scorpions in Iran is the main cause of scorpionism and public health problem. The northern of Iran is rainy and covered by dense forest, but the southern and eastern part geographically is semi-desert and desert areas and frequency of scorpions stings are >50 000 cases/year.

Our observation and literature suggested that deserts scorpions are important and scorpionism in deserts regions of Iran is serious health problem. This study concluded that six buthidae scorpion species distribute in deserts area that three of them (*Apistobuthus suasanae*, *Butacus macrocentrus* and *Vachoniolus iranus*) are medically dangerous.

Science population density in desert of Iran is comparatively high; hence the knowledge of scorpion distribution in these regions is important.

#### Khoozestan province material examined:

Iran, Khoozestan Province, Baghmalek, 31°55'17"N 49°22'15"E, 185 m a.s.l., II.2007, 1♀ RRLS, leg. Mashipour & Bahrani; Ahvaz-Omidyeh road , 30°37'49"N 49°31'47"E, (Locality No. 812/803/), V. 2007, 2♀ FKCP, leg. Mashipour & Bahrani; near Masjed- soleyman, 31°38'40"N 48°56'41"E, 53 m a.s.l. (Locality No. A-Ma 806), VIII.2007, 5♀ 4ims. RRLS, leg. Navidpour & Mashipour; 45 km NW of Masjedsoleyman, Lali, 31°18'33"N 49°03'39"E, 329 m a.s.l. (Locality No. La-815-3), X.2007, 2ims.(♂♀) FKCP, leg. Mashipour & Hayader; Shush (Apadana Palace), 32°10'55"N 48°15'39"E, 75 m a.s.l., X.2007, 2♀ RRLS, leg. Navidpour, Mashipour & Bahrani; Ahvaz-Naft Sefid road, 31°27'24"N 49°57'37"E, 148 m a.s.l., 2007, 2♂1juv, leg. Mashipour & Tofigh.

**Bushehr province material examined:** Iran, Bush- ehr Prov., Bushehr to Dayer road, Dero Ahmad village, 27°53'47"N 51°35'51"E, 4 m a.s.l. (Locality No. Bu-27), XI.2007, 1juv. RRLS, 1♀ im. FKCP, leg. Mashipour, Hayader & Habibzadeh.

## Discussion

Deserts from 25-30% of the land's surface (polis, 1991),



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