

## Litter size in scorpion (Arachnida: Scorpiones) species from Khyber Pakhtunkhwa, Pakistan

## Размер вышлода у скорпионов (Arachnida: Scorpiones) из Хайбер-Пахтунхва, Пакистан

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КЛЮЧЕВЫЕ СЛОВА: Buthidae, Scorpionidae, Scorpipidae, репродуктивная биология.

**ABSTRACT.** Litter size is crucial to the survival of species in their environment and constitutes useful information for conservation purposes. Information about litter size for eight scorpion species from Pakistan is provided. Pregnant females were field collected and kept in laboratory conditions until juvenile birth. Data from litter size were provided for the following species: *Compsobuthus rugosulus*, *Hottentotta alticola*, *H. jalalabadensis*, *H. tamulus*, *Isometrus maculatus* (Buthidae), *Deccanometrus latimanus* (Scorpionidae), *Scorpiops pseudomontanus*, and *S. petersii* (Scorpipidae). In addition, we found that Pakistani scorpions give birth during the warm months of the year. Our results provide important insights into the biology and conservation of Pakistani scorpions.

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**РЕЗЮМЕ.** Размер вышлода имеет решающее значение для выживания видов в окружающей среде и представляет собой полезную информацию для целей охраны природы. Предоставлена информация о размере вышлода восьми видов скорпионов из Пакистана. Беременных самок собирали в полевых условиях и содержали в лаборатории до рождения молоди. Данные о размере вышлода были предоставлены для *Compsobuthus rugosulus*, *Hottentotta alticola*, *H. jalalabadensis*, *H. tamulus*, *Isometrus maculatus* (Buthidae), *Deccanometrus latimanus* (Scorpionidae), *Scorpiops pseudomontanus* и *S. petersii* (Scorpipidae). Обнаружено, что пакистанские скорпионы дают потомство в теплые месяцы года. Полученные результаты важны для изучения биологии и охраны пакистанских скорпионов.

### Introduction

Scorpions exhibit many unusual reproductive traits among the arachnids; for example, they possess a gestation period ranging from a few months to a year (e.g., Polis [1990]; Albuquerque, Lira [2016]; Lira *et al.* [2021]). These arachnids also possess a highly variable litter size, ranging from 1 to 105 [Polis, 1990; Lourenço, 2007; Outeda-Jorge *et al.*, 2009]. In addition, some species, particularly those from the Buthidae family, are capable of storing sperm after a single insemination and producing multiple broods (e.g., Outeda-Jorge *et al.* [2009]; Albuquerque, Lira [2016]; Lira *et al.* [2021]). According to Outeda-Jorge *et al.* [2009], litter size in scorpions is known for about 10% of the described species. This lack of knowledge is particularly surprising considering that information about litter size may provide useful insight on species ecological traits important to conservation. For example, species that produce few litters are more susceptible to habitat changes than those with larger litters [Forster, Vincent, 2004]. In addition, environmental conditions play a key role in scorpion reproduction [Polis, 1990; Outeda-Jorge *et al.*, 2009]. Females of these arachnids give birth in protected places under optimal environmental conditions [Polis, 1990]. Thus, aiming to fill this knowledge gap about scorpions' biology, here we present data on litter size and date of birth of eight species from Pakistan belonging to three families (Buthidae, Scorpionidae, and Scorpipidae).

### Material and methods

Scorpion pregnant females were collected at night (18:00–03:00 h) using ultraviolet lights in different sites in Pakistan. After field collection, scorpions were kept individually in plastic terraria (17 x 13 x 10 cm) with a sand layer (2.5 to 3.5

Table 1. Litter size and month of birth in scorpion species from Pakistan.  
Таблица 1. Размер выплода и месяцы отрождения скорпионов Пакистана.

Species	N	Litter size	Month of birth
Buthidae			
<i>Compsobuthus rugosulus</i> (Pocock, 1900)*	4	33–40	June–August
<i>Hottentotta alticola</i> (Pocock, 1895)*	11	33–42	July–September
<i>Hottentotta jalalabadensis</i> Kovařík, 2007*	9	37–40	April–August
<i>Hottentotta tamulus</i> (Fabricius, 1798)*	12	38–45	July–September
<i>Isometrus maculatus</i> (DeGeer, 1778)	3	27–29	August
Scorpionidae			
<i>Deccanometrus latimanus</i> (Pocock, 1894)*	13	15–23	July–August
Scorpiopidae			
<i>Scorpiops pseudomontanus</i> Kovařík et Ahmed, 2009*	9	20–25	July–August
<i>Scorpiops petersii</i> Pocock, 1893*	5	26–30	July–August

\* Indicates new data.

cm) and humid cotton at their bottom as a water source. Individuals were kept in laboratory conditions at a mean temperature of 32.5 °C (25–40 °C) and air moisture of 55% (50–60%). Females were fed weekly with mealworm and superworm and observed weekly until the registration of the birth of juveniles.

## Results and Discussion

Data on litter size and date of birth (month) were obtained for 66 females belonging to eight species (Table 1). Overall, buthid scorpions from *Hottentotta* Birula, 1908, and *Compsobuthus* Vachon, 1949 genera produce broods with higher litter sizes (Table 1). In contrast, scorpionid *Deccanometrus latimanus* (Pocock, 1894) produced brood with few litters (Table 1). Pakistani scorpion females give birth between April and September, with most of them giving birth in July and August (Table 1).

Our study provides data about litter size from eight scorpion species found in Pakistan; of these, seven species are new. Overall, the buthid species analysed exhibited a larger litter size. Scorpions from this family are typically classified as r-strategists [Polis, 1990]. R-strategist species invest in quantity rather than quality of offspring (i.e., large-sized offspring), explore resources in temporary patches, and have high population growth rates [Southwood, 1962; Begon *et al.*, 2006]. For example, *C. rugosulus* (Pocock, 1900) has a litter size three times higher when compared to its congener *C. weneri* (Birula, 1908) (5–14 juveniles) [Lourenço, 2007]. Similarly, *Hottentotta* scorpions analysed in our study also exhibited a higher litter size (33–45 juveniles) when compared to other *Hottentotta* species: *H. hottentotta* (Fabricius, 1787) (n = 12–21), *H. judaicus* (Simon, 1872) (n = 15–18), *H. trilineatus* (Peters, 1861) (n = 12), and *H. pachyurus* (Pocock, 1897) (n = 16) [Lourenço, 2007; Mirza *et al.*, 2009]. Finally, we also found a higher number of juveniles from the Pakistani population of *I. maculatus* (DeGeer, 1778) (n = 27–29) than recorded in the literature for this species (n = 12–21) [Lourenço, 2007]. According

to Polis [1990], life-history traits of scorpion species may be influenced by environmental factors such as temperature, which may directly affect metabolism and indirectly influence reproduction. Another possible explanation is that the variation is due to the conditions for raising the animals.

Previous authors have reported that stressed females in captivity are highly likely to cannibalise their juveniles [Sarmiento *et al.*, 2008; Warburg, 2011].

For scorpionids from the Heterometrinae Simon, 1879 subfamily, litter size is quite variable: *Deccanometrus phipsoni* (Pocock, 1893) (n = 9), *Heterometrus longimanus* (Herbst, 1800) (n = 34), and *Sahyadrimetrus scaber* (Thorell, 1876) (n = 30–35) [Polis, 1990; Mirza, Sanap, 2009]. In our study, we recorded a relatively small litter size in the scorpionid *D. latimanus* (n = 15–23). The small litter size exhibited by *Deccanometrus* Prendini et Loria, 2020 species may be making these scorpions vulnerable to extinction, as these animals are targeted by the illegal pet trade [Prendini, Loria, 2020]. All of the heterometrinae species are fossorial, constructing burrows under stones or in open ground [Prendini, Loria, 2020]. In this way, these animals are easily found and collected. In relation to scorpiopid scorpions, to the best of our knowledge, the reports for *S. pseudomontanus* Kovařík and et Ahmed, 2009, and *S. petersii* Pocock, 1893, are the first records for litter size in the Scorpiopidae family. The scorpiopids comprise a large scorpion family, distributed widely across the Oriental region, that currently encompasses about 80 species from two genera [Kovařík *et al.*, 2020].

Our results suggest that Pakistani scorpion species reproduce during the spring and summer months. In Pakistan, between May and September, the temperature increases after recording lower values during the winter [Salma *et al.*, 2012]. For homeothermic animals such as scorpions, the increase in temperature implies increased activity. Our results are similar to those described for South American scorpions, where most of their species give birth during warm months [Outed-Jorge *et al.*, 2009]. Finally, we reported the litter size

for eight scorpion species from Pakistan; data on seven of them is new to science. In addition, we found that scorpion species from Pakistan give birth to their juveniles during the warm months of the year.

#### Disclosure statement

No potential conflict of interest was reported by the authors.

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