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Records of scorpions from the Palestinian Territories, with the first chromosomal data (Arachnida: Scorpiones)

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Seven species were collected from several habitats in the West Bank, namely Leiurus quinquestriatus, Androctonus crassicauda, Compsobuthus werneri, Orthochirus scrobiculatus, Hottentotta judaicus, Nebo hierichonticus, and Scorpio maurus. Karyotypic data on Leiurus quinquestriatus (2n=22), Hottentotta judaicus (2n=16), and Scorpio maurus fuscus (2n=52) are reported here for the first time.

Keywords: Scorpions, Arachnida, Palestinian Territories, karyotype.

Introduction

The order Scorpiones is a fascinating group of arthropods with over 2000 described species. Its taxonomy continues to undergo revision and new species are described as new data accumulate from morphology, cytogenetics, and DNA. In the Levantine countries, some initial faunal work on scorpions was done by Vachon (1966, 1974), Levy, Amitai, and Shulov (1970, 1973), Levy and Amitai (1980), followed by studies by Amr & Al-Oran (1994), Lourenço (1999, 2002), Kabakibi, Khalil, and Amr (1999), Lourenço, Modrý, and Amr (2002), Stathi and Lourenço (2003).

A recent review showed that the karyotypes of only some 60 out of the over 2000 known species of scorpions have been studied (Schneider, Zacaro, Pinto-da-Rocha, Candido, & Cella, 2009). The only study on scorpion chromosomes in the Middle East was done in Egypt on some members of the genus Androctonus (Moustafa, Alaa, Sarhan, & Yaseen, 2005).

Our study focused on the West Bank (Bethlehem, Hebron, Nablus, and Ramallah districts, and the Jordan valley) and includes the first findings on the chromosomes of three species.

Material and methods

Scorpions were collected during the day, by turning over pebbles and other objects under which they hide, and at night, by walking and scanning the ground with ultraviolet flash lights. All specimens are deposited in the recently created Palestine Natural History Museum (PMNH), Bethlehem, Palestinian Territories.


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Karyotyping of scorpion species was done from gonadal tissues dissected in saline solution by the method described by Schneider et al. (2009). We found that the success rate is variable and depends on the seasonality of reproduction in these scorpions (see notes in results and discussion).

**Results**

**Family Buthidae C. L. Koch, 1837**

*Leiurus quinquestriatus* (Ehrenberg, 1828)


This is the most common species in the West Bank. 31 specimens of the 70 scorpions collected by us (43%) belong to this species. It was a ubiquitous species found mostly in rocky arid regions (not noted in the forested or Mediterranean climate area). The scorpions were very abundant in some areas. For example, in the hills near Wadi Fasayil in the Jordan valley we found scorpions on average about one in every 2 square metres. Females with 15-20 developed embryos were collected during May and June. The number of pectinal teeth ranged between 31 and 38 (average 34) in males (n=10) and 23 and 35 (average 30) in females (n=14).

*Androctonus crassicauda* (Olivier, 1807)

Material: Jordan Valley: Al Auja (PMNH1404, ♀, 16.xi.2010).

There are many previous records of this species from arid areas in the Palestinian Territories and nearby countries (Levy & Amitai, 1980, Amr & El-Oran, 1994). A total of 25 pectinal teeth was counted in this female, which was collected in less rocky terrain in the Jordan valley (arid region near an oasis).

*Compsobuthus werneri* (Birula, 1908)


This species was only found in the Bethlehem District in our collection. One female collected in June had eight embryos. The number of pectinal teeth was 11-11 and 18-18 in two females and 18-18 in a male.

*Orthochirus scrobiculosus* (Grube, 1873)


These two new localities represent the northernmost record for the species (see Levy & Amitai, 1980; Amr & El-Oran, 1994). The pectinal teeth in two females were 14-14 and
15-15. The species was collected from hammada desert habitats with loose reddish soil along the main highway in the Jordan Valley. One female was found with 12 embryos. This species is associated with arid habitats.

**Hottentotta judaicus** (Simon, 1872)


This is a strictly Mediterranean species known from forested areas as well as open habitats dominated by *terra rossa* soil. We also found it in cultivated fields (olives, almonds, figs). Kovařík (2007) revised the genus and described several new species. We have collected this species in the Bethlehem district from several localities. The range of the pectinal teeth number is 25 to 30 (average 27.6) in males (N=5) and 23-30 (average 28.1) in females (N=9).

**Family Diplocentridae Karsch, 1880**

**Nebo hierichonticus** (Simon, 1872)


The type specimen described by Simon (1872) was from the Jordan Valley. A revision of the genus *Nebo* was made by Francke (1980), who recognised six species including three new species. Pectinal counts on our two female specimens showed 13-13 and 15-15 teeth.

**Family Scorpionidae Latreille, 1802**

**Scorpio maurus fuscus** (Ehrenberg, 1829)


Species of the genus *Scorpio* are widespread from Morocco to Iran and from Turkey to Yemen (Hendrixson, 2006). The one species in Palestine has two colour forms described as two different subspecies: *S. maurus fuscus* and *S. m. palmatus* (Ehrenberg, 1828), which show differences in the length of the genital operculum in the female, other minor morphological differences, and a striking difference in coloration. The number of pectinal teeth was 10 to14 in males (N=3) and 8-8, 9-9, and 10-10 in females (N=3). Females with 12-15 embryos were found during May and June.
Chromosomal study results

We report here the first karyotypes of *Hottentotta judaicus* to have 2n=16 chromosomes, confirmed by diplotene (8 homologues) in 6 specimens from different locations (specimens PMNH1386, 1411, 1462, 1476, 1480 and 1513; Figure 1). There were three pairs of metacentrics and the other chromosomes were acrocentric. Karyotypes from both males and females of *Leiurus quinquestriatus* show a diploid number of 22 confirmed with diplotene findings of 11 pairs (Figure 1). We could not definitely distinguish the X and Y chromosomes in males but they are probably pair 1 in Figure 2. Our chromosomal data on *Scorpio maurus fuscus* are based on one male from from Ertas near Bethlehem. The diploid number was 52 from five metaphases although the quality did not allow us to distinguish X and Y chromosomes (Figure 3).
Fig. 2. Cytogenetics in a male *Leiurus quinquestriatus*. A. Meiotic diplotene. B. Pachytene. C. Mitotic metaphase. D. Karyotype from metaphase.

**Discussion**

Variation in the chromosomal number within scorpions is very large compared to other arachnids. Chromosomal numbers have been reported from as low as $2n=5$ to as high as $2n=175$ (Schneider et al., 2009). However, care must be taken when gonadal tissues are used to identify metaphases of meiosis and they must be distinguished from the diplotene of meiosis, a confusion that probably explains the odd number of chromosomes reported in some papers. Most species of the family Buthidae exhibit a predominance of Mattos, Cella, Candido, Carvalho, and Schneider (2012) studied the karyotype of 11 species of Buthidae in Brazil with diploid numbers ranging from 6 to 28. In other low diploid numbers ($2n=24$) and holocentric chromosomes (Soleglad & Fet, 2003).
families such as the Bothriuridae, species of the genus *Brachistosternus* showed a diploid number of 42 to 46 (Rodríguez-Gil, Ojanguren-Affilastro, Barral, Scioscia, & Molina, 2009).

The karyotypes reported here for three species of scorpions are the first in the Eastern Mediterranean region and the first reports on these three species. In Iran, the karyotype for *Odontobuthus* species was 2n=22 and in *Buthacus* sp. 2n=14 (Khazzab & Farzanpej 1998). Moustafa et al. (2005) studied the karyotypes of four species of the genus *Androctonus* in Egypt (*A. australis, A. bicolor, A. amoreuxi* and *A. crassicauda*), and all these species exhibited the same diploid chromosome number of 2n=24.

The African *Hottentotta trilineatus* was reported to have a 2n=24 (Newlands & Martindale, 1980), compared to 2n=16 for *H. judaicus* in the present study. We obtained a diploid number of 52 for *Scorpio maurus fuscus*. The high diploid number in *Scorpiidae* compared to *Buthidae* was already noted by Schneider et al. (2009).

The taxonomy of scorpions is still undergoing significant revision (Soleglad & Fet, 2003) and in our region new species are being described based on morphology (Lourenço et al., 2002, 2010). Further studies on the karyotypes of Middle Eastern scorpions could help address phylogenetic relationships among extant species and resolve some systematic questions including the possible identification of new species.

**References**


