Euscorpius

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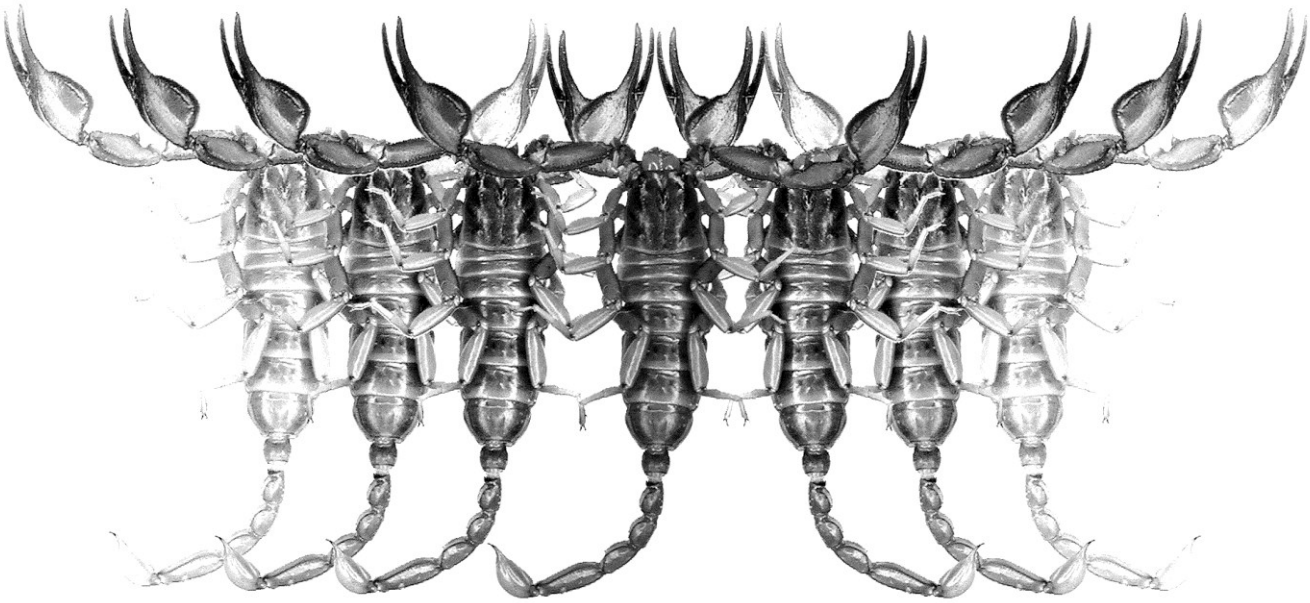

Shape of Burrows Built by *Scorpio maurus* L., 1758 (Scorpiones: Scorpionidae) from Turkey, with Description of Capture Methods

Mehmet Çolak & Ayşegül Karataş

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EDITOR: Victor Fet**, Marshall University,** 'fet@marshall.edu'
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Shape of burrows built by *Scorpio maurus* L., 1758 (Scorpiones: Scorpionidae) from Turkey, with description of capture methods

Mehmet Çolak [1] & Ayşegül Karataş [2]

[1] Department of Biology, Ankara University, Ankara, Turkey
[2] Department of Biology, Faculty of Science & Arts, Niğde University, Niğde, Turkey

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Summary

Shapes of burrows built by *Scorpio maurus* in southern and south-eastern Turkey were investigated. *S. maurus* were observed to build burrows with average 20 cm depth and 30 cm length. The burrows were concentrated in agricultural fields, farms, near gardens, and in areas with 5–10% slope. 116 specimens were captured, 77.5% from underground burrows, and 22.5% from their burrows under stones. A new method was tried in order to drive *Scorpio maurus*, an obligate digger type of scorpions, out of their burrows. Water was poured into a burrow, and the scorpion, which came out near the entrance of the burrow, was captured by placing a shovelful of soil 10 cm behind the entrance. Habitats of *Scorpio maurus* were observed, and shapes of underground burrows and burrows built under stones were documented.

Introduction

Scorpio maurus was described by Linnaeus in 1758 in the 10th volume of *Systema Naturae*. This polymorphic species (or, likely, a complex of species) is found in Africa and Asia. *Scorpio maurus* belongs to obligate digger scorpions that build their burrows by digging tunnels in low-sloped areas and, rarely, under stones. Information on scorpion burrows is important in order to understand the evolution and ecology of many types of scorpions (Polis, 1990). Hadley (1974) stated that burrow digging behavior of scorpions is an adaptation for avoiding adverse effects of high temperature and sunlight. The burrow protects scorpions from predators and from hot and cold weather, and also prevents dehydration in arid climate. It also protects the scorpion from external factors during molting, when it becomes vulnerable to such factors. Burrow-building scorpions return to their burrows at night after hunting and perform the most of their vital activities in their burrows (Koch, 1978; Polis & Farley, 1980; Shorthouse & Marples, 1980; Polis et al., 1986; Polis, 1990).

Levy & Amitai (1980) reported that subspecies *S. maurus fuscus* (Ehrenberg, 1829) and *S. m. palmatus* (Ehrenberg, 1828) differed in structure of their burrows and substrate preferences. *S. m. palmatus* preferred brown-red sandy soils, loess, and alluvial soils whereas *S. m. fuscus* preferred harder soils such as basalt and rendzina. Rutin (1996) reported that *S. m. palmatus* burrows in Israel are semi-circular, about 30 cm long; the digging activity stops in arid summer and winter months, scorpions removing soil from inside the burrow to outside after rain. Rutin (1996) measured the amount of soil taken outside after rain in an attempt to understand the amount of erosion in the soil in the area. Burrows of *S. maurus mogadorensis* Birula, 1910 and *S. m. punicus* Fet, 2000 are depicted in Kovařik (2009: 138, figs. 476-481). Hembree et al. (2012) determined the shape of the burrow built by *Hadrurus arizonensis* (Caraboctonidae) another digger scorpion, in laboratory.

As scorpion sampling methods, Williams (1968) listed checking beneath the objects at the surface (also known as stone rolling), digging the burrow of the scorpion that digs tunnels, shedding loose barks and checking behind, capturing by entrapping and determining through ultraviolet. It is said that capturing tunnel-digger scorpions is difficult and demanding.

In this study, a new method is introduced for capturing scorpions. In addition, information is provided regarding the shape of burrows built by *Scorpio maurus* both underground and under stones as well as their habitats.

Material and Methods

We studied 116 *Scorpio maurus* specimens collected during field work in Adıyaman, Hatay, Kilis, Gaziantep, Kahramanmaraş, Şanlıurfa, and Mardin Provinces of Turkey. Traditionally, scorpions are collected under stones during the day, and with the help of

Figures 1-4: 1. The entrance of a scorpion burrow. **2.** Water poured inside the burrow. **3.** A shovel plunged 10 cm away from the entrance of the burrow. **4.** Scorpion extracted from the burrow.

UV light at night. It is difficult during the day to collect obligate digger scorpions (such as *Scorpio* spp.), which do not build burrows under stones. On the other hand, one has to dig a hole from 0.2 to 2 m deep to remove scorpions from their burrows during the day. Sometimes, the burrow is lost as falls into the tunnel. It is not possible to know which way to dig; also, one is quite likely to hurt the scorpion through such difficult operations. In this study, burrows of *Scorpio maurus* were recognized by their entrances. During the day, a new method was implemented to drive the scorpion outside its burrow. We poured approximately 300 ml of water into scorpion's burrow. Having filled the burrow with water, we waited for a very short while, and then plunged a shovel 10 cm away from the entrance and extracted a shovelful of soil. In the extracted soil, we encountered the scorpion, which came at the entrance of the burrow due to the poured water. In this way, the scorpion was captured without inflicting any harm and without digging a deep hole (Figs. 1–4)

In order to determine the shape of burrow built by *Scorpio maurus* we poured plaster inside a burrow and waited for one day for the plaster to get solid. After one day, the burrow was dug vertically in line with the plaster and the shape of the burrow was revealed. Underground tunnels and burrows under stones were photographed (Figs. 6–7).

Results

It was observed that *Scorpio maurus* built their burrows in low-sloped areas, near agricultural fields and gardens, and pastures near villages (81%) for the most part. A minor proportion, on the other hand, builds their burrows on the mountain slopes (19%). In suitable habitats, density of scorpions reached 60–80 per 100 m^2.

Scorpio maurus build their burrows in low-pitched areas with a slope of 5–10% in which no rainwater can accumulate during the water. In underground tunnels and burrows under the stone, we found only one specimen in each burrow. The entrance of their burrows is flat

Figures 5-6: 5. Entrance of *Scorpio maurus* burrow, Hatay Province. **6.** Shape of *Scorpio maurus* burrow under stones, Hatay Province.

whereas it gets semi-circular at the bottom (Fig. 5). The width of the burrow entrance is proportionate to the size of the scorpion. On average, they are about 14 mm wide and 10 mm high. The distance between burrows is 0.5–2 m in low-sloped areas but 50–100 m or more in mountainous areas. *Scorpio maurus* rarely build their burrows under stones (22.5% collected under stones, 77.5% from underground burrows). It was determined that they build their burrows in the shape of "**┗┓**". Underground tunnels were observed not to be straight but always convoluted. Such a design provides several advantages, for instance it allows the inside of the burrow to be darker in daytime, and isolates the burrow in windy and cold weather. In April, some burrow entrances were found to be closed. Scorpions seal the burrow entrances during winter by placing soil they extract from the tunnel at the entrance. They open these entrances, which remain closed for the entire winter, in spring when it gets warmer. Thus scorpions protect themselves against the cold in winter. In rainy seasons, some soil is carried by rainwater into the burrow. Scorpions remove this soil from the burrow after the rain, and place it at the lower side of the slope. Their burrows are generally 30 cm long and 15–30 cm deep according to the microclimate in the ground. Some burrows found in Gaziantep Province had a slightly spiral structure at 15–20 cm depth. Galleries and burrows under stones have only one entrance. No secondary chamber or segment was encountered at the bottom or at any other branch of the tunnel. It was observed that the scorpion makes a 10–20 mm deep hole at the flat bottom so as to be able to turn inside the burrow.

Discussion

Scorpio maurus, which is an obligate digger scorpion, is found to build their burrows in lowland areas with 5–10% slope in Turkey. On hillsides, generally understone burrows were found. One or two burrows were found per hectare. In Şanlıurfa and Mardin Provinces, they generally prefer to live near agricultural fields. Therefore, they feed on insects which harm agricultural activities. They have an important place in the biological struggle in agriculture. From Jordan, Amr & El-Oran (1994) reported that *Scorpio maurus* build their burrows under stones or in terra rossa soil; and they found 15 specimens in an area of 500 m^2 in an oak forest. In this study, dense populations were found in the steppes of Şanlıurfa and Mardin Provinces.

Scorpions take out soil eroded by rainwater and place it before the burrow entrance. Polis (1990) reported that soil extracted from the burrow prevents rainwater from flowing inside; we also observed this in our study.

Shachak & Brand (1983) stated that *S. maurus palmatus* may be found in the same burrow in May and June, during the mating period. In Gaziantep Province, in June, we found a male and a female under the same stone. As suggested by Shachak & Brand (1983), couples come together during the mating period. However, in other times, only one scorpion was found in each burrow. The fact that burrow entrances are 50–100 cm far from each other in suitable habitats indicates that *Scorpio maurus* does not display cannibalism. If this was the case, the burrow entrances must have been farther away from each other.

According to Cloudsley-Thompson (1965), *S. maurus* built their burrows 75 cm deep in Sahara Desert. Also Abdel-Nabi et al. (2004) recorded that the burrow of *S. m. palmatus* have min 20 and max 80 cm deep in Egypt. In this study, burrows were observed to have an average 20 cm depth. Since Turkey has milder climate than Sahara Desert, burrows are closer to the surface.

So far, four methods have been known to capture digger scorpions: checking beneath the objects at the surface; detection with UV light during the night; pitfall traps; and digging the burrow (Honetschlager, 1965; Williams, 1968; Stahnke, 1972; Sissom et al., 1990).

These methods have several disadvantages; for instance, one has to check constantly whether the scorpion is entrapped or not, or whether the trap remains intact after it has been laid. This may take weeks or months. Since digger scorpions depend on their burrows to a great extent, it is highly unlikely for them to be entrapped. With the UV method, the scorpion could be seen only as it waits at the entrance of the burrow during the night. Observations indicate that scorpions come to the entrance of the burrow and wait there, coming outside only during a short while in the night (Williams, 1966, 1987; Koch, 1978; Lamoral, 1979; Polis, 1990). However, when an attempt is made to capture the scorpion with forceps, it is very likely for the animal to feel threatened and flee into the burrow immediately. On the other hand, it is very difficult and takes much time to dig a burrow that is determined to be there. While digging, it is probable to lose the direction and harm the scorpion. It becomes impossible to dig out especially a scorpion found at 2 m depth in hard soil.

In the method of capturing by pouring water, as introduced here, there is no need to dig the soil meters deep. In a very short while, approximately in 30 seconds, even scorpions located in the deepest areas of the burrow are captured. No harm is inflicted on a scorpion in this way. There is no need to wait before the burrow until the scorpion comes out of its burrow. This method may be useful in capturing other digger scorpions as well, such as *Cheloctonus* spp., *Heterometrus* spp. and *Opistophthalmus* spp., and others.

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Figures 7-8: 7. Shape of *Scorpio maurus* burrow in soil, Gaziantep Province. **8.** A habitat of *Scorpio maurus* in a mountainous area, Hatay Province.

Figure 9: A habitat of *Scorpio maurus* on 5–10 % slope, Mardin Province.

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