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SHORT COMMUNICATION

TYPES OF SHELTER SITES USED BY THE GIANT WHIPSCORPION *MASTIGOPROCTUS GIGANTEUS* (ARACHNIDA, UROPYGI) IN A HABITAT CHARACTERIZED BY HARD ADOBE SOILS

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ABSTRACT. Shelter site selection by *Mastigoproctus giganteus* in an atypical microhabitat in the northern Chihuahuan Desert characterized by hard adobe soils is described for the first time. The majority of the 321 whipscorpions (70.4%) were found within rock crevices during periods of highest daytime ambient temperatures, as compared to those found under plant debris (4.4%) or inside small mammal holes (25.2%). The percentage of available crevices, holes or plant debris that were occupied by whipscorpions was 41.5, 3.8 and 7.3%, respectively. Most occupied crevices (66.7%) were in the shade. Depths of occupied crevices ranged from 6.4–36.7 cm. Crevice widths ranged from 0.7–2.9 cm. Whipscorpions used crevices whose height above the surface of the ground ranged from 6.5 cm–1.1 m. No whipscorpions were observed at the ground surface, even in shaded areas, between 0645 and 1910 hr (CST).

Keywords: Retreat, rock crevices

Whipscorpions (Arachnida, Uropygi) are found worldwide, from southeastern Asia, Indonesia, Australia, New Zealand, India, the whole of Africa and Europe, as well as North and South America (Pocock 1895; Haupt 2000). The posterior 3 pairs of legs are used for walking whereas the anterior pair are modified as sensory organs which allow then to detect and respond to chemical and tactile stimuli (Geethabali & Moro 1988). Thelyphonids possess an attenuated, multi-segmented tail, and typically have median and lateral eyes (Shultz 1990).

The genus *Mastigoproctus* (Arachnida, Uropygi, Thelyphonidae), with 14 species, occurs in Cuba, the Antilles, Mexico, southern regions of the United States, and South America (Haupt 2000). Depending on the species, these arachnids typically inhabit mesic habitats and can be found beneath logs, leaf litter, and within burrows (Cloudsley-Thompson 1991). Some species have adapted to xeric conditions and can be found in more arid woodlands and forests in Columbia, Brazil, and desert regions in Mexico and North America (Rowland & Cooke 1973). These arachnids are well known for their ability to spray defensive, vinegar-like secretions from their pygidial glands (Schmidt et al. 2000).

The giant whipscorpion *Mastigoproctus giganteus* (Lucas 1835) is a common representative of the arachnid fauna of the northern Chihuahuan Desert (Punzo 2001). It is a nocturnal predator that feeds on a wide variety of arthropod prey (Punzo 2000a). It typically seeks shelter during daylight hours beneath surface plant debris, in shallow burrows, or within rock crevices (Punzo 2000b). In Big Bend National Park (BBNP), located in the Big Bend region of far west Texas (Brewster County; northern region of the Chihuahuan Desert), *M. giganteus* is most commonly found in microhabitats associated with sand-loam soils characterized by soil hardness values ranging from 7.2–8.3 kg/cm^2, and least likely to be found in areas where hard, adobe soils predominate (penetrometer readings: 37–41 kg/cm^2; Punzo 2000a, 2001).

Burro Mesa (31°47′N, 103°18′W; elevation: 870–917 m) is located in the west-central region of the Park (Maxwell et al. 1967). Although this site is characterized by hard, adobe soils (38–40 kg/cm^2) and an abundance of rocks and small boulders, *M. giganteus* does occur at this location (Punzo 2001). Because plant surface debris is sparse at this site, nymphs and adults of *M. giganteus* typically seek shelter from harsh summer daytime temperatures within rock crevices. The purpose of this study was to identify types of shelter sites and analyze specific physical features of rock crevices used by *M. giganteus*.

The study sites consisted of three 30 m transects chosen at random within a 1.0 km radius of Burro Mesa. Whipscorpions were hand-collected (between the hours of 1200 and 1500 hr) during June and July of 2002 by walking slowly through the area during daylight hours. This time period is characterized by the highest ambient temperatures at this site (36.9–41.2 °C). For each animal collected I recorded total body length, the air temperature (held 1 cm above substrate where animal was initially observed), and type of shelter site where it was found.

Rock crevices were inspected using a high-intensity fiber optic illuminator (Model ER-59–2242, Wards, Rochester, NY). This provided adequate illumination of the deepest crevices. When an animal was observed within a crevice, a 1m wooden ruler was slowly inserted into the crevice until its tip touched the animal in question, and the distance from the crevice opening to the animal was recorded. In order to determine the species encountered the animal was then gently prodded to the surface using a plastic rod, 75 cm in length.

I also recorded the following measurements associated with rock crevices occupied by *M. giganteus*: (1) depth of the crevice; (2) width of the crevice; (3) height of the crevice from the ground and (4) whether the occupied crevice was found in the shade, open sun or sun-shade mosaic. Additionally, I counted the number of crevices and other potential shelter sites (plant debris, occupied and abandoned mammal burrows) within the transects, and searched under plant debris and within burrows for the presence of whipscorpions. Burrows ranged in depth from 12–48 cm. Voucher specimens (SR-67815–67821) have been deposited in the Invertebrate Collections at Sul Ross State University (Alpine, TX), and at the University of Tampa.

Mean monthly air temperatures (1200 CST) at study sites were 37.8 °C ± 0.14 SE (June) and 38.7 °C ± 0.08 (July). A total of 456 whipscorpions were found. Thirty-nine of these were tritonymphs (8.5%) ranging in body length from 35–40 mm; 231 (50.7%) were adult males (44–52 mm); and 186 (40.8%) were females (48–57 mm). No proto- or deutonymphs were found.

The majority of whipscorpions were found within rock crevices (n = 321; 70.4%; 26 nymphs, 152 males, 143 females) as compared with those found under surface plant debris (n = 20; 4.4%; 3 nymphs, 12 males, 5 females) and within holes in the ground (n = 115; 25.2%; 29 nymphs, 39 males, 47 females) (Chi square: $X^2 = 46.73$, $P < 0.05$). Along transects there were 773 crevices, 1564 holes and 516 clumps of plant debris. The percentage of available crevices, holes or plant debris that were occupied by whipscorpions was 41.5, 3.8 and 7.3%, respectively. The most common plant debris sheltering whipscorpions were fallen leaves or stems of lechuguilla (*Agave lechuguilla*), sotol (*Dasylirion leiophyllum*), blind prickly pear (*Opuntia rufida*), and rat-tail cactus (*Coryphantha pottsii*). Holes ranged from 8–37 cm in depth.

All whipscorpions found within crevices, burrows or under plant debris were alone and those found in rock crevices had their entire bodies within the crevice. Most of the crevices with animals were in the shade (66.7% or 201 out of 301), as compared to crevices with animals in sun-shade mozaic (20.9% or 63 out of 301) and open sun (12.2% or 37 out of 301).

Depths of crevices occupied by whipscorpions ranged from 6.4–36.7 cm (mean: 18.23 ± 5.41 SE). Width of crevices ranged from 0.7–2.9 cm (mean: 1.64 ± 0.44 SE). Whipscorpions used cracks in surface rocks whose height above the surface of the ground ranged from 6.5 cm–1.1 m (mean: 11.32cm ± 2.58 SE).

These results show that individuals of *M. giganteus* prefer to use rock crevices at these study sites, where hard adobe soils predominate, even though there are over twice the number of holes present. Out of 1564 holes that were located, only 115 (3.8%) contained a whipscorpion. Most of the holes examined were occupied by rodents (n = 863; 55.1%) or shrews (n = 121; 7.7%) which indicates that small mammals are capable of excavating burrows, even in the presence of hard soils. *Mastigoproctus giganteus*, in contrast, may not only lack this ability, but may avoid burrows occupied by small mammals such as grasshopper mice, deer mice and shrews, animals known to include arthropods in their diets (Schmidly 1977; Punzo 2003).

Previous studies on the efficacy of different types of shelter sites to protect desert arthropods from high daytime summer temperatures have indicated that ambient temperatures immediately below plant debris are typically higher than those associated with crevices and burrows (Cloudsley-Thompson 1975; Crawford 1981). Thus, during periods of highest ambient temperature, seeking refuge under plant debris may not allow ectotherms to adjust body temperatures within the preferred range (Punzo 2000b). This may explain why only a small percentage of whipscorpions (4.4%) were found under plant debris at Burro Mesa. This appears to apply to other large arthropods as well. Out of 516 clumps of plant debris, only 11 (2.1%) were occupied by scorpions (Vaejovidae), 8 (1.5%) by solifugids (Eremobatidae), 7 (1.3%) by wolf spiders (Lycosidae), 6 (1.1%) by male tarantulas (Theraphosidae), and 9 (1.7%) by centipedes (Scolopendromorpha).

No whipscorpions were found at the ground surface, even in shaded areas, between 0645 and 1910 hr (CST). This is in agreement with the nocturnal activity patterns reported for *M. giganteus* at other sites within BBNP (Punzo 2000a) as well as other desert areas (Cloudsley-Thompson 1991). The only arthropods regularly observed actively moving over the ground surface between 1200 and 1500 hr were harvester ants (Formicidae: *Pogonomyrmex* spp.), velvet ants (Mutillidae: *Dasymutilla* spp.), and the desert millipede (*Orthoporous ornatus*).

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