

TROPHIC AND TEMPORAL NICHE INTERACTIONS IN
SYMPATRIC POPULATIONS OF *EREMOBATES*
PALPISSETULOSUS FICHTER AND *E. MORMONUS* (ROEWER)
(SOLPUGIDA: EREMOBATIDAE)

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ABSTRACT

Studies were conducted from April to August 1993, on the diets and dietary overlap, as well as diel activity patterns of sympatric populations of the solpugids, *Eremobates palpisetulosus* and *E. mormonus*. Although both species are generalist predators, they do exhibit different prey preferences based on the hardness of the cuticle. Seventy eight percent of the diet of *E. palpisetulosus* consisted of hard-bodied orthopteran and coleopteran insects, whereas 77% of the diet of *E. mormonus* consisted of softer-bodied dipteran, heteropteran, and orthopteran insects as well as spiders. No significant dietary differences were found between sexes. Both solpugid species exhibit similar temporal patterns of activity although *E. mormonus* does remain active at the surface for a longer period of time.

INTRODUCTION

The importance of competition as a primary factor in determining the structural organization of animal communities has been the subject of intensive debate over the last two decades (Schoener, 1974; Connor and Simberloff, 1979; Dunham, 1980; Roughgarden, 1986; Punzo, 1992). It has also been suggested that various multi-dimensional niche axes (i.e. temperature, food, space, time) can have significant effects on other ecological interactions including competition (Tracy and Christian, 1986). Arthropod predators that

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inhabit xeric regions frequently exhibit similar temporal patterns of activity (nocturnal) and often feed on similar prey items (Cloudsley-Thompson, 1975; Punzo, 1994a, 1994b). In view of the aridity, high temperatures, and fluctuating prey density levels that often characterize desert ecosystems, the potential for intra- and inter-specific competition is quite high (Dunham, 1980).

Solpugids are a major component of the arachnid fauna inhabiting desert regions (Muma, 1951; Cloudsley-Thompson, 1977; Punzo, 1993, 1994c). Although some information is available on the hunting behavior (Bolwig, 1952; Cloudsley-Thompson, 1961; Muma, 1966; Wharton, 1987), diet (Punzo, 1994b, 1994c, 1994d) and thermal requirements (Cloudsley-Thompson, 1977; Punzo, 1994a) of Solpugida, no studies have been conducted on the possible competitive interactions between sympatric species. The purpose of the present study was to analyze the dietary preferences and temporal patterns of activity for the solpugids, *Eremobates palipsetulosus* and *E. mormonus*.

MATERIALS AND METHODS

Using total body length as an indicator (Muma, 1951), adult males (18–23 mm, total body length) and females (19–26 mm) of *E. palipsetulosus* and *E. mormonus* were collected and marked as previously described by Punzo (1994a), as they wandered on the surface of the ground at night during April–August, 1993. All animals were collected within a 10 km radius of Lajetas (Brewster Co., Texas), located within the northern region of the Chihuahuan Desert. A detailed description of the vegetational zones and geology of this region of Trans Pecos Texas is given by Tinkam (1948). Individuals of both species were collected on sandy substrates associated with a sotol-lechuguilla community, with the dominant vegetation consisting of sotol (*Dasyllirion leiophyllum*) creosote (*Larrea divaricata*), tarbrush (*Flourensia cernua*), mesa sacahuista (*Nolina erumpens*), lechuguilla (*Agave lecheguilla*), mesquite (*Prosopis glandulosa*) and scattered clumps of chino grass (*Bouteloua breviseta*). Collection methods included hand-collecting and the use of pitfall traps.

Solpugids were identified following Muma (1951). Data on the time of day, place of capture (utilizing USGS topographical maps), total body length, sex, surface temperatures, and the presence of

prey in the chelicerae were recorded for each animal as previously described by Punzo (1991, 1992). A total of 463 *E. palpisetulosus* adults were collected, 64 of which (13.8 %) were in possession of a prey item, as well as 387 *E. mormonus* adults, 47 of which (12.1 %) had a prey item. Prey items were carefully removed from the chelicerae using forceps and placed in 70% ethanol for subsequent identification to order or family depending on the degree of digestion. Levins' standardized measure of trophic niche breadth (B_A) was calculated from data based on percent frequency of occurrence of food items as described by Krebs (1989), where B_A values can range from 0 (prey species in only one prey category) to 1.0 (prey species represented equally in all resource categories). Dietary and temporal niche overlap (D) were calculated according to Floyd and Janssen (1983):

$$D = 1 - 0.5 \sum_{i=1}^n P_{xi} - P_{yi}$$

where P_{xi} and P_{yi} are frequencies of prey classes or time intervals for species x and y, respectively, for the i^{th} category. The index, D, can range from 0 (no overlap) to 1.0 (complete overlap). Frequencies (%) of occurrence for various prey taxa (trophic niche) and time intervals of ground surface activity (temporal niche) were used for the determination of D as described by Floyd and Janssen (1983) and Schoener (1983). All statistical procedures used in data analyses followed Sokal and Rohlf (1981).

RESULTS AND DISCUSSION

E. palpisetulosus and *E. mormonus* are both generalist predators and will feed on a wide variety of arthropod prey species (Table 1). This is in general agreement with previous data on allopatric populations of *E. palpisetulosus* (Punzo, 1994b) and *E. mormonus* (Punzo, 1994c) from different study sites, as well as for several other solpugid species (Muma, 1966; Punzo, 1994d). Diets of males and females appear to be similar (ANOVA, $p > 0.5$). *E. remobates palpisetulosus* feeds more extensively on hard-bodied arthropods such as coleopterans and orthopterans, whereas *E. mormonus* captured a higher proportion of soft-bodied prey such as blattellid and gryllid nymphs as well as spiders. This is reflected

Table 1. Number of prey items captured by *Eremobates palpisetulosus* (N = 64 solpugids and prey items) and *E. mormonus* (N = 47) during field observations. Percentage (frequency of occurrence) of total prey given in parentheses. Development stage of prey: A (adult), N (nymph), L (larva).

Prey taxon	<i>E. palpisetulosus</i>	<i>E. mormonus</i>
Insecta		
Coleoptera	(26.5)	(4.3)
Carabidae (A)	8	
Scarabaeidae (A)	3	
Tenebrionidae (A)	1	2
Undetermined (A)	5	
Dictyoptera	(1.5)	(14.9)
Blattellidae (N)	1	7
Diptera	(1.5)	(8.5)
Muscidae (A)		1
Undetermined (A)	1	3
Heteroptera	(1.5)	(8.5)
Lygaeidae (A)	1	
Undetermined (A)		4
Lepidoptera	(3.1)	(4.2)
Noctuidae (A)	1	
Nymphalidae (A)	1	2
Orthoptera	(51.6)	(29.8)
Acrididae (A)	21	
(N)	1	3
Gryllidae (A)	1	11
Undetermined (A)	7	
(N)	3	
Arachnida	(14.1)	(29.8)
Araneae (A)	5	14
Scorpiones (A)	4	

in the relatively low degree of dietary overlap ($D = 0.56$). Several nocturnal arthropod species such as velvet ants (Mutillidae), blister beetles (Meloidae), and millipedes, characterized by well known chemical defense mechanisms and common in the study area, were not captured by either of these solpugid species. Measurements of trophic niche breadth (Table 2) indicate that *E. palpisetulosus* chooses prey from a narrower resource range than *E. mormonus*. No evidence of cannibalism was found although it has been reported for other solpugids (Bolwig, 1952; Muma, 1966).

Table 2. Levins' standardized measure of trophic niche breadth (B_A) based on the percent frequency of occurrence of various prey items.

Prey taxon	Percent frequency of occurrence	
	<i>E. palpisetulosus</i>	<i>E. mormonus</i>
Coleoptera	26.5	4.3
Dictyoptera	1.5	14.9
Diptera	1.5	8.5
Heteroptera	1.5	8.5
Lepidoptera	3.1	4.2
Orthoptera	51.6	29.8
Arachnida	14.1	29.8
B_A	0.298	0.598

Both solpugid species exhibit strong nocturnal patterns of activity (Table 3) which is common for desert arachnids (Cloudsley-Thompson, 1977; Wharton, 1987; Punzo, 1991, 1994a). No individuals of either species were observed on the surface before 2100 hr in the summer and before 2000 hr in the spring. The peak period of activity for *E. palpisetulosus* was between 2200 and 2400 hr in the spring, and between 2200 and 0100 hr in the summer. For *E. mormonus*, peak activity periods were between 2200 and 0100 hr for both spring and summer months. Calculation of temporal niche overlap (D) yielded a value of 0.67 for the spring and 0.64 for the summer, indicating that these solpugids occupy a similar temporal niche axis.

This study indicates that although these solpugids are generalist predators, they appear to select different types of prey perhaps based on the hardness of the exoskeleton. This may represent one way in which interspecific competition is reduced in these sympatric species. With respect to temporal patterns of activity, *E. mormonus* adults exhibited a longer period of activity at the surface. Since microhabitat, food and time represent the three major categories of resource dimensions (Schoener, 1974; Roughgarden, 1986), a difference in any one of these dimensions could effectively reduce competition. Future studies should focus on possible species differences in foraging (hunting behavior, prey prepara-

Table 3. Percentage of adult solpugids active at hourly intervals (18 = 1800 to 1859 hr). N = number of different solpugids observed during each season (spring: Apr. 16-June 20; summer: June 21-Aug. 29). No significant differences were found between sexes. Mean ground surface temperatures (deg C) are given in parentheses.

Species	N	Time of activity											
		18	19	20	21	22	23	24	01	02	03	04	
<i>E. palpisetulosus</i>													
SPRING	268	0 (36.4)	0 (35.2)	1.2 (34.3)	9.4 (32.1)	21.4 (31.6)	30.3 (30.7)	17.6 (30.1)	7.1 (29.7)	7.4 (29.3)	3.7 (28.7)	1.9 (27.4)	
SUMMER	195	0 (46.3)	0 (45.1)	0 (43.8)	2.5 (42.6)	17.1 (41.2)	28.6 (39.6)	30.3 (38.5)	15.2 (37.6)	2.7 (36.2)	2.6 (34.8)	0 (33.6)	
<i>E. mormonus</i>													
SPRING	173	0	0	2.8	6.6	14.3	18.1	23.7	18.4	16.1	14.3	0	

tion), microhabitat preference, the role of soil hardness in habitat selection (especially burrowing sites), fecundity, age and body size of the female at first reproduction, mating behavior, longevity, and responses to thermal stress.

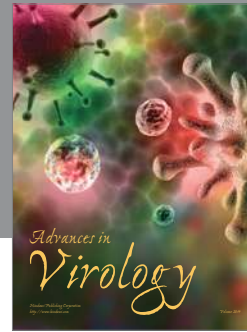
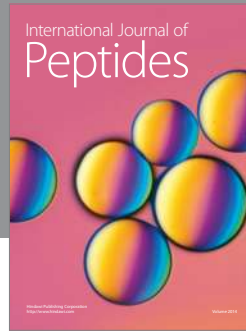
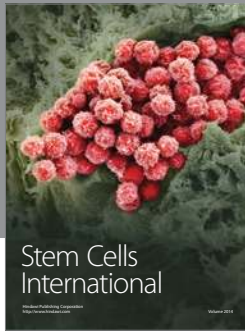
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