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COURTSHIP BEHAVIOR AND LIFE CYCLE OF THE WOLF SPIDER *SCHIZOCOSA MCCOOKI* (ARANEAE, LYCOSIDAE)

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ABSTRACT

Individuals of *Schizocosa mccooki* (Montgomery) are found in open areas of pinyon-juniper woodland in New Mexico. They co-occur with individuals of *Alopecosa kochi* (Keyserling) and *Lycosa coloradensis* Banks. Individuals of *S. mccooki* overwinter as immatures. They then mature in May, and mating occurs in May and June. During courtship, a male *S. mccooki* will make a quick jump, assume a position facing the female, and perform a series of palpal movements. The pattern of sound production includes a series of 2-18 bursts of percussion, with each burst consisting of 2-4 individual taps of the palps. The sounds produced from a courtship sequence of two individuals from Saskatchewan, Canada, were very similar to the sounds produced by the individuals from New Mexico.

INTRODUCTION

Schizocosa mccooki (Montgomery, 1904) is a medium-sized wolf spider common throughout the western United States. Its reported range is from southern Canada to central Mexico, from the Pacific Ocean, east to mid-Texas and in the northeast, to Michigan (Dondale and Redner 1978). Dondale and Redner (1978) describe *S. mccooki* as abundant, widespread, and variable. *S. mccooki* has typically been collected by pitfall traps (Allred 1975) or by headlamp collecting, as reported here. The preferred habitats of *S. mccooki* appear to be open ground or small desert shrubs in pinyon pine-juniper woodland, in grass and sedge as on the shore of Lake Erie (Dondale and Redner 1978), or in dry grassland (Buckle 1972). A brief description of the courtship can be found in Buckle (1972) (misidentified as *S. avida*) and Uetz and Stratton (1982). The present

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study was undertaken to examine aspects of courtship of *S. mccooki* quantitatively, to compare the courtship of *S. mccooki* from New Mexico with the courtship of *S. mccooki* from Saskatchewan, Canada, and to describe the life cycle of *S. mccooki* from New Mexico.

METHODS

Individuals of *S. mccooki* were collected in pinyon-juniper woodland, in an approximately 5 km^2 area on the southwest border of Santa Fe, Sante Fe Co., New Mexico. Collecting was done with a headlamp, from early evening, after sundown, until midnight. In order to reduce sampling bias, each specimen that was seen was pursued until captured. Each night's catch was identified, sexed if mature, and carapace width was measured (Hagstrum 1971). The number of individuals collected in one evening varied from 0 to 20 spiders. Collections were made from April through November, after which time conditions were such that no spiders were seen. Means and 95% confidence intervals for carapace width were calculated for each month's collections.

In June 1979, 25 individuals (4 males and 21 females) were collected. These spiders were transported to Ohio, where courtship studies were done. Spiders were housed individually in plastic rectangular containers (7 cm X 7 cm X 13 cm), and were fed crickets *(Acheta domestica)* or mealworms *(Tenebrio molitor)* twice weekly. Each was supplied with a cotton-plugged water vial as a source of moisture. All courtship observations were made in June 1979.

Courtship behavior of three males was recorded on film with a Nizo Super 8 movie camera (speed 54 fps.) Sound and vibration recordings were made of all four courting males with a Bruel and Kjäer accelerometer (Type 4366) high sensitivity vibration pickup leading to a Bruel and Kjäer sound level meter (Type 2203). The output was recorded by a Teac tape recorder (model 2300) which had a frequency response range of 40 Hz to 24 kHz. All recordings were made at 19.05 cm/sec (7.5 ips). The accelerometer was placed on a piece of paper which had served as a cage liner for a female *S. mccooki.* To obtain a visual representation of the sound, tapes were played through a recording oscilloscope. The tapes were also played through a Bruel and Kjäer sound level recorder (Type 2304), a high speed recording instrument designed for the measurement of signal level variations. Portions of the recordings of *S. mccooki* have been deposited at the Borrer Library of Bioacoustics at The Ohio State University, Columbus, Ohio.

A tape of the courtship of two individuals of *S. mccooki* from southwestern Saskatchewan, Canada was obtained from D. J. Buckle. Quantitative comparisons of these individuals were made with the New Mexico specimens. Details of the recording procedure are in Buckle (1972).

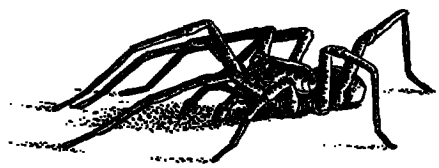

Fig. 1.–Position of male *Schizocosa mccooki* during sound production.

RESULTS AND DISCUSSION

Courtship Behavior.–The male *S. mccooki* responded with courtship in the presence of a conspecific female. Courtship began immediately following the first physical contact between male and female. In three or four instances, the male did not respond with courtship when presented with only the female's cageliner (which held the female's silk, and possible a pheromone). No chemoexploring (movement of the dorsum of the palp on the substrate – Tietjen 1977) was observed.

Analysis of high speed film showed that a typical courtship sequence began with the male making a quick jump, assuming a position facing the female with his venter flush with the substrate (Fig. 1), and then performing a series of palpal drums. This drumming has been called "bursts of percussion" (Uetz and Stratton 1982), or "tapping palpi on the substrate with nearly contiguous strums" (Buckle 1972). The movement was reported as "stridulatory sounds" by Dondale and Redner (1978). The palps were in contact with the substrate except when the drumming occurred. The primary movement of the palp was clearly percussive, with the entire palp moving up and down. In some instances, the palps were raised and lowered together, but usually the palps were drummed in an alternating sequence. While drumming, the male spider made no movement with the rest of his body. High-speed-film analysis indicated an occasional oscillation of the palp that was similar to the movement made during stridulation in other species of *Schizocosa* and *Lycosa* (Rovner 1975, Stratton and Uetz 1981, 1983). However, if stridulation (passing a scraper across a file) was occurring it was not detected with the recording techniques and analysis used. Clearing and mounting the male palp and examining it microscopically indicated a stridulatory organ is present. Thus, the relative importance of percussion and stridulation in this species remain untested.

The pattern of sound production consists of a series of 2 to 18 bursts, each burst including 2 to 4 individual taps of the palps. The overall pattern of sounds is shown in Fig. 2. Of the New Mexico spiders a series consisted of 2 to 18 bursts ($\bar{x}$ = 6.5 bursts/series) with an average length of 5.2 seconds/series, and separated from the next series by an average of 26.9 seconds. The average time between bursts of percussion was 1.4 seconds (Table 1). The individuals from Canada showed an average of 6.1 bursts/series, an average duration of 3.3 seconds/series, and separated from the next series by an average of 21.5 seconds. The average time between bursts of percussion was 1.9 seconds. Even though the sample size of spiders is not sufficient to permit statistical comparisons, it is clear that the percussive patterns in the courtship of the two populations are very similar. Although clines in many characters are known (Endler 1977), clines in behaviors have not been extensively studied. This type of quantitative description will permit further com-

Table 1.–Quantitative comparison of the courtship of *Schizocosa mccooki* collected from New Mexico and Saskatchewan, Canada (means are indicated ± 2 S.D.).

Geographic Locality	Number of bursts per series	Duration of a series (sec)	Interseries interval (sec)	Burst rate (burst/sec)
New Mexico	6.5 ± 4.4	5.2 ± 4.4	26.9	1.46 ± 0.82
(4 males)	n = 28	n = 14	n = 2	n = 14
Saskatchewan	6.1 ± 8.5	3.3 ± 5.2	21.5 ±45.6	1.9 ± 1.44
(2 males)	n = 28	n = 28	n = 28	n = 28

parisons of courtship behavior in this species over a geographic range. Attempts at interbreeding between the two populations would provide the ultimate test of whether the courtship patterns are the same, or are similar enough to allow interbreeding (*i.e.*, that they are indeed the same species and not "cryptic" species, *sensu* Walker 1964).

Habitat and Life Cycle.–Specimens of *S. mccooki* were mostly found in the open areas of a pinyon-juniper woodland. Although they were occasionally collected among small shrubs, such as snakeweed *(Gutierrezia sarothrae)*, or rabbit brush *(Chrysothamnus nauseosus)*. One of us (DCL) has collected *S. mccooki* elsewhere in the west and found it to occur in sagebrush meadows. Collections showed that *S. mccooki* overlapped little with sympatric species of wolf spiders in their preferred habitats. *Alopecosa kochi* (Keyserling) was found only beneath trees, and *Lycosa coloradensis* Banks built burrows in open areas between pinyons and junipers (Lowrie, unpub. data).

Adult males and females of *S. mccooki* can be found from May through October. Collections indicated that 96% of the animals matured within a week of each other. Most matings probably occur in late May and June. Egg sacs are laid, carried and hatch in July. Individuals overwinter as immatures, and mature the following spring. The spiders are occasionally active on warmer days in the winter; thus, they are not true hibernators but are quiescent in the cold. Although the number of instars in *S. mccooki* is not known, the

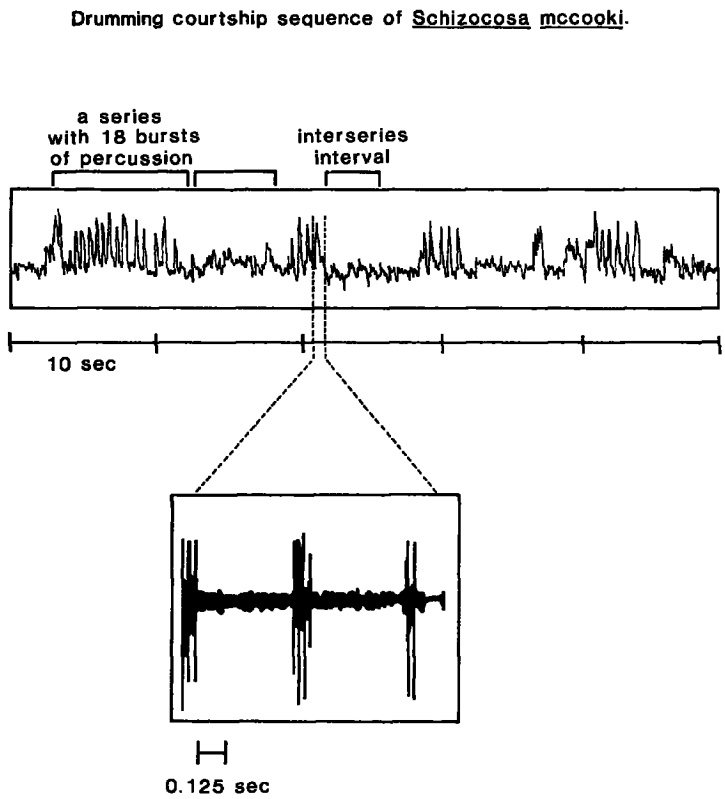

Fig. 2.–Courtship sequence of *S. mccooki*. Sequence of 50 seconds, showing series of bursts of percussion and interseries intervals. Inset is sequence of 1.25 second showing three bursts, with 2-4 taps of the palps in each burst.

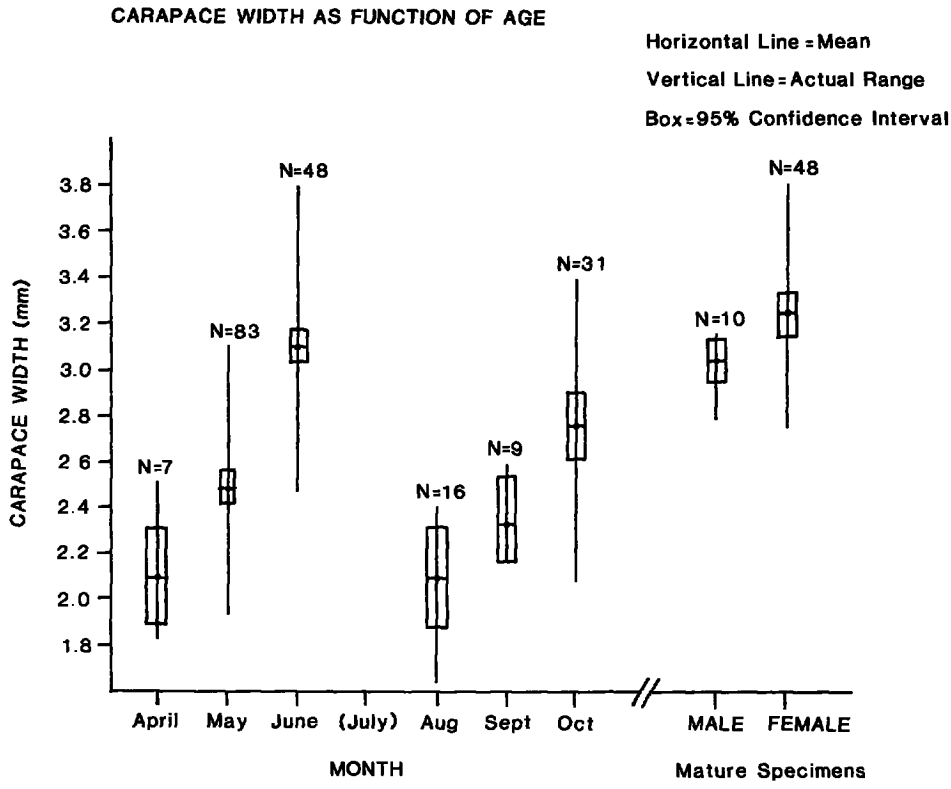

Fig. 3.–Carapace width of *S. mccooki* as a function of month of collection.

growth of the species through the growing season is indicated by carapace width (Hagstrum 1971) (Fig. 3). Curiously, the carapace width of immature spiders collected in the spring was less than the carapace width of those collected in the fall. As this cannot be a reduction in the size of individuals, it can probably be attributed to a small collection sample in April.

Mature males were slightly smaller than mature females (mean carapace width in mm: male $\bar{x}$ = 3.04, N = 10; female $\bar{x}$ = 3.23, N = 48). The size of the New Mexico population was smaller than the figures reported by Dondale and Redner (1978) (mean carapace width, male $\bar{x}$ = 4.06, N = 131; female $\bar{x}$ = 4.46, N = 153).

CONCLUSIONS

This study provides a description of the sounds produced by *S. mccooki* during courtship. The importance of these sounds has not yet been experimentally demonstrated; however, the apparent lack of visual signals (the male moves little during a courtship bout) suggests that the acoustic signals are important. The natural substrate used by male *S. mccooki* in courtship is unknown but of interest. It is possible that the vegetation on which the spiders are sometimes found could be used during courtship as a

substrate which conducts the vibrational signals. The other possibility is that the spiders are on the bare ground (which is bare of leaflitter). How the substrate is used by the spiders and what selection pressures exist for drumming and stridulating are intriguing questions awaiting further investigation.

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