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A COMPARISON OF POPULATIONS OF WOLF SPIDERS (ARANEAE, LYCOSIDAE) ON TWO DIFFERENT SUBSTRATES IN SOUTHERN FLORIDA

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ABSTRACT. Wolf spiders were sampled from sandy and grassy substrates every month for one year at Archbold Biological Station, Lake Placid, Florida, from December 1981 through November 1982. It was found that the faunas were different in species composition, even though they were within a few meters of one another. Light-colored species, such as *Lycosa ceratiola* and *Lycosa osceola*, were more abundant on or restricted to the sandy surface, while darker colored species, such as *Lycosa miami, Lycosa annexa, Lycosa abdita* and *Schizocosa crassipes* were more abundant on or restricted to, the grassy substrate. A total of twelve species of lycosids were collected.

Archbold Biological Station currently contains 2023.5 hectares of Lake Wales Ridge scrub, dominated by slash pine, *Pinus elliotti* Engleman, sand pine, *Pinus clausa* (Engleman) Sargent, several species of scrub oaks, *Quercus* spp., saw palmetto, *Serenoa repens* (Bartr.) Small and *Sabal etonia* Swingler ex. Nash, among others (Vander Kloet 1979). The scrub region of south Florida is unique and the largest part of the remaining scrub on the Lake Wales Ridge occurs on the station. The wolf spider fauna is highly varied and contains some unique or nearly unique elements, such as *Sosippus placidus* Brady and *Geolycosa xera* McCrone (Franz 1982). Richman (1984) listed 15 known species for Highlands County. Most of the species involved are little known, other than their original descriptions. Two of the species which were recorded in the list are very abundant at the station. These are *Lycosa ceratiola* Gertsch & Wallace and *Lycosa miami* Wallace. Wallace (1942) included *L. miami*, but not *L. ceratiola*, in the *lenta* group; but both appear to be related, based on their morphology. An observation was made in 1981 by Richman and Whitcomb that there seemed to be a difference in the lycosid fauna on sand compared with the fauna on grass. To document this difference we decided to sample wolf spider populations on both substrates monthly for a year and then compare the results to test the hypothesis that there was a distinct difference between the faunas and that it persisted throughout the annual cycle.

METHODS

An area immediately adjacent to and south of the main building at Archbold Biological Station (27°20′N, 81°20′W) was selected for accessibility and for the presence of both grassy areas and sandy areas. The areas were approximately 10 × 100 m (1000 sq. m) and were perpendicular to each other. The grassy area was just south of the main building and was oriented along a north-south line, whereas the sandy area edge was just south of the south edge of the grassy area and was oriented along a east-west line (Fig. 1). Both substrates were sampled monthly at night from December 1981 through November 1982 (Table 1), using headlighting techniques (Wallace 1937). A minimum of 50 spiders was collected on each substrate during each sampling period (total minimum of 100 spiders/month), except for the first sample (December 1981) when a minimum of 24 was collected on each substrate and for grass in September 1982 when 29 were collected. Depending on the number of people searching

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and the time of year, the samples were collected in anywhere from 10 minutes to two hours, but usually took 20–30 minutes. We used a relatively standard number of spiders because it was felt that this would give us a relative proportion of adults and immatures. At no time did we attempt to obtain absolute densities. Because the eye shine was used to collect all samples in both cases, rather than just searching for spiders, we feel that the proportions reasonably reflected the populations present on the substrates. While the sand had little vegetation on it, the grass was short on the grassy area and presented no problems in seeing the eye shine. The spiders were preserved in alcohol and later identified and each carapace width measured (including immature specimens). Identifications were made by Allen Brady, Hope College, Holland, Michigan; G. B. Edwards, Florida State Collection of Arthropods, Gainesville, Florida; and the senior author. Once adults were identified, it became possible to at least tentatively identify the majority of the immature specimens. Most of the immature specimens were identified by the senior author. Weather data were provided by Archbold Biological Station. Samples of specimens collected are deposited at the Archbold Biological Station (complete synoptic collection), the Arthropod Museum of New Mexico State University (partial synoptic collection), and the Florida State Collection of Arthropods (partial synoptic collection and most extra and immature specimens).

Statistical analyses included preliminary frequencies and time plots for counts of each species and substrate combination. Also chi-square tests of homogeneity were conducted to compare occurrence of different species. These chi-square tests included: substrate by month comparisons for each species; substrate species comparisons for each month; and month by sex comparisons for each substrate and species combinations. Problems were experienced with sparseness in chi-square tables due to low counts for all but two species and all sexes. Finally, an analysis of variance was performed for each substrate and species combination to compare average size over months. All analyses were performed using SAS© (SAS Institute 1989, 1990).

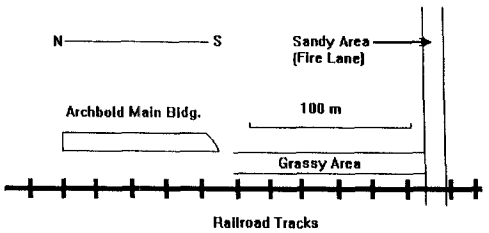

Figure 1.—Map of Archbold Biological Station main building area, showing the two study sites. Scale is approximate. Map modified from Abrahmson et al. 1984.

RESULTS

A total of five species of *Lycosa*, three species of *Rabidosa*, one species of *Gladicosa*, one species of *Pardosa*, one species of *Sosippus*, and one species of *Schizocosa* was collected at the study site over the year (Table 2). Of these, eight species

Table 1.—Collecting dates for *Lycosa* spp. at Archbold Biological Station, Highlands County, Florida (1981–1982). * Two teams used.

Date	Time of collection	
	Grass substrate	Sand substrate
17 December 1981	Approximately hour after sundown	
21 January 1982	7:00–7:20 P.M. EST*	7:20–7:36 P.M. EST
22 February 1982	7:30–8:00 P.M. EST	8:00–8:30 P.M. EST
22 March 1982	7:45–8:05 P.M. EST	8:05–8:30 P.M. EST
20 April 1982	7:50–8:20 P.M. EST	8:25–8:55 P.M. EST
19 May 1982	9:05–9:15 P.M. EDT	9:15–9:30 P.M. EDT
21 June 1982	9:00–9:30 P.M. EDT	9:30–10:00 P.M. EDT
22 July 1982	9:00 PM EDT*	9:00 P.M. EDT*
18 August 1982	9:20–1:15 P.M. EDT	8:35–9:20 P.M. EDT
20 September 1982	8:30–9:30 P.M. EDT*	8:30–9:30 P.M. EDT*
26 October 1982	Approximately hour after sundown	
22 November 1982	Approximately hour after sundown	

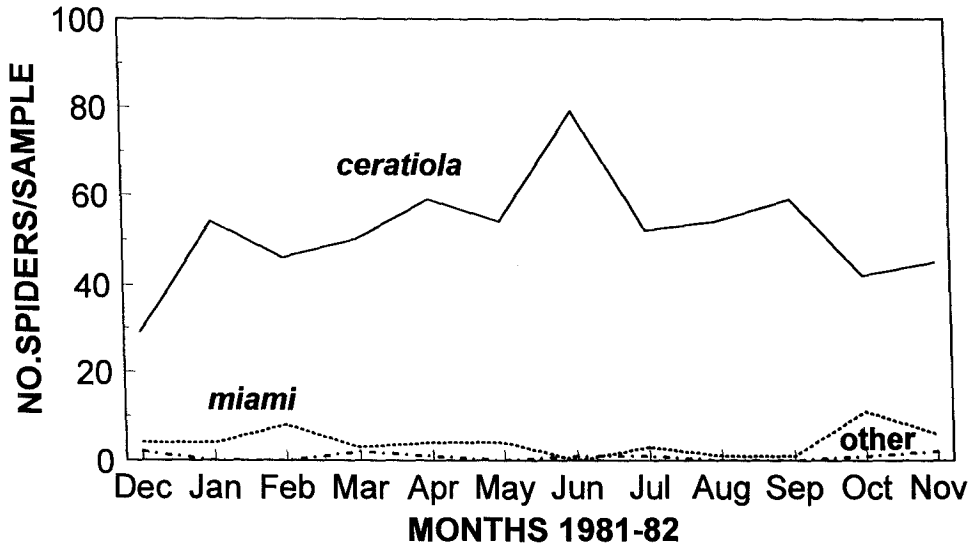

Figure 2.—Numbers of *Lycosa ceratiola*, *Lycosa miami* and other lycosids on sand at Archbold Biological Station, Highlands County, Florida, December 1981 to November 1982.

were not listed by Richman (1984). Only two of the species collected in this study, *L. ceratiola* and *L. osceola*, were in the Archbold Biological Station Collection at the time of the study. In addition to the wolf spiders, at least one immature specimen of the giant crab spider, *Heteropoda venatoria* (Linnaeus), and one of an unidentified gnaphosid were collected on the grassy surface over the year.

The chi-square test of homogeneity of occurrence of species on the two substrates indicated that there was indeed a significant difference ($P < 0.005$ for all months) between the frequency of *Lycosa ceratiola* and *Lycosa miami* on the two substrates. Only the samples from August were questionable because 25% of the cells had expected counts of less than five. This sparseness was a common problem when more than these

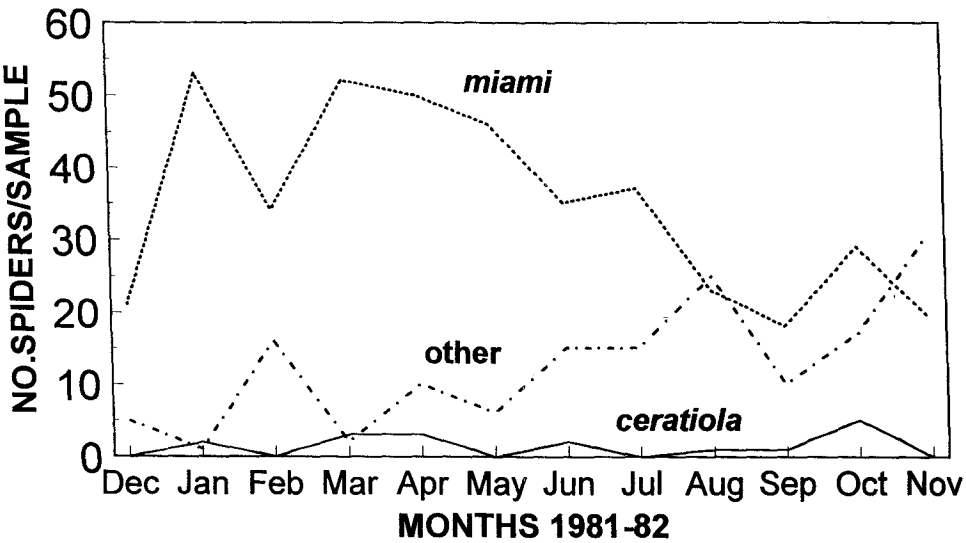

Figure 3.—Numbers of *Lycosa ceratiola*, *Lycosa miami* and other lycosids on grass at Archbold Biological Station, Highlands County, Florida, December 1981 to November 1982.

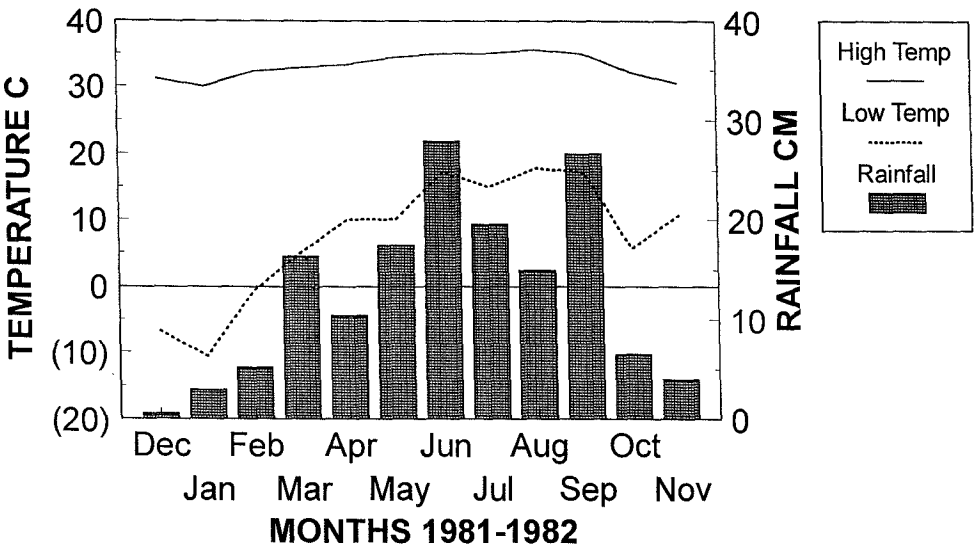

Figure 4.—Weather data for Archbold Biological Station, Highlands County, Florida, December 1981 to November 1982. Temperatures are averages for each month in °c. Rainfall is total for month in cm.

two species were included in the analysis, even though it is evident that there is a real difference between the species recovered on sand and those recovered on grass. Thus, no statistically valid conclusions can be made about the other species.

Monthly counts (Figs. 2, 3) for the two species demonstrate this distinct difference very well. It is quite obvious that the sandy colored *L. ceratiola* preferred sandy substrates, while the darker *L. miami* preferred the grassy substrate.

Size analysis was only meaningful for *L. ceratiola* on sand and *L. miami* on grass. These were present throughout the 12 months of the sampling period. The average carapace width for these two species each month is shown in Table 3. It is curious that while immatures were present at all times of the year, adult males of *L. miami* were found in only four scattered months (December, March and July–August). Adult females of *L. miami* were collected in December and March–August, whereas males of *L. ceratiola* were collected from March–July and females in January and March–November (Table 3).

Some prey records were obtained, especially

Table 2.—Species of *Lycosa* and other Lycosidae collected at Archbold Biological Station, Highlands County, Florida, 1981–1982. Specimens of *Lycosa ceratiola* and *Lycosa miami* include those collected on both sand and grass and so do not match totals in Table 3. Identifications were by Allen Brady, G. B. Edwards and D. B. Richman. Species with "*" were not listed by Richman (1984).

Species	Substrate	*n* and sexes
Gladicosa pulchra (Keyserling)*	Grass	1♂
Lycosa abdita Gertsch*	Grass, sand	2♂, 10♀, 3 imm.
Lycosa annexa Chamberlin & Ivie*	Grass	23♂, 13♀, 41 imm.
Lycosa ceratiola Gertsch & Wallace	Sand, grass	23♂, 55♀, 561 imm.
Lycosa miami Wallace	Grass, sand	12♂, 22♀, 432 imm.
Lycosa osceola Gertsch & Wallace	Sand (1 on grass?)	3♀, 2 imm.?
Pardosa littoralis Banks*	Grass	1♂, 1♀, 5 imm.
Rabidosa hentzi (Banks)*	Grass (2 on sand)	1♂, 7 imm.
Rabidosa punctulata (Hentz)*	Grass	1♀, 3 imm.
Rabidosa rabida (Walckenaer)*	Grass	2 imm.
Schizocosa crassipes (Walckenaer)*	Grass (1 on sand)	3♂, 10♀, 12 imm.
Sosippus floridanus Simon	Grass	1 imm.

Table 3.—Mean carapace width (mm) for *Lycosa ceratiola* on sand and *Lycosa miami* on grass at Archbold Biological Station, December 1981 to November 1982. Adult males and females present in the sample are noted by the symbols ♂ or ♀.

Date	*Lycosa ceratiola* (*n*) (Range) (SD)	*Lycosa miami* (*n*) (Range) (SD)
December	3.10 (29) (1.17–5.67) (1.36)	3.80 (21) (1.67–8.17) (1.91) 1♂, 1♀
January	2.62 (54) (1.17–5.83) (1.21) 2♀	2.66 (53) (1.33–5.17) (0.83)
February	2.50 (46) (1.00–5.50) (1.05)	2.38 (34) (1.50–5.00) (0.77)
March	4.01 (50) (1.16–7.50) (1.62) 8♂, 4♀	3.59 (52) (1.83–7.83) (1.39) 1♂, 2♀
April	3.66 (59) (1.50–6.50) (1.47) 2♂, 4♀	4.06 (50) (1.83–8.83) (1.39) 4♀
May	3.68 (54) (1.67–6.67) (1.33) 1♂, 3♀	4.23 (46) (2.50–8.67) (1.30) 1♀
June	4.43 (79) (1.00–7.50) (1.82) 6♂, 16♀	4.04 (35) (1.33–7.33) (1.74) 2♀
July	3.36 (52) (1.33–7.00) (1.67) 4♂, 8♀	5.25 (37) (1.67–8.50) (1.91) 6♂, 7♀
August	2.74 (54) (1.67–7.33) (1.14) 4♀	4.48 (23) (1.50–7.83) (2.04) 4♂, 4♀
September	2.56 (59) (0.83–5.33) (1.33) 4♀	5.37 (18) (1.67–7.00) (1.12)
October	3.10 (42) (1.17–5.33) (1.15) 1♀	3.28 (29) (0.83–6.67) (1.44)
November	3.39 (45) (1.33–6.00) (1.35) 5♀	2.90 (19) (1.17–5.33) (1.17)

for *Lycosa ceratiola*. On 20 April 1982 at least 10 individuals of this species were collected with alates of the fire ant *Solenopsis* sp. (Formicidae). The same collection produced a click beetle (Elateridae), a scarab beetle *Ataenius platensis* (Blanchard) (Scarabaeidae) and a leafhopper, *Draeculacephala inscripta* Van Duzee. On 22 July 1982 individuals of *L. ceratiola* had caught a muscid fly, two scarabs and a mirid bug in the genus *Lygus*. On the 18 August 1982 a *L. ceratiola* was taken with a beetle fragment. On the same date a specimen of *L. miami* had captured a rove beetle (Staphylinidae). On 22 October 1982, a record for made of *L. miami* with a male gryllid cricket, and on 22 November, with one psychid larva and a myrmycine ant.

Weather data are summarized in Fig. 4. The lowest temperature was −11 °C in January 1982 and the highest was 35.6 °c in August. The highest rainfall was in June (27.85 cm) with the second highest in September (26.63 cm). December 1981 had the lowest rainfall (0.55 cm). With the exception of the cold periods in January and December (to −6.7 °c), the weather was very mild, even at night, and spiders were always found.

DISCUSSION

With these results we can make the following statements: 1), *Lycosa ceratiola* is most often found on the sandy substrate where it is most likely to be cryptic; 2), Conversely, *Lycosa miami* is most often found on the grassy substrate where it is most likely to be cryptic; 3), The grassy substrate has a higher species diversity (2:1) than the sandy substrate; 4), There were also more specimens of species that were found on both substrates (other than *L. ceratiola*) on grass than on sand; 5), The size analysis indicated that the various sizes were spread through the year, but that the smallest spiderlings were found in August for *Lycosa ceratiola* and in September for *Lycosa miami*. However, average carapace widths were the smallest for both species in February (Table 3). The low carapace widths in winter reflects the lower number of adults and the high numbers of (probably) third instar spiderlings. Thus most egg sacs were probably produced from the late summer and fall, although this may have been somewhat more spread out than for more northern species; finally, 6), prey, especially of *L. ceratiola*, appears to be quite varied and includes ants, beetles, crickets, true bugs, leafhoppers and caterpillars. Alate ants are readily attacked during mating flights.

The apparent crypsis of the two major species of *Lycosa* may be somewhat puzzling, as these are obviously nocturnal spiders. However, it might be noted that on moonlight nights the sandy color of *L. ceratiola* made it nearly invisible, whereas specimens of *L. miami* were visible as almost shadow-like bodies against the white sand. The reverse was true on the grassy areas. Thus the crypsis may serve to conceal the spiders from attack by vertebrate predators, especially night birds, such as screech owls, which are known predators of large lycosid spiders (Ross 1969).

The lack of female spiders carrying spiderlings or eggs is possibly a result of the larger, commoner (*lenta* group) species staying in their burrows during the egg laying and early spiderling

stages and, in the case of the smaller, rarer, species, may be a result of the low numbers taken. It is well established that members of the *lenta* species group are burrowers (Wallace 1942; Gertsch 1979). The less-collected species, some of which normally carry their eggs and first instar young with them, rarely came out on the grassy or sandy areas, but primarily stay on surfaces under the scrub canopy. The one specimen of *Sosippus* collected was obviously a stray, as these spiders build funnel webs in litter and shrubs (Brady 1962). Also, since only a few of the burrowing *Lycosa osceola* were collected, even on sandy surfaces, it is thought that they may have preferred sandy areas between plants in the nearby scrub. The scrub habitat was not sampled during the study, partly because of the difficulty of headlighting in that habitat. However, *L. osceola* was seen in the spaces between scrub plants on several occasions.

The fact that some large species of *Lycosa* differ in their substrate preference has been demonstrated in the past for two members of the *lenta* group, *L. lenta* Hentz and *L. ammophila* Wallace (Harper 1971). In these species *L. lenta* preferred leaf-litter and *L. ammophila* preferred sand. As noted earlier, Wallace (1942) placed *L. miami*, but not *L. ceratiola*, in the *lenta* group. It seems likely, from our observations and from the apparently similar morphology and appearance (especially the structure of the male palpi, female epigyna and general color pattern– *L. ceratiola* looks much like a very pale *L. miami*), that these two species, like *L. lenta* and *L. ammophila*, belong in the same species group. Where these "*Lycosa*" species will eventually be placed is unclear at the present time. However, it seems to be evident from both Harper (1971) and the current study that the various species of lycosids do partition their habitats in peninsular Florida.

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