MORPHOLOGICAL AND PHYLOGENETIC PATTERNS IN DIURNAL VS. NOCTURNAL SPIDERS

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Abstract: Nocturnal animals share traits adaptive to being active at night, sometimes as a result of convergent evolution. We hypothesized that nocturnal vs. diurnal grassland spiders would differ in their morphological characteristics and phylogeny. However, we found no difference between nocturnal and diurnal spiders in body size, eye number, cryptic coloring or foraging behavior; neither was there a difference in the proportional representation of different families of spiders found during the day versus those found at night.

Key words: Araneae, *convergent evolution, temporal distribution*

INTRODUCTION

Convergent evolution occurs when ecological or evolutionary pressures select for similar morphologies and behaviors among different phylogenetic groups (Begon et al. 1990). For example, streamlined form for movement through water has been selected for in most fish, some mammals, and even some birds. Similarly, large eyes have evolved independently in at least three different families of nocturnal birds: e.g., the boat billed heron, owls, and potoos (Stiles and Skutch 1989).

There are at least six spider families present at Palo Verde National Park (Babineau et al. 1999). Families of spiders may exhibit convergent evolution as a result of differential selective pressures on spiders that are active in day vs. night. It could be that spiders that are diurnal vs. nocturnal have repeatedly evolved to be morphologically similar to each other and different from spiders active at the other time. Alternatively, eye morphology and hunting strategy, which serve as diagnostic traits in distinguishing spider families (Kaston 1973), may be so evolutionarily conserved that day vs. night activity is primarily determined by phylogeny. In this case, hunting strategy might be dictated by evolutionary history, as opposed to the case where hunting strategy is relatively plastic, and morphology evolves accordingly. We predicted that night-active spiders would be relatively larger (because they are less vulnerable to visual predators), less cryptic, have more eyes and display different foraging behavior than day-active spiders.

METHODS

We sampled the diurnal and nocturnal spiders in an open grass field bordering the marsh at Palo Verde National Park, Costa Rica on 12 January 2004. We established six 10 m transects spaced 5 ft apart and examined 6 in on either side of the transect once during the day (0930 - 1100) and once during the night (2130 - 2300). For all spiders we recorded size, coloration (camouflaged or not), activity, and presence or absence of a web. In the same location we also set 15 pitfall traps evenly spaced on a 25′ x 15′ grid, filled halfway with soapy water. We emptied pitfalls after 10 h of day collecting and 10 h of night collecting. We recorded size, coloration, number of eyes, sex and family for each spider collected in pitfall traps.

RESULTS

We collected 22 spiders representing eight families from the night pitfall traps and seven spiders representing four families from the day pitfall traps. Three families were repre-

sented in both day and night samples (Table 1). Neither body size ($t = 0.27$, $df = 27$, $P = 0.79$), sex ($X^2 = 1.21$, $df = 1$, $P = 0.27$) nor eye number ($t = 0.77$, $df = 27$, $P = 0.45$) differed between day and night spider communities.

We found 51 spiders during the day transect and 28 spiders during the night transect (Table 2). Day and night communities were very similar with respect to occurrence of camouflage and webs. Spiders found at night were larger than those found during the day, but this might have been the result of detection bias and was not supported by the pitfall data. Spiders found during the day were somewhat more likely to be active than those found at night.

Table 1. Number of spiders from each family found in 15 pitfall traps run during one day and one night. Bold indicates families found in both night and day samples.

Family	Day	Night	Total
Agelinidae	**2**	**7**	**9**
Araneidae	**1**	**2**	**3**
Caponiidae	0	1	1
Hahniidae	0	2	2
Lycosidae	**3**	**7**	**10**
Lyssomonidae	0	1	1
Pisauridae	0	1	1
Salticidae	1	0	1
Zoropsidae	0	1	1
Total	7	22	29

Discussion

Surprisingly, we found no difference in size, coloration, or eye number between spiders found during the day vs. night, suggesting that these morphological characteristics are not unique to nocturnally or diurnally active spiders. There may, however, be other morphological adaptations that differentiate nocturnal and diurnal spiders that we did not measure.

Because there was no clear pattern of family assemblage between spiders found during the day and night, our data suggest that adaptations necessary for nocturnal vs. diurnal lifestyles are evolutionarily labile within families.

For several reasons the results of our study were somewhat inconclusive. Limited captures in the pitfalls precluded statistical tests for associations between time of activity and spider taxonomy. The pitfalls were probably most effective at capturing ground foraging spiders and least effective at capturing spiders in orbs or jumping spiders (Salticidae). Day and night transects were not easily comparable because detection ability varied between night and day and because lights were needed to conduct nighttime search, potentially changing the spiders' activity patterns. The fact that we found larger spiders at night might be because larger spiders react more to invasive lights and are then easier to see. The lights may also have caused spiders to freeze, which would explain the higher proportion of activity found among spiders detected during the day transects.

The apparent lack of taxonomic or morphological patterning of spiders with respect to

Table 2. Characteristics of spiders detected during surveys conducted in the day vs. night along six 10 m transects.

	# present	Mean size (mm)	Percent with camouflage	Percent with web	Percent active
Day	51	3.21 ± 0.43	35	22	67
Night	28	4.86 ± 0.56	43	21	43

nocturnal vs. diurnal activity suggests that other ecological factors might be more important than time of activity. For example, the morphological characteristics that we measured may be more representative of habitat type (e.g. forest vs. grass and underbrush) and prey within habitat type (e.g. Homopterans vs. Orthopterans) rather than traits unique to nocturnal or diurnal activity. Future studies could compare morphological, behavioral and taxonomic affiliations between habitats.

LITERATURE CITED

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