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Abundance and web characteristics of *Micrathena gracilis* and *Micrathena mitrata* (Araneae: Araneidae) in west-central Illinois, USA

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Abstract. We investigated abundance and web characteristics (web elevation and spiral area) of the spiny orb weavers *Micrathena gracilis* (Walckenaer 1805) and *Micrathena mitrata* (Hentz 1850) using transect surveys in oak-hickory forest stands in west-central Illinois. Surveys resulted in 153 collected individuals or observations of adult females (70 *M. gracilis* and 83 *M. mitrata*). Peak abundance of both species occurred in late July, with a density of 0.03 females per m^2 for each species. Web spiral area and web elevation were both greater for *M. gracilis* than *M. mitrata*. *Micrathena mitrata* web spiral area was larger in plots in which spiders had been previously removed than in plots without removal. These results suggest that the two species have different vegetation structure or microclimate preferences, and may respond to availability of unoccupied habitat differently.

Keywords: Web elevation, web spiral area, spiny orb weavers

The orb weaver genus *Micrathena* includes 104 species of primarily Neotropical forest spiders (Levi 1985). These spiders have a striking spiny abdomen and occupy vertical orbs with an open hub. They assume an upside-down position on the web, with the abdomen held horizontally (Gonzaga & Santos 2004). The smaller males are rarely found in the web with females (Levi 1985). Three species, *Micrathena gracilis* (Walckenaer 1805), *Micrathena mitrata* (Hentz 1850), and *Micrathena sagittata* (Walckenaer 1841) occur in the eastern United States, and all three are found in Illinois (Levi 1985; Sierwald et al. 2005).

Micrathena gracilis and *M. mitrata* co-occur in the deciduous forests of Alice L. Kibbe Life Science Station in west-central Illinois, USA. These two species share the same habitats and occur together during similar times of the year, with webs abundant in late summer and early fall (Howell & Jenkins 2004). Both species build their webs in the forest understory. Some *M. gracilis* individuals relocate frequently, but others may occupy the same web site for days or even weeks (Hodge 1987b). The orb portion of the web of *M. gracilis* is removed in the evening and rebuilt at dawn, but the frame of the web may persist for several days (Hodge 1987a). *Micrathena gracilis* is the larger of the two species, with females ranging from 7.0 to 10.8 mm and males 4.2 to 5.1 mm in length. *Micrathena mitrata* females range from 4.7 to 6.0 mm and males from 3.0 to 3.7 mm in length (Levi 1978).

Polyphagous predators can be ecologically important in influencing prey populations, as evidenced by successful biological control programs involving generalist predators (Murdoch et al. 1985; Riechert & Lawrence 1997). Several studies have investigated *M. gracilis* natural history and behavior, including prey selection, attraction, and web orientation (Uetz & Biere 1980; Biere & Uetz 1981; Uetz & Hartsock 1987; Vanderhoff et al. 2008), mating behavior (Bukowski & Christenson 1997a, b, 2000), and web site residence time and macrohabitat selection (Hodge 1987a, b). However, there is relatively little information on *M. mitrata* specifically and on the two species when co-occurring. In this study, we compared abundance and web characteristics (web spiral area and web elevation) of *M. gracilis* and *M. mitrata*.

METHODS

We did this study at Alice L. Kibbe Life Science Station in Hancock County, Illinois, USA. We established four study plots (40°21′59.01″N, 91°24′30.53″W; 40°22′00.75″N, 91°24′23.18″W; 40°22′10.37″N, 91°24′35.46″W; 40°22′10.85″N, 91°24′31.02″W) in a mature dry-mesic upland oak-hickory forest. Each plot consisted of two transects. Each transect was 80 m^2 (4 m wide and 20 m long), and transects within plots were 15 m apart. Plots were ca.100 to 150 m apart, and were a minimum of 50 m from the forest edge.

We surveyed for *Micrathena* between 09:00 and 15:00 on 11 dates (29 May, 10 June, 13 July, 22 July, 29 July, 11 August, 23 August, 13 September, 20 September, 11 October and 20 October) by walking the transects and scanning vegetation for the presence of *Micrathena* females. We misted the webs with a water bottle to make them more visible (Tolbert 1977). For each *Micrathena* web found, we recorded height and width of the web spiral and used these measurements to calculate web spiral area. We also measured web elevation (distance to the bottom of the web spiral from the ground). In two plots (the "sampled" plots) we collected the *Micrathena*, and in the other plots (the "observation" plots) we identified the species of *Micrathena* but did not collect them. This was done to examine potential effects of removal on *Micrathena* web characteristics.

Mean web spiral area and elevation, with 95% confidence intervals, were calculated for sampled and observation plots, and for the pooled data, for each *Micrathena* species. Because no spiders from the sampled plots had been removed prior to 13 July, calculations were also done excluding the data from this date. We tested for a potential association between relative abundance of the two species and survey method using the chi-square test with the 13 July data excluded.

Voucher specimens are deposited in the Western Illinois University Department of Biological Sciences Entomology Collection.

Table 1.—*Micrathena gracilis* and *Micrathena mitrata* mean web spiral area (cm^2) and elevation (cm), with 95% confidence intervals in parentheses, in sampled (spiders were collected) and observation (spiders were recorded but not collected) plots, and pooled across survey method, in Hancock County, Illinois, oak-hickory forest. For *M. gracilis*, $n = 70$ ($n = 30$ and $n = 40$ in sampled and observation plots, respectively). For *M. mitrata*, $n = 83$ ($n = 41$ and $n = 42$ in sampled and observation plots, respectively).

Web characteristic	Survey method	*Micrathena gracilis*	*Micrathena mitrata*
Spiral area	Sampled	438.2 (345.6, 530.8)	239.7 (198.0, 281.3)
	Observation	405.1 (350.1, 460.1)	170.9 (149.9, 191.9)
	Pooled	419.3 (370.0, 468.7)	204.9 (181.0, 228.7)
Elevation	Sampled	147.6 (135.2, 159.9)	100.7 (88.5, 112.9)
	Observation	155.3 (149.8, 160.8)	105.9 (97.6, 114.2)
	Pooled	152.0 (145.9, 158.0)	103.3 (96.1, 110.5)

RESULTS

Our study produced 153 collected individuals or observations of adult female *Micrathena* sp. (70 *M. gracilis* and 83 *M. mitrata*). We found the first adult females of both species on 13 July. Greatest abundance of *M. gracilis* (21 individuals) occurred on 29 July whereas greatest abundance of *M. mitrata* (also 21 individuals) occurred on 22 July, giving a maximum density of 0.03 females per m^2 for each species. We found female *M. gracilis* as late as 20 September and *M. mitrata* until 11 October.

Thirty (42.9%) of the *M. gracilis* females and 41 (49.4%) of the *M. mitrata* females were found in the sampled plots. Excluding the 13 July data, 26 of 60 (43.3%) *M. gracilis* and 37 of 72 (51.4%) *M. mitrata* were found in sampled plots. There was no statistically significant difference in relative abundance of the two species in relation to the survey method ($X^2_1 = 0.85$, $P = 0.36$).

Mean web spiral area was greater for *M. gracilis* than for *M. mitrata*, based on lack of overlap in confidence intervals (Table 1). Neither *M. gracilis* mean web spiral area nor mean web elevation differed between sampled and observation plots. *Micrathena mitrata* webs had greater mean web spiral area in sampled than in observation plots (Table 1). Exclusion of 13 July data changed these means and confidence intervals slightly but did not affect overall results.

DISCUSSION

Micrathena gracilis and *M. mitrata* were present in roughly equal numbers based on our survey results, and seasonal patterns of the two species overlapped substantially. Some *Micrathena* individuals may occupy the same web site for extended periods, though this behavior has only been studied in *M. gracilis*, for which a mean residence time of 6.7 d was found (Hodge 1987b). It is therefore possible that we surveyed some individuals more than once in the observation plots, although the length of time between survey dates (minimum = 7 d, mean = 15.4 d) probably minimized this.

We found little overlap in either web spiral area or web elevation between the two species, which could contribute to resource partitioning. Differences in web spiral area and elevation may also reflect differences in microhabitat preferences. Hodge (1987a) suggested that vegetation structure, which determines the spatial structure of attachment sites, is important in habitat selection by *M. gracilis*. The lower elevation of *M. mitrata* webs in our study could be related to availability of suitable attachment sites for their smaller webs. Intense solar radiation has been shown to affect web orientation or body position in *M. gracilis* (Biere & Uetz 1981) and *Micrathena schreibersi* (Perty 1833) (Robinson & Robinson 1974). The lower elevation of *M. mitrata* webs in our study could be associated with avoidance of direct sunlight as well. Competition may also be a factor in determining habitat use patterns. Uetz et al. (1978), in a study of central and southern Illinois *Micrathena*, showed that presence of other species, especially congenerics, can result in changes in *M. gracilis* web placement. However, unlike our study, Uetz et al. (1978) found that *M. gracilis* web elevation overlapped that of *M. mitrata* substantially, and *M. mitrata* upper elevation limits were greater than those of *M. gracilis*. Webs of *M. sagittata* tended to occur at lower elevations in that study. This suggests that relative elevation of webs of these species may vary with habitat, geographic location, or presence of another congeneric.

Webs of *M. mitrata* were substantially larger in the sampled than in the observation plots in our study (Table 1). This could indicate that *M. mitrata* web size is constrained by the presence of *M. gracilis*, but that *M. mitrata* invades available habitat more quickly than *M. gracilis* and occupies more favorable web location sites in the absence of its congeneric. Our results could also suggest greater web size plasticity in *M. mitrata* than in *M. gracilis*.

These results indicate that *M. gracilis* and *M. mitrata* are abundant orb weavers in west-central Illinois upland forests and differ substantially in web elevation and spiral area. The two species may also differ in their response to availability of unoccupied habitat and in their microhabitat requirements.

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