THE EFFECT OF SEASON OF FIRE ON DENSITY OF FEMALE GARDEN ORBWEAVERS (ARANEAE: ARANEIDAE: ARGIOPE) IN FLORIDA SCRUB

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In his landmark book on fire ecology, Whaley (1995, p. 209) states: “the question of whether the absolute abundance of invertebrate populations changes after fire still remains” unresolved. As he details, the reasons for this dilemma are several, but inadequate experimental design and non-quantitative sampling methods are pervasive problems in the literature (Whaley 1995). Most of the “less-than-ideal studies” suggest that many species of arthropods, especially arboreal taxa, decline after fire and recover relatively rapidly (Whaley 1995). In addition, time-of-year of fire relative to the life cycle of an organism may be very important in post-fire recovery of populations.

In light of comments and criticisms of Whaley (1995) and more recently van Mantgem et al. (2001), I decided to conduct a replicated, randomized study of the effect of season of fire on the density of garden orbweavers (Argiope Audouin) in Florida scrub. My hypothesis was that winter burns conducted before Florida scrub. My hypothesis was that winter burns conducted before Florida scrub. My hypothesis was that winter burns conducted before Florida scrub. My hypothesis was that winter burns conducted before Florida scrub. My hypothesis was that winter burns conducted before Florida scrub. My hypothesis was that winter burns conducted before Florida scrub. My hypothesis was that winter burns conducted before Florida scrub. My hypothesis was that winter burns conducted before Florida scrub. My hypothesis was that winter burns conducted before February 2001 and 2007 I chose at random 3 “unburned” units adjacent to recently burned ones; all the controls had been burned 3-7 years previously, so they had regenerated their shrubby matrix. I randomly located five 20 × 25- m (= 0.05 ha) plots in each of the 15 experimental burn units. In Oct 2001 or 2007 I visited the recently burned and control plots shortly after dawn on foggy mornings when dew-laden spider webs were easily seen and traversed each plot at 2-3 m intervals to census webs occupied by Argiope females. I inspected every orb-web to identify the resident spider and recorded the number of webs for each species in each plot (n = 75 plots in total). This method for censusing web-building spiders was validated previously by Enders (1973), Tolbert (1977), and Carrel (2001).

Throughout this study I found only 2 of the 3 species of Argiope known to occur in scrub at Archbold (Levi 1968). Argiope florida Chamberlin & Ivie, the Florida garden spider, and A. aurantia Lucas, the yellow garden spider, were widespread, but A. trifasciata (Forskål), the banded garden spider, was not detected in any plot. Argiope florida appears to prefer xeric sites and A. aurantia seems to favor mesic sites, but the 2 species frequently occur in syntopy, within 1-3 meters of one another in the scrub (pers. observ.). Perhaps their habitat preferences overlap extensively, yet there are so few studies on A. florida (Justice et al. 2005) that one cannot refer to published data to make any credible inferences. When I have searched extensively in scrub at Archbold in Oct over the course of 7 years (2001-2007) I have found some female A. trifasciata on orb-webs near seasonal ponds that are embedded in the scrub matrix, but they have never been common.

In 2001, I detected 73 female A. florida and 19 female A. aurantia Lucas in fifteen 0.05-ha control plots, equal to a species ratio of 79%:21% and mean overall density of female Argiope spp. of 122.7 ± 10.0 spiders/ ha. In 2007, I found the density of female Argiope spp. in control plots was virtually the same as before (124.0 ± 21.6/ ha), but the numerical ratio of the 2 species was reversed: a total of 20 A. florida and 73 A. aurantia (22%:78%) were present. The observed year-to-year difference in relative abundance of the 2 species was highly significant (\(\chi^2 = 61.9, df = 1, P <\))
have significantly fewer female spiderlings had ceased, effectively eliminated Argiope spp. (Figs. 1). Hence, summer burns occurring after ballooning of these orbweaving spiders (Fig. 1). Presumably Feb burns destroyed Argiope egg sacs present in the affected burn units, but subsequently in spring and early summer aerial dispersal of spiderlings from nearby unburned scrub replaced lost spiders, so Argiope populations in fall were normal.

In contrast, plots in both summer burns were significantly depauperated; they contained few if any webs of these orbweaving spiders (Fig. 1). However, summer burns occurring after ballooning by spiderlings had ceased, effectively eliminated Argiope species in oak scrub at Archbold. The lack of repopulation of summer-burned plots is not surprising in light of the limited propensity of immature and adult Argiope to move more than several meters over the course of 2–3 weeks from one web site to a new one (Enders 1973, 1976, 1977; Tolbert 1977). Web site tenacity is high in all post-spiderling stages of Argiope, regardless of site quality, unless strong winds destroy the orb-webs (Enders 1975, 1977).

The density of female Argiope in the unburned scrub in 2001 and 2007 (~125 spiders/ha), while it seemed typical for Archbold in late summer and early fall (pers. observ.), actually was much lower by 1-2 orders of magnitude than others have documented in northern states (latitude 35-39_N). Horton & Wise (1983) found 1,400-1,700 female A. aurantia and A. trifasciata/ha in an old field in eastern Maryland; McNett & Rypstra (2000) detected nearly 8,000 A. trifasciata/ha in an old field in southern Ohio; and Enders (1973) counted approximately 16,000 female A. aurantia/ha on sericea lespedeza (Lespedeza cuneata) in road cuts in eastern North Carolina. Such high densities are achieved in large part because spiders in the genus are very tolerant of one another: extensive field studies provide little if any evidence for interspecific competition, intraspecific competition, or cannibalism (Enders 1975, 1977; Tolbert 1977; Horton & Wise 1983). Perhaps the xeric conditions and low abundance of insect prey that prevail in Florida scrub prevent Argiope from achieving high densities. Evidence for this comes from decades of observations by scientists and visitors at Archbold in late summer and fall that consistently note large, dense aggregations of Argiope aurantia and other orbweavers in wooded sites along the shores of lakes in central Florida where the microclimate is humid and where midges and other insects are plentiful.

In this study I demonstrated that the season of burning a native habitat (Florida scrub) negatively affected the short-term abundance of large araneid spiders (2 Argiope spp.). Although I did not measure reproductive output by the spiders, clearly areas burned in summer that harbored few

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**TABLE 1. RESULTS OF UNIVARIATE ANOVA FOR DENSITY OF ARGIOPE SPP. (# WEBS/0.05 HA) AS A FUNCTION OF TREATMENT (n = 5), REPLICATE BURN UNIT/TREATMENT (n = 3), AND SAMPLE PLOT WITHIN EACH BURN UNIT (n = 5). SPIDER DENSITY WAS TRANSFORMED BEFOREHAND TO NORMALIZE THE ERROR VARIANCES OF THE RESIDUALS (SEE TEXT FOR DETAILS).**

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
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<th>P</th>
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<td>0.595</td>
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<tr>
<td>Error</td>
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<td>0.264</td>
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![Graph showing spider density by fire treatment](image-url)
if any female *Argiope* in the subsequent fall would be expected at best to yield relatively small numbers of spiderlings in the following spring. The diminution of *Argiope* in summer-burned units likely was temporary because spiderlings from nearby unburned habitats in the following year probably colonized and repopulated all of them, much as they did all other burn units at Archbold regardless of their fire history. A similar recovery within a year after burning oak scrub at Archbold was reported for the red widow spider, *Latrodectus bishopi* Kaston (Carrel 2001). But a word of caution is in order. The results of population genetic analyses, published by Ramirez & Haakonsen (1999), indicate that as suitable habitats for *Argiope* spp. and other spiders become increasingly fragmented, more isolated, and less extensive, then long-distance dispersal of spiderlings by ballooning may become ineffective at maintaining genetic cohesion across species’ ranges.

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**SUMMARY**

The density of female garden orbweavers (*Argiope* spp.) as a function of season of fire in Florida oak scrub was determined in Oct in replicated, randomly chosen 0.05-ha plots. Winter burns earlier in the year did not significantly lower spider densities relative to unburned controls, but summer burns largely extirpated local spider populations. Supplementary information on line at http://www.fcla.edu/FlaEnt/fe912.htm

**REFERENCES CITED**


