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 university of garden orbweavers (Carrel et al. 2001). I 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 floridensis 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 floridensis appears to prefer xeric sites and A. aurantia seems to favor mesic sites, but the 2 species frequently occur in sympathy, 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. floridensis (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. floridensis and 19 female A. aurantia Lucas in fifteen 0.05-ha control plots, equal to a species ratio of 79.0:21.0 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. floridensis and 73 A. aurantia (22.0:78.0) were present. The observed year-to-year difference in relative abundance of the 2 species was highly significant (\(\chi^2 = 61.9, df = 1, P < 0.0001\)).
have significantly fewer female webs of these orbweaving spiders (Fig. 1). Hence, summer burns occurring after ballooning 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).

| Source of variation | df | MS    | F   | P    |
|---------------------|----|-------|-----|------|
| Treatment           | 4  | 8.058 | 29.519 | <0.0001 |
| Burn unit           | 2  | 0.143 | 0.523 | 0.595 |
| Plot                | 4  | 0.173 | 0.635 | 0.639 |
| Error               | 64 | 0.264 |       |      |

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Fig. 1. Mean density of female Argiope spiders (+ SE, n = 15) in Florida scrub as a function of fire treatment. Treatments having the same letter are not significantly different (P > 0.05) from one another.
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**

ABRAHAMSON, W. G., A. F. JOHNSON, J. N. LAYNE, AND P. A. PERONI. 1984. Vegetation of the Archbold Biological Station, Florida: an example of the southern Lake Wales Ridge. Florida Scient. 47: 209-250.

ANDERSON, J. F. 1978. Energy content of spider eggs. Oecologia 37: 41-57.

CARREL, J. E. 2001. Population dynamics of the red widow spider (Araneae: Theridiidae). Florida Entomol. 84: 385-390.

ENDERS, F. 1973. Selection of habitat by the spider *Argiope aurantia* Lucas (Araneidae). Am. Midl. Nat. 90: 47-55.

ENDERS, F. 1975. Change of web site in *Agriope* spiders (Araneidae). Am. Midl. Nat. 94: 484-490.

ENDERS, F. 1976. Effects of prey capture, web destruction and habitat physiognomy on web-site tenacity of *Argiope* spiders (Araneidae). J. Arachnol. 3: 75-82.

ENDERS, F. 1977. Web-site selection by orb-web spiders, particularly *Argiope aurantia*. Anim. Behav. 25: 694-712.

HORTON, C. C., AND D. H. WISE. 1983. The experimental analysis of competition between two syntopic species of orb-web spiders (Araneae: Araneidae). Ecology 64: 929-944.

JUSTICE, M. J., T. C. JUSTICE, AND R. L. VESCI. 2005. Web orientation, stabilimentum structure and predatory behavior of *Argiope florida* Chamberlin & Ivie 1944 (Araneae, Araneidae, Arigopinae). J. Arachnol. 33: 82-92.

LEVI, H. W. 1968. The spider genera *Gea* and *Argiope* in America. Bull. Mus. Comp. Zool. 136: 319-352.

MAIN, K. N., AND E. S. MENGES. 1997. Archbold Biological Station Fire Management Plan. Land Management Publication 97-1. 104 pp.

MCNETT, B. J., AND A. L. RYPSTRA. 2000. Habitat selection in a large orb-weaving spider: vegetational complexity determines site selection and distribution. Ecol. Entomol. 25: 423-432.

RAMIREZ, M. G., AND K. E. HAAKONSEN. 1999. Gene flow among habitat patches on a fragmented landscape in the spider *Argiope trifasciata* (Araneae: Araneidae). Heredity 83: 580-585.

SPSS 2005. SPSS for Macintosh, Release 11.0. SPSS Inc., Chicago, IL.

TOLBERT, W. W. 1977. Aerial dispersal behavior of two orb weaving spiders. Psyche 84: 13-27.

VAN MANTGEM, P., M. SCHWARTZ, AND M.-B. KEIFER. 2001. Monitoring fire effects for managed burns and wildlife: coming to terms with pseudoreplication. Nat. Area. J. 21: 266-273.

WALEY, R. J. 1995. The Ecology of Fire. Cambridge University Press, Cambridge, UK.