Scientific Note

HERBIVORY OF THE FEDERALLY ENDANGERED *Schwalbea americana*—The federally endangered hemiparasite, *Schwalbea americana* L. (Scrophulariaceae), is a fire-dependent species primarily associated with the southeastern Coastal Plain (United States Fish and Wildlife Service 1992, 1995). Historically, *S. americana* ranged from New York to Texas (Pennell 1935), but due to fire suppression and habitat fragmentation, it has been reduced to a fraction of its original range (United States Fish and Wildlife Service 1992, 1995). Knowledge of the species biology of *S. americana* is limited. While conducting a study to isolate potential factors controlling the fire-induced flowering response of *S. americana* (Norden 2002, Norden and Kirkman in press), we observed severe insect herbivory in one particular treatment across three of our study sites.

Various degrees of destruction of both vegetative and reproductive portions of *S. americana* individuals due to herbivory by buckeye butterfly larvae (*Junonia coenia*, Lepidoptera, Nymphalidae) occurred following the application of our experimental treatments (listed in Table 1). For a detailed description of treatment application, see Norden (2002) and Norden and Kirkman (in press). To quantify the degree of herbivory across our treatments, we assigned each individual within treatment plots to one of two herbivory classes: 0 = none to minor herbivory (holes in leaves/flowers or minor stem defoliation) and 1= major to complete herbivory (complete stem defoliation or <1 cm of stem remaining). A Friedman's distribution-free test for a randomized complete block design was used to analyze differences in proportion of individuals in the major to complete herbivory class due to treatments (PROC RANK, PROC GLM; SAS Institute Inc. 1989).

Major to complete herbivory (i.e., all leaves gone or stem completely destroyed) was nearly restricted to re-sprouting individuals in the competing vegetation exclusion + stem clipping treatment, in which neighboring vegetation was anchored down with landscape staples and *S. americana* stems were clipped at the soil surface (Table 1, $F = 22.00$, $p < 0.01$). None of the individuals in either the fire or control treatments experienced major to complete herbivory, and only minor damage (i.e., holes in leaves or flowers) was observed on some individuals.

We have not observed previous caterpillar herbivory of *S. americana* to the extent that occurred in this study. Many lepidopteran species (particularly specialists, such as the buckeye butterfly, which concentrates on species in the family Scrophulariaceae) oviposit directly on the desired host plant due to limited mobility of the larvae (Feeney et al. 1983). It is possible that the absence of herbivory to individuals in the fire treatment may be explained simply by the fact that we burned after the butterflies had oviposited (i.e., eggs were destroyed in the fire). However, because this species of butterfly has a continual life cycle and oviposits throughout the year (J. Neel, pers. comm.), opportunities for ovipositing on resprouting *S. americana* individuals following fire would have occurred.

Contrary to our findings, previous studies have shown increased herbivory following fire (Dolva and Scott 1982, Negron-Ortiz and Gorchov 2000). Elevated levels of nitrogen, a limiting nutrient for survival and growth of many herbivorous insects, have been reported in resprouting leaves following fire (Grove et al. 1980, Negron-Ortiz and Gorchov 2000). These former studies support the plant vigor hypothesis (Price 1991) that herbivores preferentially feed on the most vigorous plants. However, we found that herbivory was lower as a result of burning, and that there was no significant difference in the amount of herbivory between the most vigorous (burned) and least vigorous (control) plants.

A likely explanation for our findings involves the host-search behavior of female butterflies, which use a combination of visual and chemical recognition cues in searching for a suitable host plant on which to oviposit (Rausher 1978, Feeney et al. 1983, Parmesan et al. 1995). Therefore, if appropriate host plants are physically and chemically difficult to detect because of dense vegetation, they may not be utilized (Stanton 1982). It is probable that the buckeye butterfly females in our study area were not able to detect *S. americana* individuals in the fire and mow + rake treatments due to thick re-growth of *Aristida beyrichiana* Trin. and

Table 1. Percent of *Schwalbea americana* individuals per plot (mean ± SE) in herbivory class 1 (major to complete herbivory). Statistical significance is indicated with an asterisk ('*') ($p < 0.01$)

Treatment	% Individuals
Control (no treatment)	0.00
Fire	0.00
Competing vegetation exclusion + stem clipping	45.54 ± 3.31*
Mowing + raking	4.08 ± 2.23

Rupr. (wiregrass) and other ground cover species. This host-search behavior also explains the lack of herbivory in our control (unburned) areas, in which herbaceous ground cover was extremely dense and *S. americana* plants were often obscured. In the competing vegetation exclusion + stem clipping treatment, re-sprouting *S. americana* individuals were visually exposed and thus, were particularly vulnerable to detection by searching butterflies. It is possible that additional experimental treatments/management techniques that potentially alter the structure of neighboring vegetation may have similar, unintentional effects on insect herbivory of *S. americana*.

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