

Observations of *Speyeria diana* (Diana Fritillary) Utilizing Forested Areas in North Carolina that have been Mechanically Thinned and Burned

Josh W. Campbell^{1,*}, James L. Hanula¹, and Thomas A. Waldrop²

Abstract - *Speyeria diana* (Diana fritillary) is a forest dwelling butterfly that has been eradicated from portions of its native habitat in North Carolina. This loss has been attributed to habitat destruction and pesticide use, resulting in its status as a species of special concern. During the spring and summer of 2003 and 2004, we conducted butterfly surveys on forested 10-ha plots in the southern Appalachians of North Carolina in which various forest management practices had been applied. During one survey (June 2004), we observed male Diana fritillary butterflies feeding on flowering *Oxydendrum arboreum* (sourwood) within plots that had been mechanically thinned and burned. These plots also had the greatest herbaceous plant cover. Our observations suggest that some forest management related disturbances, resulting in increased herbaceous plant cover, may help in conserving this species.

Introduction

Speyeria diana Cramer (Diana fritillary) is considered very rare in much of its known range. Preferring deciduous and pine woodlands near streams, its core habitat is the southern Appalachians from West Virginia to north Georgia and Alabama, and the Ozark and Ouachita Mountains in Arkansas and Oklahoma. Formerly found in southeastern Virginia (Scott 1986), the Ohio River valley, and northeastern North Carolina (Glassberg 1999, Opler and Malikul 1992), it is now considered extinct or a stray within these areas. Cutting and conversion of old-growth hardwood forests to agricultural land, is considered one of the main reasons for their decline (Hammond and McCorkle 1983). However, Hammond and McCorkle (1983) point out that populations in the Appalachians “appear quite healthy and may actually be expanding with the regrowth of hardwood forests.” To further this recovery, it is important to understand one aspect of past forest management had been the removal of fire from the ecosystems. Here we present an observation that forest management practices that include fire with other disturbances may enhance food resources for the Diana fritillary.

Methods

Our study was part of the National Fire and Fire Surrogate Study designed to examine the impacts of fuel reduction treatments on multiple

¹USDA Forest Service, Southern Research Station, 320 Green Street, Athens, GA, 30602-2044. ²USDA Forest Service, Southern Research Station, 233 Lehotsky Hall, Clemson University, Clemson, SC 29634. ³Current address - School of Sciences and Mathematics, Shorter College, 315 Shorter Avenue, Rome, GA 30165. *Corresponding author - jcampbell@shorter.edu

components of forested ecosystems across the United States (Youngblood et al. 2005). We sampled pollinating insects on three study blocks on the Green River Game Management Area in the Blue Ridge Mountain Province near Hendersonville, NC (Polk and Henderson counties). Twelve study sites were selected on the basis of size, stand age, cover type, and management history. Each site comprised a minimum of 14 ha to allow for a 10-ha measurement area and a buffer of at least one tree length (approximately 20 m) around the measurement area. Treatments applied to 10-ha plots consisted of: (1) untreated control, (2) dormant-season burn, (3) mechanical, and (4) mechanical plus dormant-season burn. The mechanical treatments consisted of chainsaw felling and bucking of the shrub understory, composed primarily of *Rhododendron maximum* L. (rhododendron), *Kalmia latifolia* L. (mountain laurel), and small diameter trees (< 7.5 cm). Cut material was left in place for both the mechanical and mechanical-plus-burn plots. Shrubs were cut during winter, 2001–2002, and plots that were burned were treated on March 12 or 13, 2002.

Approximately once a month during the spring and summer, colored pan traps and malaise traps were used to assess diversity and abundance of floral visiting insects (Campbell 2005). Flowering plant and butterfly surveys were also conducted each time the traps were operated. The survey consisted of slowly walking a 200-m transect and identifying and counting each butterfly seen. Butterfly counts during transect walks have been used effectively to evaluate abundance and diversity (New et al. 1995, Pollard and Yates 1993). We also identified plants that were flowering during survey walks. Surveys were done between 10 AM and 3 PM on days with average temperatures and weather (i.e., rainfall, wind, etc.) typical for the corresponding time of year. Butterfly surveys allowed us to note species that were not being captured in the pan or malaise traps and to better estimate species richness for this group.

Herbaceous plant cover was estimated on 200 one-m² subplots within each 10-ha treatment plot and was categorized within a series of ranges: < 1%, 1–10%, 11–25%, 26–50%, 51–75%, and > 75%. We used the midpoint of each range to calculate plant cover per m² for the treatment plots. Herbaceous plant cover was analyzed using PROC GLM (SAS 1985) to conduct two-way ANOVAs with treatments and blocks as dependent variables, and the % herbaceous plant cover as the independent variable. The Ryan-Einot-Gabriel-Welsch (REGWQ; SAS 1985) multiple-range test was used to determine differences in percent herbaceous plant cover between treatments.

Results and Discussion

During the June 17, 2004 survey, four male *Diana* fritillaries were observed visiting *Oxydendrum arboretum* (L.) DC. (flowering sourwood) on the three mechanical plus burn plots. Although not part of the survey, several male *S. diana* were again observed visiting sourwood within the mechanical-plus-burn treated sites when picking up traps on June 23, 2004. *Speyeria diana* is considered to be a federal species of concern in North Carolina by the Fish

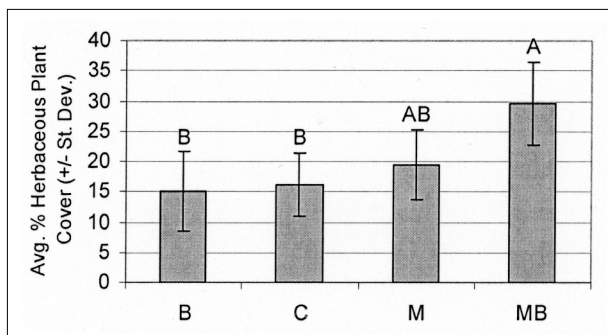
and Wildlife Service, Asheville, NC, and is also on the North Carolina Animal Watch List compiled by the North Carolina Natural Heritage Program (Legrand et al. 2004). Although it has a widespread distribution in the southeastern United States, its populations are scattered and have been shown to fluctuate greatly between years (Vaughan and Shepherd 2005). It has been eradicated in portions of eastern North Carolina due to habitat alteration and pesticide use (Vaughan and Shepherd 2005).

Mechanical-plus-burn treatments caused the greatest changes in basal area of trees because increased fuel loads on the plots resulted in hotter fires and more tree mortality (Campbell 2005). Tree mortality and the mechanical removal of dense shrubs (mostly *Rhododendron* sp. and *Kalmia* sp.) allowed more sunlight to reach the forest floor. Likewise, removal of competing shrubs and some trees probably increased nutrient availability to herbaceous plants. We observed greater herbaceous plant cover (Fig. 1), and Hutchinson and Phillips (2006) reported greater species richness of understory plants, on the mechanical plus burn plots, which should have increased the amount and diversity of nectar resources available to the Diana fritillaries. *Speyeria diana* depends on abundant nectar resources to maintain populations, and prescribed fire increases nectar resources (Rudolph et al., 2006). Our observations are consistent with Thill et al. (2004), who reported that thinning and burning on plots in Arkansas resulted in higher abundances of the Diana fritillary due to increased abundance of nectar resources. Thus, Hammond and McCorkle's (1983) observation that *Speyeria* spp. are indicators of native, undisturbed ecological communities may not be complete. Our observations and those of Thill et al. (2004) suggest that some disturbances that reduce tree and shrub density, including prescribed burning, favor this species.

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Figure 1. Average % of herbaceous plant cover ($\pm$ st. dev.) found among the various forest management treated sites on the Green River Game Management Area near Hendersonville, NC. B = burn only, C = control, M = mechanical, MB = mechanical



plus burn. Columns with the same letter are not significantly different at $p \leq 0.05$ (Ryan-Einot-Gabriel-Welsch multiple-range test [REGWQ]; SAS 1985).

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