

MONARCH (*DANAUS PLEXIPPUS* L. NYMPHALIDAE) MIGRATION, NECTAR RESOURCES AND  
FIRE REGIMES IN THE OUACHITA MOUNTAINS OF ARKANSASD. CRAIG RUDOLPH, CHARLES A. ELY, RICHARD R. SCHAEFER, J. HOWARD WILLIAMSON, AND RONALD E. THILL  
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**ABSTRACT.** Monarchs (*Danaus plexippus*) pass through the Ouachita Mountains in large numbers in September and October on their annual migration to overwintering sites in the Transvolcanic Belt of central Mexico. Monarchs are dependent on nectar resources to fuel their migratory movements. In the Ouachita Mountains of west-central Arkansas migrating monarchs obtain nectar from a variety of plant species, especially *Bidens aristosa* and other composites. Fire suppression has greatly altered the structure of forest communities with major implications for ecological relationships. Sites that are undergoing restoration to a shortleaf pine-bluestem grass community following thinning and frequent prescribed fire, and thought to closely resemble pre-European conditions, support increased abundances of nectar resources and migrating monarchs compared to untreated controls. These results suggest that widespread fire-suppression since the early 1900s has substantially reduced nectar production for migrating monarchs in the Ouachita Mountains Physiographic Region.

**Additional key words:** Interior Highlands, surveys, restoration

The eastern North American population of the monarch butterfly, *Danaus plexippus* L., undertakes one of the most remarkable migrations of any lepidopteran (Urquhart 1976, Brower & Malcolm 1991). During the fall most individuals of this population migrate to extremely restricted sites in the Transvolcanic Belt of central Mexico (Urquhart 1976, Calvert & Brower 1986). Concern has been expressed about the continued health of this population and the persistence of the massive migration phenomenon (Wells *et al.* 1983, Brower & Malcolm 1991). Changes in abundance and quality of larval hosts (Zalucki & Brower 1992), loss of critical overwintering sites due to logging and fire (Brower 1996, Brower *et al.* 2002), vehicle mortality (McKenna *et al.* 2001), pesticides (Oberhauser 2004), introduced species (Calvert 2004), and transgenic Bt modified crops (Losey *et al.* 1999, Jesse and Obrycki 2004) have been identified as actual or potential threats. Less attention has been directed to landscape-level changes in nectar availability which ultimately fuels the extended fall migration to central Mexico (Garcia & Equihau-Zamora 1997, Brower & Pyle 2004).

Land use changes and management protocols in more natural habitats have drastically altered essentially all the land base that constitutes the breeding range and migration corridors of *D. plexippus* in eastern North America. The Ouachita Mountains Physiographic Region of west-central Arkansas and southeastern Oklahoma, encompassing 3,237,600 ha, remains primarily forested (Bukenhofer and Hedrick 1997). However, logging, fire suppression, and silvicultural management have altered vegetation structure and composition throughout the region (Foti and Glenn 1991, Masters *et al.* 1995). Fire-maintained shortleaf pine (*Pinus echinata*) forests were widespread in the

Ouachita Mountains until the early 20th century (Foti & Glenn 1991). Since the original harvest of these pine forests, most forested sites have been altered using intensive short-rotation pine production or remain as more natural forests, but have been subjected to fire suppression for several decades (Bukenhofer and Hedrick 1997). In either case, the abundance and quality of nectar resources available to Lepidoptera has been drastically altered (Thill *et al.* 2004).

The managers of the Ouachita National Forest have initiated a landscape scale restoration of the fire-maintained shortleaf pine-bluestem (*Schizachrium* spp., *Andropogon* spp.) ecosystem on 48,706 ha (U. S. Forest Service 1996). Restoration involves thinning the overstory, reduction of midstory vegetation, and prescribed burning on a three-year return interval. This restoration was undertaken to restore habitat for the endangered red-cockaded woodpecker (*Picoides borealis*) and to restore what is thought to be the pre-European structure and composition of the vegetation (Foti and Glenn 1991, Bukenhofer and Hedrick 1997). A number of authors have examined the effect of these restoration efforts on a diversity of taxa (see Thill *et al.* 2004).

As part of ongoing studies of the effects of restoration of fire-maintained shortleaf pine-bluestem habitat on lepidopteran communities, butterfly and nectar resource surveys were conducted in restored and untreated control plots. This paper reports results for *D. plexippus* in relation to the fire regime and suggests implications for fall migration and over-winter survival.

## MATERIALS AND METHODS

This study was conducted on the Poteau Ranger District (34°45'N, 34°15'W) of the Ouachita National