Marlene Hahn is currently a graduate student at Loyola University Chicago, pursuing an M.S. in Education — Curriculum and Instruction. She participated in the Pre-Service Teacher Internship Program at Fermilab, researching the comparison of the common wood-nymph population in differently treated habitats, resulting in the following paper. Ms. Hahn grew up in Wheaton, Illinois. She received an undergraduate degree on microbiology, from the University of Illinois (Champaign-Urbana).

Rod Walton is the coordinator for the DOE National Environmental Research Park (NERP) at Fermi National Accelerator Laboratory in Batavia, Illinois. While there he has worked on a wide variety of research projects, including plant-insect interactions, applications of game theory in animal behavior, and restoration ecology. He received his Ph.D. in Ecology and Evolutionary Biology in 1986 from Indiana University.

COMPARISON OF THE POPULATIONS OF COMMON WOOD-NYMPH BUTTERFLIES IN BURNED PRAIRIE, UNBURNED PRAIRIE AND OLD FIELD GRASSES

Marlene Hahn and Rod Walton

ABSTRACT

Common wood-nymph butterflies are found throughout the United States and Canada. However, not much is known about how they overwinter or their preferences for particular grasses and habitats. In this study, the impact of prairie management plans on the abundance of the wood-nymph population was assessed, as well as the preference of these butterflies for areas with native or non-native grasses. The abundance of common wood-nymph butterflies was determined using Pollard walks; more common wood-nymph butterflies were found in the European grasses than were found in the burned and unburned prairie sites. The majority of the vegetation at each of the three sites was identified and documented. Using a 1 X 3 ANOVA analysis, it was determined there were significantly more butterflies in the European grasses than in the burned and unburned prairie sites ($p < 0.0005$). There was no significant difference between the burned and unburned treatments of the prairie on the common wood-nymph population. A multiple variable linear regression model described the effect of temperature and wind speed on the number of observed common wood-nymph butterflies per hour ($p = 0.026$). These preliminary results need to be supplemented with future studies. Quadrat analysis of the vegetation from all three sites should be done to search for a correlation between common wood-nymph butterfly abundance per hour and the specific types or quantity of vegetation at each site. The effect of vegetation height and density on the observer's visual field should also be assessed.

INTRODUCTION

In 1975, Fermi National Accelerator Laboratory (Fermilab) started prairie restoration [1]. Since then, this restoration project has continued to grow and now includes various ecosystems. To aid this endeavor, the Ecological Land Management (ELM) Committee meets and makes recommendations for land management and prairie restoration [2]. Understanding how different animals, including insects, utilize the landscape at Fermilab is critical in managing this restoration project. Furthermore, certain insects can be used as indicators to monitor the success of the restoration process.

One of the inhabitants of the Fermilab prairie is a butterfly called the common wood-nymph. Common wood-nymph butterflies (*Cercyonis pegala*) are medium-sized butterflies (2 to 3cm in length), which live in fields, prairies, woodlands, meadows, marshes, thickets, and roadsides [3]. Unlike other types of butterflies, the common wood-nymph is found throughout the United States and Canada. These opportunistic wood-nymphs can live even in ruderal habitats [4]. Physically, common wood-nymph butterflies are brown with eyespots; however, this species of butterfly shows quite a degree of variation in appearance. Over the course of their lifespan, these butterflies lighten in color. Females are generally larger and lighter in color with larger eyespots than their male counterparts [3]. The caterpillars feed on various grasses including *Tridens flavus* (purpletop), *Andropogon gerardii* (big bluestem), *Elymus glaucus* (blue wildrye), *Festuca californica* (California fescue), and *Bromus carinatu* (California brome) [5, 6, 7]. The butterflies overwinter as caterpillars and generate one brood during the summer. The adult common wood-nymph feeds on rotting fruit and flower nectar from such plants as *Echinacea purpurea* (purple coneflower), *Liatris spicata (blazing star), Aster novae-angliae (aster), and Asclepias syriaca* (common milkweed) [8, 9].

At Fermilab, land management and treatment is based upon the vegetation; mowing and burning cycles are used to control invasive, non-native plants. However, it is also important to study the impact of these different treatments on the insects and other animals inhabiting these areas. Since the common wood-nymph is not remnant-dependent and is seen in various environments, this butterfly was used as an indicator of the effects of using burning and mowing as management techniques on the prairie habitat at

Fermilab. In this study, burned prairie, unburned prairie, and old-field habitats were used to study the effects of habitat treatments on the abundance of the common wood-nymph butterfly.

MATERIALS AND METHODS

Relative Abundance of Butterflies

During the summer of 2006, three sites with different land management treatments at Fermilab were observed during this study. Site 1 is in an area called the Interpretive Trail in ELM-25 (Figure 1). This area consists of prairie habitat that is burned every two to three years. This site was last burned in the fall of 2005. Site 2 is southeast of the Main Injector in ELM-4. This site also consists of a prairie habitat that is managed by burning every two to three years. The last burn was in fall 2003, it has been defined as unburned prairie. Site 3 is along the eastern border of Fermilab in ELM-9 [10]. This site of European grasses is mowed every other season, leaving approximately 15 centimeters of growth after the mow. It was last mowed in the summer of 2005.

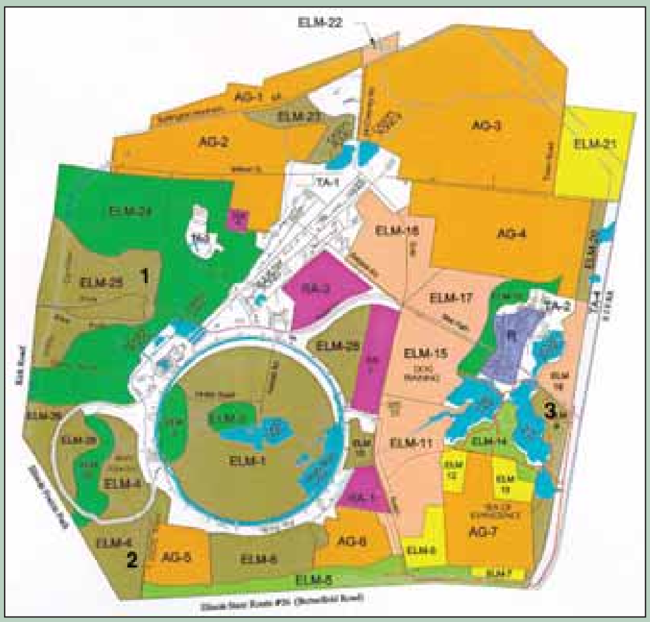

Figure 1. ELM Map of Fermi National Accelerator Laboratory [16]. The burned prairie (site 1) is indicated by a 1; unburned prairie (site 2) is indicated by a 2; and the European grasses (site 3) is indicated by a 3.

The number of butterflies was estimated using a Pollard walk. Each walk took approximately fourteen to fifteen minutes, covering approximately 550, 450, and 400 meters respectively for sites 1, 2 and 3. The Pollard walk consisted of walking five to seven minutes in one direction, a one- to five-minute walk perpendicular to the first walk, followed by a five- to seven-minute walk opposite the first direction, depending on the site [11, 12]. Walks were done between the hours of 10 AM and 3 PM on days with temperatures above 21°C with light to moderate winds [11, 13]. Meterological data was obtained from a station maintained by Fermilab within 2 km of the study sites [13]. Butterflies were counted using a hand counter to document observations of common wood-nymph butterflies within six meters of the Pollard walk [11, 12]. A walk-through of each site was performed to characterize the major plant compositions of each area [14, 15].

Statistical Analysis

A 1 X 3 Analysis of Variance (ANOVA) was used to compare the butterfly abundances at the three different sites. In this study, the independent variable was the treatment of the sites (burned prairie, unburned prairie, and old field); the dependent variable was the number of wood-nymph butterflies per hour found at each site.

Multiple variable linear regression analysis with a backward selection of variables was performed to determine which weather variables (relative humidity, temperature, and wind speed) affected the abundance of butterflies during the study.

RESULTS

Quantitative Analysis of Butterflies

Figure 2 shows the daily abundance of common wood-nymph butterflies per hour found at each site during the study. Over the course of the study, the average number of butterflies observed was 3.7 in the burned prairie, 4.1 in the unburned prairie, and 10.7 in the European grasses. To correct for slight timing differences, the average number of butterflies per hour was calculated. Figure 3 shows the average number of butterflies per hour found at each site during the course of the study. ANOVA results showed that there was a significant difference between the observed butterflies per hour at the three sites ($F_{2, 27} = 15.569$, $p < 0.0005$). Results of the ANOVA were significant at 0.05. A Tukey HSD post-hoc test showed that the European grass habitat supported significantly more butterflies than either of the prairie sites ($p < 0.0005$); however, there was not a statistically significant difference between the prairie sites with different treatments.

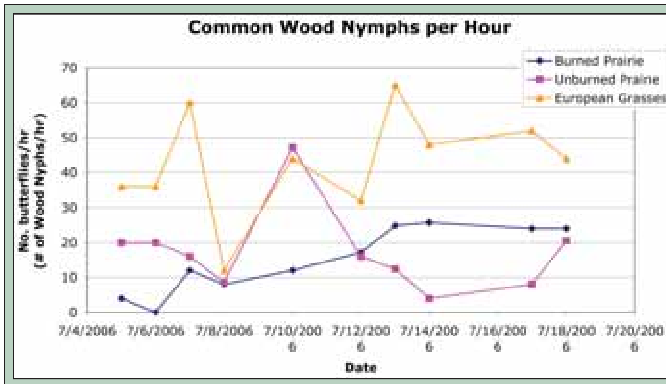

Figure 2. Common wood-nymph abundance per hour.

Multiple linear regression analysis with backward selection of variables showed temperature and wind speed significantly affected the abundance of the common wood-nymph at any given site on

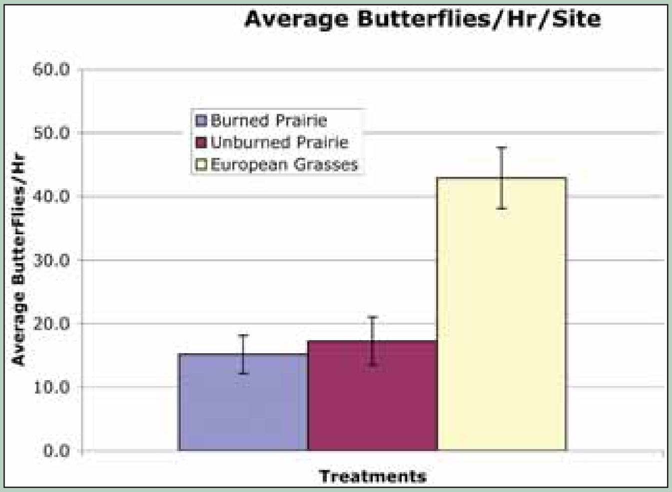

Figure 3. Average number of common wood-nymph per hour at each site during ten day study. Error bars represent the standard error of the means.

a given day ($F_{2, 27} = 4.205$, $p = 0.026$). Wind speed had a negative effect on the number of butterflies observed per hour ($t = -2.240$, $p = 0.033$), while temperature had a positive effect on the number of butterflies observed per hour ($t = 2.339$, $p = 0.027$).

Site 1: Burned Prairie	Site 2: Unburned Prairie	Site 3: European Grasses
big bluestem grass	big bluestem grass	Canadian thistle
black-eyed Susan	compass plant	chicory
compass plant	crown vetch	crown vetch
Culver's root	Culver's root	daisy fleabane
daisy fleabane	curled dock plant	dogwood
foxglove beard tongue	daisy fleabane	field clover
golden Alexander	dogwood	goat's beard
grey-headed coneflowers	foxglove beard tongue	Hungarian brome
Hungarian brome	Indian hemp	jimson weed
Indian hemp	mountain mint	multifloral rose
Indian milkweed	Queen Anne's lace	plantain
indigo	rattlesnake master	quack grass
mountain mint	rosin weed	Queen Anne's lace
obedient plant	sedge carex	ragweed
prairie dock	smart weed	reed canary grass
purple coneflowers	sweet black-eyed Susan	Timothy grass
Queen Anne's lace	tall coreopsis	wild grape vines
reed canary grass	tall goldenrod	yellow sweet clover
rattlesnake master	white sweet clover	
rosin weed	whorled milkweed	
sawtooth sunflowers	wild bergamot	
spiderwort	wild grape	
stiff goldenrod		
switch grass		
tall coreopsis		
tick trefoil		
white sweet clover		
wild bergamot		
wild quinine		
wild raspberry		
yellow sweet clover		

Table 1. Vegetation found at each site [14].

Description of Study Area

Site 1, the burned prairie, had the most diverse vegetation of the three sites (Table 1). The dominant species within this site was big bluestem (*A. gerardii*), although not overwhelmingly so. Site 2, the unburned prairie, had fewer species of vegetation than the burned prairie site. Again, the dominant species was big bluestem (*A. gerardii*); however, the distribution of vegetation within these two sites was very different. Based upon observation during the Pollard walks, the burned prairie's vegetation was more evenly distributed throughout the site, while the unburned prairie had two distinct areas with different distributions of vegetation. The northeastern area of the unburned prairie consisted mainly of forbs, while the rest of this site consisted mainly of grasses. Most of the butterflies seen in the unburned prairie were found within a small area of grasses just south of the forbs area. In contrast to both prairie sites, site 3 consisted of mainly non-native grasses; this European grassland area lacked the variation in vegetation species found in both prairie sites. The dominant vegetation at this site was Hungarian brome (*Bromus inermis*).

DISCUSSION AND CONCLUSIONS

The ANOVA and Tukey HSD post-hoc test results indicate a statistically significant difference in the abundance of common wood-nymph butterflies in the European grasses compared to both prairie sites. The fact that more common wood-nymph butterflies were found in the European grasses than in the two prairie sites was somewhat unexpected, in that common wood-nymphs are a native butterfly and might be expected to prefer native grasses. Nonetheless, this preliminary study on land management treatments of grasslands showed a native butterfly species preferentially living in non-native grasses. There was no significant difference in observed butterfly numbers between the two treatments of the prairie. These data suggest the types of vegetation within the area, or other unknown variables within a site, might be more significant than whether the land is burned, unburned, or mowed. It has been previously documented that various grasses are the host plant for the common wood-nymph larvae. All three sites contained various grasses, but, qualitatively, there were more grasses in the European site than in the prairie sites, which were more diverse in the number of vegetation species. This suggests that the common wood-nymph is a generalist species which does not discriminate between types of grasses.

The multiple regression analysis created a model in which temperature and wind speed affected the number of butterflies observed per hour. This result is not surprising. As it has been noted previously, butterflies should be observed on days with low wind and temperatures above 21°C [11]. Interestingly, the interaction between wind speed and temperature does seem to be more important than either wind speed or temperature alone.

This preliminary study provides guidance for future studies. Future research on land management treatments using the common wood-nymph as an indicator species should include a quadrat analysis of the existing vegetation in order to quantify differences between sites. Informal observations noted several common wood-nymphs on disrupted grasslands or edges of grasslands. This observation suggests future studies in which a path is mowed at each site to use as a comparison to the unmowed path. A caveat of this study is that the Pollard walk data is dependent on seeing the butterflies six meters on either side of a pathway. These data and analysis did not take into account the density of the vegetation and the visual field of the observer to see the butterflies.

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