Influence of habitat and temperature on distribution and species composition of butterflies (Order: Lepidoptera) at UNDERC

BIOS 569: Practicum in Field Biology

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Abstract.

The wide distribution of butterflies in the northern woods is an important element in the dynamics of this ecosystem. Butterflies are recognized by the scientific community as bio-indicators. Evidence suggest that species from the *Lepidoptera* order are sensitive to environmental stresses such as climate change, soil contamination, habitat fragmentation and water pollution. My research was conducted in five open field grassy areas at UNDERC (University of Notre Dame Environmental Research Center) property. Counting six butterfly families during 11 days in 5 open grassy habitats I tested the effect of temperature on the distribution and diversity of butterfly families in open grassy habitats. The results suggest that there is an equal range distribution of Lepidoptera families around all five sites at UNDERC. Moreover the results suggest a relationship between temperature range and body length and wing span, because temperature plays an important role in the phenotypic characteristics of this abundant group of insects.

Introduction

Butterflies are one of the most admired insects because they present brilliant patterns of coloration, metamorphic birth, and striking reproduction, nutritional behavior and death. There are approximately 115 species of butterflies in the northern woods of Minnesota, Michigan, Wisconsin and the south center of Canada most from the order *Lepidoptera*, which are great pollinators (Weger, 2002).

Biological diversity is a good environmental indicator of habitat health (Blair, 1999). UNDERC is one of the most diverse ecosystems in the Upper Peninsula with abundant resources available to sustain butterflies populations. By studying and

attempting to measure the diversity of butterflies, it may be possible to establish a relationship between the health levels of the habitat with the presence of butterflies. In previous studies it has been documented that relative abundance of Lepidoptera family can represent the diversity for the whole ecosystems were these insects are distributed (Khan et al., 2004).

Even though butterflies are the one of the most admired insects groups be humans, is not well known that they are sensitive to climate and chemicals changes (Clark, unknown). It's important to test the variation in butterfly family and habitats dynamics to establish diversity patterns Gilbert and Singer, 1975). Some habitats components that influence the patterns of butterfly diversity are determine by abiotic and biotic factors such as: vegetation including host plants, food availability, temperature and wind exposure (Khan et al. 2004). In open grassy habitats we can find the major components of the butterflies diet, which include flower nectar, sap, fruit juices, carrion, scat and wetland moisture (Weber, 2002). The resources such as host plants and food source for butterflies available in grassy areas make them indispensable sites for their survivor and consequently for our survey.

Moreover these microclimates contribute to the family diversity keeping specific requirements fundamental to sustain this group of insects (Shapiro and Cardé, 1969). Recognizing the importance of the habitats requirements for Lepidoptera families in general, I predict that habitats combine to temperature ranges at each site will have an effect in the distribution of the Lepidoptera family, body size including wing size and body length. Is well study that others types of insects such as grasshoppers exhibit thermal sensitivity in their performance (Forsman, 1999). Cold weather slows

development of insects while often increasing the food requirements of their warm-blooded predators. Death of butterfly larvae during dull humid weather constitutes a major mortality factor. Summer temperatures are correlated with changes of range in some British butterflies this carries the implication that climatic factors may determine large-scale population, extinctions and recolonization. British workers tend to find that cold or dull weather reduces butterfly fecundity, estimated from egg counts (Gilbert and Singer, 1975). Butterflies wings function in body temperature regulation (Weber, 2002).

. In this survey the presence of butterfly diversity indicate which grassy area will be healthier. With this investigation I test the relationship between butterfly body length and wing span and temperature at each site. Also I test the relationship between the patch size and the body size of Lepidoptera families. Finally I test the relative abundance of the butterfly families of the open grassy areas at UNDERC. I predict temperature will have an effect on body size: wing span and body length.

Methods

I surveyed Lepidoptera families: *Pieridae* (Whites and Sulphurs), *Papilionidae (*Swallowtails), *Lycaenidae (*Coppers, Hairstreaks and Blues), *Nymphalidae* (Brushfoots), *Hesperiidae* (Skippers) and day flight moths families at UNDREC. During 11 days during June and July months I surveyed in 2 open old fields and in 3 sites along the road. I was surveying between 10:00am to 5:00pm the active biological hours for butterflies depending of the internship availability and the weather conditions.

I recorded the butterfly diversity in Naked Field and in the Weather Station classified as open old fields and also in Tick Site, New Gravel Pit and Old Gravel Pit classified as near

to the road (fig.1). The size of each site was determined using aerial pictures. The survey was conducted during non-windy sunny days with a temperature range above 60°F (Hellmann, 2006). Using a Catch per Unit Effort technique, I surveyed the butterflies for a period of time in proportion with the area (table 1). Catching the butterflies at the end of my survey time, I catch three butterflies of each family and measure the body length and wings span of each individual with calipers. The amount of butterflies measured could vary according to the availability and the access of each butterfly at the end of the survey. Then I recorded the data in a sheet classified by family. For the temperature measures I was using thermometers and hobo data loggers to record the data during my survey period at each site. Digital photos, field guides and jars with alcohol were used for identification and collection.

I surveyed the six butterfly families distribution in the open grassy habitats, recording the relative abundance in each of the five sites at UNDERC.

Results

I ran two separate ANCOVA to analyze the effect of temperature on the body size, wings span and body length, at each site. In the first ANCOVA, I attempted to determine if there was relationship between wing span and temperature (fig. 1). There was a significant effect on the temperature for the body length ($p=0.001$) (see fig. 1) and also there was a significant effect between temperature and wing span ($p=0.001$) (see fig.2).

For my second ANCOVA, I analyze the effect of the patch size on the body size: wing span and body length by family. Concluding that there is not significant effect of the area

in the body length, but there is a significant effect between body length and family (p=0.001). Other significant difference is between the family and the wing span, even there is not significant effect on the wings span and area (p=0.001).

I used a Chi-square test for to analyze the relative abundance, testing there is not significant relative abundance between butterflies family and site. Concluding in this way there is not significant difference of individuals of each family per site (χ^2=23.022, p=0.113).

Discussion

Understanding the relationship between Lepidoptera families and abiotic factors such as temperature and area, is important to understand the ecosystems dynamics. At UNDERC The relative abundance of butterflies at UNDERC is closely related to the wide range of temperature to other spaces pretty similar. This implies that at each site will be the similar or the same amount of Lepidoptera families among all the open grassy areas and the fields. The presence of all Lepidoptera families at each site is represented in a wide range. Butterfly families site selection could be determine by the availability of some factors such as: food available, access to solar light to regulate their body temperature also open space to flight away from predators or some others to use the breeze to flight to other places. Butterflies as bio-indicators can monitor the health of an environment or ecosystems. Butterflies at UNDERC can indicate, anticipate and monitor chemicals and physical changes in the environment, especially in the open grassy areas. Because butterflies are sensible to different abiotics factors, especially temperature they will restrict their biological activities. Considering this factor is important to mention that collect data is a hard work, sometimes difficult to standardize and process because

requires a long time to replicates, also depends sometimes in the chance for catching and record the data of body length and wing span. Further more is important to be delicate with the wings especially during the measures such as body length and depends the survey and could be an intensive job if one person is alone.

The replications for this research are not enough to establish a strong relationship or effect between two or three variables. For this reason I recommend to sample 20 days minimum during different seasons to establish to make stronger future tests.

Acknowledgments

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Tables

Table 1. Distribution of time per area at each surveyed site

Surveyed Site	Surveyed Time (minutes)	Area (m^2)
Naked Field	40 min.	18,000
Weather Station	30 min.	12,000
Tick Site	20 min.	4,000
Old Gravel Pit	10 min.	1,800
New Gravel Pit	5 min.	1,000

Figures

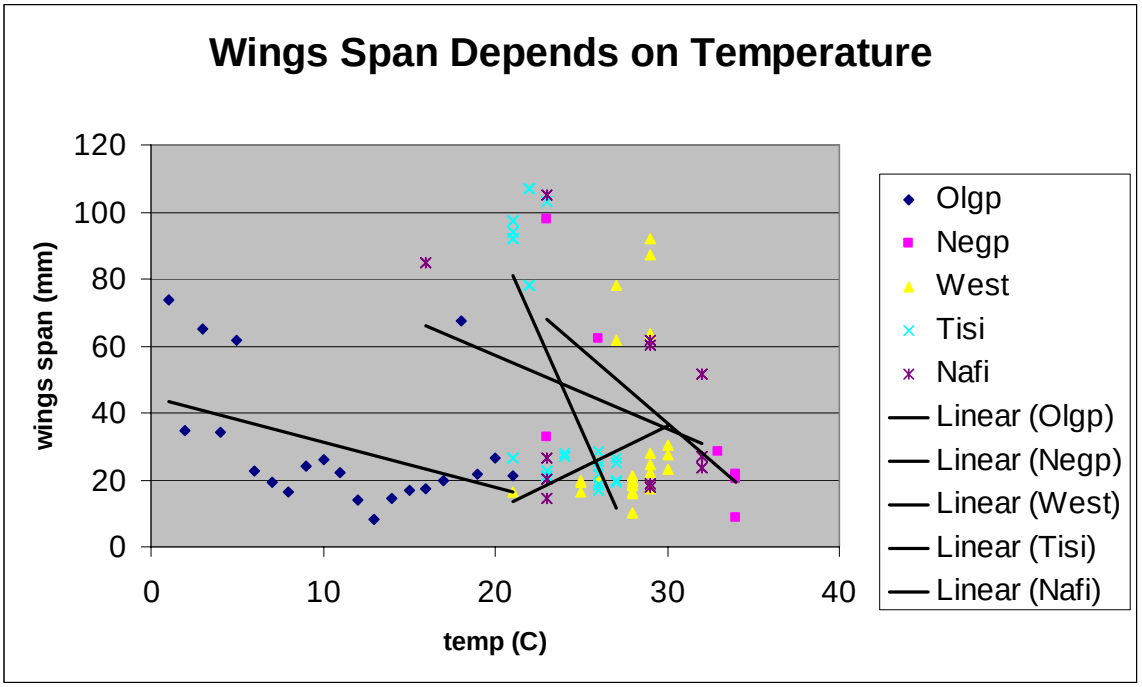

Figure 1. This graph represent the effect of temperature on wings span each site. Equation for the trendlines are as follows: Tick Site (Tisi) y = -11.522x + 322.72, R2 = 0.5666; New Gravel Pit (Negp) y = -4.4395x + 170.28,R2 = 0.6143; Weather Station (West) y = 2.5214x - 39.348, R2 = 0.0439; Old Gravel Pit (Olgp) y = -1.3569x + 44.759, R2 = 0.1863; Naked Field (Nafi) y = -2.1835x + 100.82, R2 = 0.1342.

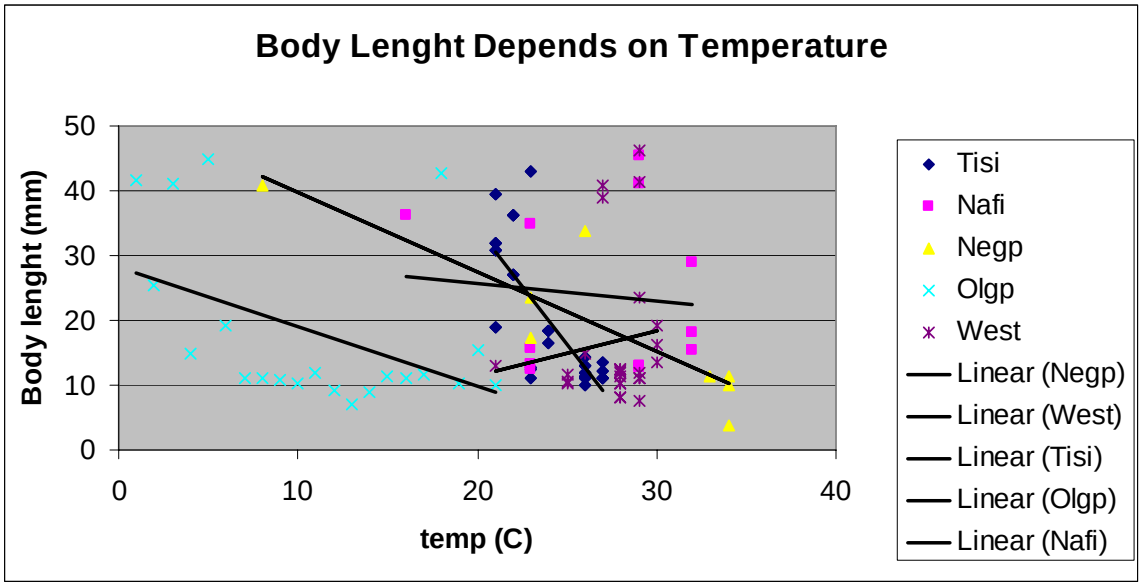

Figure 2. This graph represent the effect of temperature on body length each site. Equation for the trendlines are as follows: Tick Site (Tisi) y = -3.558x + 105.32, R2 = 0.6018; New Gravel (Negp)y = -1.224x + 51.907,R2 = 0.7593; Weather Station (West) y = 0.7112x - 2.8379, R2 = 0.0155, Old Gravel Pit (Olgp) y = -0.9273x + 28.286, R2 = 0.2014; Naked Field (Nafi) y = -0.2575x + 30.759, R2 = 0.0106

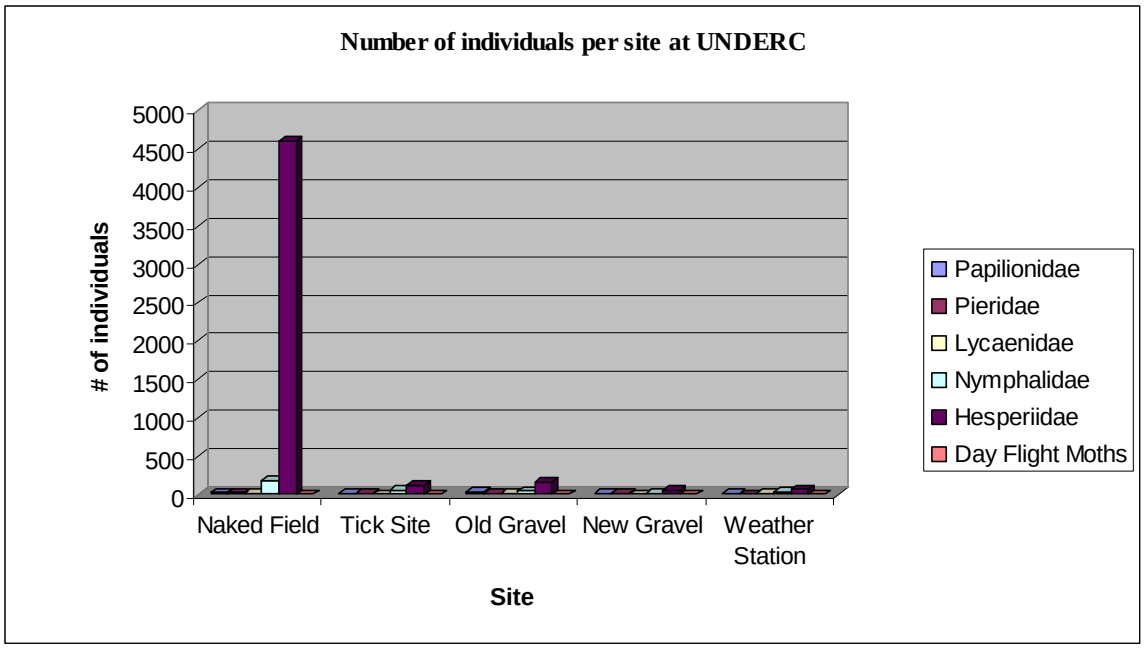

Fig. 3 The number of individuals per site. Is interesting how the number Hesperiidae (skippers) stand out from the total of 4,615 at Naked Field