

QUANTITATIVE ASSESSMENT OF POTENTIAL KARNER BLUE BUTTERFLY (*LYCAEIDES MELISSA SAMUELIS*) REINTRODUCTION SITES IN ONTARIO

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Abstract

The karner blue butterfly (KBB) (Lycaeides melissa samuelis) was extirpated in Canada in 1991. Restoration work has been performed to restore its oak savannah habitats in Ontario. Promising results have been observed from the restoration work, but no systematic scheme has been employed to evaluate the quality of these restored sites. This paper evaluates several potential KBB reintroduction sites by looking at both biotic and abiotic aspects. Plant community structure and light intensity of these sites will eventually be compared with those of the largest KBB sites in the U.S.A. Recommendations can then be made upon where butterflies should be taken for reintroduction based on the degree of similarity in vegetation and microhabitat among the sites. Data collected in 2002 suggests that High Park is quite different from the other potential reintroduction sites in Ontario in terms of both plant community structure and microhabitat characteristics while the other sites are all similar.

Introduction

The karner blue butterfly (KBB) (*Lycaeides melissa samuelis*) is one of the six subspecies of *Lycaeides melissa* (Lane and Weller, 1994.) It occurs only in oak/pine savannah/barren habitats. Its larvae feed only on wild lupine (*Lupinus perennis*) while the adult butterflies use a wide variety of flowering plants as nectar sources. KBB larvae have glandular structures on their bodies which secrete a nectar-like solution when stimulated by ants. As a food supplement for the ants, this “nectar” causes them to tend the KBB larvae, hence protecting the larvae from predators and parasitoids. Studies have shown that absence of tending ants could decrease the survivorship of KBB larvae (Savignano, 1994).

The KBB historically inhabited a wide range in North America between 41 and 45 degrees north latitude from Minnesota to Maine (Dirig, 1994,) but in the past century, its range has shrunk and become fragmented and its number dropped by more than 99%. As a result, it has been listed since 1992 as federally endangered rangewide by the U.S. Fish and Wildlife Service.

The major cause of the decline of the KBB is habitat destruction and degradation by humans. Conversion of savannah into agricultural land is one form of destruction while wild fire suppression is a form of habitat degradation because fire is essential to maintain the early successional status of savannah and to eliminate invasive fire intolerant species alien to the savannah habitat (Bond and van Wilgen, 1996.)

Conservation of the KBB is important because not only is it an endangered taxon, but so is its oak savannah habitat, of which only 0.02% of its original area is left (Nuzzo 1986.) Moreover, the KBB is both an “indicator” species indicative of good quality savannah habitat, and an “umbrella” species, which when protected, attends protection for many other species depending on the oak savannah habitat.

KBB was extirpated in several states in the U.S.A., including Iowa, Illinois, Pennsylvania, Massachusetts and Maine, and it is now only found in the states of New Hampshire, New York, Michigan, Indiana, Wisconsin and Minnesota (Baker, 1994.) In Ohio, the KBB was extirpated in 1988, but was reintroduced in 1998. This seems to be successful as the species has been observed to be reproducing naturally at the reintroduction site (Tolson *et al.*, 1999.) However, long-term monitoring is needed to determine if this reintroduction is truly a success.

In Canada, the KBB was once found in Ontario and was extirpated in 1991 (Packer, 1994.) A KBB Recovery Team was established in Ontario in 1991, with the aim of reintroducing the species into Ontario from the U.S.A. A protocol for captive rearing of the KBB was developed by the Metro Toronto Zoo based on the experience of the Toledo Zoo in Ohio. Also, numerous oak savannah sites have been managed or restored by prescribed burns, lupine planting and other management strategies as site preparation for reintroduction of the KBB.

Objectives

Despite the improved quality of oak savannah sites as a result of active management, a quantitative assessment is needed to determine if the sites are ready for reintroduction of the KBB. Once the sites are shown to be ready, the next question will be from where in the U.S.A. should KBB be taken for the purpose of reintroduction in the selected sites in Ontario?

To answer these questions, we will be comparing the biotic (including plant communities and ant fauna) and abiotic aspects (including temperature, humidity and light intensity) among potential reintroduction sites in Ontario and potential source butterfly sites in the USA. By doing so, three important questions concerning reintroduction of the KBB can be answered. First of all, by doing a plant community survey and ant survey, we can assess the quality (e.g., densities of wild lupine (*Lupinus perennis*) and adult nectar sources and availability of tending ant species) of the selected sites in Ontario. This will allow us to determine whether these sites are ready for reintroduction of the KBB, or further restoration work needs to be done before KBB reintroduction should proceed. Secondly, recommendations will be made upon where KBB should be taken for reintroduction in various sites in Ontario based on the degree of similarity of biotic and abiotic aspects between the potential reintroduction sites in Ontario and the source butterfly sites in the U.S.A. Lastly, based on the current plant community structure, microhabitat characteristics and management history, recommendations will be made upon future management strategies for the sites in Ontario.

Study Sites

The selected potential reintroduction sites in Ontario include: 1) The Pinery Provincial Park (PPP), Grand Bend; 2) The Karner Blue Sanctuary (KBS), Port Franks; 3) The Manestar Tract (MT), St. Williams; and, 4) High Park (HP), Toronto. All these are historic localities of the KBB in Ontario. At each of these sites, study was concentrated on 3 to 4 sub-sites where wild lupine (*Lupinus perennis*) was found.

Three potential source butterfly sites were identified in the U.S.A They are: 1) Saratoga County Airport, New York State; 2) Indiana Dunes National Lakeshore, Indiana; and, 3) Manistee National Forests, Michigan. These areas support some of the largest KBB populations in the U.S.A.

Materials and Methods

In summer 2002, each Ontario site was visited twice. During each visit, a complete vegetation survey was performed. This includes a herbaceous layer survey using the traditional transect-quadrat method (Gleason, 1920; Arrhenius, 1922), woody species survey using the nearest-neighbour method (Cottam and Curtis, 1949; Cottam *et al.*, 1953; Cottam and Curtis., 1956), and canopy cover estimation. Air temperature, relative humidity and light intensity were measured using portable dataloggers continuously for three days. Integrated light intensity was also measured. One hundred petri dish lightmeters, which contained a stack of photographic paper sandwiched by two pieces of black paper, were left at each site at the height of 5cm to 10cm (2 to 4 inches) above ground, which was the height of the crown of wild lupine (*Lupinus perennis*) for approximately 40 days. The stacks of photographic paper were then developed in ammonia vapour in the lab (Friend, 1961; Sullivan and Mix, 1983).

The collected vegetation data were analysed by using the software CANOCO to perform Detrended Correspondence Analysis (DCA). Integrated light intensity data were calibrated according to the time of exposure at the sites. A formula, which takes into account the latitude of the site and the time of the year (Monteith, 1962), was used to calculate how much light energy should have been received at ground level if the sky had been completely clear for the whole period when the lightmeters were left at the sites. The integrated light intensity recorded by the lightmeters was then expressed as a percentage of the light that should have been received with the assumption of complete cloudlessness. The four sub-sites in High Park were combined into two for light intensity data analysis because of small sample sizes. Two-way Analysis of Variance (ANOVA) was used for the comparison of the integrated light intensity among the sites. When a significant difference was detected, the Tukey Test (Zar, 1996) was performed to determine which sites were different in terms of integrated light intensity.

Preliminary Results and Discussion

Three DCA diagrams were generated from the vegetation data collected at the Ontario sites in 2002. They were done by including: 1) all herbaceous species; 2) only first brood KBB nectar source plants; and, 3) only second brood KBB nectar source plants. They are shown as Figures 1, 2 and 3 respectively. In Figure 1, the sub-sites in High Park (HP) are clustered on the left side while the circles representing the other sites are on the right. This suggests that the plant community structure in HP was quite different from those of the other three Ontario sites, which were relatively similar. The Pinery Provincial Park (PPP) and the Karner Blue Sanctuary (KBS) sub-sites are particularly close to one another in Figure 1. A similar distribution of the sub-sites on the DCA diagrams can also be observed in Figures 2 and 3 even though the separation between the sub-sites in HP and those of other sites is not as clear-cut as in Figure 1. This shows that the difference in plant community structure between HP and other sites are at least partially the results of the difference in first and second brood KBB nectar source plants between HP and other sites. A solid dot representing wild lupine (*Lupinus perennis*) was also included in Figure 1. It is located close to the HP sub-sites, which suggests that this locality had the highest lupine densities among all sites, which was indeed true according to the vegetation data.

Figure 1. DCA diagram showing the scatter plot of the sub-sites in four Ontario oak savannahs (all species included) and *Lupinus perennis*.

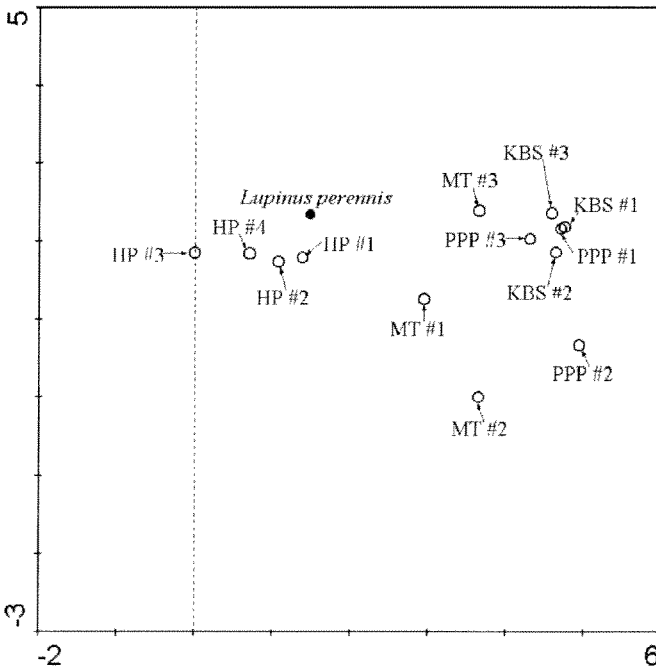


Figure 2. DCA diagram showing the scatter plot of the sub-sites in four Ontario oak savannahs (only 1st brood nectar source plants included).

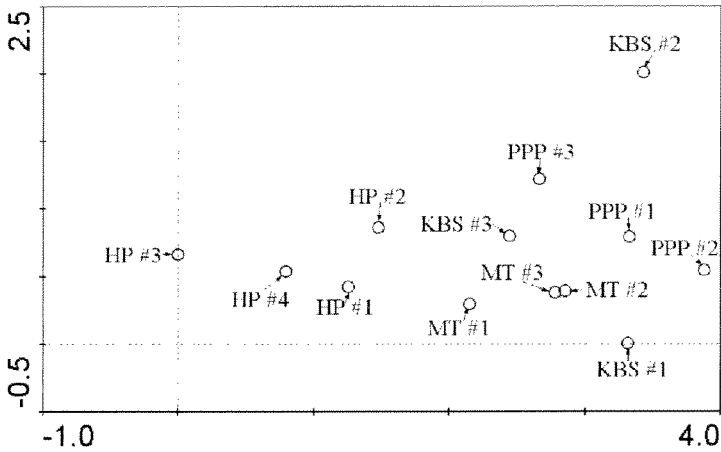
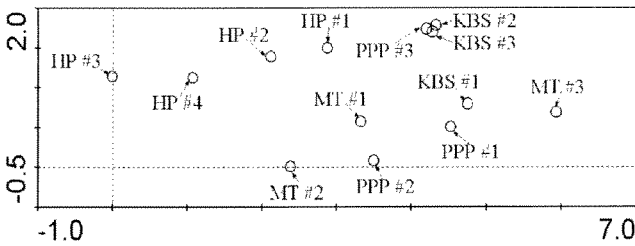


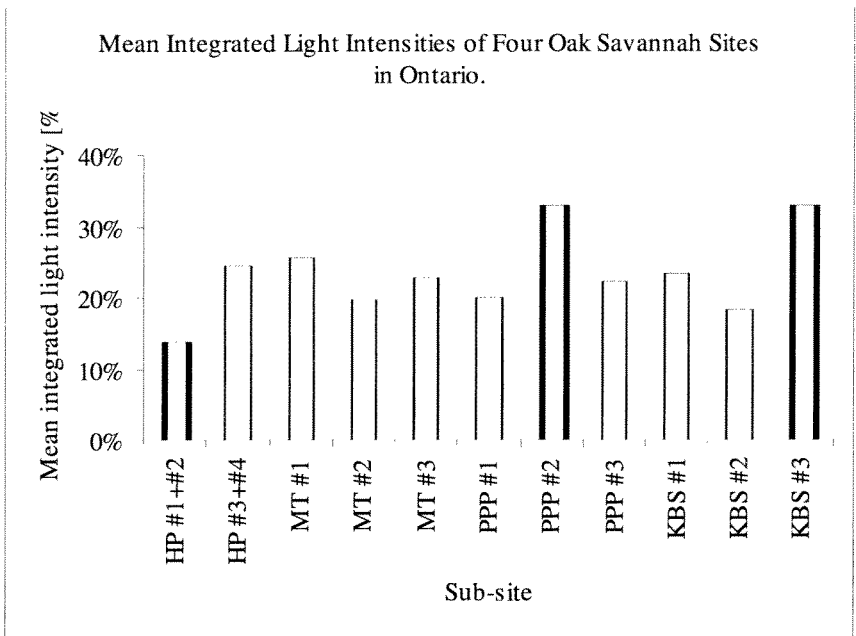
Figure 3. DCA diagram showing the scatter plot of the sub-sites in four Ontario oak savannahs (only 2nd brood nectar source plants included).



Mean integrated light intensities using petri dish lightmeters are plotted as Figure 4. The results of the Tukey test show that the sub-sites HP #1+#2 and the sub-sites KBS #3 and PPP #2 were significantly different in terms of integrated light intensity ($P < 0.05$). Bars representing these sub-sites are highlighted in Figure 4.

Combining the results of the vegetation survey and the integrated light intensity, HP seems to be quite different from the other three sites, in terms of both vegetation community structure and microhabitat characteristics. This suggests that when reintroducing the KBB in Ontario, a separate source KBB population will be preferable for HP as opposed to the other reintroduction sites in order to maximize the chances of reintroduction success at all sites.

Figure 4. The mean integrated light intensity measured by using petri dish lightmeters in four Ontario oak savannah sites.



Future Research

In summer 2003, both the potential reintroduction sites in Ontario and the potential source butterfly sites in the USA will be visited twice to perform vegetation and microhabitat surveys, using the same method as in 2002. Ant specimens will also be collected in 2003 to detect the presence of tending ant species. These data will then be used to determine if the sites in Ontario are ready for reintroduction of the KBB and where in the USA should we take KBB for reintroduction to individual Ontario sites. Recommendations will then be made upon future management strategies for the Ontario sites.

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