# Butterfly Monitoring at ***rare*** Charitable Research Reserve: 2009

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2009

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## Acknowledgements

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# 1.0 Background

## 1.1 *rare* Charitable Research Reserve

The butterfly monitoring took place at ***rare*** Charitable Research Reserve in Cambridge, Ontario. This is a non-profit organization founded in 2001, which owns 913-acres of land at the confluence of the Grand and Speed Rivers. The goal of ***rare*** is to conserve the land by focusing on research, education, conservation, and ecological restoration (***rare***, 2008).

The property contains many different landscapes and habitats, which are home to species at risk regionally, provincially, nationally and globally (***rare***, 2008).

## 1.2 Ecological Monitoring

Research programs and ecological monitoring has provided answers to multiple environmental management issues (Vaughan et al., 2001). Ecological monitoring supplies decision-makers with reliable data in order to deal with changing environmental conditions and maintain a sustainable economy and a healthy environment (Vaughan et al., 2001).

Monitoring involves making regular observations and taking measurements at regular time intervals over a period of time (Vaughan et al., 2001). The length of time is essential to the design and purpose of the monitoring program (Vaughan et al., 2001).

There are two underlying reasons for ecosystem monitoring. These are 1. to create baseline data that characterizes the present status of ecosystem components and 2. to identify changes over time, and in particular, changes that are greater than the natural variation established in the baseline data (Vaughan et al., 2001).

## 1.3 Ecological Monitoring and Assessment Network (EMAN)

EMAN is a network of organizations and individuals engaged in ecological monitoring in Canada, in order to better detect, describe and report on ecosystem changes which are occurring (EMAN, 2007). EMAN's Coordinating Office (EMAN CO) works in partnership with its network to increase the efficacy of ecosystem monitoring in order to foster informed decision-making and to enhance environmental awareness in Canada (EMAN, 2007).

## 1.4 Why Monitor Butterflies?

A butterfly monitoring protocol was set up on ***rare*** property in 2006 by Jessica Grealey. This protocol has been followed for the monitoring that took place in the summer of 2009. The purpose of repeating this protocol was to determine if any changes have occurred in butterfly populations over the past three years. As well, the monitoring can

provide insights into changes occurring in different habitats on the property, whether they are negative or positive alterations. For example, the monitoring can be used to evaluate the success of restoration efforts which have been undertaken since 2004.

Butterflies are excellent indicators of environmental change. For example, rare or threatened butterflies can signify broader environmental threats (New et al., 1995). Butterflies have complex life cycles, which make them good indicators of the health of herbaceous communities, herbivorous arthropods and other taxonomic groups (Waltz & Covington, 2004).

Butterflies are recognized as indicators of environmental change due to human or natural disturbances (Hogsden and Hutchinson, 2004). For instance, they are affected by changes in local weather, irradiance, climate and the availability of host plants for their larval and adult stages (Hogsden and Hutchinson, 2004).

Since butterflies are indicators of environmental change, monitoring their populations can alert us to these alterations, which could otherwise go unnoticed and undocumented.

Another reason to monitor butterflies is that they are relatively easy to observe, compared to other species of insects. As well, butterflies have restrictive habitat requirements, as females will only lay eggs on one or two host plants (Grealey, 2006a). Therefore, habitat loss has a huge impact on butterfly populations. Another reason for monitoring is because of their short life span, which makes it easy to see changes in population over several generations in a short time period (Grealey, 2006a). Lastly, butterflies are susceptible to changes in the climate since their wing temperature must be at least 25°C before they can fly. Severe weather events, cold periods and unexpected frosts can significantly affect butterfly populations (Grealey, 2006a). Also, in recent years there has been evidence that butterflies are appearing outside of their normal range due to increases in temperature, therefore, butterfly monitoring can provide evidence of global warming (Grealey, 2006a).

## 2.0 Methodology

Transect counts have been used around the world to monitor butterfly populations, especially in Britain's Butterfly Monitoring Scheme, which was launched in 1976. The transect method does not disturb butterfly behaviour, or require a lot of time and labour. As well, it presents an index of population size and can be used to measure changes in abundance. This methodology was used during the 2006 monitoring and again during the 2009 season and involves the observer walking a transect (a fixed route) while recording butterflies observed within a 10m distance on all sides (Grealey, 2006b).

Three transects are monitored weekly on the property (see appendix A). Transect #1 and #2 were set up by Jessica Grealey in 2006, while Transect #3 was added this year. See appendix B for transect descriptions.

Each 2-3 km transect is monitored once a week, weather permitting. Each transect is divided into sections, which correspond with habitat changes as much as possible (Grealey, 2006b). Butterflies within a 10 m radius of the observer are recorded along each transect. A 10-minute stop is made in the approximate middle of each section (see appendix B for GPS coordinates of the stop location in each section) to observe and record butterflies within the 10m range (Grealey, 2006b).

A recording form is used to properly record butterflies while monitoring (see appendix C). The observer must note the start and end time, as well as the temperature when monitoring. Also important is the wind speed, which is recorded using the Beaufort Wind Scale (see appendix D) and the percentage of sun during monitoring. At the bottom of the form there is a place to record the sunshine level in each section. An "s" is for sunny, a "c" for cloudy, "c&s" for more cloud than sun, and "s&c" for more sun than cloud.

Stops are permitted to correct identification issues and recording continues from where the stop was made. It is suggested that a butterfly net is used to ensure proper identification. If there is an identification problem, in the absence of an expert, the more common species of butterfly should be recorded. As well, a digital camera is helpful for proper documentation of an individual, so an expert opinion can be sought for identification and misidentification can be corrected (Grealey, 2006b).

The ideal recording season is roughly 26 weeks, starting the first week of April and finishing the last week of September (Grealey, 2006b). The recording season for 2006 was five weeks from mid-July to August, while the season was thirteen weeks in 2009 from mid-May to August. The recording seasons have been shortened due to time constraints and the duration of employment.

Each transect should be monitored at least once a week and the best time to monitor is the middle of the day (Grealey, 2006b). Warm weather is necessary and the wind speed should not go above a 5 on the Beaufort Wind Scale. These requirements can make monitoring at the beginning and end of the season difficult.

An index of abundance can be generated using butterfly counts, which includes stratified random sampling and the sum of the average weekly counts that allows comparisons to be made between sites. Butterfly species must be monitored independently of each other, due to their differences in behaviour, which abundance indices cannot compare (Grealey, 2006b). For instance, one species might be conspicuous, while another is not (Grealey, 2006b).

## 3.0 Annual Butterfly Count

An annual butterfly count has been held in the summer at ***rare*** in 2006, 2008 and 2009 to supplement the monitoring done in 2006 and 2009. In 2006, there were 38 species observed and 727 individuals (Grealey, 2006b). There was no butterfly count in 2007 due to poor weather conditions. In 2008, a total of 42 species and 1,590 individuals were

recorded (see appendix E for the full 2008 results). The 2009 count had a total of 29 species and 463 individuals (see appendix F the complete 2009 results), which is significantly lower than the previous two years. The weather was similar to that of the rest of the summer, cool and overcast, which helps explain the low number of butterflies observed.

This year, the annual butterfly count was held on July 19th, after being re-scheduled from July 18th due to unfavourable weather conditions. Sixteen observers in five parties spent the day observing butterflies.

## 4.0 Results

Butterfly monitoring results from 2009 can only be compared for the same five-week monitoring period during which butterfly monitoring was conducted in 2006. The 2006 data spans from July 18-August 24 and the comparative 2009 data is from July 13-August 14. The 2009 data ends a week earlier than the 2006 because of the end date of employment. A section follows on results from 2009 outside of this time period, but cannot be compared to 2006, as data from before mid-July was not collected in 2006. All raw data, pictures, completed transect forms and related documents can be found on the ***rare*** computer network at Z:\Level4\Charlotte\Butterflies.

See table 1 for the total number of species recorded in each transect and the total for all three transects over the entire May-August 2009 monitoring season. The total number of species recorded during the monitoring season was 31, while the total number of individuals was 1751.

See table 2 for the number of species and individuals per transect for the 2009 recording season.

### 4.1 Climatic Data

The weather for May-August 2009 was unusual for a southwestern Ontario summer. Average temperatures for these months were lower than in previous years (see figure 1), which is not ideal for butterfly populations. As mentioned above, butterfly wings must be at a temperature of at least 25°C before they can take flight. Therefore, warm temperatures are required to allow normal behavioural patterns.

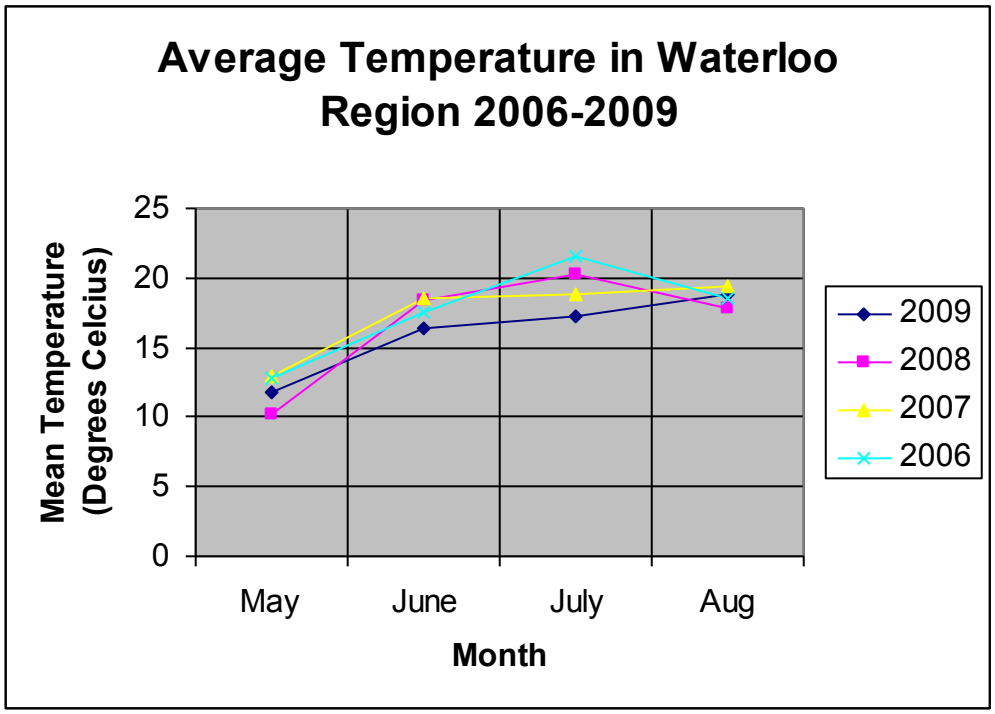


**Figure 1 – Average Monthly Temperature in Waterloo Region, May-August, 2006-2009** (Environment Canada, 2008).

As well, average precipitation rates were abnormally high for May-August 2009 (see figure 2). Increased precipitation will also negatively affect butterflies, which require warm, sunny weather to fly.

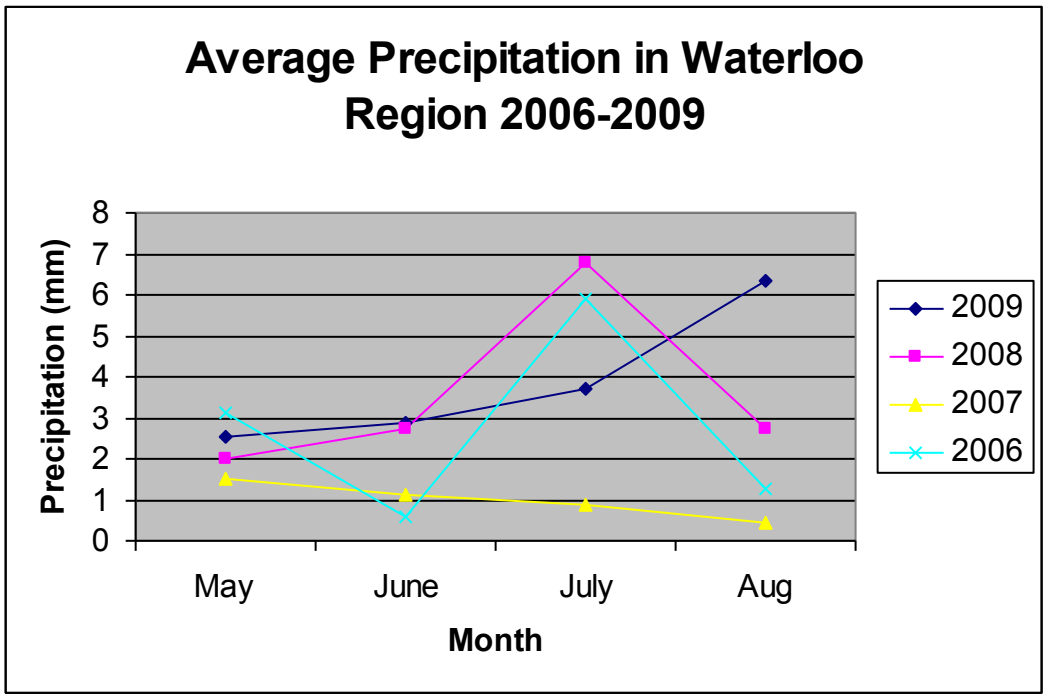


**Figure 2 – Average Monthly Precipitation in Waterloo Region May-August, 2006-2009** (Environment Canada, 2008).

**Table 1 – Total Numbers of Butterflies Observed by Species and Transect in 2009**

| | Transect 1 | Transect 2 | Transect 3 | Total |
|---|---|---|---|---|
| **Species Common Name** | | | | |
| Banded Hairstreak | 0 | 0 | 4 | **4** |
| Black Swallowtail | 1 | 12 | 0 | **13** |
| Broad-winged Skipper | 3 | 0 | 0 | **3** |
| Cabbage White | 254 | 411 | 37 | **702** |
| Clouded Sulphur | 15 | 98 | 29 | **142** |
| Common Sooty Wing | 6 | 0 | 0 | **6** |
| Common Wood Nymph | 11 | 9 | 24 | **44** |
| Coral Hairstreak | 1 | 0 | 0 | **1** |
| Delaware Skipper | 7 | 2 | 0 | **9** |
| Dun Skipper | 3 | 0 | 0 | **3** |
| Eastern Comma | 2 | 4 | 5 | **11** |
| Eastern Tiger Swallowtail | 0 | 20 | 4 | **24** |
| European Skipper | 146 | 45 | 148 | **339** |
| Eyed Brown | 3 | 0 | 1 | **4** |
| Great Spangled Fritillary | 4 | 2 | 5 | **11** |
| Inornate Ringlet | 15 | 15 | 0 | **30** |
| Little Wood Satyr | 86 | 10 | 56 | **152** |
| Monarch | 22 | 48 | 56 | **126** |
| Mourning Cloak | 8 | 16 | 7 | **31** |
| Northern Crescent | 10 | 2 | 13 | **25** |
| Northern Pearly Eye | 11 | 7 | 18 | **36** |
| Painted Lady | 0 | 1 | 1 | **2** |
| Question Mark | 1 | 1 | 0 | **2** |
| Red Admiral | 2 | 1 | 1 | **4** |
| Red Spotted Purple | 2 | 1 | 1 | **4** |
| Silver Spotted Skipper | 0 | 0 | 2 | **2** |
| Spring Azure | 4 | 1 | 0 | **5** |
| Summer Azure | 0 | 2 | 1 | **3** |
| Tawny Emperor | 0 | 6 | 0 | **6** |
| Tawny-edged Skipper | 1 | 0 | 0 | **1** |
| Viceroy | 2 | 2 | 0 | **4** |
| White Admiral | 0 | 1 | 1 | **2** |
| | | | | |
| **Total** | **620** | **717** | **414** | **1751** |

**Table 2 – Total Numbers of Butterfly Species and Individuals Observed by Transect in 2009**

| Transect Number | Number of Species | Number of Individuals |
|---|---|---|
| 1 | 25 | 620 |
| 2 | 24 | 717 |
| 3 | 20 | 414 |

### 4.2 Transect #1 Monitoring Results

#### 4.2.1 Mid-July to Mid-August Results

The total number of species observed in Transect #1 in 2009 during this time period was 19, while the number of individuals was 279 (see figure 3). In 2006, the total number of species was 22 and the number of individuals was 424 (see figure 4).

#### 4.2.2 May-August Results

The total number of species found in Transect #1 over the entire monitoring season for 2009 was 25, while the total number of individuals was 620. Certain species were observed in May-July in 2009 which were not found in 2006, most likely because of the shortened recording season in 2006. These 10 species include the: Tawny-Edged Skipper, Spring Azure, Red-Spotted Purple, Northern Crescent, Mourning Cloak, Dun Skipper, Delaware Skipper, Coral Hairstreak, Common Sooty Wing and the Broad-Winged Skipper.

Seven species were observed in Transect #1 in 2006 which were not found in 2009, presumably because of the poor weather conditions of 2009. These species were the: Banded Hairstreak, Bronze Copper, Eastern Tiger Swallowtail, Giant Swallowtail, Hickory Hairstreak, Pearl Crescent and Summer Azure.

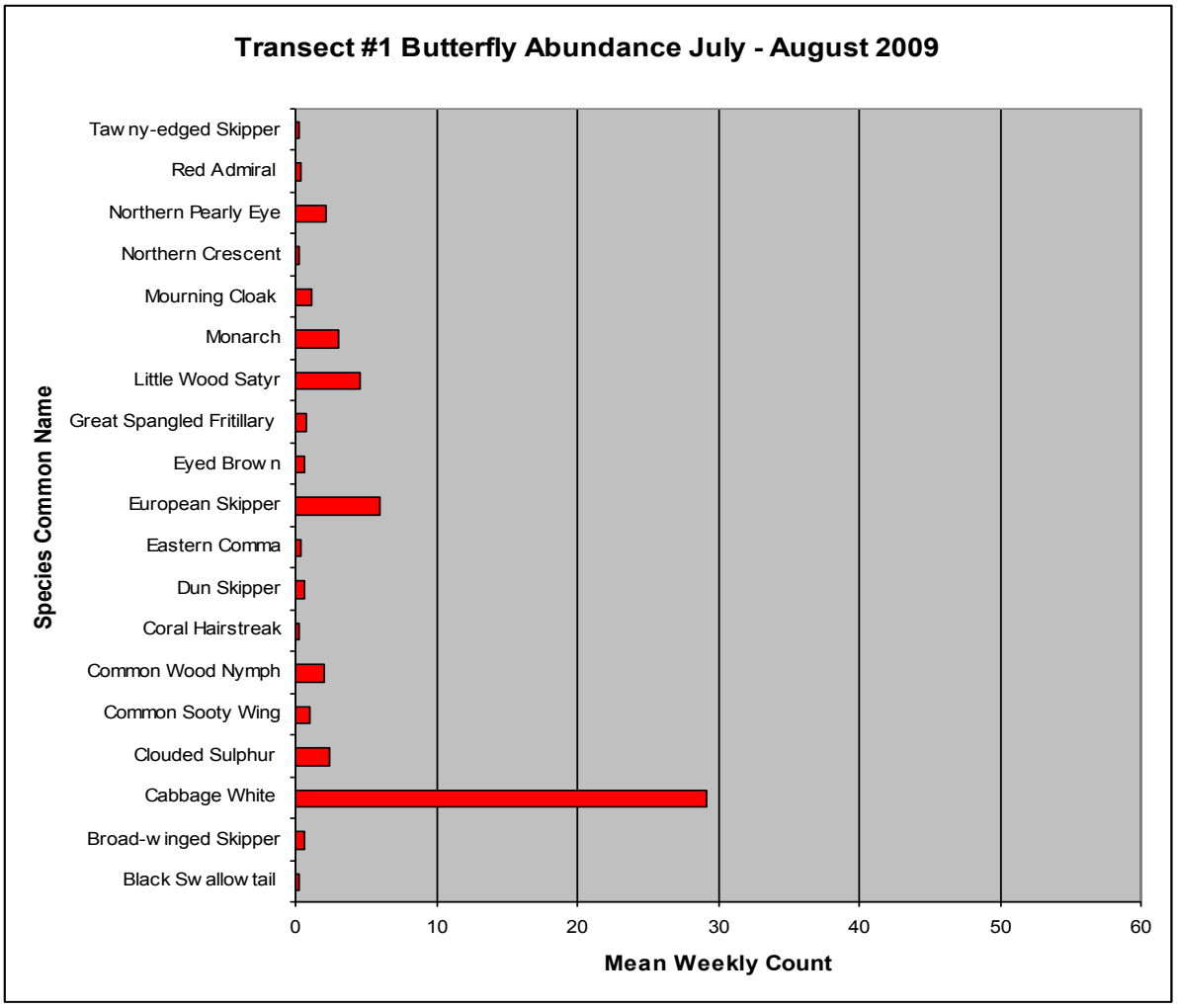


**Figure 3 – Transect #1 Butterfly Abundance July-August 2009**

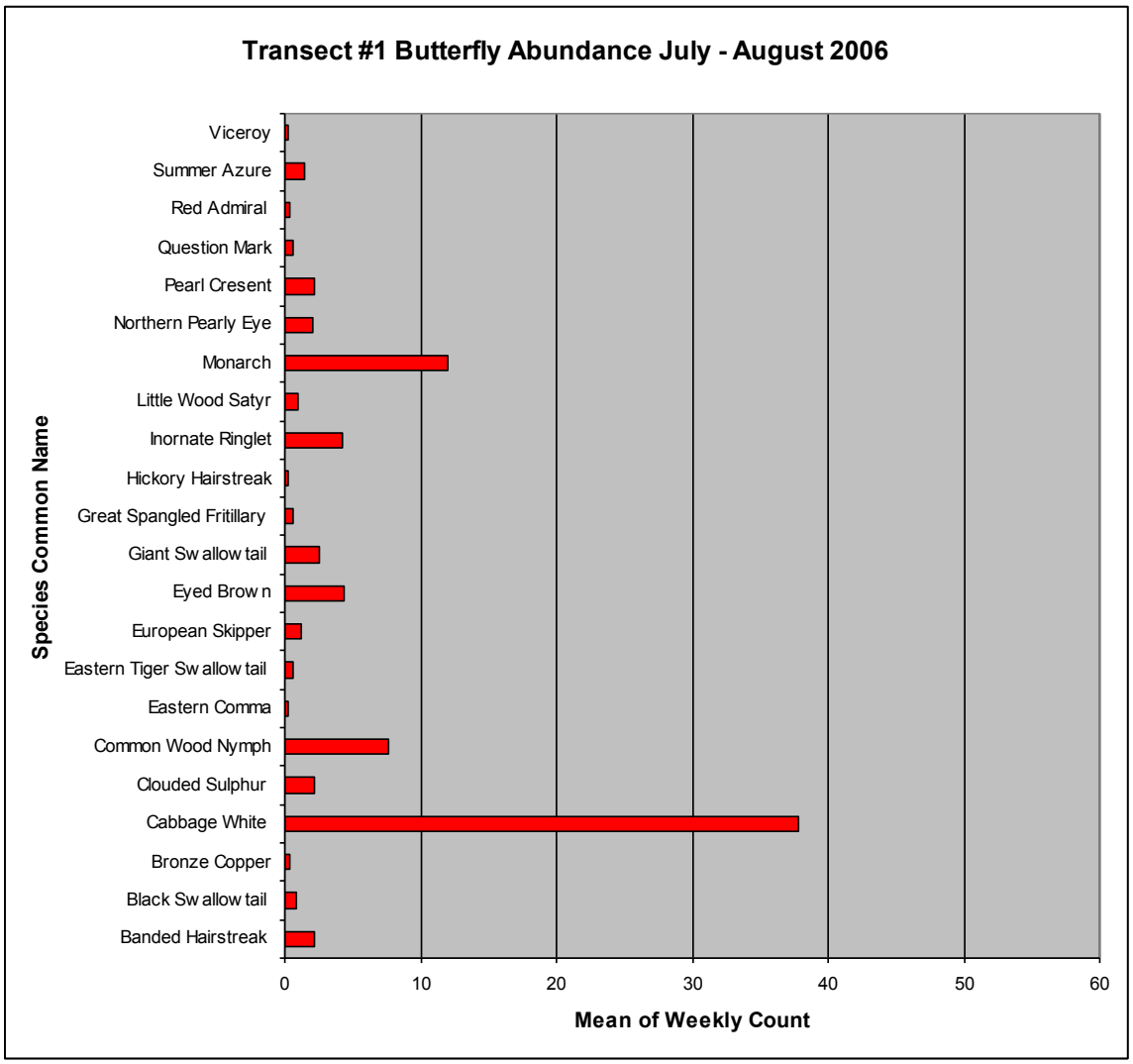


**Figure 4 – Transect #1 Butterfly Abundance July-August 2006**

## 4.3 Transect #2 Monitoring Results

### 4.3.1 Mid-July to Mid-August Results

In 2009, there were 15 species and 275 individual butterflies observed in Transect #2 throughout mid-July to mid-August (see figure 5). In 2006, there were 13 species and 413 individuals recorded on this transect (see figure 6).

### 4.3.2 May-August Results

In total, 24 species were observed in Transect #2 from May-August in 2009, while 699 individuals were noted. Sixteen species were observed in 2009 that were not present in 2006 which include the: Delaware Skipper, Eastern Comma, Eastern Tiger Swallowtail,

European Skipper, Great Spangled Fritillary, Little Wood Satyr, Mourning Cloak, Northern Crescent, Northern Pearly Eye, Painted Lady, Question Mark, Red Admiral, Red Spotted Purple, Spring Azure, Viceroy and White Admiral.

A total of six species were not located in 2009, but were observed in 2006. These include the: Common Sooty Wing, Eastern Tailed Blue, Giant Swallowtail, Inornate Ringlet, Orange Sulphur and Pearl Crescent.

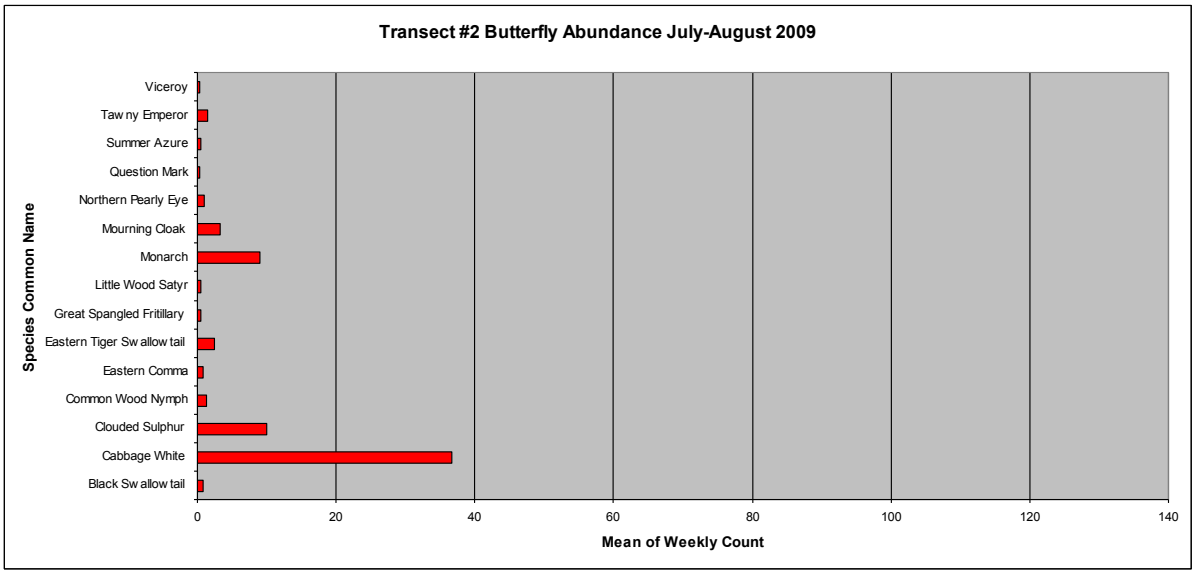


**Figure 5 - Transect #2 Butterfly Abundance July-August 2009**

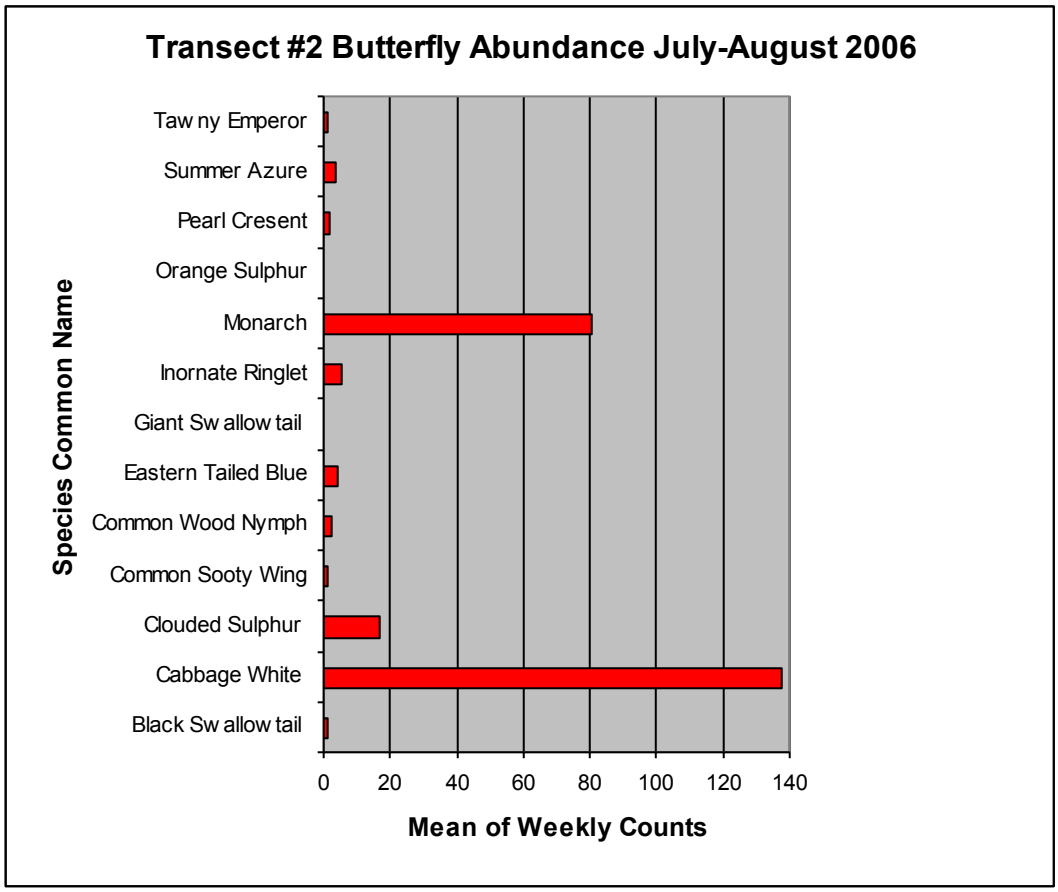


**Figure 6 - Transect #2 Butterfly Abundance July-August 2006**

### 4.4 Transect #3 Monitoring Results

Transect #3 was added this year to the monitoring protocol, therefore, the data collected in 2009 will be used as baseline data. The duration of monitoring on this transect was from July 1 –August 14. The data from this transect will not be compared to other sites because of habitat differences and the absence of data from previous years.

#### 4.4.1 July-August Results

The total number of species observed in Transect #3 was 20 and there were 414 individuals recorded (see figure 7).

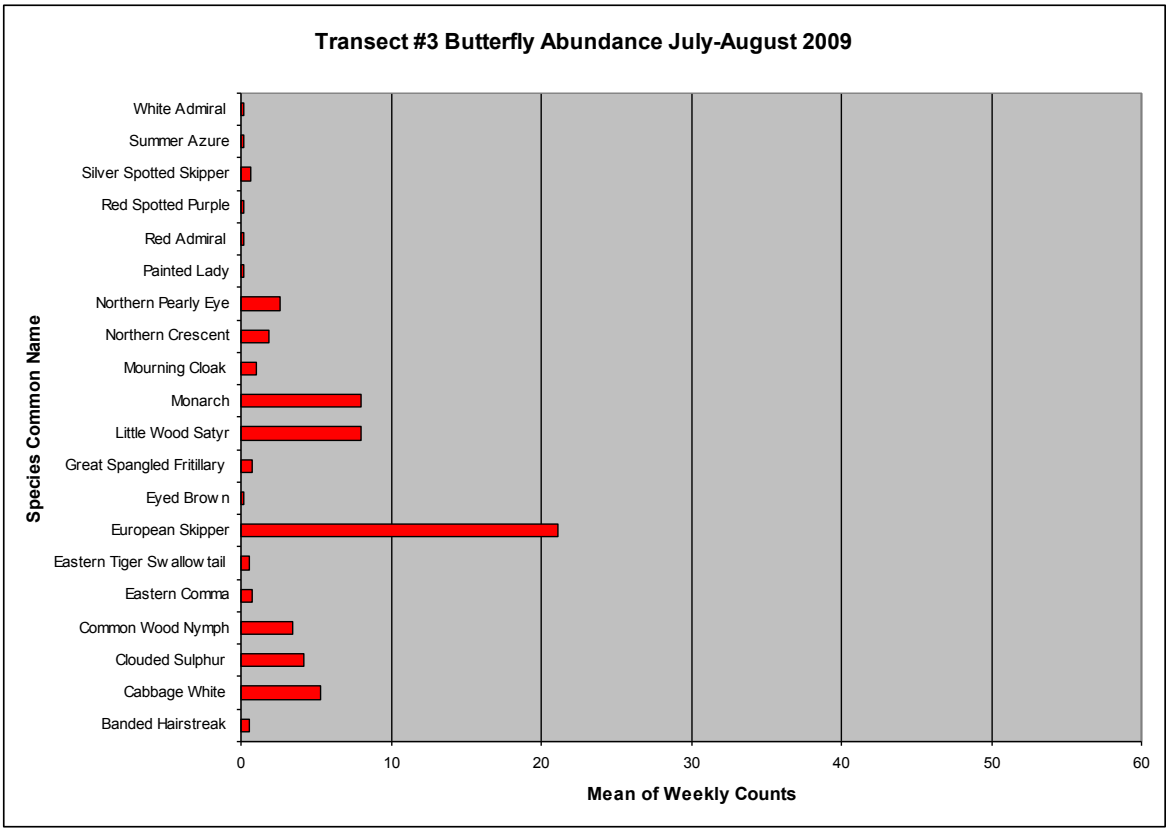


**Figure 7 - Transect #3 Butterfly Abundance July-August 2009**

# 5.0 Discussion

## 5.1 Patterns Over Time and Space

Due to butterflies' reliance on weather and climate, there are generally fewer butterflies early in the season when the weather is cooler and wetter, than in the warm, sunny summer months of July and August. This trend was experienced throughout the 2009 monitoring season as the number of butterflies in May and June was less than that in July and August.

In terms of patterns over space in regards to diversity, Transect #1 had 25 butterfly species, while Transect #2 had 24. Transect #2 had more individual butterflies, with 717 compared to Transect #1 which had 620. Both Transects #1 and #2 are comparable in terms of diversity, however Transect #2 did have significantly more individual butterflies. Transect #3 is not compared to the others because of the late start in the recording season.

## 5.2 Transect Trends in 2009

There are five species that are dominant throughout all three transects in terms of individual number of butterflies. These are the Cabbage White (702), European Skipper (339), Little Wood Satyr (152), Clouded Sulphur (142) and Monarch (126).

Transect #1 follows a similar trend. The individual butterfly totals for this transect are: Cabbage White (254), European Skipper (146), Little Wood Satyr (86), Monarch (22) and Clouded Sulphur (15). The habitats in this transect host a large population of Cabbage White butterflies, which are found all over the property. This transect contains different types of habitat, but no unique habitats where specialized niche butterflies are found and therefore, the five butterflies that dominate this transect are the top five for all three transects.

Transect #2 is different from the overall trend in that the Little Wood Satyr is not one of the dominant species. The Transect #2 individual butterfly totals are: Cabbage White (411), Clouded Sulphur (98), Monarch (48), European Skipper (45) and Eastern Tiger Swallowtail (20). This transect is clearly dominated by Cabbage White as there are four times as many of this butterfly as the next most populated butterfly species, the Clouded Sulphur. The non-diverse agricultural habitat allows a large population of Cabbage White and Clouded Sulphur butterflies to flourish.

Transect #3 also strays from the trend as it is the only transect which is not dominated by Cabbage White. The individual butterfly totals are as follows: European Skipper (148), Little Wood Satyr (56), Monarch (56), Cabbage White (37) and Clouded Sulphur (29). The most populous species for this transect was the European Skipper butterfly while the Cabbage White was only ranked as the 4$^{th}$ highest in terms of number of individuals. This transect could prove to be the most diverse in the future, when monitoring is done over several years for the entire recording season. The habitat types found on this transect include meadow, coniferous and deciduous forest, wet meadow/forest areas and plantations, which provide many different host plants for butterflies. The habitat in Transect #3 is more diverse than the other two transects, which could explain why it is not dominated by the Cabbage White butterfly.

One key species that was missing this summer from all transects was the Giant Swallowtail, which was prominent in 2006. This has also been noticed at the Guelph Arboretum, where Giant Swallowtails have been plentiful in past years and were absent this year.

### 5.3 Comparison of 2006 to 2009 Data

The following comparisons relate to data collected in transects #1 and #2 for both 2006 and 2009.

#### 5.3.1. Transect #1

The data collected from 2006 and 2009 is fairly similar. Both transects are mostly dominated by Cabbage White butterflies and have a good population of Monarchs, Common Wood Nymphs and/or Little Wood Satyrs. In 2006, 22 species were observed in this transect, while in 2009, 19 species were recorded. The number of individuals is

quite different (424 in 2006 and 279 in 2009) but this could be attributed to poor weather conditions experienced during 2009.

Overall, the diversity of butterfly species was maintained from 2006 to 2009, which is an indication that the habitat is being preserved. The individual numbers of butterflies decreased, but this can be attributed to the uncharacteristic weather conditions.

This transect contains a number of different habitat types (meadow, riparian, forest, cliffs and alvars) that host different butterfly species, which explains why this transect is the most diverse of the three.

### 5.3.2 Transect #2

The data for 2006 and 2009 is similar, as this transect has been dominated by the same three species in both years, which are the Cabbage White, Monarch and Clouded Sulphur. The area labeled as South Field in appendix H has been planted with alfalfa since 2007, which can account for the large number of Clouded Sulphur butterflies whose larvae use this plant as a host. Cabbage White butterfly larvae feed on a wide variety of plants from the mustard family, which are also prevalent in this transect.

The number of individuals observed in 2006 was 413, and 275 were recorded 2009. The decrease can also likely be explained by the poor weather conditions experienced this summer.

One key difference is that species diversity increased from 13 to 15 from 2006 to 2009, which did not occur on Transect #1. Several areas along Transect #2 have been left to regenerate starting in 2004 and have continued to the present year (see appendix G), which could be a reason why the diversity has increased. This transect runs mostly along a non-organic agricultural area, but since regeneration has occurred, more species have been able to prosper in this area. This trend should continue as more regeneration occurs in the future. Other restoration projects have found twice as many butterfly species after one year of treatment and 1.5 times as many after two years (Waltz and Covington, 2004). The results from this transect are not as dramatic, but this is the only transect in which an increase in species number occurred on the property.

The increase in butterfly diversity indicates the habitat is being maintained and even improved over time. As more regeneration occurs and more time passes, the number of species and individuals should be expected to increase with the growing plant diversity.

## 6.0 Conclusions

Butterfly diversity has been maintained on ***rare*** property since 2006, even though the individual numbers have declined. Butterfly habitats have been maintained or improved in Transects # 1 and #2 which enables the respective butterfly populations to continue thriving.

The decrease in butterfly numbers is probably due to the cooler, wetter weather conditions.

Baseline data was collected on Transect #3 this summer and future monitoring will determine what butterfly trends are present in that area. . The partial monitoring undertaken in 2009 has shown that butterfly species diversity and population numbers are high and it will be interesting to see what patterns develop after a full season of monitoring is completed.

## 7.0 Recommendations

An annual butterfly count should be done at ***rare*** every year in order to do a full assessment of the species found on the property, as some butterflies are found in specific habitats not included in the transect monitoring.

It is useful for those participating in the butterfly count to have butterfly identification skills. Therefore, if the timing works out, those wishing to partake in the count should take Jessica Grealey's butterfly workshop at the University of Guelph Arboretum, in order to learn how to catch and identify butterflies.

Butterfly monitoring should continue on all three transects every year, in order to continue documenting trends and remain consistent. Baseline data has been collected on transect #3 and it is imperative to continue collecting data in this area so conclusions may be drawn about butterfly populations there.

It is recommended that more land be left to regenerate or be actively restored on ***rare*** property and specifically in Transect #2 where multiple fields bordering the monitoring area are farmed with a mono-crop. As well, these fields are treated with pesticides, which is not ideal for butterfly populations and other flora or fauna. To further increase butterfly diversity and population levels, ***rare*** should attempt to continue to decrease the amount of pesticide applications on their agricultural fields.

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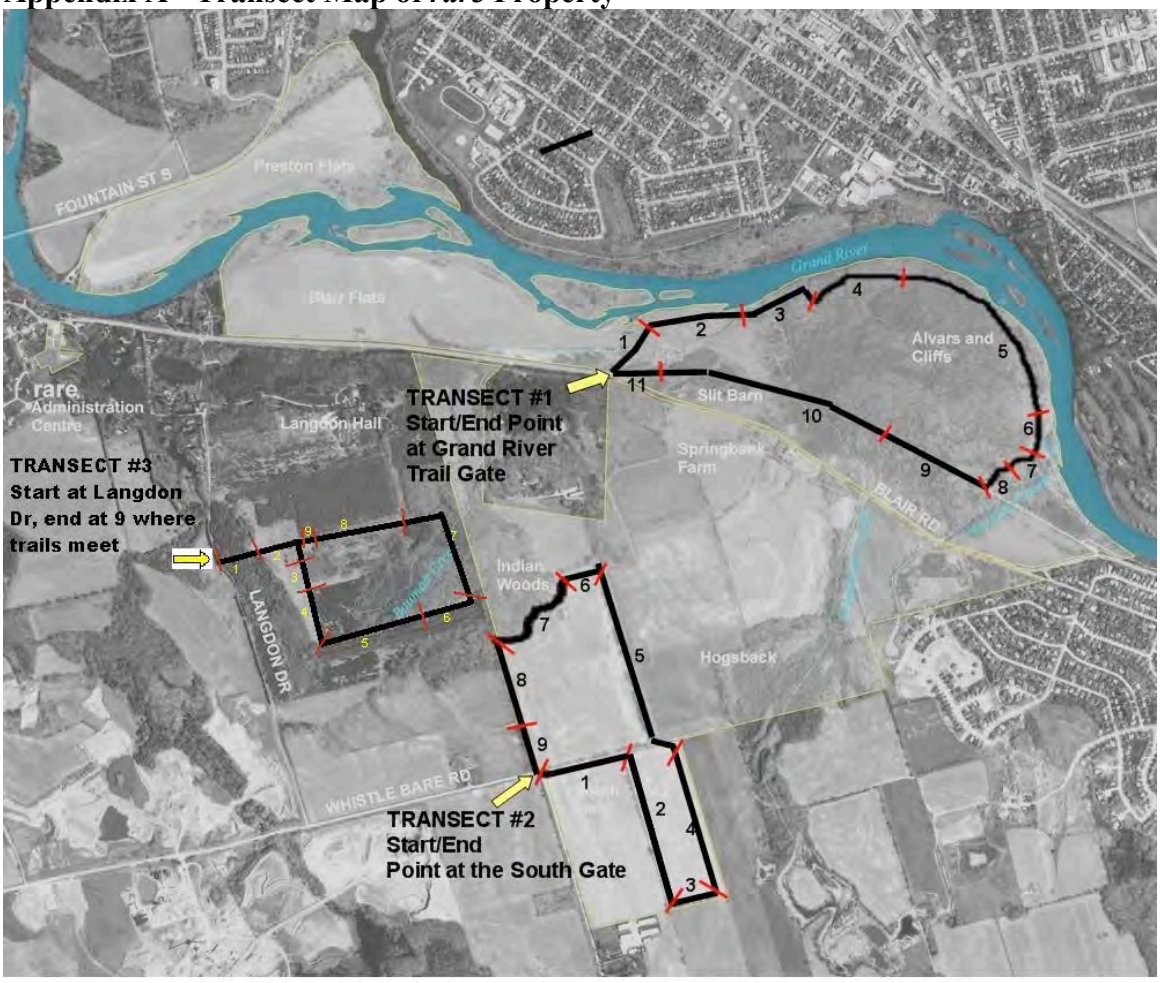
## Appendices

## Appendix A - Transect Map of *rare* Property



**Appendix B – Transect Descriptions**

**Transect One - Meadow/Cliffs & Alvars**

**Section one (N 43° 22.980’ W 80° 21.475’)**
- Grasslands
- Milkweeds
- Goldenrod

**Section two (N 43° 23.053’ W 80° 21.254’)**
- Riparian Meadow
- South side of transect- shrubs and trees

**Section three (N 43° 23.053’ W 80° 21.254’)**
- Riparian area with trees on south side
- Grasses/sedges
- Small shrubs
- Goldenrods

**Section four (N 43° 23.119’ W 80°21.037’)**
- Forest trail with open canopy areas
- Mainly conifers
- On cliffs

**Section five (N 43° 22.966’ W 80°20.605’)**
- Deciduous forest trail

**Section six (N 43° 22.767’ W 80°20.625’**
- Open shrub land

**Section seven (N 43° 23.016’ W 80° 20.650’)**
- Deciduous forest trail

**Section eight (N 43° 22.709’ W 80° 20.694’)**
- Open shrub land

**Section nine (N 43° 22.812’ W 80° 20.892’)**
- Blair trail-deciduous forest

**Section ten (N 43° 22.912’ W 80° 21.303’)**
- Blair trail-dense shrub growth on both sides of trail

**Section eleven (N 43° 22.927’ W 80° 21.552’)**
- Wetland on either side of trail

**Transect Two - Agricultural and Hedgerow**

**Section one (N 43° 22.192' W 080° 21.703')**

- Meadow-south side of transect
- Deciduous trees & shrubs- north side of transect
- Bordering alfalfa field

**Section two (N 43° 22.043' W 080° 21.555')**

- Hedgerow along a corn field edge
- Mostly open with some shrubs

**Section three (N 43° 21.915' W 080° 21.411')**

- Hedgerow of deciduous trees along a corn field edge

**Section four (N 43° 22.058' W 080° 21.401')**

- Open corn field

**Section five (N 43° 22.359' W 080° 21.585')**

- Deciduous hedgerow of mostly Oak spp.
- Bordering winter wheat field on east side
- Bordering corn field on west side

**Section six (N 43° 22.551' W 080° 21.735')**

- Hedgerow with deciduous trees, grapevines and tall grasses
- North and south of transect is corn

**Section seven (N 43° 22.459' W 080° 21.855')**

- Meadow bordered by deciduous trees (Indian Woods) to the North and corn to the south of transect

**Section eight (N 43° 22.296' W 080° 21.888')**

- Hedgerow of deciduous trees, mostly maple bordering corn field
- Shady areas

**Section nine (N 43° 22.215' W 080° 21.861')**

- Hedgerow of shrubs, vines, and grasses bordering corn field.

**Transect Three - Langdon Drive**

**Section one (N 43° 22.342' W 080° 22.374')**
- Coniferous forest – cedar, shrubs, ash
- Stop by swamp

**Section two (N 43° 22.358' W 080° 22.282')**
- Meadow species – milkweed, golden rod, grasses, sedges
- Stop at junction of trails

**Section three (N 43° 22.324' W 080° 22.272')**
- Black locust plantation and meadow
- Stop halfway

**Section four (N 43° 22.280' W 080° 22.253')**
- Meadow – milkweed, golden rod, grasses and sedges
- Spruce forest on east side
- Stop near single coniferous tree on west side

**Section five (N 43° 22.254' W 080° 22.172')**
- Spruce and deciduous forest
- Stop where wet area ends (will change from year to year)

**Section six (N 43° 22.288' W 080° 22.230)**
- Meadow – grasses and sedges
- Walnut plantation
- Stop halfway

**Section seven (N 43° 22.374' W 080° 22.390')**
- Langdon Hall trail
- Deciduous forest – sugar maple, beech and oak
- Woodland plants/flowers – may apple, solomon's seal, trillium, ferns
- Stop on cement bridge over Bauman Creek

**Section eight (N 43° 22.373' W 080° 22.189')**
- Laneway
- Deciduous forest – sugar maple, shrubs
- Stop near pile of logs

**Section nine (N 43° 22.362' W 080° 22.267')**
- Meadow – vetch, grasses and sedges
- Scattered trees and shrubs, golden rod
- Stop halfway before the junction of trails

**Appendix C – Sample Recording Form**

| Butterfly Recording Form- Southern Onta | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year: 2009 | Date: July 20 | | Recorder: C.Moore | | | | | |
| Site Name: rare Charitable Research Reserve Transect#3 | | | | | | | | |
| Start Time: 13:05 | End Time: 15:00 | | Start Temp: 23.1C | | | | | |
| Sun. 70% | Wind Speed: Light air | | | | | | | |
| | | | | | | | | |
| SECTION | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Appalachian Brown | | | | | | | | |
| Banded Hairstreak | | | | | | | | |
| Black Dash | | | | | | | | |
| Black Swallowtail | | | | | | | | |
| Broad-winged Skipper | | | | | | | | |
| Bronze Copper | | | | | | | | |
| Cabbage White | | 2 | 2 | 1 | | 1 | | |
| Clouded Sulphur | | | | 1 | | | | |
| Common Sooty Wing | | | | | | | | |
| Common Wood Nymph | | 4 | | | | 1 | | |
| Crossline Skipper | | | | | | | | |
| Delaware Skipper | | | | | | | | |
| Dun Skipper | | | | | | | | |
| Eastern Comma | | | | | | | | |
| Eastern Tailed Blue | | | | | | | | |
| Eastern Tiger Swallowtail | | | | 1 | | | | |
| European Skipper | | | | | | 1 | | |
| Eyed Brown | | | | | | | | |
| Giant Swallowtail | | | | | | | | |
| Great Spangled Fritillary | | | | | | | | |
| Hickory Hairstreak | | | | | | | | |
| Inornate Ringlet | | | | | | | | |
| Little Wood Satyr | | 1 | | | 1 | 3 | | 2 |
| Little Yeloo | | | | | | | | |
| Long Dash | | | | | | | | |
| Monarch | | 2 | 1 | 1 | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Mourning Cloak | | | | | | | | |
| Northern Broken Dash | | | | | | | | |
| Northern Crescent | | | | | 3 | | | |
| Northern Pearly Eye | | | 1 | | 4 | 3 | | |
| Orange Sulphur | | | | | | | | |
| Painted Lady | | | | | | | | |
| Pearl Cresent | | | | | | | | |
| Peck's Skipper | | | | | | | | |
| Question Mark | | | | | | | | |
| Red Admiral | | | | | | | | |
| Red Spotted Purple | | | | | | | | |
| Spring Azure | | | | | | | | |
| Striped Hairstreak | | | | | | | | |
| Summer Azure | | | | | | | | |
| Tawny Emperor | | | | | | | | |
| Tawny-edged Skipper | | | | | | | | |
| Viceroy | | | | | | | | |
| White Admiral | | | | | | | | |
| SECTION | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Sunshine | s&c | c | c | c | s&c | s&c | s&c | s&c |

Notes: Section 3 possible great spangled fritillary, incidentals: 1 black swallowtail (back garden at admin building in

## Appendix D – The Beaufort Wind Scale

## The Beaufort Wind Scale

| FORCE | DESCRIPTION | SPECIFICATIONS FOR USE ON LAND |
|---|---|---|
| 0 | Calm | Calm; smoke rises vertically. |
| 1 | Light air | Direction of wind shown by smoke drift, but not by wind vanes. |
| 2 | Light Breeze | Wind felt on face; leaves rustle; ordinary vanes moved by wind. |
| 3 | Gentle Breeze | Leaves and small twigs in constant motion; wind extends light flag. |
| 4 | Moderate Breeze | Raises dust and loose paper; small branches are moved. |
| 5 | Fresh Breeze | Small trees in leaf begin to sway; crested wavelets form on inland waters. |
| 6 | Strong Breeze | Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty. |
| 7 | Near Gale | Whole trees in motion; inconvenience felt when walking against the wind. |
| 8 | Gale | Breaks twigs off trees; generally impedes progress. |
| 9 | Severe Gale | Slight structural damage occurs chimney-pots and slates removed). |
| 10 | Storm | Seldom experienced inland; trees uprooted; considerable structural damage occurs. |
| 11 | Violent Storm | Very rarely experienced; accompanied by wide-spread damage. |
| 12 | Hurricane | -- |

**Appendix E – 2008 Annual Butterfly Count Results**

**Cambridge (Rare Charitable Research Reserve), ON.** Yr. 2, 43°22.9'N 80°21.3'W, center at center N of Blair Rd. about 1.7 mi E of jct. of Blair Rd. and Fountain St. in Cambridge. See 2006 report for habitats. Elevation: 928-928 ft. **13 July 2008**; 0930-1500 hrs; sun AM 76-100%, PM 51-75%; 15-28°F; wind 13-17 mi/hr. 14 observers in 5 parties. **Total party-hours** 6; **total party-miles on foot** 9. **Observers:** E. Barkley, M. Burrell, M. Cassidy, Jessica Grealey (709 Keatswood Cresent, WAterloo, ON N2T 2R6), S. Hentsch, C. Humphrey, K. Jackson, L. Lamb, G. Michalenko, M. Muir, G. Richardson, J. Turchin, M. Wolosinecky, L. Work.
Black Swallowtail 4, E. Tiger Sw. 19, Cabbage White 816, Clouded Sulphur 85, Orange Su. 10, Coral Hairstreak 15, Acadian Ha. 4, Banded Ha. 59, Hickory Ha. 1, Striped Ha. 20, E. Tailed-Blue 2, 'Summer' Spring Azure 2, Am. Snout 2, Gr. Spangled Fritillary 8, Meadow Fr. 2, Pearl Crescent 3, N. Cr. 12, Question Mark 2, E. Comma 1, Mourning Cloak 29, Am. Lady 4, Red Admiral 4, Red-spotted Admiral 12, Viceroy 1, Tawny Emperor 1, N. Pearly-eye 23, Eyed Brown 25, Appalachian Brown 3, Little Wood-Satyr 63, Com. Wood-Nymph 154, Monarch 14, Silver-spotted Skipper 2, European Sk. 127, Peck's Sk. 1, Tawny-edged Sk. 24, Long Dash 1, N. Broken-Da. 3, Delaware Sk. 15, Dion Sk. 2, Black Da. 6, Dun Sk. 8, Polygonia sp. 1. **Total** 42 species, 1,590 individuals.

The highlighted species are special to rare- they are highly local and not known in many places within the region.

**Appendix F – 2009 Annual Butterfly Count Results**

**Cambridge (Rare Charitable Research Reserve), ON.** Yr. 3, 43°22.9'N, 80°21.3'W, center at N of Blair Rd. about 1.7 mi E of jct. of Blair Rd. and Fountain St. in Cambridge. Floodplain;agricultural;old field; cliffs & alvars; hedgerows; old growth forest; early successional; roadside. **19 July 2009;** 1030-1530 hrs; sun AM 11-25%, PM 11-25%; 64-70°F; wind 13-24 mi/hr. 16 observers in 5 parties. **Total party-hours** 24; **total party-miles on foot** 9. **Observers:** E. Damstra, G. Grainge, Jessica Grealey (709 Keatswood Cresent, WAterloo, ON, N2T 2R6), K. Hodder, L. Lamb, C. Moore, I. Moore, S. O'Neil, C. Pomeroy, G. Richardson, J. Shea, V. Slocombe, B. Snider, C. Snider, E. Snider, W. Watson.
Black Swallowtail 1, E. Tiger Sw. 1, Cabbage White 151, Clouded Sulphur 25, Orange Su. 3, Coral Hairstreak 1, Banded Ha. 8, Gr. Spangled Fritillary 4, Pearl Crescent 12, N. Cr. 2, E. Comma 3, Gray Comma 1, Red Admiral 1, Red-spotted Admiral 1, Tawny Emperor 2, N. Pearly-eye 20, Eyed Brown 24, Appalachian Brown 11, Little Wood-Satyr 20, Com. Wood-Nymph 75, Monarch 11, Least Skipper 1, European Sk. 62, Peck's Sk. 1, Tawny-edged Sk. 2, Delaware Sk. 6, Broad-winged Sk. 1, Black Dash 1, Dun Sk. 12. **Total** 29 species, 463 individuals. **Field Notes:** Count originally scheduled for July 18th but was re-scheduled for the 19th. Conditions were not ideal (cool, overcast) but were consistent with the unusually cool and rainy weather experienced in southern ontairo this summer. On average, temperatures are 6 degrees celicus cooler.

## Appendix G – South Field Regeneration Areas at *rare*