# Beaverhill Bird Observatory Butterfly Internship: Summer 2019

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## How Butterfly Abundance is Affected by Wind Speed

**Abstract**

The Beaverhill Natural Area, outside of Tofield, Alberta, provides habitat and an area for studying many wildlife and insect species, such as the ecological and economically important butterfly. The purpose of this research is to analyze how changes in wind speed affect the overall abundance of the two most common species in the area, Greenish Blues (*Plebejus saepiolus*) and Northern Crescents (*Phyciodes cocyta*), as well as the total count of all butterflies seen this field season. Although the results are inconclusive, I offer insight into the caveats of the sampling method for this type of study, the introduction of confounding factors, and also the importance of continued surveying.

**Introduction**

Butterflies have immense ecological and economic importance. According to Butterfly Conservation Europe (2008), butterflies provide an aesthetic benefit to humans, contribute to ecotourism opportunities and therefore economic revenue, provide benefits to ecosystems such as pollination and pest control, and they can be an integral part of a thriving food chain. Butterflies can also act as an indicator species, meaning their abundance and diversity can be used as an indicator of the health of the ecosystem in which they are present (Ghazanfar 2016). Furthermore, it is evident that butterflies can be used as an indicator species for climate change as they are often sensitive to any changes in the climatic conditions or vegetation in their habitat (Manzoor *et al.* 2013). As a result of climate change, average hourly wind speed and high wind events are expected to increase in Canada (Cheng *et al.* 2014), which may further affect the ability of certain species of butterflies to survive and reproduce.

The Beaverhill Bird Observatory and Natural Area, established in 1984, is located approximately 8 kilometres east of Tofield, Alberta and provides habitat and an area for studying many wildlife and insect species. During the 1970s and throughout the late 1990's and 2000's, butterfly surveys have been conducted in the area (Flockhart 2002), which have been used to gain insight into the abundance and diversity of species present. The purpose of this study is to analyze how the most common butterfly species in the Beaverhill Natural Area respond to changes in wind speed. Through survey counts, it is evident that for this field season the most common species, those present for the longest time period and in the highest numbers, were Greenish Blues (*Plebejus saepiolus*) and Northern Crescents (*Phyciodes cocyta*). In addition, I aimed to determine how the total number of butterflies recorded on any given day was affected by wind speed. Davis and Garland (2002) and Brattström *et al.* (2008) show that certain species of butterflies tend to either avoid high wind speeds or remain close to the ground where wind has less of an effect. While Greenish Blues are generally weak fliers, Northern Crescents have a flap-glide flight pattern (Northwest Territories Environment and Natural Resources 2012), but their small size makes them susceptible to the negative effects of high winds such as increased energetic loss (Ancel *et al.* 2017). For these reasons, I expected that the abundance of the most common species, Greenish Blues and Northern Crescents, and the total count of butterflies would decrease with increasing wind speed.

In addition to these questions, the raw data produced throughout this study can also be used to further supplement or compare the previous data that has been gathered at the Beaverhill Bird Observatory in terms of species abundance and diversity.

**Methods**

A total of eleven surveys were conducted in the Beaverhill Natural Area on separate days between the months of May to August, 2019. All surveys, except two, were conducted alone. In order to address species abundance and diversity, a modified Pollard Walk butterfly count method was used. This method consists of walking along a fixed transect once per week, at a constant pace and only in favorable weather conditions (Pollard 1977). In this case, surveys were only to be conducted on days where wind speed was below 20km/h, temperature was above 15°C and excessive rain could be avoided, due to the believed inactivity of butterflies in such conditions.

During each Pollard Walk survey, species were counted and identified using sight, and when possible, captured using a net. Any species captured would be carefully placed into a clear plastic bag and photographed to show fore- and hindwings on both the dorsal and ventral sides. Species identification was confirmed by comparing the field photographs to images and characteristics described in *Alberta Butterflies* (Bird *et al.* 1995). Species were only recorded as "unidentified" when they could not be correctly identified by sight due to distance or speed and capture could not take place.

While at the Beaverhill Bird Observatory, wind speed at the beginning and end of each survey was recorded using the Beaufort Scale in kph. In addition to recording wind speed, metadata including temperature and cloud cover were also recorded at the beginning and end of each survey. One survey consisted of two transects, loop A and loop B, with which the start and end time of each loop was also recorded. Loop A travelled through shrubland, forest and grassland, while loop B travelled through open woodland, forest and wetland habitats (Figure 1). All such survey dates and times, species identifications and counts, wind speed data and metadata were recorded in an excel spreadsheet.

Additional wind speed data was later gathered using the Alberta Agriculture and Forestry Current and Historical Alberta Weather Station Data Viewer (Alberta Agriculture and Forestry 2019). Using the Weather Station Data Viewer, the "Shonts AGCM Weather Station" location, "wind speed at 2m (km/h)" category and a period of "hourly (from Sept 2008)" were all selected for each individual date on which surveys occurred. Using the table produced, only the "wind speed at 2m (km/h)" per hour-long period in which more than 25 consecutive minutes of survey time occurred were averaged. This produced one average wind speed for each survey date. Using Excel, this average wind speed per survey was then plotted against the total count of all butterfly sightings, Greenish Blues, and Northern Crescents. For both Greenish Blues and Northern Crescents only survey dates on which specimens were present were included.


**Figure 1.** Loop A and loop B transect routes for the 2019 Beaverhill Bird Observatory Pollard Walk butterfly count (provided by Steve Andersen).

**Results**

The relationship between both Greenish Blues and Northern Crescents and wind speed is marginally positive, whereas the relationship between the total count of all butterflies and wind speed is marginally negative. However, an $R^2$ value of 0.0583 indicates that the variation in the total count of Greenish Blues is not explained by increasing wind speed (Figure 2). The slight increase in the number of Northern Crescents is only weakly correlated with an increase in wind speed, as seen by an $R^2$ value of 0.3339 (Figure 3). Again, an $R^2$ value of 0.0363 indicates that the variation in the total count of all butterflies at the Beaverhill Bird Observatory cannot be explained by an increase in wind speed (Figure 4).

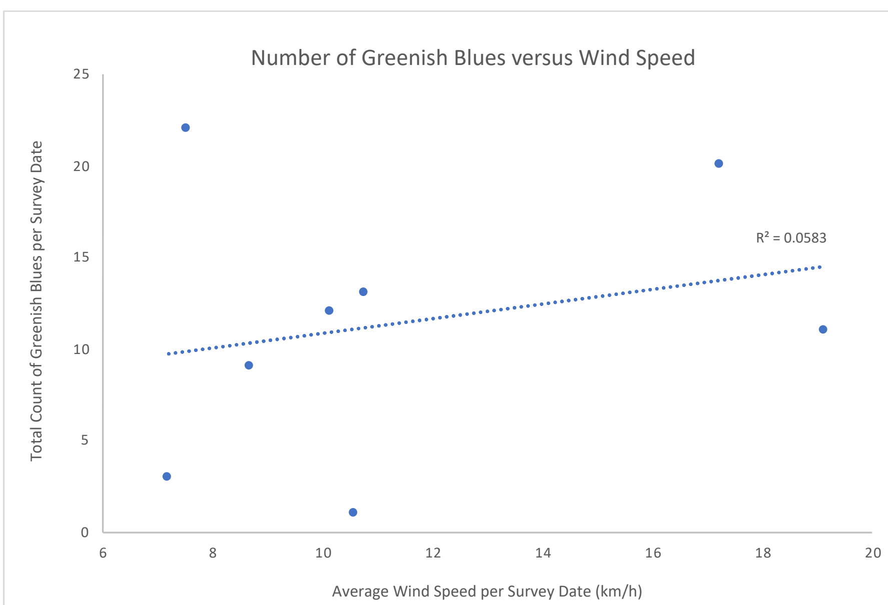


**Figure 2.** Total count of Greenish Blues (*Plebejus saepiolus*) versus the average wind speed (km/h) per survey date.

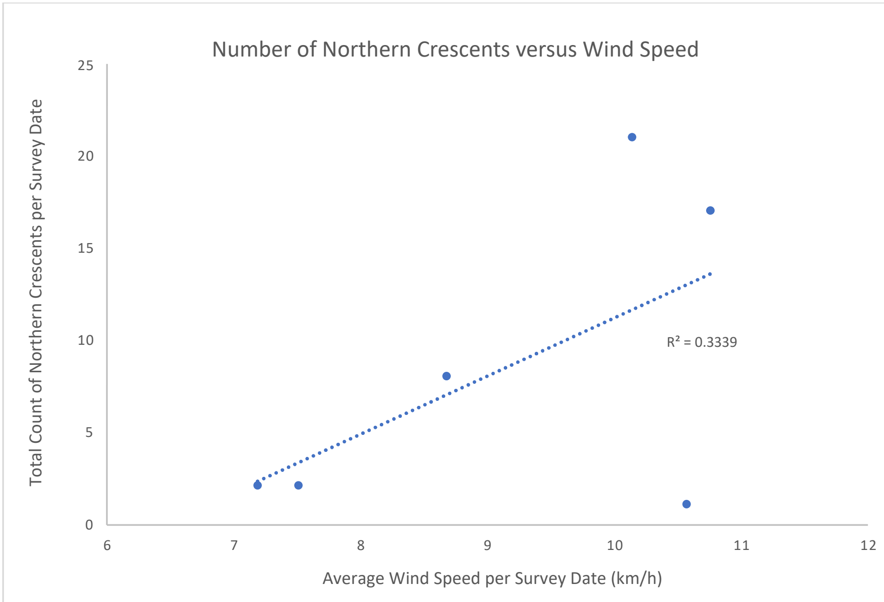


**Figure 3.** Total count of Northern Crescents (*Phyciodes cocyta*) versus the average wind speed (km/h) per survey date.

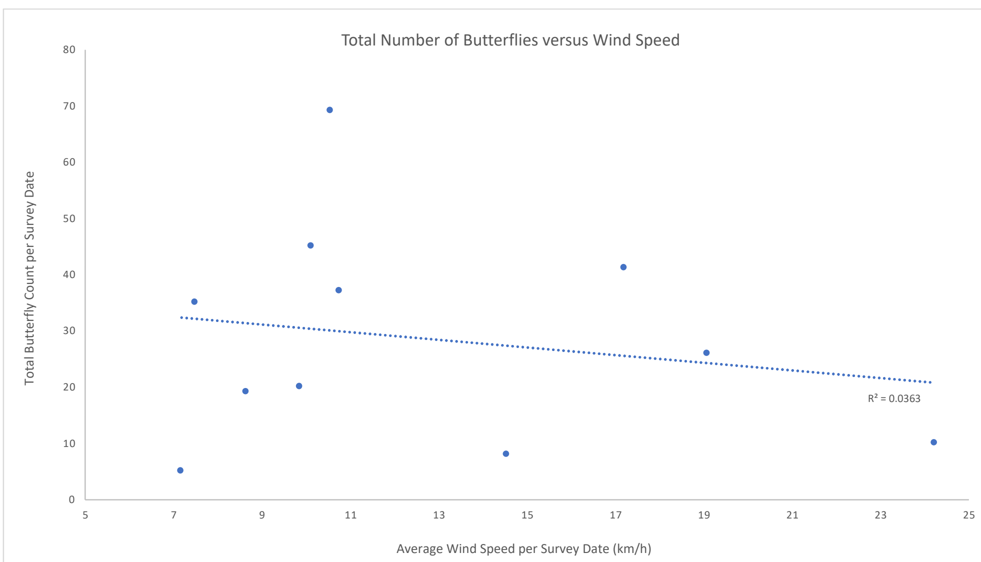


**Figure 4.** Total count of all butterflies versus the average wind speed (km/h) per survey date.

## Discussion

Since wind speed is expected to increase with climate change (Cheng *et al.* 2014), land clearing and disturbance (Pugh 2017), and can change with the successional state of an area, it is important to know how butterfly species will react to such changes. For example, high wind speeds may have the potential to decrease a butterfly's ability to feed and mate, as they may be unable to fly. While other species may be well adapted to higher wind speeds, both Greenish Blues (*Plebejus saepiolus*) and Northern Crescents (*Phyciodes cocyta)*, are generally "weak" fliers. For this reason, I predicted that their abundance would decrease with increasing wind speed. I also predicted that the overall count of all butterflies during my surveys at the Beaverhill Bird Observatory would follow the same trend.

While Greenish Blues and Northern Crescents both slightly increased with increasing wind speed, the relationship was not significant enough to state that wind was the sole cause. The slightly stronger correlation between wind speed and Northern Crescent numbers may be explained by a lower surveyed top wind speed, as no samples occurred where wind speed exceeded 20km/h for Greenish Blues, 11km/h for Northern Crescents, and 25km/h for all butterfly species. Without such samples, it is therefore more difficult to accurately determine if their numbers would decrease with a further increase in wind speed. The abundance of both species, Greenish Blues and Northern Crescents, may also follow a bell-curve shape with regards to wind speed, where they show preference for intermediate speeds. However, the total number of all butterflies recorded did slightly decrease with increasing wind speed, though not significantly. While my results did not conclusively support my hypotheses, several confounding factors and sampling errors were also introduced.

Factors such as temperature and cloud cover act together to affect butterfly numbers, but were not taken into consideration during data analysis. As well, the time of year during which the surveys took place was also not considered. Butterfly numbers are not constant over time, instead their abundance occurs in a more bell-curved fashion. Taking into consideration the survey date could potentially produce drastically different results. In addition, during a three-week period at the beginning of August surveys did not take place, which may have caused a misrepresentation of the most common species and an underestimation of species total counts. The total count of Greenish Blues may have also been underestimated during particular surveys, as the positive identification of certain specimens as Greenish Blues or other, similar looking species of Blues, did not take place. Such specimens were then recorded as "unidentified" but still counted towards the total number of butterflies observed on that survey date. Surveying more than once-per-week would also increase the significance of any results, as many species may be missed or underestimated solely due the small sample size.

Lastly, it has been noted that during this field season central Alberta experienced higher than average precipitation and rain events (Classen 2019), as well as a late spring. These weather extremes may have affected the overall abundance and diversity of species present as well as their phenology and timing of emergence. Certain species such as Milbert's Tortoiseshell, Dreamy Duskywing, and Gray Commas were not observed this year, but have been recorded in previous years (Flockhart 2000; Sandrowski 2016; Vehring 2014; Golly 2018) and may be explained by the extreme weather conditions. For example, Rodriguez *et al.* (1994) shows that any change in precipitation and water availability can result in changes in butterfly larvae survival rates due to changes in vegetation they rely upon.

Standardized surveys have been invaluable in terms of comparing the abundance and diversity of different species present in the Beaverhill Natural Area for many years. However, further surveys should be conducted in the area in order to better determine how climatic conditions such as wind speed, precipitation, temperature and cloud cover, vegetation states, or disturbance may result in changes to biodiversity and overall abundance. Although not possible in the Beaverhill Natural Area, I would suggest that a manipulative experiment be performed where all factors except wind speed, including the number of butterflies examined, are kept constant. Other beneficial research that could potentially be conducted would be to examine how the abundance of butterflies of different sizes and flight patterns differs with varying wind speeds.

**Raw Data**

I have included in this report my raw data, located in Appendix 1, for future use by students and staff to gain a better understanding of the abundance and diversity of butterflies at the Beaverhill Bird Observatory.

**Acknowledgements**

I would like to thank my mentor, Steve Andersen, for showing me how to succeed with this project and for taking the time to answer all of my questions. I would also like to thank John Acorn for meeting with me to discuss the wonder that is butterflies and for providing me with great insight into their behaviour and flight patterns. Lastly, I would like to thank all the staff at the Beaverhill Bird Observatory for making it such a wonderful and educational place to visit as well as the SCiP (Serving Communities Internship Program) for funding students' research and helping them start their careers!

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# Appendix 1 - Raw Data

| | Species Common Name | 20-May | 27-May | 04-Jun | 11-Jun | 16-Jun | 29-Jun | 03-Jul | 12-Jul | 14-Jul | 26-Jul | 20-Aug | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **Red-Disked Alpine** | 1 | | | | | | | | | | | 1 |
| 2 | **Cabbage White** | 6 | 8 | | | | | | | | | | 14 |
| 3 | **Mourning Cloak** | 2 | 3 | 1 | | | | | | | | | 6 |
| 4 | **Spring Azure** | | 2 | | | | | | | | | | 2 |
| 5 | **Canadian Tiger Swallowtail** | | 4 | 6 | 4 | 1 | | | | | | | 15 |
| 6 | **Arctic Skipper** | | | 1 | | | | | | | | | 1 |
| 7 | **Common Alpine** | | | 2 | 3 | 2 | 1 | | | | | | 8 |
| 8 | **Greenish Blue** | | | 11 | 20 | 22 | 9 | 3 | 13 | 12 | 1 | | 91 |
| 9 | **Silvery Blue** | | | | 3 | 2 | | | | | | | 5 |
| 10 | **Mustard White** | | | | 5 | 1 | | | 1 | | 9 | | 16 |
| 11 | **Clouded Sulphur** | | | | 5 | 1 | | | | | 33 | 5 | 44 |
| 12 | **Hobomok Skipper** | | | | | 1 | | | | 1 | | | 2 |
| 13 | **Northern Crescent** | | | | | 2 | 8 | 2 | 17 | 21 | 1 | | 51 |
| 14 | **Common/Inornate Ringlet** | | | | | 1 | | | 4 | 5 | 3 | | 13 |
| 15 | **White Admiral** | | | | | | 1 | | 1 | 3 | | | 5 |
| 16 | **Great Spangled Fritillary** | | | | | | | | 1 | | 2 | | 3 |
| 17 | **European Skipper** | | | | | | | | | 3 | 18 | | 21 |
| 18 | **Common Wood Nymph** | | | | | | | | | | 2 | 1 | 3 |
| 19 | **Western White** | | | | | | | | | | | 2 | 2 |
| | **Unidentified** | 1 | 3 | 5 | 1 | 2 | | | | | | | 12 |
| | **Total Sightings** | 10 | 20 | 26 | 41 | 35 | 19 | 5 | 37 | 45 | 69 | 8 | |
| | **Start Time** | 15:03 | 14:50 | 12:09 | 12:44 | 14:46 | 11:16 | 13:25 | 14:02 | 13:25 | 13:49 | 11:27 | |
| | **Start Temperature (°C)** | 18.5 | 23.0 | 17.0 | 19.0 | 21.7 | 13.0 | 16.2 | 23.5 | 22.5 | 23.0 | 17.0 | |
| | **Start Cloud Cover (%)** | 30% | 5-10% | 30% | 30% | 15-20% | 5% | 80-90% | 5% | 30% | 5% | 0% | |
| | **Start Wind (Beaufort Scale)** | 4 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | |
| | **End Time** | 16:08 | 16:07 | 13:11 | 14:05 | 16:27 | 13:08 | 14:53 | 16:10 | 15:37 | 15:51 | 12:33 | |
| | **End Temperature (°C)** | 17.0 | 23.9 | 16.9 | 19.8 | 22.7 | 13.0 | 16.6 | 24.1 | 24.2 | 23.0 | 19.2 | |
| | **End Cloud Cover (%)** | 60% | 5-10% | 70% | 60% | 30% | 80-90% | 80% | 15% | 5-10% | 5% | 0% | |
| | **End Wind (Beaufort Scale)** | 4 | 2 | 3 | 3 | 1 | 2 | 3 | 3 | 2 | 3 | 3 | |