


# The Butterflies of Waterloo Region

## An Annotated Checklist, a Species Scarcity Ranking, and a Transect-Based Analysis of Urban vs. Rural Populations

Jessica E. Linton

**2012**

Toronto Entomologists' Association

ISBN 0-921631-38-5

Author's Note

I am employed by Natural Resource Solutions Inc. in Waterloo as a Terrestrial and Wetland Biologist and Project Manager (jlinton@nrsi.on.ca). This is a condensed version of Grealey (2010), my thesis for the Master in Environmental Studies thesis degree at the University of Waterloo, with a few updates for 2010 and 2011 records. Jessica Grealey was my maiden name. The thesis was completed under the direction of Dr. Stephen Murphy and Dr. Brendon Larson. Thanks are due to more people than I can name, but I would especially like to mention Craig Campbell, Larry Lamb, John Powers and the late Frank Stricker.

The scientific names employed for the butterflies throughout this study are based on Pelham (2008). Common names follow Layberry et al. (1998) except that "gray" is substituted for "grey" to conform to the current trend to use continentally-consistent names (thus, Gray Comma and Gray Hairstreak). Both the common name and scientific name are provided the first time a species is mentioned, but only scientific names are used thereafter.

All of the data collected for this study has been contributed to the Toronto Entomologists' Association for use in its new butterfly atlas project.

Cover Photos: Tawny Emperor (*Asterocampa clyton*) and the Giant Swallowtail (*Papilio cresphontes*) taken by the author.

---

## 1. INTRODUCTION

The Region of Waterloo is located in southwestern Ontario, Canada. It encompasses the cities of Kitchener, Waterloo, Cambridge, and four surrounding townships.

This paper seeks to answer the following questions about butterflies in the Region:

1. What species of butterflies are uncommon or rare? How has their presence/absence changed over the last 80 years?
2. How do different land uses affect butterfly abundance and diversity?

In order to answer the first question above, section 2 (pp. 2 – 22) reviews data on butterfly presence/absence and assigns each butterfly species a regional status. This results in the identification of 46 uncommon and rare species. In addition a review of butterfly observations from 1929 to 2010 and interviews with local butterfly experts provide a long-term perspective.

The second question is addressed in section 3 (pp. 22 – 34). This section examines changes in butterfly abundance and diversity in areas of different land use to determine how different land uses are potentially affecting butterfly communities. Overall butterfly abundance was observed to be highest in industrial areas and lowest within golf courses and residential areas. Overall butterfly diversity was greatest in Environmentally Sensitive Policy Areas (ESPAs), which are designated in the Region of Waterloo's Official Policies Plan (Region of Waterloo 2006c). ESPAs also provide habitat for the highest number of rare and uncommon species. This provides some evidence that current regional policies for protecting rare species are effective.

## 2. SPECIES CHECKLIST WITH ASSESSMENT OF POPULATION STATUS

With a population of approximately 478, 000 people, Waterloo Region is the 10th largest urban area in Canada and the 4th largest in Ontario. The population is expected to exceed half a million people by the year 2016. The Region consistently ranks as one of the fastest growing communities in Canada (9% from 2001 to 2006). Residential development continues to grow even faster than the population due to declines in family size (Region of Waterloo 2006a).

Currently, agriculture represents 65% of land use activities in the Region, whereas urban centres represent 21.4% (C. Rumig pers. comm. 2010). Agriculture surrounds the urban centres of Kitchener, Waterloo, and Cambridge. In 2006, Woolwich Township accounts for almost one third of all farm land (Region of Waterloo 2006b).

Natural habitats have been preserved within 80 ESPAs, which represent approximately 4.9% of land within the Region (C. Rumig pers. comm. 2010). These are designated in the Region of Waterloo's Official Policies Plan, which stipulates that some types of development are prohibited within these areas (Region of Waterloo 2006c).

The remaining 8.7% of land area within the Region is represented by a variety of land uses including rural residential, natural habitats on private lands, city-owned natural areas, aggregate extraction, and recreational areas such as golf courses outside the urban boundary.

### Butterfly Observation Data

A total of 4,433 records of butterfly observations in the Region for 1929-2011 were obtained from the following sources:

- Toronto Entomologists' Association (Lepidoptera Summaries for the years 1969-2010);
- Natural Heritage Information Centre (NHIC 2010);
- Canadian Biodiversity Information Facility (Government of Canada 2003);
- E.L. James Collection at the University of Waterloo;
- University of Guelph Insect Collection;
- Canadian National Insect Collection records (Government of Canada 2003);
- Royal Ontario Museum Collection records (Government of Canada 2003);
- Private collection of Lawrence Lamb;
- Waterloo County Butterfly Checklist (Lamb 1967);
- Private collection of Dr. John K. Morton;
- Private collection and field notes of Frank Stricker;
- Field notes, private collection, and various papers by Craig Campbell;
- Annual monitoring data from the rare Charitable Research Reserve (Grealey 2006; Moore 2009 and 2010);
- North American Butterfly Association (NABA) Cambridge Butterfly Count data (Grealey & Lamb 2006-2010);
- Field notes and personal observations of the author.

These records show that of the three hundred butterfly species known to occur in Canada (Hall 2009), over one-third (102 species) have occurred in the Region of Waterloo at some point in time. Of these, 68 species have been confirmed to be present within the last 5 years (2006-2011). See Appendix A (pp. 37-41) for a complete checklist.

**Relative Abundance or Scarcity**

Each species was assigned a regional status based on the number and distribution of known sites within the Region (Table 1).

**Table 1. Regional Population Status Definitions**

| Regional Population Status | Definition |
|---|---|
| Very Common | Known from 30 or more sites. |
| Common | Known from 20-29 sites. |
| Uncommon | Known from 11-19 sites. |
| Rare | Known from 10 or less sites. |
| Extirpated | Formerly a resident, but currently is not known to occupy any sites within the Region. |
| Unknown | Not enough data available to assign a status at this time |

The thresholds identified for assigning regional statuses are subjective, so they were determined with input from local experts (A. Wormington pers. comm. 2010; L. Lamb pers. comm. 2010; C. Campbell pers. comm. 2010).

For consistency, these methods are based on similar undertakings in the nearby Regions of Hamilton (Wormington and Lamond 2003) and Halton (Wormington 2006), although there are some differences to account for differences in the data sets. This included using an additional status of 'very common' to account for species that were known from comparatively more sites and are frequently observed throughout the Region. A 'site' is defined as a location that is separated from any other site by at least 1 kilometer (Wormington and Lamond 2003; Wormington 2006). In addition to this modification in terms of the number of known sites, I also modified the methodology by considering the following information when assigning a regional status:

- Published life history and distribution information (Layberry et al. 1998; Hall 2009);
- current status in Ontario (NHIC 2010);
- last known observation date; and
- status information available for nearby localities (Wormington and Lamond 2003; Wormington 2006).

A total of 81 species were assigned regional statuses:

- Twenty-one butterfly species were assigned a regional status of 'very common.' These species, which included permanent residents and seasonal colonists, have been observed at 30 or more sites across the Region and have been consistently observed over time up until 2010.
- Thirteen species of butterfly were assigned a regional status of 'common.' These species, also permanent residents and seasonal colonists, have been observed at between 20 and 29 separate sites and all but one species, the White Admiral (*Limenitis arthemis arthemis*), have been consistently observed over time until 2010. Based on the recent decline in observations apparent through the records review and discussions with local experts (L. Lamb and C. Campbell), the White Admiral was assigned a regional status of 'uncommon.'
- Another eighteen permanent residents and one immigrant were assigned a regional status of 'uncommon.' The majority of these species were assigned this status based on the number of separate locations where they have been observed (11-19). Two species, the

Milbert's Tortoiseshell (*Aglais milberti*) and Gray Comma (*Polygonia progne*), were also assigned a status of 'uncommon' despite the fact that they are known from more than 19 sites. This status reassignment was based on the consideration that the vast majority of records for these species were collected prior to the mid-1980s. In the last 5 years the Milbert's Tortoiseshell has only been observed 7 times at four sites and the Gray Comma has only been observed once.

- Twenty eight butterfly species were assigned a regional status of 'rare' permanent residents, seasonal colonists, or immigrants. For the majority of these species (23) this status assignment was based on the number of sites (10 or less). The remaining 5 species, the Variegated Fritillary (*Euptoieta claudia*), Aphrodite Fritillary (*Speyeria aphrodite*), Pink-edged Sulphur (*Colias interior*), Meadow Fritillary (*Boloria selene*) and Baltimore Checkerspot (*Euphydryas phaeton*), were also assigned a status of 'rare' due to the historical nature of records for these species.
- One species, the Wild Indigo Duskywing (*Erynnis baptisiae*) was assigned a regional status of 'unknown.' This species was observed in the Region for the first time in 2010 and it is too early to tell if this species has established permanent colonies in the Region.

I also make a distinction between species which live permanently in the Region and overwinter here (residents) and those that migrate through the area and do not overwinter here (Table 2).

**Table 2. Definitions for Butterfly Residency**

| Status | Definition |
|---|---|
| Permanent Resident | Long-term populations are present and species is known to overwinter in the Region. |
| Temporary Resident | Long-term populations do not exist; however the species will overwinter and set up temporary colonies. |
| Former Resident (Extirpated) | A species was formerly known to be a resident but is no longer found within the Region. |
| Immigrant | A species that is not capable of overwintering in the Region but migrates here from another area. Generally these species do not reproduce because larval food plants are scarce or absent. Some immigrants arrive annually whereas others only appear sporadically. |
| Seasonal Colonist | A species that migrates to the Region and successfully reproduces, however they cannot overwinter here. |

Finally, butterflies are also classified as specialists or generalists. For the purposes of this study, 'generalists' are species which occur in a variety of habitat types including disturbed areas. The larvae of generalist species will feed on several different plants, often represented by several genera or plants that are widespread and abundant in a variety of habitats. 'Specialists' are defined as species that occur within a specific habitat type and are unlikely to occur in disturbed areas. Their larvae will usually have one or more specific foodplants represented by the same genus or family. Butterflies which are known specialists (Layberry et al. 1998; Hall 2009) are indicated as such in the table below.

***Species Scarcity Rankings—Regional and Provincial***

Table 3 indicates, for 81 species, the following information: regional rankings assigned by this study; provincial rankings (S-rank) assigned to each species by the Natural Heritage Information Centre; regional residency status; and the classification as a specialist vs. a generalist. The S-rank categories are: S2, imperiled; S3, vulnerable; S4, apparently secure; S5, secure; and SNA – not applicable. Residency statuses are classified as: PR, permanent resident; SM, seasonal colonist; IM, immigrant; PE, possibly extirpated; and UN, unknown.

**Table 3. Population Status Assignment of Butterfly Species found in Waterloo Region (sorted by status)**

| Family | Species name | Common Name | SRANK[1] | Regional Residency | Regional Status | Specialist[2] |
|---|---|---|---|---|---|---|
| HESPERIIDAE | *Euphyes vestris* | Dun Skipper | S5 | PR | Very Common | |
| | *Thymelicus lineola*** | European Skipper | SNA | PR | Very Common | |
| | *Polites peckius* | Peck's Skipper | S5 | PR | Very Common | |
| | *Poanes viator* | Broad-Winged Skipper | S4 | PR | Common | √ |
| | *Anatrytone logan* | Delaware Skipper | S4 | PR | Common | |
| | *Poanes hobomok* | Hobomok Skipper | S5 | PR | Common | √ |
| | *Wallengrenia egeremet* | Northern Broken-Dash | S5 | PR | Common | |
| | *Polites themistocles* | Tawny-edged Skipper | S5 | PR | Common | |
| | *Euphyes conspicua* | Black Dash | S3 | PR | Uncommon | |
| | *Ancyloxypha numitor* | Least Skipper | S5 | PR | Uncommon | |
| | *Pompeius verna* | Little Glassywing | S4 | PR | Uncommon | √ |
| | *Polites mystic* | Long Dash Skipper | S5 | PR | Uncommon | |
| | *Epargyreus clarus* | Silver-spotted Skipper | S4 | PR | Uncommon | |
| | *Carterocephalus palaemon* | Arctic Skipper | S5 | PR | Rare | |
| | *Erynnis lucilius* | Columbine Duskywing | S4 | PR | Rare | √ |
| | *Pholisora catullus* | Common Sootywing | S3 | PR | Rare | |
| | *Polites origenes* | Crossline Skipper | S4 | PR | Rare | |
| | *Euphyes dion* | Dion Skipper | S3 | PR | Rare | √ |
| | *Erynnis icelus* | Dreamy Duskywing | S5 | PR | Rare | |
| | *Hylephila phyleus* | Fiery Skipper | SNA | SM | Rare | |
| | *Erynnis juvenalis* | Juvenal's Duskywing | S5 | PR | Rare | |
| | *Poanes massasoit* | Mulberry Wing | S4 | PR | Rare | √ |
| | *Thorybes pylades* | Northern Cloudywing | S5 | PR | Rare | √ |
| | *Erynnis baptisiae* | Wild Indigo Duskywing | S4 | PR | Unknown | |
| LYCAENIDAE | *Lycaena hyllus* | Bronze Copper | S5 | PR | Very Common | √ |
| | *Celastrina neglecta* | Summer Azure | S5 | PR | Very Common | |

| Family | Species name | Common Name | SRANK[1] | Regional Residency | Regional Status | Specialist[2] |
|---|---|---|---|---|---|---|
| | *Celastrina ladon* | Spring Azure | S5 | PR | Common | |
| | *Satyrium acadica* | Acadian Hairstreak | S4 | PR | Uncommon | |
| | *Satyrium calanus* | Banded Hairstreak | S4 | PR | Uncommon | |
| | *Satyrium titus* | Coral Hairstreak | S5 | PR | Uncommon | |
| | *Cupido comyntas* | Eastern Tailed Blue | S5 | PR | Uncommon | |
| | *Satyrium liparops* | Striped Hairstreak | S5 | PR | Uncommon | |
| | *Lycaena dorcas* | Dorcas Copper | S5 | PR | Rare | √ |
| | *Callophrys niphon* | Eastern Pine Elfin | S5 | PR | Rare | √ |
| | *Satyrium edwardsii* | Edwards' Hairstreak | S4 | PR | Rare | √ |
| | *Feniseca tarquinius* | Harvester | S4 | PR | Rare | √ |
| | *Satyrium caryaevorus* | Hickory Hairstreak | S3 | PR | Rare | |
| | *Lycaena helloides* | Purplish Copper | S3 | PR | Rare | |
| NYMPHALIDAE | *Cercyonis pegala* | Common Wood-Nymph | S5 | PR | Very Common | |
| | *Polygonia comma* | Eastern Comma | S5 | PR | Very Common | |
| | *Lethe eurydice* | Eyed Brown | S5 | PR | Very Common | |
| | *Speyeria cybele* | Great Spangled Fritillary | S5 | PR | Very Common | |
| | *Megisto cymela* | Little Wood-Satyr | S5 | PR | Very Common | |
| | *Boloria bellona* | Meadow Fritillary | S5 | PR | Very Common | |
| | *Danaus plexippus* | Monarch | S2N,S4B | SM | Very Common | |
| | *Nymphalis antiopa* | Mourning Cloak | S5 | PR | Very Common | |
| | *Polygonia interrogationis* | Question Mark | S5 | SM | Very Common | |
| | *Vanessa atalanta* | Red Admiral | S5 | SM | Very Common | |
| | *Limenitis archippus* | Viceroy | S5 | PR | Very Common | |
| | *Vanessa virginiensis* | American Lady | S5 | SM | Common | |
| | *Coenonympha tullia* | Common Ringlet | S5 | PR | Common | |
| | *Lethe anthedon* | Northern Pearly-Eye | S5 | PR | Common | √ |
| | *Vanessa cardui* | Painted Lady | S5 | SM | Common | |

| Family | Species name | Common Name | SRANK[1] | Regional Residency | Regional Status | Specialist[2] |
|---|---|---|---|---|---|---|
| | *Phyciodes tharos* | Pearl Crescent | S4 | PR | Common | |
| | *Limenitis arthemis astyanax* | Red-Spotted Purple | S5 | PR | Common | |
| | *Limenitis arthemis arthemis* | White Admiral | S5 | PR | Uncommon | |
| | *Polygonia progne* | Gray Comma | S5 | PR | Uncommon* | |
| | *Aglais milberti* | Milbert's Tortoiseshell | S5 | PR | Uncommon* | |
| | *Lethe appalachia* | Appalachian Brown | S4 | PR | Uncommon | √ |
| | *Junonia coenia* | Common Buckeye | SNA | IM | Uncommon | |
| | *Nymphalis l-album* | Compton Tortoiseshell | S5 | PR | Uncommon | |
| | *Phyciodes cocyta* | Northern Crescent | S5 | PR | Uncommon | |
| | *Asterocampa clyton* | Tawny Emperor | S2S3 | PR | Uncommon | √ |
| | *Euphydryas phaeton* | Baltimore Checkerspot | S4 | PR | Rare* | √ |
| | *Boloria selene* | Silver-bordered Fritillary | S5 | PR | Rare* | |
| | *Speyeria aphrodite* | Aphrodite Fritillary | S5 | PR | Rare* | |
| | *Euptoieta claudia* | Variegated Fritillary | SNA | IM | Rare* | |
| | *Libytheana carinenta* | American Snout | SNA | SM | Rare | √ |
| | *Speyeria atlantis* | Atlantis Fritillary | S5 | PR | Rare | |
| | *Chlosyne nycteis* | Silvery Checkerspot | S5 | PR | Rare | |
| | *Phyciodes batesii* | Tawny Crescent | S4 | PR | Rare | √ |
| PAPILIONIDAE | *Papilio polyxenes* | Black Swallowtail | S5 | PR | Very Common | |
| | *Papilio glaucus* | Eastern Tiger Swallowtail | S5 | PR | Very Common | |
| | *Papilio cresphontes* | Giant Swallowtail | S3 | PR | Uncommon | |
| PIERIDAE | *Pieris rapae*** | Cabbage White | SNA | PR | Very Common | |
| | *Colias philodice* | Clouded Sulphur | S5 | PR | Very Common | |
| | *Colias eurytheme* | Orange Sulphur | S5 | PR | Very Common | |
| | *Colias interior* | Pink-edged Sulphur | S5 | PR | Rare* | √ |

| Family | Species name | Common Name | SRANK[1] | Regional Residency | Regional Status | Specialist[2] |
|---|---|---|---|---|---|---|
| | *Pontia protodice* | Checkered White | SNA | SM | Rare | |
| | *Pyrisitia lisa* | Little Yellow | SNA | IM | Rare | |
| | *Pieris oleracea* | Mustard White | S4 | PE | PE | |

*Denotes that status was assigned not just in terms of number of sites, but through consideration of the apparent decline of records and discussions with local experts

**Denotes non-native species

[1]NHIC 2010; [2]Based on information in Layberry et al. (1998)

**LEGEND**

| Provincial Rank (SRANK) | Residency |
|---|---|
| S2- Imperiled | PR- Permanent Resident |
| S3- Vulnerable | SM- Seasonal colonist |
| S4- Apparently Secure | IM- Immigrant |
| S5- Secure | PE- Possibly Extirpated |
| SNA- Not applicable | UN- Unknown |

A total of 21 species of butterfly were excluded from the Regional status assignment. This was due to a number of considerations, most notably that all of these species had been observed 5 or fewer times in the Region and all existing records were more than 40 years old. It is possible that some of these records are misidentifications and most are rare strays from their known Canadian range. It most cases specimens were no longer available. These exclusions are presented in Table 4. If observed in the Region today, their presence would be considered significant.

**Table 4. Butterfly Species Excluded from the Regional Status Assignment**

| Family | Species name | Common Name | SRANK[1] | # of Sites | Last year observed |
|---|---|---|---|---|---|
| HESPERIIDAE | *Erynnis martialis* | Mottled Duskywing | S2 | 1 | 1957 |
| | *Hesperia comma* | Common Branded Skipper | S4S5 | 1 | 1967 |
| | *Pyrgus communis* | Common Checkered Skipper | SNA | 2 | 1967 |
| | *Amblyscirtes vialis* | Common Roadside Skipper | S4 | 2 | 1967 |
| | *Hesperia sassacus* | Indian Skipper | S4 | 1 | 1950 |
| | *Amblyscirtes hegon* | Pepper and Salt Skipper | S4 | 1 | 1944 |
| | *Erynnis brizo* | Sleepy Duskywing | S1 | 5 | 1967 |
| | *Euphyes bimacula* | Two-Spotted Skipper | S4 | 7 | 1967 |
| LYCAENIDAE | *Lycaena phlaeas* | American Copper | S5 | 1 | 1957 |
| | *Lycaena epixanthe* | Bog Copper | S4S5 | 1 | 1967 |
| | *Strymon melinus* | Gray Hairstreak | S4 | 1 | 1957 |
| | *Callophrys polios* | Hoary Elfin | S4 | 1 | 1942 |
| | *Plebejus saepiolus* | Greenish Blue | S4 | 1 | 1954 |
| NYMPHALIDAE | *Chlosyne harrisii* | Harris's Checkerspot | S4 | 3 | 1957 |
| | *Speyeria idalia* | Regal Fritillary | SNA | 4 | 1952 |
| | *Polygonia satyrus* | Satyr Comma | S4 | 2 | 1970 |
| PAPILIONIDAE | *Battus philenor* | Pipevine Swallowtail | SNA | 4 | 1964 |
| | *Papilio trolius* | Spicebush Swallowtail | S4 | 2 | 1944 |
| | *Eurytides marcellus* | Zebra Swallowtail | SNA | 1 | 1965 |
| PIERIDAE | *Pieris virginiensis* | West Virginia White | S3 | 3 | 1967 |
| | *Abaeis nicippe* | Sleepy Orange | SNA | 1 | 1934 |

[1]NHIC 2010

**LEGEND**

**Provincial Rank (SRANK)**

S1- Critically Imperiled

S2- Imperiled

S3- Vulnerable

S4- Apparently Secure

S5- Secure

SNA- Not applicable

## Discussion

This qualitative analysis of butterfly presence/absence data in combination with discussions with local experts has allowed for a preliminary assessment of how butterfly communities have changed over the past 80 years in the Region of Waterloo. There are evident changes in the abundance of several species. Most of these changes have been recorded as overall declines in species presence but in a few cases increases in observations have been documented (Eberlie 1999; C. Campbell pers. comm. 2010; L. Lamb pers. comm. 2010). The methods used to assign a regional status to butterflies resulted in the identification of 47 uncommon or rare species. This is comparable to the identification of uncommon or rare species in the nearby Regions of Hamilton (43 species) and Halton (38 species) (Wormington and Lamond 2003; Wormington 2006). For the 23 species identified as rare permanent residents in Table 3, additional field work is required to check historic sites and potentially new sites containing suitable habitat.

The following sections provide a qualitative summary of the records collected on a species by species basis in order to identify general trends as well as changes observed in individual populations of species or specific groups. This section has been organized by family and in some cases subfamily and is followed by a summary of general trends.

### *Pieridae*

The family Pieridae includes butterflies commonly referred to as the 'whites' and 'sulphurs'. Nine species in the family Pieridae have been recorded in the Region belonging to two subfamiles.

#### a) Whites (Subfamily Pierinae)

The Cabbage White (*Pieris rapae*) is the most commonly observed species of butterfly in the Region of Waterloo, as it is in most localities across Canada. An exotic species in North America, it was introduced in Quebec City in the 1860s and has spread throughout North America using a variety of plants in the mustard family (Brassicaceae) as larval foodplants (Capinera 2000; Hall 2009; Walton 2010).

Following the introduction of *P. rapae* in North America the Mustard White (*P. oleracea*) drastically decreased in abundance, a pattern that some researchers attribute to intense competition for habitat (Scudder 1989; Longstaff 1912; Klots 1951). *P. oleracea* was commonly observed in the Region until the early 1950s (F. Stricker pers. comm. 2009). By the early 1960s it was a rarity and it has not been recorded in the Region since 1986. Some studies have suggested that despite the potential for intense interspecific competition among these two species, there is no evidence of ecological displacement, so the decline of *P. oleracea* is perhaps better attributed to land use changes and the limited extent of preferred larval foodplants such as Rock Cress (*Arabis* spp.) and Toothwort (*Cardamine diphylla*) (Chew 1981; Keeler et al. 2006). Area searches in localities where *P. oleracea* was historically present did not result in any new observations of this species although Toothwort was observed within Schaeffer's Woods and Homer Watson Park. Because this species has not been observed in the Region of Waterloo in 24 years, it was assigned a status of 'possibly extirpated.' Additional field work is required in order to confirm its absence from the Region.

The Checkered White (*Pontia protodice*) is widespread throughout the southern United States with colonies extending into Canada sporadically (Layberry et al. 1998). It is considered a

rare seasonal colonist in the Region and has not been observed since 1967. If observed in the Region today it should be considered rare.

The West Virginia White (*Pieris virginiensis*) is an uncommon woodland species in southern Ontario which was historically considered to be a Species at Risk in southern Ontario (Layberry et al. 1998). It was taken off the provincial Species at Risk list as new colonies were found farther north (Hall 2009). There are only 4 documented records of this species from 3 sites in the Region, the most recent being 1967 therefore it was not assigned a regional status (Lamb 1967). Permanent colonies of *P. virginiensis* have been documented in nearby Regions and its larval foodplant (*Cardamine diphylla*) is common in Regional woodlands (TEA Occasional Publication 1975; Riotte 1967; Wormington and Lamond 2003; Wormington 2006). Field checks in 2010 in Springwood Park and Homer Watson Park did not result in any new records for this species although its larval foodplant was observed in small numbers. It is possible this species has been overlooked as has happened in nearby Regions where it was thought not to persist, then an abundance of colonies were discovered (A. Wormington pers. comm. 2010).

**b) Sulphurs (Subfamily Coliadinae)**

The Clouded Sulphur (*Colias philodice*) and Orange Sulphur (*Colias eurytheme*) have consistently been documented as common species since the 1930s. The caterpillar of both of these sulphurs feed on members of the family Fabaceae, especially clover (*Trifolium repens* ) and alfalfa (*Medicago sativa*), both of which are abundant throughout the agricultural landscape in the Region. The Pink-edged Sulphur (*Colias interior*) was historically reported as uncommon and local (F. Stricker pers. comm. 2009), which is consistent with its general trends in abundance throughout Canada (Layberry et al. 1998). Although it has historically been reported at 11 separate sites, it has not been observed in the Region since 1987 (F. Stricker collection), therefore it should be considered regionally rare until field work is completed to confirm its abundance in the Region. The Little Yellow (*Pyrisitia lisa*) is a common migratory species that does not overwinter in Canada but has been observed infrequently in the Region (Hall 2009). Records for this species are sporadic although it has been reported as recently as 2006 in the southern end of the Region (Blair). There is no evidence to confirm if this species establishes breeding colonies in the Region, so it is currently considered a rare immigrant.

The Sleepy Orange (*Abaeis nicippe*) is a rare stray in Canada and has been reported once in the Region of Waterloo, in 1934 (Layberry et al. 1998; Wormington 1999). This species was excluded from the regional status assignment. A specimen was taken by E. Leonard James which is housed at the University of Waterloo. An attempt was made to view the specimen, however the collection was damaged by a flood a few years ago and the majority of specimens are completely ruined. Later it was discovered that this specimen was examined in 1991 prior to the flood, and its identification was confirmed as a *Eurema nicippe* (Wormington 1998).

***Papilionidae***

This family of butterflies includes those commonly referred to as the 'swallowtails.' There are 14 species of swallowtail in Canada (Layberry et al. 1998), 6 species of which have been reported in the Region of Waterloo. The Eastern Tiger Swallowtail (*Papilio glaucus*) and the Black Swallowtail (*P. polyxenes*) are by far the most common species in this family in the Region. *P. polyxenes* is common in southern Ontario and is commonly observed throughout the Region. *P. glaucus* is also a common species in southern Ontario but confusion between this species and the more northern Canadian Tiger Swallowtail (*P. canadensis*) presented difficulty in sorting through old records. Historically, *P. canadensis* was believed to be a subspecies of the *P.*

*glaucus* but advances in physiological and genetic research have resulted in *P. canadensis* being classified as a distinct species (Hagen et al. 1991). *P. glaucus* is very common in the Region of Waterloo which means the majority of regional records for *P. canadensis* were likely misidentified or improperly labeled based on previous taxonomic classifications. For the purposes of this study, records for *P. canadensis* were considered *P. glaucus*.

The Giant Swallowtail (*P. cresphontes*) is Canada's largest butterfly. In Canada, this species was found in the Carolinian Zone of southwestern Ontario exclusively with periodic observations further north (Hall 2009). This species has expanded northward dramatically during the 21st century, often observed in gardens, using Northern Prickly Ash (*Zanthoxylum americanum*), common hop tree (*Ptelea trifoliata*), Common Rue (*Ruta graveolens*), and Gas Plant (*Dictamnus albus*) as larval foodplants (Crolla 2009a). In the Region, a well-known population occurs along the Grand River Floodplain at the *rare* Charitable Research Reserve in Cambridge where a colony of Northern Prickly Ash is established. Prior to the discovery of this population, only a few sporadic records existed including 5 collections between 1935 and 1950 in Kitchener (F. Stricker collection) and two observations in 2001 (M. Burrell pers. comm. 2010) and 2003 (L. Lamb collection) in the City of Waterloo. In 2006 numerous *P. cresphontes* made up the population at the *rare* Charitable Research Reserve and larva could easily be found on larval foodplants. The population appeared to decrease after 2006, with only one individual observed in each of 2008, 2009 and 2010. In 2011 there were numerous sightings of *P. cresphontes* throughout the Region including within the urban areas of Kitchener, Waterloo, and Cambridge.

The Pipevine Swallowtail (*Battus philenor*), Spicebush Swallowtail (*Papilio trolius*), and Zebra Swallowtail (*Eurytides marcellus*) have been reported in the Region but were excluded from the regional status assignment. *Eurytides marcellus* is periodically reported in southwestern Ontario and has been known to breed using Pawpaw (*Asimina triloba*) as a larval foodplant, however it is unknown if there is a resident breeding population in Ontario (Hall 2009). One specimen was collected in Kitchener by Frank Stricker in 1965 which is the only known occurrence of this species in the Region. *Battus philenor* is considered a rare breeding immigrant in Canada (Layberry et al. 1998), and has only been reported in the Region on three occasions in the City of Kitchener and in North Dumfries Township (F. Stricker field notes). A observation in 2005 is believed by the author to be one that was raised in captivity and released (TEA 2005). *Papilio trolius* is a permanent resident of the Carolinian forests north of Lake Erie (Layberry et al. 1998). This species was collected in the City of Kitchener once in the 1930s and once in the 1940s by Frank Stricker, who indicated in his field notes that it was once fairly common in the area. However, this cannot be confirmed due to the lack of historical records prior to the 1930s.

***Lycaenidae***

This family of butterflies includes the butterflies commonly known as the blues, coppers, hairstreaks, and harvesters. In Canada, there are 63 species that belong to this family (Layberry et al. 1998), 18 of which have been reported in the Region of Waterloo.

**a) Hairstreaks and Elfins (Subfamily Theclinae)**

Seven species belonging to the hairstreak subfamily have been recorded in the Region of Waterloo. The Acadian Hairstreak (*Satyrium acadica*), Banded Hairstreak (*S. calanus*), Striped Hairstreak (*S. liparops*), and Coral Hairstreak (*S. titus*) are generally considered uncommon in the Region although they can be locally abundant. The Edwards' Hairstreak (*S. edwardsii*) and

Hickory Hairstreak (*S. caryaevorus*) have been documented much less commonly in the Region. Only three records exist for *S. edwardsii* (Ceasar 1957; Lamb 1967; J.K. Morton collection), although it may have been overlooked due to its similarity to *S. calanus* (Layberry et al. 1998). Historically, *S. caryaevorus* was only reported from one location where suitable habitat has been destroyed by development (C. Campbell pers. comm. 2010). In 2006 it was observed on two occasions at the *rare* Charitable Research Reserve in Cambridge. *S. caryaevorus* has been previously considered a sensitive species although it is now known populations tend to fluctuate from year to year (Hall 2009). Currently, *S. caryaevorus* is considered provincially 'imperiled' (S3) (NHIC 2010). In the Region both *S. edwardsii* and *S. caryaevorus* are considered rare. The Gray Hairstreak (*Strymon melinus*) has only been documented in the Region once in 1957 in Waterloo (Ceasar 1957). This species appears sporadically throughout its Canadian range but can be common (Layberry et al. 1998).

Only two regional records exist for the Eastern Pine Elfin (*Callophrys niphon*). It was first reported near Branchton in 1997 but more recently (2010) was observed at the Huron Natural Area (TEA 1997; J. Linton pers. obs. 2010). It is possible that it has been overlooked due to its small size (22-27mm wingspan) and dark colouring which make it quite inconspicuous. Only one Hoary Elfin (*C. polios*) was collected in Kitchener in 1942 (F. Stricker collection) therefore it was excluded from the regional status assignment.

**b) Coppers (Subfamily Lycaeninae)**

Twelve species belonging to this subfamily are known to occur in Canada (Layberry et al. 1998), 5 of which have been reported in the Region. The Bronze Copper (*Lycaena hyllus*) is the only species in this subfamily that is commonly encountered in the Region. It is not abundant but can be locally common, especially along the floodplain of the Grand River (J. Linton pers. obs.). The American Copper (*L. phlaeas*) has only been reported on one occasion in 1957 in Ayr therefore it was excluded from the regional status assignment (Lamb 1967). In nearby Regions it is reported as an uncommon permanent resident (Wormington and Lammond 2003; Wormington 2006). The Bog Copper (*L. epixanthe*) was excluded from the regional status assessment as it has also only been documented once in the Region, from the Glen Morris Area (North Dumfries Township) in 1967 (Government of Canada 2003- ROM Collection). The Dorcas Copper (*L. dorcas*) was discovered in the Region in 1980 in a wet meadow in North Dumfries Township (Sharp and Campbell 1980). It has been more recently observed at Taylor Lake in 1990 and collected at Oliver Bog in 1996 (TEA 1990; L. Lamb collection). Habitat for this species is limited in the Region to wet areas where shrubby cinquefoil (*Potentilla fruticosa*) occurs but small, isolated populations may still persist. The Purplish Copper (*L. helloides*) has been reported from more sites than *L. dorcas* throughout the Region. The most recent records have been in North Dumfries Township in 1977 (TEA 1977) and Cambridge in 1996 (L. Lamb collection). Both *L. helloides* and *L. dorcas* were assigned a regional status of rare however field work is required to confirm their persistence in the Region. In Ontario, *L. helloides* is considered 'imperiled' (S3) meaning it is vulnerable to extirpation (NHIC 2010).

**c) Blues (Subfamily Polyommatinae)**

This relatively large subfamily of Lycaenidae consists of 19 species in Canada, 4 of which have been documented in the Region of Waterloo. The Spring Azure (*Celastrina lucia*) and the Summer Azure (*C. neglecta*) are the two most commonly encountered species. Previously *C. neglecta* was treated as a summer 'form' or subspecies of *C. lucia*, but it was later determined

that it was in fact a distinct species (Layberry et al. 1998; Pavulaan and Wright 2000). Based on this distinction, historical records collected in the Region were sorted by reported flight times (Layberry et al. 1998). Observations made between April and May were classified as *C. lucia* and observations made from June on were considered *C. neglecta*. The Eastern Tailed Blue (*Cupido comyntas*) has been consistently observed over the years in the Region although it has never been observed as abundant (C. Campbell pers. comm. 2009; J. Linton pers. obs.). Lastly, the Greenish Blue (*Plebejus saepiolus*) has been documented once in the Region in 1944 (F. Stricker field notes). This species is common throughout its Canadian range, which includes northern Ontario, but is very rare in the southern portion of the province (Layberry et al. 1998). It was excluded from the regional status assignment. The Cherry Gall Azure (*Celastrina serotina*), which was first officially recognized as a species in 2005, has not yet been recorded in the Region.

**d) Harvesters (Subfamily Miletinae)**

Only one member of this subfamily, which has carnivorous larvae, occurs in North America- the Harverster (*Feniseca tarquinius*). It has been recorded 8 times in the Region within 5 sites, most recently in 1990 at Riverside Park (TEA 1990). Because this species often occurs singly, is a fast, erratic flyer, and tends to be extremely local it may easily be overlooked (Layberry et al. 1998). It is considered regionally rare.

***Nymphalidae***

This family was previously treated as several separate families which were reclassified into the single largest family of butterflies in the world. These butterflies are commonly referred to as the 'brush-footed' butterflies due to their reduced forelegs which are covered in long hairs, resembling a brush (Layberry et al. 1998). In Canada there are 101 species in the family Nymphalidae, 36 of which have been documented in the Region of Waterloo.

**a) Snouts (Subfamily Libytheinae)**

This subfamily is only represented by one species in Canada – the American Snout (*Libytheana carinenta*). This species is a rare migrant throughout most of its Canadian range, although some years it arrives in large numbers (Layberry et al. 1998). It is a confirmed breeder in the province of Ontario. However, because numbers fluctuate considerably from year to year, it is difficult to assign the species a national conservation status (Hall 2009). *Libytheana carinenta* has been documented in the Region on 7 occasions since the 1960s, most recently in 2008 and 2010 at the *rare* Charitable Research Reserve (J. Grealey and L. Lamb 2008; 2010) and in a residential garden in northwest Waterloo (J. Linton pers.obs.). It was considered a rare immigrant in the Region until 2010 when it was observed to lay eggs on a hackberry seedling (*Celtis occidentalis*) behind *rare*'*s* main office building (G. Richardson per. comm. 2010). Its regional status is now considered a rare seasonal colonist.

**b) Fritillaries (Subfamily Argynninae)**

This Subfamily is further divided into two groups - the greater fritillaries which includes species in the genus *Speyeria* and *Euptoieta,* and the lesser fritillaries in the genus *Boloria.* Twenty-five species of fritillary have been recorded in Canada, however the majority of them

are associated with the more northern habitats and climates (Layberry et al. 1998). Only 7 species belonging to this subfamily have been documented in the Region of Waterloo.

Of the greater fritillaries, the Great Spangled Fritillary (*Speyeria cybele*) is by far the most common. The other greater fritillaries have declined dramatically in abundance over the last few decades (L. Lamb pers. comm. 2009; F. Strick pers. comm. 2009; C. Campbell pers. comm. 2010). The Atlantis Fritillary (*S. atlantis*) has been documented at 10 sites but has not been observed since 1983. If these species persist in the Region, they should be considered rare. The Regal Fritillary (*S. idalia*) has been observed at 4 separate sites but not since 1952. It is a very conspicuous species and would be difficult to overlook. *S. idalia* has experienced widespread declines over its range and appears to be an accidental vagrant in Canada, with no known permanent colonies (Mason 2001; Hall 2009). Six specimens were collected in the Kitchener area between 1937 and 1952 by Frank Stricker who indicated that small colonies were present historically (F. Stricker pers. comm. 2009). *S. atlantis* and the Aphrodite Fritillary (*S. aphrodite*) were historically common in the Region of Waterloo until the 1960s (F. Stricker pers. comm. 2009; L. Lamb pers. comm. 2009). *S. aphrodite* was last documented in the Region in 1970. Its original status of 'uncommon' (based on the number of sites (23) it was observed at) was changed to 'rare' due to the time elapsed since the last observation of this species in the Region. *S. atlantis* was last documented in 1983 (F. Stricker field notes). *S. atlantis* and *S. aphrodite* are fairly common throughout their Canadian range and may still be present in small numbers throughout the Region (Layberry et al. 1998). The Variegated Fritillary (*Euptoieta claudia*) is a rare migratory stray in Ontario (Layberry et al. 1998). It has been historically documented in Cambridge, Kitchener and North Dumfries Township, but never reported as common (F. Stricker field notes; L. Lamb collection; C. Campbell pers. comm. 2009). After a gap of some years, it was observed again in 2009 and 2010 (TEA 2009 2010).

The lesser fritillaries are represented by two species in the Region; the Meadow Fritillary (*Boloria bellona*) and Silver-bordered Fritillary (*B. selene*). *B. bellona* is the most widespread of the lesser fritillaries in Canada and *B. selene* is reported as common in eastern Canada (Layberry et al. 1998). Previously, both of these species were documented frequently within the Region. Records sharply decrease for *B. selene* in the late 1960s, with the last documented record in 1990 (TEA 1990), therefore its status of 'common' was reassigned to be 'rare'. Records for *B. bellona* occur up until 2010, but have declined dramatically in abundance since the early 1970s.

**c) Checkerspots and Crescents (Subfamily Melitaeinae)**

This subfamily of butterflies is represented by 17 species in Canada, 6 of which have been documented in the Region of Waterloo. The Harris's Checkerspot (*Chlosyne harrisii*) is reported as a very local species which can be common in northwestern Ontario (Layberry et al. 1998). It has only been documented in the Region of Waterloo on 3 occasions (F. Stricker field notes; Caesar 1957), most recently in 1957, and was therefore excluded from the regional status assignment. The Silvery Checkerspot (*C. nycteis*) has been documented in the Region on numerous occasions but not after 1965. Both of these species are believed to be declining within their known ranges in the eastern United States (O'Donnell et al. 2007; Webster and deMaynadier 2005).

The Baltimore Checkerspot (*Euphydryas phaeton*) was previously much more common in the Region of Waterloo (L. Lamb pers. comm. 2009; F. Stricker pers. comm. 2009). It has been observed at 33 separate sites. However, there are only 3 observations since 1990, with the most recent being in 2008 (TEA 2003-04, 2008). It was therefore assigned a regional status of rare. This species is known to be fairly localized to where its larval food plant, turtlehead (*Chelone glabra*) occurs (Layberry et al. 1998). In the Region, turtlehead grows in small numbers in

marshes and swamps but is not considered rare (B. Woodman pers. comm. 2010; Richardson and Martin 1999).

The crescents are represented by 3 species in the Region. The Pearl Crescent (*Phyciodes tharos*) and Northern Crescent (*P. cocyta*) are both common throughout the Region. The Tawny Crescent (*P. batesii*) has only been documented in the Region on 4 occasions at 3 sites, most recently in 1978 (TEA 1978). This species is considered uncommon and local throughout its Canadian range and rare within the Region (Layberry et al. 1998).

**d) Anglewings, Tortoiseshells, Thistle Butterflies, and Peacocks (Subfamily Nymphalinae)**

This morphologically diverse group of butterflies is represented by 16 species in Canada, 11 of which have been documented in the Region of Waterloo. Several members of this subfamily are common and relatively abundant in the Region. The Mourning Cloak (*Nymphalis antiopa*) and Eastern Comma (*Polygonia comma*) are often two of the first species observed in early spring and are commonly observed through to autumn (J. Linton pers. obs.). The Red Admiral (*Vanessa atalanta*), Painted Lady (*V. cardui*), and Question Mark (*Polygonia interrogationis*) are all common, seasonal colonists in southern Ontario and are common in the Region of Waterloo (Layberry et al. 1998). The American Lady (*V. virginiensis*) is also considered a common seasonal colonist although it has been reported less frequently. The Common Buckeye (*Junonia coenia*) is also a migrant in Canada and has been observed less commonly in the Region then other migrants. It is known to sometimes establish temporary breeding colonies during good migration years such as the one experienced in 2010 (Layberry et al. 1998). In 2010 it was observed in Branchton, the Huron Natural Area in Kitchener, and Laurel Creek Conservation Area (Shea pers. comm. 2010; TEA 2010).

Historically, the Gray Comma (*Polygonia progne*) was also reported as common in the Region (F. Stricker field notes). This species is still present in the Region (Grealey and Lamb 2009), however it has not been frequently observed since the late 1980s and is therefore considered uncommon. The Satyr Comma (*P. satyrus*) has been documented in the Region on two occasions, most recently in 1970 (F. Stricker field notes). These observations are likely rare strays as this species in known from a more western range in Canada (Layberry et al. 1998). It was therefore excluded from the regional status assignment.

The Milbert's Tortoiseshell (*Aglais milberti*) and Compton Tortoiseshell (*N. l-album*) were previously much more abundant in the Region (L. Lamb pers. comm. 2009; F. Stricker pers. comm. 2009). Although these species appear to be less common, both are still present in small numbers in the Region and both should be considered uncommon. *N. l-album* was most recently observed in 2009 (J. Linton pers. obs.), while *A. milberti* was observed at 3 separate sites in 2010 (Moore 2010; B. Woodman pers. comm; J. Linton pers. obs.).

**e) Admirals (Subfamily Limenitidinae)**

This subfamily of butterflies is only represented by 4 species in Canada, 2 of which have been documented in the Region. The White Admiral (*Limenitis arthemis arthemis*) is common throughout Canada while the Red-spotted Purple (*Limenitis arthemis astyanax*), a subspecies of *arthemis*, is only found in southern Ontario (Layberry et al. 1998). Historically both were observed throughout the Region, however in recent years *Limenitis arthemis astyanax* has become more abundant. There are only 5 documented records of *Limenitis arthemis arthemis* since 2001 (Burrell pers. comm. 2010; 2001; Grealey and Lamb 2006; Moore 2009; TEA 2009). The viceroy (*Limenitis archippus*) is the other member of this subfamily which occurs in the

Region. This species has consistently been observed to be very common and is often observed in a variety of habitats throughout the Region.

**f) Emperors (Subfamily Apaturinae)**

This subfamily is represented by 2 species in Ontario: the Hackberry Emperor (*Asterocampa celtis*) and the Tawny Emperor (*A. clyton*). *A. clyton* is reported as less common and more restricted in range than *A. celtis* (Layberry et al. 1998) however several small, known colonies are present within the Region (J.K. Morton, pers. comm. 2009; J. Linton pers. obs.). *A. clyton* is considered provincially 'imperiled' (S3) and indicating it is at risk of extirpation (NHIC 2010). There are no documented records of *A. celtis* in the Region although it is known to often occupy the same habitats and fly with *A. clyton*.

**g) Satyrs and Wood Nymphs (Subfamily Satyrinae)**

This relatively large subfamily of butterflies is represented by 34 species in Canada, but only 6 within the Region of Waterloo. The Northern Pearly-Eye (*Lethe anthedon*), Eyed Brown (*Lethe eurydice*), Appalachian Brown (*L. appalachia*), Common Wood-Nymph (*Cercyonis pegala*) and Little Wood-Satyr (*Megisto cymela*) are all commonly encountered species in the Region. *Lethe anthedon* and *L. appalachia* are almost always observed in wooded habitats, while *L. eurydice* and *Megisto cymela* are observed in more diverse habitats including woodland edges, thickets, and meadows (J. Linton pers. obs.). Historically, the Common Ringlet (*Coenonympha tullia*) was much less common in southern Ontario however it is now one of the most commonly observed species during its flight time in the Region (Eberlie 1999; J. Linton pers. obs.). Subspecies *inornata* is most commonly encountered, however for the purposes of this study individuals have not been broken down into subspecies.

**h) Milkweed Butterflies (Subfamily Danainae)**

The Monarch (*Danaus plexippus*) is the only representative of this subfamily in Canada. *D. plexippus* is a well-known and studied species due to its spectacular annual migration. Individuals who breed in southern Ontario migrate from Canada to Mexico every year. It is not uncommon for *D. plexippus's* abundance to fluctuate from year to year; however it should be considered a widespread and common seasonal colonist in the Region. *D. plexippus* is the only species that occurs in the Region which is considered to be a Species at Risk both provincially and nationally (OMNR 2009; COSEWIC 2009). This status affords this species protection under the *Species at Risk Act* 2002 and *Endangered Species Act* 2007.

**Hesperiidae**

This family of butterflies, commonly referred to as the 'skippers' is represented by 70 species in Canada belonging to 3 Subfamilies (Layberry et al. 1998). Thirty-two of these species have been documented in the Region of Waterloo. Skipper butterflies are often overlooked by observers due to their drab appearance and have been excluded by some local record compilers (Lamb 1967). The current abundance of many of the species within this subfamily is not accurately known. Skipper observations were frequently documented in the Region prior to the 1970s by Frank Stricker. Several localized species, which were not recorded in the 1980s and 1990s, have been reported during the relatively recent Cambridge NABA butterfly count. It is

likely that the large data gap that exists for skippers is due to lack of interested observers and that many of these species are present in local colonies that have been overlooked.

**a) Pyrgine Skippers (Subfamily Pyrginae)**

This subfamily is represented by nine species in the Region. The Silver-spotted Skipper (*Epargyreus clarus*) is the largest skipper species found in Canada. It is never observed in large numbers but can be locally common in the Region of Waterloo, often observed visiting gardens in more developed areas (F. Stricker pers. comm. 2009; J. Linton pers. obs.). The Northern Cloudywing (*Thorybes pylades*) has been documented in the Region on 4 occasions, most recently in 2009 at the Sudden Tract (J. Linton pers. obs.). This species is common and widespread throughout its Canadian range but is reported as rarely abundant (Layberry et al. 1998). It is possible that this small, dark skipper that is partial to wooded areas may have been overlooked by local observers and it is actually more common than the records suggest.

The duskywings (*Erynnis*) are a larger group of medium-sized skippers that are often difficult to identify (Layberry et al. 1998). Six species of duskywings have been documented in the Region of Waterloo. The Dreamy Duskywing (*E. icelus*), Juvenal's Duskywing (*E. juvenalis*), and Columbine Duskywing (*E. lucilus*) are common within their southern Ontario ranges and their larval foodplants are found throughout the Region (Layberry et al. 1998). *E. icelus* has not been observed in the Region since 1978. *E. juvenalis* and *E. lucilus* had not been observed in the Region since the late 1960s until 2010. It is possible that these early spring flyers have simply been overlooked or ignored by observers. The Wild Indigo Duskywing (*E. baptisiae*) was documented in the Region for the first time in 2010 (J. Linton pers. obs.). Historically this species was uncommon and restricted to habitats in southwestern Ontario where its larval foodplant Wild Indigo (*Baptisia tinctora*) occurred (Hall 2009). Recently, it has been observed to be rapidly expanding its range using Crown Vetch (*Coronilla varia*), a non-native plant commonly used in local hydroseed mixtures, as a larval foodplant (Crolla 2009b). In 2010, *E. baptisiae* was observed at 8 separate sites to be quite abundant (J. Linton pers. obs.). It is too early to tell if this species has established permanent colonies in the Region. Therefore, it was the only species assigned a residency and regional status of 'unknown.'

The Sleepy Duskywing (*E. brizo*) is uncommon throughout its Canadian range and is closely associated with oak woodlands (Layberry et al. 1998). It has been observed in the Region on 9 occasions at 5 sites, most recently in 1967, in areas that have been since severely altered by development (F. Stricker field notes). The Mottled Duskywing (*Erynnis martialis*) was documented in the Region on one occasion in 1957 (Caesar 1957). This species is rare, very local, and only found in dry habitats where its larval food plant, New Jersey Tea (*Ceanothus americanus*), occurs (J. Grealey 2009). This isolated record of *E. martialis* in Kitchener is considered a rare stray or possible misidentification (no specimen was taken). The Common Checkered Skipper (*Pyrgus communis*) has been documented in the Region on two occasions in 1937 and 1967 (F. Stricker field notes). It is common resident in the southern portion of the Prairie Provinces but is also known to stray into southwestern Ontario (Layberry et al. 1998). Due to the limited records and the time elapsed since they were last observed all three of these species were excluded from the regional status assignment

The Common Sootywing (*Pholisora catullus*) can be locally common in southern Ontario but is considered provincially 'imperiled' (S3) and rare in the Region (Layberry et al. 1998; NHIC 2010). It was historically documented in Waterloo and Kitchener infrequently and in recent years has been observed at the *rare* Charitable Research Reserve (F. Stricker field notes; Grealey and Lamb 2006 and 2010; Grealey 2007; Moore 2009).

**b) Intermediate Skippers (Subfamily Heteropterinae)**

The Arctic Skipper (*Carterocephalus palaemon*) is the only representative of this subfamily in Canada. It is reported as common throughout its Canadian range although it has only been documented in the Region at 7 sites (Layberry et al. 1998). The most recent observations subsequent to 1990 were at the Huron Natural Area and the *rare* Charitable Research Reserve (TEA 1990; J. Linton pers. obs. 2010; Moore 2010).

**c) Branded Skippers (Subfamily Hesperiinae)**

Twenty-one species belonging to this large subfamily have been observed in the Region of Waterloo, many of which are common. The European Skipper (*Thymelicus lineola*) is by far the most commonly observed skipper species in the Region (J. Linton pers. obs.). *Pieris rapae* is the only species that rivals it as the most common species in southern Ontario (Hall 2009). After its introduction from Europe to London, Ontario in 1910, it spread throughout Canada and can now be observed by the thousands at single locations (Hall 2009). There are several other species of branded skippers that are commonly observed throughout the Region such as the Least Skipper (*Ancyloxypha numitor*), Tawny-edged Skipper (*Polites themistocles*), Dun Skipper (*Euphyes vestris*), Long Dash Skipper (*Polites mystic*), and Peck's Skipper (*Polites peckius*). The Broad-Winged Skipper (*Poanes viator*), Northern Broken-Dash (*Wallengrenia egeremet*), and Dion Skipper (*Euphyes dion*) have been observed less frequently within the Region but colonies have been observed to persist at the *rare* Charitable Research Reserve in Cambridge and may persist elsewhere in the Region. *Euphyes dion* is considered provincially 'imperiled' (S3) (NHIC 2010). The Black Dash (*Euphyes conspicua*) is reported as an uncommon and very local species in southern Ontario and is also considered provincially 'imperiled' (S3) (Layberry et al. 1998; NHIC 2010). This species has been observed in numerous locations throughout the southern portion of the Region, most recently at the *rare* Charitable Research Reserve in Cambridge during the 2006, 2008, 2009, and 2010 annual butterfly counts (identified by G. Richardson) and the Branchton Prairie in 2005 (TEA 2005). The Mulberry Wing (*Poanes massasoit*) also tends to be a very local species but can be common within colonies (Layberry et al. 1998). This species has also been observed mainly in the southern portion of the Region, most recently in 2005 at the Branchton Prairie and in 2010 at the Sudden Tract (TEA 2005; Moore 2010). The Little Glassywing (*Pompeius verna*) has been documented in a number of localities throughout the Region although it is considered local and uncommon in southern Ontario (F. Stricker field notes; TEA 1990; Layberry et al. 1998). It was reported by the TEA as being known from upwards of 20 localities in the Region in 1990 but since then has only been observed once in 2010 at the rare Charitable Research Reserve (TEA 1990). The Crossline Skipper (*Polites origenes*) is also local and uncommon in Ontario (Layberry et al. 1998). It has been documented in the Region at 5 sites, most recently in 2008 in North Dumfries (TEA 2008).

The Two-spotted Skipper (*Euphyes bimacula*) is uncommon and very local in Ontario (Layberry et al. 1998). It has been documented in the Region on 8 occasions, all prior to 1968 (F. Stricker field notes; Government of Canada 2003- ROM Collection). The Salt and Pepper Skipper (*Amblyscirtes hegon*) and Common Roadside Skipper (*A. vialis*) have been documented once and twice respectively in the Region which are the only known records of these species in this area therefore they were excluded from the regional status assignment (F. Stricker field notes). It is likely these observations were of rare strays outside their usual range, however *A. vialis* has been observed recently to be expanding in numbers (Hall 2009). The Fiery Skipper (*Hylephila*

*phyleus*), the Common Branded Skipper (*Hesperia comma*), and the Indian Skipper (*Hesperia sassacus*) are very rare species in southern Ontario (Layberry et al. 1998). *Hylephila phyleus* has been observed three times, in 1955, 1967 and 2011, while *Hesperia comma* and *H. sassacus* have been documented once in 1967 and 1950 respectively (F. Stricker field notes; Government of Canada 2003- ROM Collection; Lamb 1967; G. Richardson, pers. comm. 2012, confirming photo of T. Beaubien). Based on these isolated observations, it is unlikely that permanent colonies persist in the Region therefore they were excluded from the regional status assignment.

**General Trends**

Several general conclusions can be drawn from interviews with local collectors, personal observations, and the database of records that was compiled. In general, the abundance and richness of native butterflies in the Region has declined. Some of the historically common species, such as *Vanessa atalanta*, *V. cardui, Nymphalis antiopa, Cercyonis pegala, Polygonia interrogationis*, and *P. comma,* are still common in the Region. However certain groups of butterflies, such as the fritillaries, swallowtails, checkerspots, and tortoiseshells have dramatically declined in abundance. This general decline is consistent with a trend across Canada that has been attributed to the cumulative effects of habitat loss due to the rapid urbanization of the landscape, pesticide use, collecting, and the lack of protection afforded to butterflies and their habitats (Hall 2009).

In 2008 the regional government launched a campaign to eliminate the use of non-essential lawn pesticides. A temporary pesticide by-law was later replaced by the *Pesticide Act of Ontario* which prohibits the use of pesticides for cosmetic use on lawns and in public areas. This ban is relatively recent and it is therefore very difficult to assess the impact of local pesticide use on butterfly communities. Pesticides are still permitted on agricultural fields, golf courses, and in public areas with pest infestations.

Collecting, particularly of rare or uncommon species, may have impacted the butterfly population. Based on the record collection and research done for the regional status assignment it can be said with certainty that butterfly collecting was much more popular in the Region prior to 1980. Some collectors' notes indicate that they were taking hundreds and even thousands of specimens in the Region every year. Even rare species were caught and mounted rather then left to reproduce.

Only two non-native species, *Pieris rapae* and *Thymelicus lineola,* are found in the Region which are the most commonly encountered species. According to the Natural Heritage Information Centre these are the only two non-native butterfly species occurring in Ontario (NHIC 2010). At this time there is no evidence to suggest that the increase in non-native species abundance is related to the decline of native species. It is likely that the generalist tendencies and abundance of larval foodplants has made it easier for non-native populations to persist. The diversity of species that has been observed to persist at the *rare* Charitable Research Reserve implies that if a similar search effort was applied elsewhere in the Region (within similar habitats) that local colonies of less common species may be found however more field work is required to confirm this.

A large data gap exists between 1980 and 2005, particularly for butterflies in the skipper family (Hesperiidae). Based on recent efforts to document butterfly species in the Region through annual NABA counts, the establishment of permanent butterfly monitoring transects, and field work completed as part of this research, several species not documented since the 1970s have been confirmed to be present within the Region e.g. *Poanes viator*, *Erynnis lucilius*, *Poanes massasoit*, *Thorybes pylades*. Habitat exists for several other species historically known

from the Region indicating that colonies may still persist if they have been overlooked due to lack of observers.

Some species historically reported as uncommon or rare have been confirmed in recent years to persist within the Region e.g. *Euphyes conspicua*, *Nymphalis l-album*, *Pompeius verna*, however field checks are required to confirm the presence/absence of other rare species in habitats that still exist. There is currently no regional policy that requires butterfly surveys to be completed as part of Environmental Impact Studies for future development projects; therefore small, isolated colonies of butterflies could be destroyed without consequence. If butterfly surveys were required as part of development impact assessments like breeding birds, plants, and herpetofauna, the regional status assignment presented in this section could be used by local agencies to determine the importance of habitat for butterflies within proposed development areas. This regional status assignment could also be used in identifying conservation targets, restoration projects, and mitigation plans.

## 3. SPECIES DIVERSITY ACROSS URBAN VS. RURAL LAND USES – THE "URBAN GRADIENT"

It was hypothesized that butterfly community composition would differ between different land uses due to the combination of environmental variables that characterize each land use type. This included the type of habitats present, herbaceous vegetation cover, abundance of non-native plant species, canopy cover and availability of nectar plants. Typically, designated natural areas in the Region of Waterloo are characterized by forested upland or wetland habitats. Because butterflies are sun lovers that tend to prefer more open habitats, it was thought that designated natural areas may not support the highest diversity of species. It was also hypothesized that land uses that had little habitat diversity or low overall vegetation cover would support less diverse butterfly communities.

### Site Selection

A total of 15 sites were selected using aerial photographs to represent a variety of land-uses across the Region. These included ESPAs, urban parks, recreational areas, golf courses, residential neighborhoods, and industrialized areas. Sites were selected based on a number of factors including geographical location within the Region, site accessibility, and how well they represented a particular land use. These sites were visited one week prior to the commencement of the 2009 monitoring season to further refine and map the transect routes.

These different land uses, and the combination of different environmental variables that characterize each land use type, are frequently referred to in the literature as the "urban gradient." ESPA areas were consistently ranked the 'most natural' followed by urban parks, golf courses, residential areas and lastly, industrial areas were considered the 'most urban' land use.

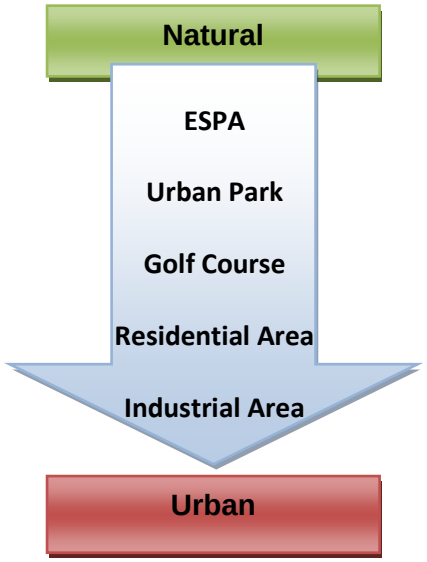


**Figure 1. The Urban Gradient**

To ensure the sites selected for monitoring provided a representative data set for their particular land use, three sites of each land use type were selected. The sites chosen were: ESPAs: Roseville Swamp (North Dumphries Township), Sudden Tract (North Dumphries Township), and *rare* Charitable Nature Reserve (Cambridge); urban parks: Bechtel Park (Waterloo), Waterloo Park (Waterloo) and Riverside Park (Cambridge); golf courses: Grey Silo Golf Course (Waterloo), Elmira Golf Club (near Elmira) and Foxwood Golf Club (near St. Agatha); residential areas: New Hamburg, St. Clements, and the Beechwood West subdivision in Waterloo; and industrial areas: Kumpf Drive in Waterloo, Wabanaki Drive in Kitchener, and the industrial area near Ayr just south of Highway 401. For further details and a map, see Grealey (2010).

**Transect Counts**

I adopted the method of transect counts, which form the basis of the UK's Butterfly Monitoring Scheme, the largest-scale butterfly monitoring effort in the world (UKBMS 2006). Transect counts provide an index of population size and therefore can be used to measure changes in abundance (Pollard and Yates 1993). The reliability of transect counts has been fully tested in Europe and to date it is the most cited method used to monitor butterflies. Time and resource constraints also supported the use of this method, as opposed to other methods such as point counts or area searches.

The data collection generally followed the protocol outlined by Pollard and Yates (1993): the recorder imagined themselves inside a 5m box and walked at a uniform pace along the transect route recording all the butterflies seen within the 5m prescribed limits. The precise width of the observation area used by researchers in other studies has varied. The width of the "box" may be decided by the recorder but once it has been adopted it may not change (Pollard and Yates 1993). In open habitat types butterflies can be identified at greater distances. The 5m 'box' was selected so that the observation area would be consistent across sites. A larger observation area would not be possible at some sites due to dense vegetation. Stops were made to resolve identification problems and recording was resumed from the point where the

walk was interrupted. A digital camera was used to photograph species which could not be identified in the field.

Pollard and Yates (1993) recommended recording for 26 weeks in the United Kingdom, and this is standard practice in the UK Butterfly Monitoring Scheme. This timeframe was modified to more accurately reflect the flight times of local butterflies (Layberry et al. 1998).

Originally, it was planned that the recording season for the current study would be shortened to 23 weeks, beginning the second last week of May and ending the last week of October. Based on flight times of Ontario butterfly species this recording season would capture all species within the Region including the flight times of early migrants and overwintering adults that appear in early May and the late-flying butterflies seen until the end of October (Holmes et al. 1991; Layberry et al. 1998). Butterfly observations usually peak in July, but July 2009 was the coldest year since 1915 (Seglenieks 2009). This led to a shorter recording season in 2009 that was only 17 weeks long, beginning the last week of May and ending the last week of September.

To obtain a data set that would more likely account for yearly weather conditions, a second recording season occurred in 2010, beginning the second week of May and ending the last week of July (a total of 11 weeks). This time period was chosen to effectively capture the flight times of all butterflies known from the Region. Poor weather (rain and/or temperatures <19°C) cancelled four weekly counts in 2009 and one weekly count in 2010. These missed counts were estimated as the mean of the preceding and succeeding counts (Pollard and Yates 1993). This method is undesirable but must be considered due to the length of the sampling period.

I walked each of the 15 transects for 10-15 minutes once per week. This level of effort was required because of the differing flight times of different species and because mobile species such as butterflies have imperfect probabilities of detection and are not always detected at the sites they sometimes occupy (Thomson et al. 2005). Transect walks occurred between the hours of 0900hrs and 1700hrs when temperatures exceeded 19ºC and wind speed did not exceed a force of 5 (38 km/hour) on the Beaufort Scale (Environment Canada 2007). This made recording at the beginning and end of the observation season difficult due to spring rains and cooler temperatures. Sunny or partly sunny days were preferred although it was not always possible to conduct every survey in ideal weather conditions. Weather conditions such as percent cloud cover, wind speed, and air temperature were recorded during all site visits.

## Results

### *Butterfly Abundance*

A total of 1,334 individual butterflies were counted during transect walks, 800 in 2009 and 537 in 2010. The greater number of butterflies observed in 2010 may simply reflect the greater number of transects conducted that year.

Figure 2 (following page) shows the mean number of butterflies observed, classified by habitat (land use). Surprisingly, industrial areas had the largest butterfly populations although the majority of individuals were common, non-native species. Urban parks were next, followed by ESPAs and golf courses. Residential areas had the lowest number of individual butterflies. These patterns were observed in both years.

Table 5 (2nd following page) shows the breakdown of species observed by land use.

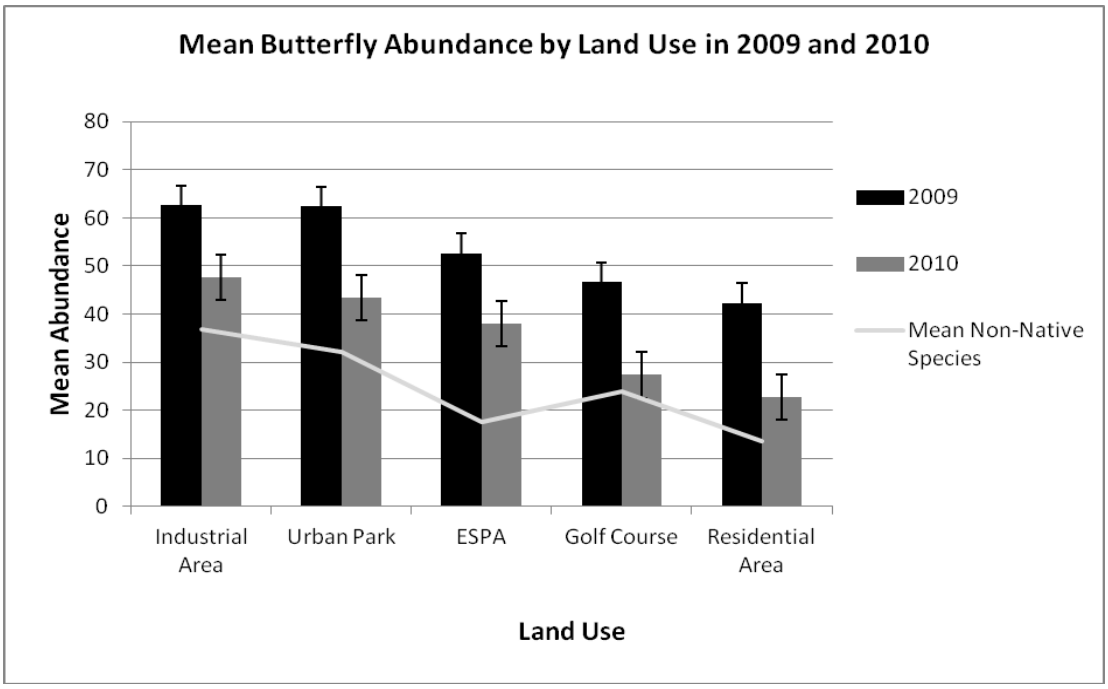
Mean Butterfly Abundance by Land Use in 2009 and 2010
Mean Abundance
80
70
60
50
40
30
20
10
0
Industrial Area
Urban Park
ESPA
Golf Course
Residential Area
Land Use
2009
2010
Mean Non-Native Species

**Figure 2.**

**Table 5. Butterflies Observed During Transect Counts in 2009 and 2010, Classified by Species and by Land Use (sorted by family and scientific name)**

| Family | Scientific Name | Common Name | Regional Status | ESPA | Urban Park | Golf Course | Residential Area | Industrial Area |
|---|---|---|---|---|---|---|---|---|
| HESPERIIDAE | *Ancyloxypha numitor* | Least Skipper* | Uncommon | 1 | | | | |
| | *Epargyreus clarus* | Silver-spotted Skipper* | Uncommon | | 1 | | | |
| | *Erynnis baptisiae* | Wild Indigo Duskywing** | Unknown | | 1 | | | 6 |
| | *Erynnis juvenalis* | Juvenal's Duskywing** | Rare | 1 | | | | |
| | *Euphyes vestris* | Dun Skipper* | Very common | 3 | | | | |
| | *Poanes hobomok* | Hobomok Skipper | Common | 4 | | | 2 | |
| | *Polites themistocles* | Tawny-edged Skipper* | Common | | 1 | | | |
| | *Thorybes pylades* | Northern Cloudywing* | Rare | 1 | | | | |
| | *Thymelicus lineola* | European Skipper | Very common | 39 | 78 | 53 | 10 | 94 |
| | | Skipper sp. | N/A | 3 | | | | |
| LYCAENIDAE | *Celastrina lucia* | Spring Azure** | Common | 1 | | | | |
| | *Celastrina neglecta* | Summer Azure | Very common | | 1 | 1 | | 1 |
| | *Lycaena hyllus* | Bronze Copper* | Very common | | | 4 | | |
| NYMPHALIDAE | *Cercyonis pegala* | Common Wood-Nymph | Very common | 10 | 4 | 4 | 1 | 1 |
| | *Coenonympha tullia* | Common Ringlet | Common | 22 | 8 | 15 | 10 | 15 |
| | *Danaus plexippus* | Monarch | Very common | 7 | 12 | 7 | 6 | 22 |
| | *Lethe anthedon* | Northern Pearly-Eye | Common | 8 | | | | |
| | *Limenitis archippus* | Viceroy* | Very common | | 1 | 1 | 2 | 1 |
| | *Limenitis arthemis astyanax* | Red-Spotted Purple | Common | 2 | | | | |
| | *Megisto cymela* | Little Wood-Satyr | Very common | 34 | 17 | | 26 | 3 |
| | *Nymphalis antiopa* | Mourning Cloak | Very common | 1 | | 3 | 1 | 1 |
| | *Nymphalis l-album* | Compton Tortoiseshell* | Uncommon | 2 | | | | |
| | *Phyciodes cocyta* | Northern Crescent | Uncommon | 11 | | 1 | 2 | |
| | *Phyciodes tharos* | Pearl Crescent** | Common | | | 1 | | |
| | *Polygonia comma* | Eastern Comma | Very common | 1 | 4 | | 1 | |

| Family | Scientific Name | Common Name | Regional Status | ESPA | Urban Park | Golf Course | Residential Area | Industrial Area |
|---|---|---|---|---|---|---|---|---|
| | *Polygonia* sp. | Anglewing Sp. | N/A | | 1 | | | |
| | *Polygonia interrogationis* | Question Mark** | Very common | 1 | 1 | 1 | | |
| | *Lethe appalachia* | Appalachian Brown | Uncommon | 12 | | | | 1 |
| | *Lethe eurydice* | Eyed Brown | Very common | 6 | | 1 | | |
| | *Speyeria cybele* | Great Spangled Fritillary* | Very common | | 1 | 3 | | |
| | *Speyeria* sp. | Fritillary Sp.** | N/A | | | 1 | | |
| | *Vanessa atalanta* | Red Admiral** | Very Common | 23 | 46 | 15 | 20 | 44 |
| | *Vanessa virginiensis* | American Lady** | Common | | 2 | | 1 | 1 |
| PAPILIONIDAE | *Papilio glaucus* | Eastern Tiger Swallowtail | Very common | 4 | | | 2 | |
| | *Papilio polyxenes* | Black Swallowtail | Very common | | 1 | | | 3 |
| PIERIDAE | *Colias eurytheme* | Orange Sulphur** | Very common | | 1 | | | |
| | *Colias philodice* | Clouded Sulphur | Very common | 8 | 23 | 20 | 11 | 13 |
| | *Pieris rapae* | Cabbage White | Very common | 67 | 109 | 90 | 100 | 127 |

*Species only observed during 2009 transect counts

**Species only observed during 2010 transect counts

***Analysis by Species***

As shown in Table 5 (previous 2 pages), 20 species were observed during transect counts in both years, while 9 species were observed only in 2009, and another 9 were observed only in 2010. A total of 38 species were observed over the 2 years. Only five individuals could not be identified to species because they escaped capture: 3 skippers, 1 anglewing in the genus *Polygonia*, and 1 greater fritillary in the genus *Speyeria*.

Over half of butterflies observed (767 of 1,334) were two non-native species: *Pieris rapae* and *Thymelicus lineola*. Non-native species seemed to be relatively more common in 2009 than in 2010, as they represented 63.9% of butterflies observed in 2009 but only 42.5% in 2010.

The 'very common ' species (based on the regional status assignment detailed in section 2) constituted half of all butterfly species observed, and were found in all 5 land use types. during transects counts. Species designated as 'common' were also observed in all land use types.

ESPA areas produced the highest species richness of common species-5, while only 2 or 3 common species were observed within each of the other land uses. This trend was also observed for 'uncommon' species, with 4 species observed within ESPA areas but only 1 or 2 within the four other land uses. Species designated as 'rare' were only observed within ESPA areas.

Overall species richness was calculated by land use for 2009 and 2010 (see below).

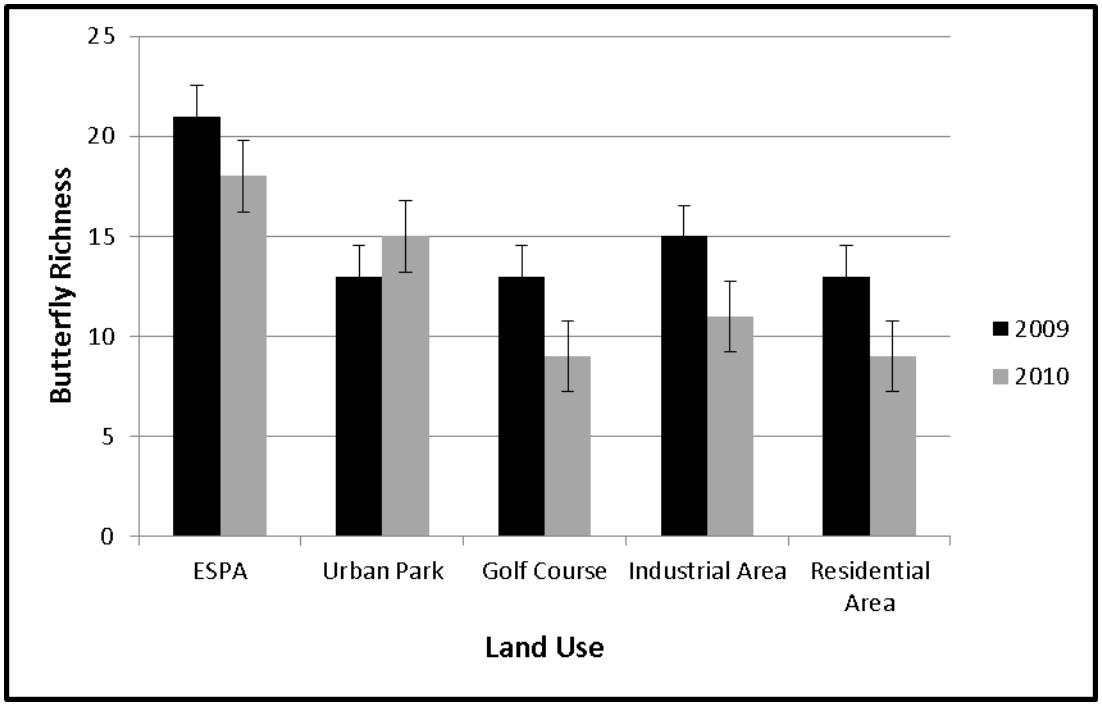


**Figure 3. Overall Species Richness by Land Use in 2009 and 2010**

These results were consistent with some hypotheses about the urban gradient: the highest average diversity was observed within ESPA areas and decreased moving down the gradient to more urbanized land uses. In both 2009 and 2010 species richness was observed to

be highest in ESPAs and urban parks. In 2009 overall species richness was equal within golf courses, residential areas, and industrial areas while in 2010 industrial areas were observed to have a higher species richness then golf courses and residential areas.

***Analysis of Land Uses by Habitat Types***

To better understand the why certain butterflies might be found in particular land uses, the different land uses were analyzed in terms of their habitat characteristics.

**A) Habitat Types**

Habitat types present within the 15 transect sites were divided into 16 general categories which were further classified as natural or created habitats. Table 6 summarizes these general habitat categories and indicates which land uses had areas representing these habitat types.

**Table 6. Habitat Types Present within each Land Use Type.**

| Habitat Type | ESPA | Urban Park | Golf Course | Residential Area | Industrial Area |
|---|---|---|---|---|---|
| **Natural Habitat** | | | | | |
| Meadow | X | | X | | |
| Woodland edge | X | X | X | | |
| Open water | | | X | | |
| Marsh | X | X | | X | |
| Deciduous Swamp | X | | | | |
| Deciduous Forest | X | | | | |
| Natural regeneration | X | | X | X | X |
| Thicket | X | X | | X | |
| Riparian | X | X | | | X |
| Mixed Swamp | X | | | | |
| Hedgerow | | X | | | |
| | | | | | |
| **Created Habitat** | | | | | |
| Manicured Lawn (open) | | X | X | X | X |
| Manicured Lawn (with trees) | | X | X | X | |
| Garden | | | | X | X |
| Pavement | | X | | X | X |
| Gravel (road shoulders, pathways) | X | X | | X | X |

Figure 4 displays the relative abundance of natural and created habitats between land uses. Transects within ESPAs had the least amount of created habitats which were limited to dirt or woodchip trail systems. Residential areas and industrial areas surveyed had the highest amount of created habitat, the majority of which was manicured lawn and pavement (roads). Golf courses surveyed had a surprising amount

of natural habitat mainly due to the presence of woodland edges and natural regeneration area (i.e. areas that were previously cleared but which have been left to naturally regenerate), but also a high proportion of manicured lawn. Urban parks surveyed had a relatively high diversity of natural habitats but also abundant areas of manicured lawn.

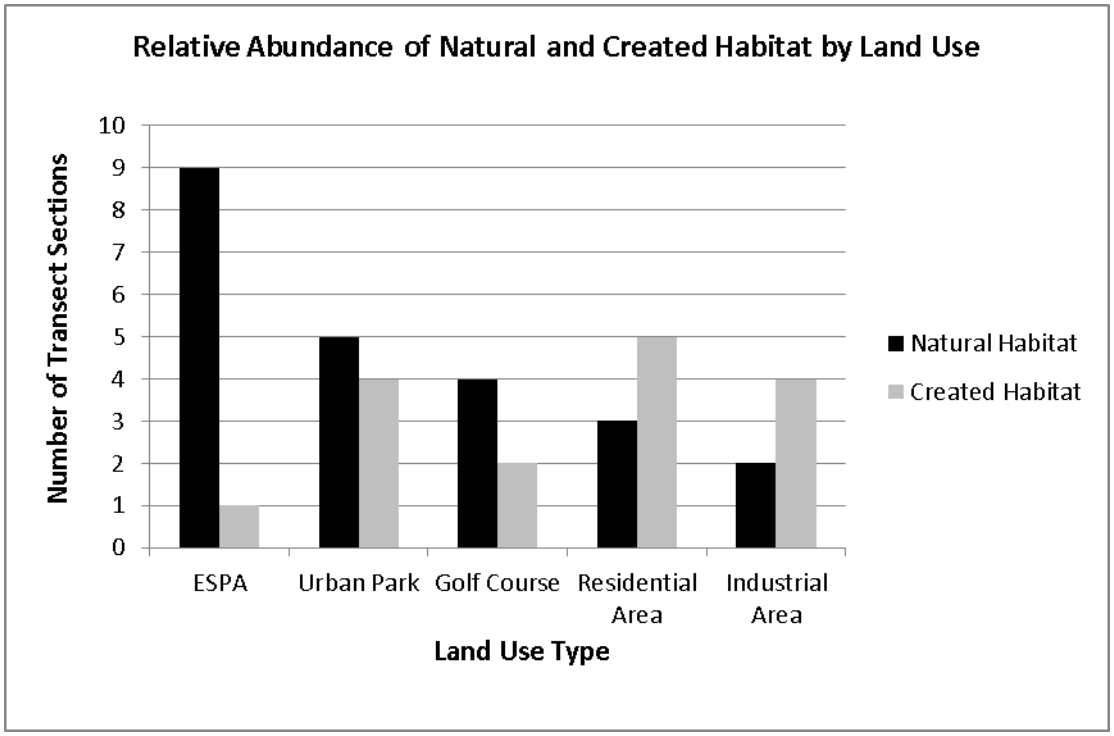


**Figure 4.**

Generally speaking, the highest diversity of butterflies was observed within ESPA areas, which also had the highest diversity of naturalized habitats. This trend continued along the urban gradient. The land uses with the least amount of naturalized habitats (Industrialized areas and residential areas) were also observed to also have the lowest mean butterfly richness. Mean abundance of butterflies within each land use was not observed to be strongly correlated to the diversity of naturalized habitats present within a given land use.

***B) Plant Richness***

Mean richness of non-native plant species at ESPA sites was substantially different from the other four land uses and represented only 29.1% of plants observed (Figure 5). Non-native plants represented more than half of the overall plant richness within urban parks, golf courses, residential areas, and industrial areas. This observation is consistent with the hypothesis about the urban gradient where the fewest non-native plant species are observed in the most natural (or least disturbed)

area and the highest number of exotic plant species are observed in the most urban (or most disturbed) areas.

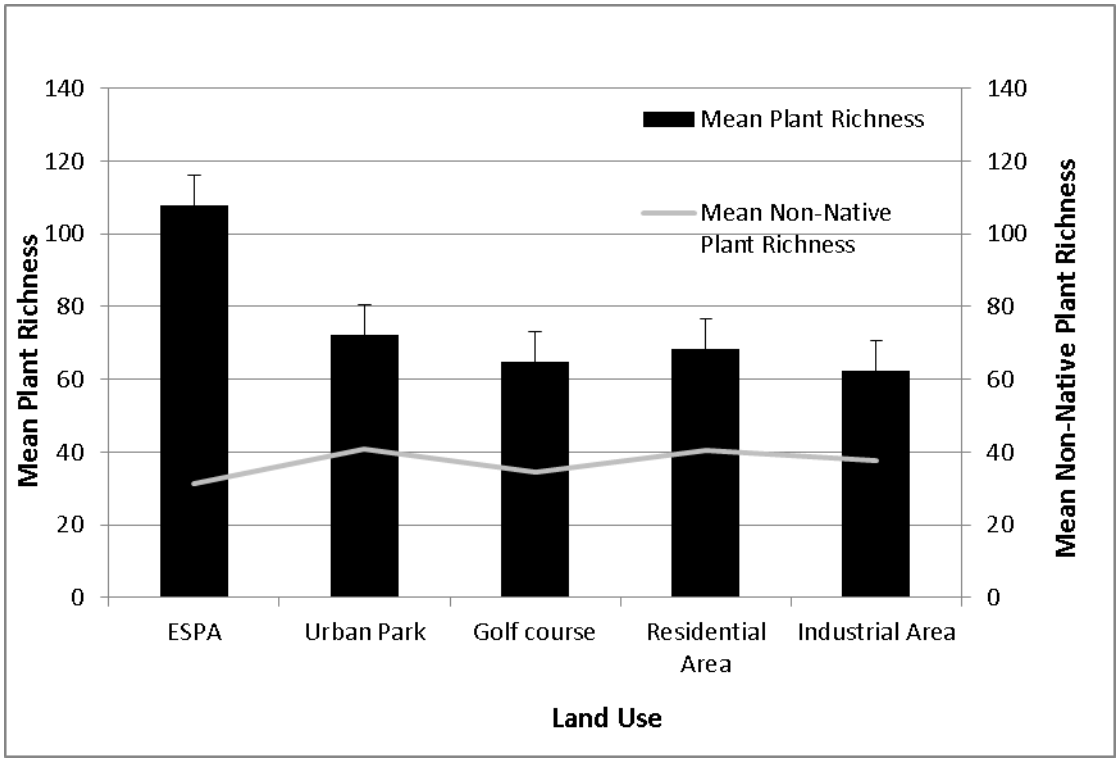


**Figure 5. Mean Plant Richness vs. Mean Non Native Plant Richness by Land Use.**

**C) Vegetation Cover**

Data collected through the established vegetation monitoring plots indicated that golf courses had the highest average percent herbaceous vegetation cover followed by urban parks, ESPAs, industrial areas, and residential areas (Figure 6). These results are influenced heavily by the abundance of manicured lawn at some of these sites which was considered for this study to be vegetation cover. Although likely not the most desirable habitat for butterflies, manicured lawns do consist of vascular plants and butterflies were observed on dandelions (*Taraxacum officinale*) and clovers (*Trifolium* spp. ) growing on lawns during surveys. ESPA areas, which had the highest relative abundance of naturalized habitats also had high proportions of bare ground or leaf litter which were not considered vegetation cover for this study. Residential and industrial areas had a high proportion of pavement compared to the other land uses which resulted in low average percent vegetation cover.

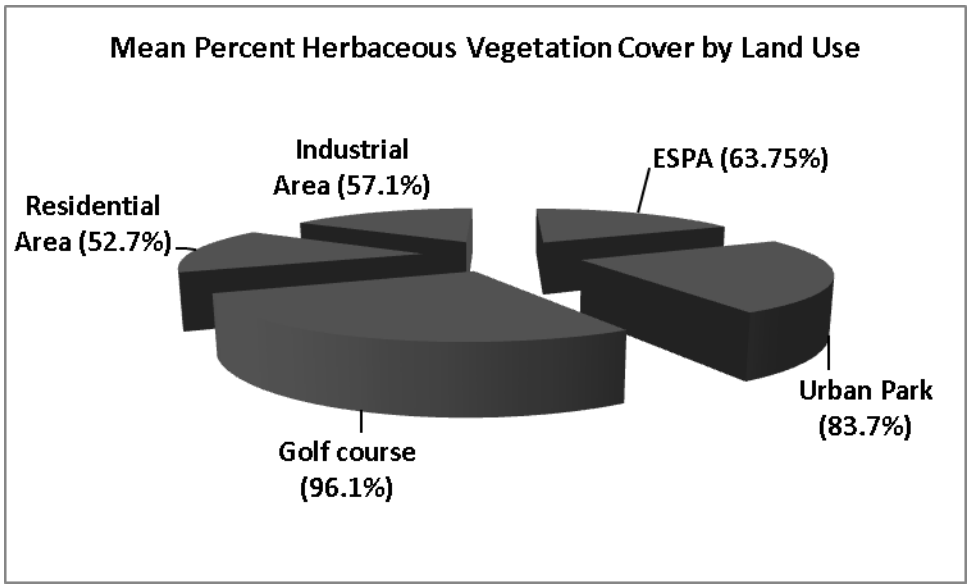


**Figure 6**.

### *D) Canopy Cover*

As indicated previously, the majority of ESPA areas in the Region of Waterloo are forested therefore not surprisingly ESPA areas had the highest average canopy cover of over 77% (Figure 7). Urban parks had the second highest canopy cover which was substantially lower than ESPAs while residential areas, industrial areas, and golf courses all had relatively low average canopy cover. Surprisingly, the highest mean butterfly richness was observed within land uses with the highest canopy cover: ESPAs.

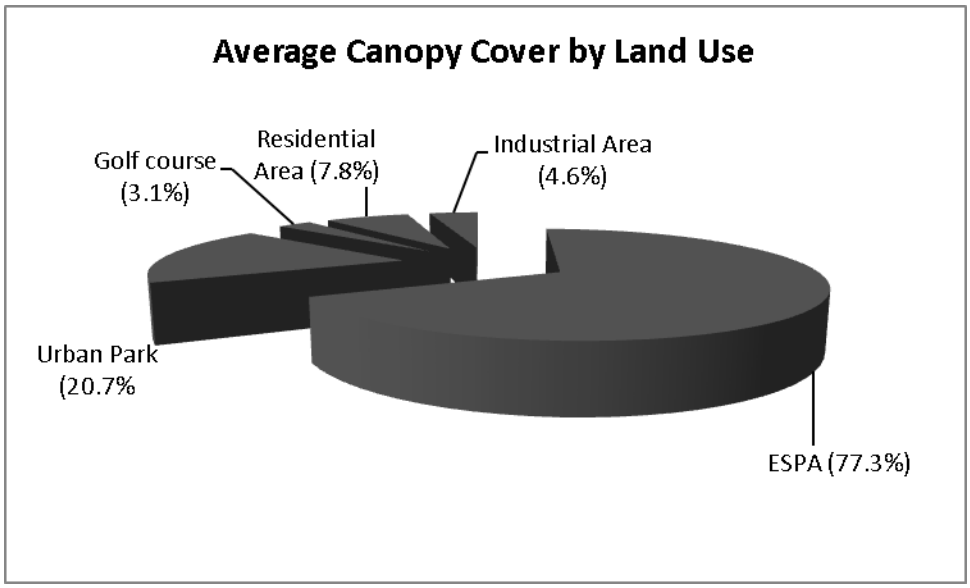


**Figure 7.**

## Discussion

Assumptions about the ordering of the urban gradient were very similar to another study by Blair (1999) which employed similar techniques for ranking similar land uses. Protected ESPAs are characterized as the 'most natural' and industrial areas or business districts are characterized as the 'most urban.' Urban parks, open spaces, residential areas and golf courses are characterized as intermediate. The diversity and types of habitat within these different land use types were consistent with assumptions about the urban gradient: the higher a land use was on the urban-rural gradient the higher diversity of created habitats and non-native plant species it was observed to have.

Overall butterfly richness observed was very similar between land uses in 2009 and 2010, however overall butterfly abundance was observed to be substantially higher in 2009 than 2010. This difference in abundance is attributed to the abundance of two non-native species observed in 2009: *Pieris rapae* and *Thymelicus lineola.* There are a number of factors that may have contributed to why these species were less abundant in 2010 but the difference in the sampling effort (17 weeks in 2009 vs. 11 weeks in 2010) and weather are likely important factors. The highest species richness was observed within ESPAs followed by urban parks, industrial areas, golf courses and residential areas. Abundance was observed to be highest within industrial areas followed by urban parks, ESPAs, golf courses, and residential areas. The land uses that represented the highest butterfly abundance also had the highest counts of *Pieris rapae* and *Thymelicus lineola* which indicate that these non-native species are able to exploit resources in urban environments and adapt to urban land uses easily.

As with other similar studies (Blair and Launer 1997), the causes of these observed patterns in distribution and abundance are difficult to isolate and are almost certainly a combination of multiple factors. Significant correlations between mean butterfly richness and factors that differ across land uses such as plant richness and canopy cover were not observed. However a higher overall richness of butterflies *was* observed in areas with a more naturalized habitats and a richer plant community with minimal invasive plant species. A higher overall richness of butterflies was also observed along transects which had more canopy cover although this is heavily influences by canopy cover within ESPAs which are an obvious outlier. Observing the highest overall species richness within areas with the highest canopy cover was surprising given that butterflies are typically sun lovers and few species prefer shaded areas. This observation could be because a higher average canopy cover does not necessarily translate to more overall shade in an area, particularly along edges or within areas with scattered trees. Trees and shrubs that provide canopy cover can also provide nectar and larval food sources for butterflies. Comparisons between mean butterfly richness, non-native plant richness and herbaceous vegetation cover did not indicate a strong relationship. During transect counts, several butterfly species were observed to be nectaring on non-native flowering plants which provided an abundant nectar source. It has also been documented that some native butterflies have adapted to use non-native plant species as larval foodplants; these include *Papilio polyxenes* and the *Erynnis baptisiae* (Layberry et al. 1998). Overall, none of the parameters examined were observed to strongly influence mean butterfly abundance.

ESPA areas supported the highest diversity of butterfly species with a relatively low abundance of non-native species. Industrial areas were hypothesized to support the lowest diversity of butterfly species; however, they supported more diversity than residential areas and golf courses. The highest proportion of non-native butterfly species was observed within industrial areas, which resulted in sites represented by industrial land uses having the highest overall abundance of butterflies in both 2009 and 2010. Based on the results of this study, it appears that residential areas, golf courses, and industrial areas provide habitat for a

significantly less diverse butterfly community than ESPAs and urban parks. This was surprising given the abundance of flowering plants in gardens, the recent pesticide ban, and the relatively recent increase in public interest in butterfly gardening due to promotion at several local garden nurseries and the development of two, local indoor butterfly attractions. It was hypothesized that due to tendency for ESPA areas to be characterized by forested habitats, that they would not necessarily support the highest diversity of butterflies. This was proven not to be the case. Average species diversity among land uses was observed to be the highest within ESPA areas in both 2009 and 2010. Transects within ESPA areas were also observed to have the highest overall diversity of plants and the lowest proportion of non-native plants indicating that these areas are effective at preserving native butterfly and plant diversity. A total of 9 species observed were restricted to ESPA areas during transect counts compared to 3 restricted to urban parks and 2 restricted to golf courses. Based on the regional status assignment, only two rare species were observed during transect counts, both only within ESPA areas. The highest proportion of regionally uncommon species was also observed within ESPA areas (four species) compared to one uncommon species observed in golf courses, industrial areas, and residential areas. The results of this study indicate that although ESPA areas tend to be characterized by forested habitat they still support the highest diversity of butterfly species. This could be due to a number of factors but is likely a combination of their relatively intact native plant communities and the open edge communities that are often formed as a result of trails and adjacent roads.

Urban parks surveyed supported a relatively high species richness and abundance which was not anticipated given the tendency for these land uses to be heavily manicured. Although these land uses had the highest proportion of manicured lawn and general landscaping, they also had patches of naturalized edges associated with wetland, woodland and riparian habitat which may be attracting butterflies. Golf courses on the other hand, which are also heavily manicured, were observed to support a low species richness. Pesticide use was observed at all three golf courses in 2009 and 2010 on two separate occasions for the control of weeds (early spring and mid-summer). These pesticides were assumed to be only applied to golf greens and not to the naturalized edges. However, it is not known what sort of impact the application of these chemicals may have on the butterfly community.

Overall these findings are consistent with a study by Clergeau (1998) who observed that in large cities, local habitat features seem more important than the landscape setting of the city. If these results are applied to urban land use planning then goals should include maintaining a diversity of naturalized habitat types, increasing plant diversity, providing a variety of nectar sources, and maintaining some canopy cover.

## 4. CONCLUSIONS

The purpose of section 2 was to present detailed baseline data on butterfly presence/absence within the Region to determine which species of butterfly are uncommon or rare and draw conclusions about how butterfly communities have changed over the last 80 years. Through the collection and review of over 4,400 records, interviews with local experts, field checks, and review of field notes and local unpublished literature, general conclusions were drawn about changes in butterfly communities and a regional status was assigned to each known to occur within the Region. It was determined that 46 species should be considered rare or uncommon while 34 should be considered common or very common. It is suggested that this regional status assignment could be a valuable resource for local agencies and government bodies during land use planning to identify important butterfly habitats for protection. The collection of this baseline data presents an opportunity for additional and continued research on

butterfly presence/absence within the Region. It would be extremely useful to add a spatial component to the database by creating a Regional butterfly atlas. Data collection could also continue on a regular basis by building a web-based interface where butterfly observations could be consistently directed. Both of these undertakings are considerable and require time and resources that are currently not readily available. The Region of Waterloo's Ecological and Environmental Advisory Committee however, has expressed interest in creating an annotated reference list of butterflies and their habitat preferences for their Greenlands Network. This is one small but progressive step for including butterflies in Regional landscape planning. Additional gaps that could be filled by future work include species-specific studies to estimate population sizes of rare or uncommon species, as well as an inventory the amount of suitable habitat for these species in the Region.

The purpose of section 3 was to determine how different land uses within the Region of Waterloo affect butterfly abundance and diversity. This question was examined through an urban gradient study which identified Environmentally Sensitive Policy Areas, designated by the Region of Waterloo, as the 'most natural' areas, followed by urban parks, golf courses, residential areas. Lastly, industrial areas were identified as the 'most urban' environments along the gradient. Butterfly richness and evenness between ESPAs and urban parks and compared to other land uses differed significantly. Residential areas, industrial areas, and golf courses were observed to not to differ significantly in terms of their species richness and evenness. Generally, overall species richness was consistent with assumptions about the urban gradient although a slightly more diverse community was observed within industrial areas than residential areas and golf courses. Butterfly abundance was observed to be heavily influenced by the abundance of two non-native species considered to be the most common species in the Region. Trends were observed between factors that characterized the different urban land uses such as plant diversity, canopy cover, and habitat types and overall butterfly species richness, however significant relationships between these variables was not observed. Based on the results of this study it appears that local habitat features play a more important role in characterizing the butterfly community then the overall urban landscape. Opportunities for additional research into landscape influences are apparent and encouraged to build on the results of this study which is focused on site-level analysis. Due to the fragmented nature of the urban landscape in the Region, the urban gradient examined in this study includes natural and urban sites that are disconnected. For example, the residential areas of New Hamburg and St. Clements are relatively isolated from the urban centers of Waterloo, Kitchener, and Cambridge. Therefore an examination of landscape drivers between these disconnected residential areas and residential areas in the main urban hubs is of interest to determine if colonization of isolated areas by less mobile butterfly species is even possible. This type of examination would increase knowledge on how landscape connectivity is influencing local butterfly communities in the Region.

A general decline in the abundance and diversity of butterflies has occurred in the Region of Waterloo. This trend will continue unless policy makers force land use planners to give them consideration. This should involve butterfly inventories of proposed development sites including open areas which provide suitable habitat for uncommon or rare butterfly species identified in this study. Butterflies are not only beautiful, they can be important pollinators and food sources for other insects as well as an important early warning of changes in an ecosystem. Land-use planning should include the creation, protection, and maintenance of open naturalized habitats, edge habitats, and butterfly gardens all which can provide habitat for other wildlife species or act as linkage habitat between larger natural areas.

## 5. REFERENCES


Blair, R. B. 1999. Birds and Butterflies along an Urban Gradient: Surrogate Taxa for Assessing Biodiversity. *Ecological Applications* 9: 164-170.

Blair, R. B. 1996. Land Use and Avian Species Diversity along an Urban Gradient. *Ecological Applications* 6: 506-519.

Blair, R. B. and A. E. Launer. 1997. Butterfly Diversity and Human Land Use: Species Assemblages along an Urban Gradient. *Biological Conservation* 80: 113-125.

Capinera, J. L. 2000. Imported Cabbage Worm, *Pieris rapae* (Linnaeus) (Insect: Lepidoptera: Pieridae). University of Florida. http://edis.ifas.ufl.edu/pdffiles/IN/IN28300.pdf (Accessed January 14, 2010).

Caesar, F. 1957. Unpublished Letter to Craig Campbell. Dated August 31, 1957.

Chew, F. S. 1981. Coexistence and Local Extinction of Two Pierid Butterflies. *The American Naturalist* 118: 655-672.

City of Guelph. 2009. *City of Guelph Natural Heritage Strategy. Phase 2: Terrestrial Inventory and Natural Heritage System.* Volume 2, Appendix B: *Significant Wildlife list for Wellington County*.

Crolla, J. 2009a. Giant Swallowtail: Northern Incursion of a Southern Belle. In: Hall, P.W. 2009. *Sentinels on the Wing: The Status and Conservation of Butterflies in Canada.* NatureServe Canada. Ottawa, Ontario 68 p.

Crolla, J. 2009b. Wild Indigo Duskywing: Native Skipper Meets Non-native Hostplant. In: Hall, P.W. 2009. *Sentinels on the Wing: The Status and Conservation of Butterflies in Canada.* NatureServe Canada. Ottawa, Ontario 68 p.

Eberlie, J. W. D. 1999. Notes of the Distribution of Coenonympha tullia. *Toronto Entomologist Association Season Summary* 1999.

Environment Canada. 2007. Marine Weather Services: The Beaufort Wind Scale Table. http://www.msc-smc.ec.gc.ca/weather/marine/beaufort_e.html (Accessed May 12, 2009).

Government of Canada. 2003. Canadian Biodiversity Information Centre. Species Access Canada: Butterflies (Lepidoptera). http://www.cbif.gc.ca/portal/digir-class.php?p_classid=1andp_lang=en (Accessed September 2008- March 2010).

Grealey, J. 2009. *The Mottled Duskywing: A Butterfly in Decline*. In: Hall, P.W. 2009 *Sentinels on the Wing: The Status and Conservation of Butterflies in Canada*. NatureServe Canada. Ottawa, Ontario 68 p.

Grealey, J. 2010. Butterfly Abundance and Diversity in the Region of Waterloo, Ontario, Canada. Unpublished Master of Environmental Studies thesis, University of Waterloo. Available from Theses Canada (National Library of Canada) at http://hdl.handle.net/10012/5742

Grealey, J. 2006. *Monitoring Butterfly Abundance and Diversity at the rare Charitable Research Reserve, Cambridge, Ontario*. Unpublished.

Grealey, J. and L. Lamb. *Rare Charitable Research Reserve Annual Butterfly Count* 2006-2010. Unpublished Data.

Hagen, R. H., R. C. Lederhouse, J. L. Bossart, and J. M. Scriber. 1991. Papilio canadensis and P. glaucus (Papilionidae) are distinct species. *Journal of the Lepidopterists Society* 45: 245-258.

Hall, P.W. 2009 *Sentinels on the Wing: The Status and Conservation of Butterflies in Canada.* NatureServe Canada. Ottawa, Ontario.

Holmes, A. M., R. R. Tasker, Q. F. Hess, and A. J.Hanks. 1991. *The Butterfly Atlas of Ontario*. Toronto, Toronto Entomologists Association.

Keeler, M. S., F. S. Chew, B. C. Goodale, and J. M. Reed. 2006. Modeling the Impacts of the Exotic Invasive Species on a Native Butterfly: Top-Down vs. Bottom-up Effects. *Journal of Animal Ecology* 75: 777-788.

Klots, A.B. 1951. *A Field Guide to the Butterflies of North American East of the Great Plains*. Houghton Mifflin, Boston.

Lamb, L. 1967. A *Checklist of Waterloo County Lepidoptera, Papilionoidea: The Butterflies. Kitchener, Ontario*. Unpublished. April 11, 1967.

Layberry, A. L., P. W. Hall, and J. D. Lafontaine. 1998. *The Butterflies of Canada*. Toronto, University of Toronto Press.

Longstaff, G. B. 1912. *Butterfly Hunting in Many Lands*. Longmans and Greens, London.

Ministry of Environment (MOE). 2009. Pesticide Legislation. http://www.ene.gov.on.ca/en/land/pesticides/index.php (Accessed September 2010).

Moore, C. 2009. Butterfly Monitoring Report for the *rare* Charitable Research Reserve. Unpublished.

Moore, C. 2010. Butterfly Monitoring Report for the *rare* Charitable Research Reserve. Unpublished.

NHIC (Natural Heritage Information Centre). 2010. Biodiversity Explorer. http://www.biodiversityexplorer.mnr.gov.on.ca/nhicWEB/main.jsp (Accessed February 20, 2010).

Pavulaan, H. and D. M. Wright. 2000. The Biology, Life History, and Taxonomy of *Celastrina neglecta major* (Lycaeinae: Polyommatinae). *The Taxonomic Report of the International Lepidoptera Survey* 2: 1-19.

Pelham, J . P. A Catalogue of the Butterflies of the United States and Canada. *Journal of Research on the Lepidoptera* 40: 1-658.

Pollard, E. and T.J. Yates. 1993. *Monitoring Butterflies for Ecology and Conservation*. London, United Kingdom, Chapman and Hall.

Region of Waterloo. 2006a. *Census Bulletin.* http://www.region.waterloo.on.ca/web/region.nsf/0/A2888970473334228525737000600C1D7/$file/Bulletin_1.pdf?openelement (Accessed October 3, 2010).

Region of Waterloo. 2006b. *Census Bulletin: Agriculture Statistics from the 2006 Census for Waterloo Region*. http://www.region.waterloo.on.ca/web/region.nsf/DocID/0FB42CEC5C282D818525760B0065A9AA/$file/Bulletin_12.pdf?OpenElement (Accessed October 24, 2010).

Region of Waterloo. 2006c. Regional Official Policies Plan. September 2006 Consolidation. http://region.waterloo.on.ca/web/region.nsf/Docid/297822CA308E1ED985256E4000697FA3?OpenDocument (Accessed November 2009).

Richardson, W. and V. Martin. 1999. Regional Municipality of Waterloo. Revisions to Waterloo Region's Significant Species List: Native Vascular Plant Component.

Riotte, J. C. E. 1967. *Pieris Virginiensis* in Ontario (Lepidoptera: Pieridae). *Entomological Society of Ontario* 98: 27-29.

Scott, J. A. 1986. *The Butterflies of North America: A Natural History and Field Guide*. Stanford, California, Stanford University Press.

Scudder, S. H. 1989. *The Butterflies of Eastern United States and Canada: Volume 1.* Cambridge, Massachusetts.

Seglenieks, F. 2009. University of Waterloo Weather Station Annual Summary – 2009. http://www.weather.uwaterloo.ca/download/historical/2009/weather_notes_2009.pdf (Accessed October 24, 2010).

Sharp M.J. and Campbell, C.A. 1980. An Ontario Range Extension for the Dorcas Copper Butterfly, *Epidemia dorcas* Kirby. *The Canadian Field Naturalist* 96: 208-209.

Toronto Entomologists' Association (TEA). 1970-2011. Ontario Lepidoptera: Seasonal Summaries. http://www.ontarioinsects.org/lep_sum.htm (Accessed September 2008-December 2011).

Toronto Entomologists' Association (TEA). 1975. *Pieris virginiensis* Edwards in Ontario. Toronto Entomologists' Association Occasional Publication No. 5.

UKBMS (United Kingdom Butterfly Monitoring Scheme). 2006. Butterflies as Indicators. http://www.ukbms.org/butterflies_as_indicators.htm (Accessed on October 17, 2008).

Walton , R. K. 2010. Cabbage White. Massachusetts Butterfly Atlas. http://www.massaudubon.org/butterflyatlas/index.php?id=106 (Accessed February 2010).

Webster, R. P. and P. G. deMaynadier. 2005. A Baseline Atlas and Conservation Assessment of the Butterflies of Maine. Maine Department of Inland Fisheries and Wildlife.

Wormington, A. 1999. The Status and Distribution of Sleepy Orange (*Eurema nicippe*) in Ontario. In: Hanks, A. J. 1999. Butterflies of Ontario and Summaries of Lepidoptera Encountered in 1998. Toronto Entomologists Association.

Wormington, A. 2006. *The Butterflies of Halton Region, Ontario: A Preliminary List*. In: J.K. Dwyer (ed.). 2006. *Halton Natural Areas Inventory: Species Checklists*.

Wormington, A. and W. G. Lamond. 2003. *The Butterflies of Hamilton, Ontario*. In: J.K. Dwyer (ed). 2003. *Hamilton Natural Areas Inventory*. Nature Counts Project. Hamilton Naturalists Club.

**Collections Examined**

1. James, E.L. Collection housed at the University of Waterloo, Department of Biology. November 3, 2008.
2. Lamb, L. Collection housed at a private residence in Waterloo, Ontario. Examined January 30, 2010.
3. Morton, J. K. Collection housed at a private residence in Waterloo, Ontario. Examined December 8, 2008.
4. University of Guelph Insect Collection, Department of Environmental Biology. Examined December 15, 2008.
5. Stricker, F. Collection housed at a private residence in Kitchener, Ontario. Examined December 5, 2008.

**Record of Interviews and Personal Correspondence**

Burell, M. Email correspondence May 28, 2009.

Campbell, C. Formal interview conducted on November 27, 2008. Ongoing Correspondence from September 2008 to November 2010.

Lamb, L. Formal interview conducted on November 10, 2008. Ongoing Correspondence from November 2008 to November 2010.

Morton, J. Formal interview conducted on December 8, 2008 at J. Morton's private residence.

Richardson, G. Email correspondence August 24, 2010 and January 16, 2012.

Rumig, C. Email correspondence October 28 and 29, 2010.

Shea, J. Email correspondence September 23 and October 8, 2010.

Stricker, F. Formal interview conducted December 5, 2008 at F. Stricker's private residence.

Woodman, B. Email correspondence March 2, 2010 and April 1, 2010.

Wormington, A. Phone conversation, October 24, 2010.

## 6. APPENDIX A: CHECKLIST OF SPECIES OCCURRING IN WATERLOO REGION

All species marked with a have been recorded in Waterloo Region in the past 5 years (2006-2011).

**Hesperiidae**

Silver-Spotted Skipper, *Epargyreus clarus*✓
Northern Cloudywing, *Thorybes pylades*✓
Dreamy Duskywing, *Erynnis icelus*
Sleepy Duskywing, *Erynnis brizo*
Juvenal's Duskywing, *Erynnis juvenalis*✓
Mottled Duskywing, *Erynnis martialis*
Columbine Duskywing, *Erynnis lucilius*✓
Wild Indigo Duskywing, *Erynnis baptisiae*✓
Common Checkered Skipper, *Pyrgus communis*
Common Sootywing, *Pholisora catullus*✓
Arctic Skipper, *Carterocephalus palaemon*✓
Least Skipper, *Ancyloxypha numitor*✓
European Skipper, *Thymelicus lineola*✓
Fiery Skipper, *Hylephila phyleus*✓
Common Branded Skipper, *Hesperia comma*
Indian Skipper, *Hesperia sassacus*
Peck's Skipper, *Polites peckius*✓
Tawny-edged Skipper, *Polites themistocles*✓
Crossline Skipper, *Polites origenes*✓
Long Dash Skipper, *Polites mystic*✓
Northern Broken Dash, *Wallengrenia egeremet*✓
Little Glassywing, *Pompeius verna*✓
Delaware Skipper, *Anatrytone logan*✓
Mulberry Wing, *Poanes massasoit*✓
Hobomok Skipper, *Poanes hobomok*✓
Broad-Winged Skipper, *Poanes viator*✓
Dion Skipper, *Euphyes dion*✓
Black Dash, *Euphyes conspicua*✓
Two-Spotted Skipper, *Euphyes bimacula*
Dun Skipper, *Euphyes vestris*✓
Pepper and Salt Skipper, *Amblyscirtes hegon*
Common Roadside Skipper, *Amblyscirtes vialis*

***Papilionidae***

Pipevine Swallowtail, *Battus philenor*
Zebra Swallowtail, *Eurytides marcellus*
Black Swallowtail, *Papilio polyxenes*✓
Giant Swallowtail, *Papilio cresphontes*✓
Eastern Tiger Swallowtail, *Papilio glaucus*✓
Spicebush Swallowtail, *Papilio Troilus*

***Pieridae***

Checkered White, *Pontia protodice*
Mustard White, *Pieris oleracea*
West Virginia White, *Pieris virginiensis*
Cabbage White, *Pieris rapae*✓
Clouded Sulphur, *Colias philodice*✓
Orange Sulphur, *Colias eurytheme*✓
Pink-edged Sulphur, *Colias interior*
Little Yellow, *Pyrisitia lisa*✓
Sleepy Orange, *Abaeis nicippe*

***Lycaenidae***

Harvester, *Feniseca tarquinius*
American Copper, *Lycaena phlaeas*
Bronze Copper, *Lycaena hyllus*✓
Bog Copper, *Lycaena epixanthe*
Dorcas Copper, *Lycaena dorcas*
Purplish Copper, *Lycaena helloides*
Acadian Hairstreak, *Satyrium acadica*✓
Coral Hairstreak, *Satyrium titus*✓
Edwards' Hairstreak, *Satyrium edwardsii*
Banded Hairstreak, *Satyrium calanus*✓
Hickory Hairstreak, *Satyrium caryaevorus*✓
Striped Hairstreak, *Satyrium liparops*✓
Hoary Elfin, *Callophrys polios*
Eastern Pine Elfin, *Callophrys niphon*✓
Gray Hairstreak, *Strymon melinus*
Eastern Tailed Blue, *Cupido comyntas*✓
Spring Azure, *Celastrina lucia*✓
Summer Azure, *Celastrina neglecta*✓

Greenish Blue, *Plebejus saepiolus*

***Nymphalidae***

American Snout, *Libytheana carinenta*✓
Variegated Fritillary, *Euptoieta claudia*✓
Great Spangled Fritillary, *Speyeria cybele*✓
Aphrodite Fritillary, *Speyeria aphrodite*
Regal Fritillary, *Speyeria idalia*
Atlantis Fritillary, *Speyeria atlantis*
Silver-bordered Fritillary, *Boloria selene*
Meadow Fritillary, *Boloria bellona*✓
Silvery Checkerspot, *Chlosyne nycteis*
Harris's Checkerspot, *Chlosyne harrisii*
Pearl Crescent, *Phyciodes tharos*✓
Northern Crescent, *Phyciodes cocyta*✓
Tawny Crescent, *Phyciodes batesii*
Baltimore Checkerspot, *Euphydryas phaeton*✓
Question Mark, *Polygonia interrogationis*✓
Eastern Comma, *Polygonia comma*✓
Satyr Comma, *Polygonia satyrus*
Gray Comma, *Polygonia progne*✓
Compton Tortoiseshell, *Nymphalis l-album*✓
Mourning Cloak, *Nymphalis antiopa*✓
Milbert's Tortoiseshell, *Aglais milberti*✓
American Lady, *Vanessa virginiensis*✓
Painted Lady, *Vanessa cardui*✓
Red Admiral, *Vanessa atalanta*✓
Common Buckeye, *Junonia coenia*✓
White Admiral, *Limenitis arthemis arthemis*✓
Red-spotted Purple, *Limenitis arthemis astyanax*✓
Viceroy, *Limenitis archippus*✓
Tawny Emperor, *Asterocampa clyton*✓
Northern Pearly-Eye, *Enodia anthedon*✓
Eyed Brown, *Lethe eurydice*✓
Appalachian Brown, *Lethe appalachia*✓
Little Wood-Satyr, *Megisto cymela*✓
Common Ringlet, *Coenonympha tullia*✓
Common Wood-Nymph, *Cercyonis pegala*✓
Monarch, *Danaus plexppus*✓