Biodiversity Study of Butterflies/Dragonflies/Damselflies that Inhabit or Frequent the Wye Marsh

Abstract

The health of our remaining wetlands has recently been a hot topic in the environmental community. These ecosystems help filter our water supplies and provide aesthetic beauty while supporting a vast biodiversity of organisms. In order to monitor the health of wetlands, indicator species are used to provide advanced warning of potential hazards. The Odonates live the majority of their lives underwater and they are good indicators for water pollutants. This study looks at the biodiversity and abundance of butterflies and Odonates in the Wye Marsh in order to get a better understanding of their populations. With frequent studies over the next few years, their population dynamics can be used to monitor the Wye Marsh ecosystem. Currently the most abundant butterfly species in the marsh is *Danaus plexippus*; the most abundant dragonfly species is *Sympetrum obtrusum*; and the most abundant damselfly species is *Ischnura verticalis*. It was also found that a new species of damselfly, *Enallagma divagans*, has extended its range farther north to include the Wye Marsh, possibly due to recent climate changes.

Introduction

Insects have inhabited the planet for billions of years. They are the most diverse group of organisms and thus have infiltrated nearly every type of habitat on Earth. They have derived their success from a variation of adaptations and unique life cycles which make the class Insecta a fascinating taxonomical study group.

What is a butterfly?

Lepidoptera is the order of insects that includes the butterflies and moths. These creatures start out their life cycle as tiny eggs that are laid on flowers, shrubs and trees. After an average gestation period of less than a week, the eggs open to reveal a caterpillar. These caterpillars vary in size, shape and colour from species to species, but they all have a common goal in mind; to eat. They will continue eating and growing for an average of 2 to 3 weeks until it is time to pupate. At this time, the caterpillar will enclose itself within a brittle chrysalis (in the case of butterflies). While inside the chrysalis, the caterpillar undergoes a metamorphosis where its body is altered and ultimately emerges from the enclosure approximately a week or two later as an adult butterfly. Once the insect is a butterfly, its behaviours include using its proboscis to drink the nectar from flowers, attempting to evade avian predators and mating with an adult of the same species to continue the cycle of life. Towards the end of the summer season, the pregnant female butterfly will lay her eggs on a specific host plant and then pass on, leaving the young to overwinter in the protective covering of the egg. However,

certain species, like the Monarch, will migrate south for the winter and return the following year.

To further classify the Lepidoptera, they are broken down into families. The swallowtails (Papilionidae) are the largest North American butterflies, and are often slow flying with their long tails. The whites and sulphurs (Pieridae) are generally white or yellow in colour, due to the presence of pigments called pteridines found almost exclusively in the bodies of this family. The gossamer-wings (Lycaenidae) have a small body size and many of their caterpillar feed solely on flower parts. Brushfoots (Nymphalidae) are named because of their greatly reduced forelegs, and this is the only family in Ontario that has certain migratory species. The skippers (Hesperiidae) received theier name from their erratic flight pattern, darting back and forth, and they can generally be distinguished by their triangular wings and large body vs. wing size. Adult butterflies have two pairs of wings, forewings and hindwings, which also have distinct colour patterns, shapes and sizes that vary from species to species. These characteristics are used in the field to identify one butterfly species from another. Butterflies are considered predominantly diurnal, active during the day, and will perform most of their daily rituals on hot summer days when the sun is brightly shining. They tend to be more lethargic in the cold and wind, resting on plants while waiting for the sun's return.

Figure 1: Photograph taken of a member of the Hesperiidae family, *Euphyes vestris* (Dun Skipper), showing the triangular wing trait (Left). Photograph taken of a member of the Nymphalidae family, *Satyrodes eurydice* (Eyed Brown), showing the shortened forelegs (Right).

What is a Dragonfly?

Odonata is the order of insects that includes the dragonflies and damselflies. This order is further divided into suborders, with Anisoptera being the suborder for the dragonflies. Dragonflies, like butterflies have an interesting life cycle that involves a metamorphosis from young to adult. Adult females will lay their eggs on the surface of the water, or on vegetation that is close to the water's surface. In many species, the larval form, or nymph, will emerge from the egg in the autumn and overwinter beneath the water. The nymph will be in a state of diapause, which is like suspended animation, throughout the winter and begin the active role of eating aquatic invertebrates in the

spring. After anywhere from a month to a few years as a nymph, the insect then crawls up out of the water and sheds its exoskeleton revealing two pairs of wings. These two forewings and two hindwings are then used to take flight as a teneral (juvenile) dragonfly. Most local species of dragonfly will survive as an adult for approximately 1 to 2 months, during which time they will feed on mosquitoes and other small insects. They will mate anywhere from early to late summer and the pregnant females will again lay the eggs on or near the water, continuing the lifecycle.

Adult dragonflies are organized further into different families. There are darners (Aeshnidae), clubtails (Gomphidae), spiketails (Cordulegastridae), cruisers (Macromiidae), emeralds (Corduliidae) and skimmers (Libellulidae), each having their own distinguishing characteristics. The darners are the largest and strongest flyers. The clubtails usually have a swollen, club-like tip on their abdomen. The spiketail females have very long, spike-like ovipositors. Most emeralds have bright green eyes and the skimmers are your typical pond-dwelling dragonflies, often with stout bodies. Species can be identified out in the field based on multiple features. Thorax and abdomen banding pattern and colour, wing shape and size, as well as the shape and size of the cerci or claspers at the end of the abdomen, are all used to distinguish one dragonfly species from another.

Figure 2: Photograph taken of a member of the Libellulidae family, *Sympetrum obtrusum* (White-faced Meadowhawk), showing the stout body trait of this family (Left). Photograph taken of two members of the Aeshnidae family, *Aeshna Canadensis* (Canada Darner), showing the male clasping the female's neck in the typical mating pose (Right).

What is a damselfly?

Zygoptera is the name of the suborder containing the damselflies. Like dragonflies, the damselfly spends most of its life as a nymph under the water. The nymphs are born, usually in the springtime, from small eggs under the water and grow underwater by eating various aquatic insects. Sometime in the late summer or early autumn the nymph will emerge from the water, shed its exoskeleton and spread its wings, to begin exploring the world as a teneral damselfly. The damselflies will very rarely travel far distances from the water where they emerged and will instead search for a mate in the surrounding coastline. Once mating has occurred, the female oviposits on the

surface of the water and the adults pass on. The length of the entire life cycle varies among species, from 1 to 3 years, but all Ontario damselflies overwinter as eggs or as nymphs, the adults cannot survive the winter and their wings are not as strong as the dragonflies so they cannot migrate over long distances.

Zygoptera is also further classified into family groups. The broad-winged damselflies (Calopterygidae) are named for their usually wide wing at the based of the thorax and they are the only family of damselflies that perform courtship displays. Spreadwings (Lestidae) are aptly named because while they are perched their wings are not folded behind their back like most damselflies, but rather their four wings are spread into a fan-like formation. The pond damsels (Coenagrionidae) are the largest family and the most diverse, living and breeding in a wide variety of habitats. To distinguish between Anisoptera and Zygoptera species, there are a few apparent differences. Anisoptera is generally larger than Zygoptera, at rest dragonflies have their wings extended and damselflies fold them behind their back, and Anisoptera species are much quicker and more agile and powerful flyers than Zygoptera species. As with Anisoptera, the key features for identifying one Zygoptera species from another is by looking at the banding pattern on their head, abdomen, thorax and sometimes on their wings. However, certain species require a closer look in order to tell one apart from another and a hand lens must be used to examine the cerci and paraprocts (male genitalia) of the specimen in detail.

Figure 3: Photograph taken of a member of the Coenagrionidae family, *Enallagma erbium* (Marsh Bluet), showing the folded wing pattern while at rest (Left). Photograph taken of a member of the Calopterygidae family, *Calopteryx maculate* (Ebony Jewelwing), showing the wide wing at the base of the thorax (Right).

Why the Wye Marsh?

The Wye Marsh consists of a 1214 ha (3000 acres) wildlife area situated in an environmentally endowed location in southern Georgian Bay. Ownership of the area is divided between the Ontario Ministry of Natural Resources Provincial Wildlife Area (1167 ha / 2884 acres) and Environment Canada's National Wildlife Area (47 ha / 116 acres). However stewardship of the wetland itself falls on the shoulders of the Friends of the Wye Marsh Inc. and it needs to be protected.

The National Wetlands Inventory (NWI) of the U.S. Fish & Wildlife Service defines wetlands as low areas where the land is saturated with water at some time during the year's growing season. They are transition zones between dry land areas and deeper water areas, and they play a vital role in keeping our environment in a state of equilibrium. Wetlands, and the plants, microbes and wildlife that inhabit them, act as filters to help clean incoming water of impurities.

The Wye Marsh has an abundance of plants and animals that live and thrive in its unique ecosystem. A mosaic of food webs can found throughout the marsh's many habitats, including mixed and coniferous forests, as well as open marsh, fen and meadow habitats and this area must be protected in order to ensure the continued survival of these incredible creatures. One way to ensure a healthy marsh is to look at indicator species that live within it. These indicator species are the ones that will be drastically affected by any change in the chemistry of the environment. For a marsh ecosystem, Odonates are one of such species.

Figure 4: A satellite image of the Wye Marsh property and surrounding residencies.

Methods

Before any sampling could commence, a permit from the Ministry of Natural Resources (MNR) was required in order capture the insects that were being studied. A capture and release permit was obtained for certain insects that inhabit the Wye Marsh.

Animals

The species of insect chosen for the MNR permit was based on the species that were observed at the Wye Marsh in 2001 according to the bioinventory done by Bob Bowles (Bowles, 2002). A complete list of the species observed in 2001, and found on the MNR permit can be seen on Table 1.

The organisms were observed out in the field and an attempt at positive identification was made. First a visual ID was attempted, and if closer inspection was required, then the following steps were taken. For the Odonates, the insect was caught in a 12-inch diameter, 3-foot long butterfly net, its wings were grabbed by the thumb and forefinger and it was removed from the net. A magnifying lens and field ID book was then used to identify the species of the insect. For butterflies, the same net was used to catch the insect and it was then placed in a clear plastic, 6-sided observation box, where it was observed using a field ID book to identify the species using distinguishing features.

Once the insect was identified, it was recorded and then released. If the insect was still unidentifiable, then it was kept in the observation box and brought back to the Wye Marsh Wildlife Centre for further study. It was then released at its place of capture later that same day.

Table 1: All insect species that were under permit from the MNR and came from the 2001 Bioinventory of the Wye Marsh by Bob Bowles.

Family name	**Species name**
Lepidoptera (Butterflies)	
Hesperiidae (Skippers)	*Ancyloxypha numitor* (Least Skipper)
	Epargyreus clarus (Silver-spotted Skipper)
	Erynnis lucilius (Columbine Duskywing)
	Euphyes vestris (Dun Skipper)
	Poanes hobomok (Hobomok Skipper)
	Thorybes pylades (Northern Cloudywing)
	Thymelicus lineola (European Skipper)
Lycaenidae (Gossamer-wings)	*Celastrina ladon* (Spring Azure)
	Celastrina neglecta (Summer Azure)
	Everes comyntas (Eastern Tailed Blue)
	Lycaena hyllus (Bronze Copper)
	Lycaena phlaeas (American Copper)
	Satrium acadica (Acadian Hairstreak)
Nymphalidae (Brushfoots)	*Boloria Bellona* (Meadow Fritillary)
	Boloria selene (Silver-bordered Fritillary)
	Cercyonis pegala (Common Wood Nymph)
	Coenonympha tullia (Common Ringlet)

	Danaus plexippus (Monarch)
	Enodia anthedon (Northern Pearly Eye)
	Euphydryas phaeton (Baltimore)
	Limenitis archippus (Viceroy)
	Limenitis arthemis (White Admiral)
	Megisto cymela (Little Wood Satyr)
	Nymphalis antiopa (Mourning Cloak)
	Nymphalis milberti (Milbert's Tortoiseshell)
	Nymphalis vau-album (Compton Tortoiseshell)
	Phyciodes selenis (Northern Crescent)
	Phyciodes tharos (Pearl Crescent)
	Polygonia comma (Eastern Comma)
	Polygonia interrogationis (Question Mark)
	Satyrodes eurydice (Eyed Brown)
	Speyeria cybele (Great Spangled Fritillary)
	Vanessa atalanta (Red Admiral)
	Vanessa cardui (Painted Lady)
	Vanessa virginiensis (American Lady)
Papilionidae (Swallowtails)	*Papilio Canadensis* (Canadian Swallowtail)
	Papilio glaucus (Eastern Tiger Swallowtail)
	Papilio polyxenes (Black Swallowtail)
Pieridae (Whites and Sulphurs)	*Colias eurytheme* (Orange Sulphur)
	Colias philodice (Clouded Sulphur)
	Pieris napi (Mustard White)
	Pieris rapae (Cabbage White)
Anisoptera (Dragonflies)	
Aeshnidae (Darners)	*Aeshna Canadensis* (Canadian Darner)
	Aeshna constricta (Lance-tipped Darner)
	Aeshna umbrosa (Shadow Darner)
	Aeshna verticalis (Green-striped Darner)
	Anaz junius (Common Green Darner)
	Boyeria vinosa (Fawn Darner)
Corduliidae (Emeralds)	*Epithica canis* (Beaverpond Baskettail)
	Epitheca cynosure (Common Baskettail)
	Somatochlora walshii (Brush-tipped Emerald)
Libellulidae (Skimmers)	*Celithemis elisa* (Calico Pennant)
	Leucorrhinia intacta (Dot-tailed Whiteface)
	Leucorrhinia proxima (Red-waisted Whiteface)
	Libellula julia (Chalk-fronted Corporal)
	Libellula luctuosa (Widow Skimmer)
	Libellula lydia (Common Whitetail)
	Libellula pulchella (Twelve-spotted Skimmer)
	Libellula quadrimaculata (Four-spotted Skimmer)
	Nannothemis bella (Elfin Skimmer)
	Sympetrum obtrusum (White-faced Meadowhawk)
	Sympetrum semicinctum (Band-winged

	Meadowhawk)
	Sympetrum vicinum (Yellow-legged Meadowhawk)
Zygoptera (Damselflies)	
Calopterygidae (Broad-winged Damsels)	*Calopteryx aequabile* (River Jewelwing)
	Calopteryx maculate (Ebony Jewelwing)
Coenagrionidae (Pond Damsels)	*Chromagrion conditum* (Aurora Damsel)
	Enallagma carunculatum (Tule Bluet)
	Enallagma civile (Familiar Bluet)
	Enallagma erbium (Marsh Bluet)
	Enallagma hageni (Hagen's Bluet)
	Ischnura verticalis (Eastern Forktail)
	Nehalinnia Irene (Sedge Sprite)
Lestidae (Spreadwings)	*Lestes disjunctus disjunctus* (Common Spreadwing)
	Lestes forcipatus (Sweetflag Spreadwing)
	Lestes rectangularis (Slender Spreadwing)
	Lestes unguiculatus (Lyre-tipped Spreadwing)

Site Habitats

Various capture sites were used in an attempt to get samples from a wide range of habitats. Sites were chosen within 100m of main access points for easy accessibility, and ranged among the different vegetation types found throughout the Wye Marsh. A GPS point was taken, using a Garmin GPS 72 unit with software Version 2.30, at a central location for each site, and surveying took place within a 50m radius of this point, paying attention not to cross from one habitat type into another.

Figure 5: Map of the Wye Marsh showing the layout of the different survey sites. The sites were numbered starting at the Wye Marsh Wildlife Centre and traveling counterclockwise around the marsh property.

Site 1 – Boardwalk and Berm at the Centre (N 44°43.640', W 079°50.572')

The boardwalk is a man made wooden pathway that is built directly over the open marsh, with cattails and lily pads on either side as well as open water. The berm is a man-made dirt pathway with various grasses, trees and shrubs growing along its length. Red osier dogwood, staghorn sumac, glossy buckthorn and common burdock line the edges of the burm which in turn is surrounded by open marsh.


Figure 6: Arial photograph taken from a helicopter flying over the Wye Marsh, showing the vegetation and topography of Site 1 (Left). Photograph taken on the berm of Site 1, showing staghorn sumac and common burdock along the berm edges (Right).

Site 2 – End of William Street (N 44°43.795', W 079°51.131')

The marsh comes to a narrow inlet at the end of William St. with many surrounding cattails and large grasses. The study area was just on either side of the inlet along the large grassy shores which are bordered on the far side by various deciduous and coniferous trees. There was also a small area of swamp milkweed just to the left of the road also bordered on the far side by a mixed forest habitat.


Figure 7: Arial photograph taken from a helicopter flying over the Wye Marsh, showing the vegetation and topography of Site 2 (Left). Photograph taken on the shoreline of Site 2, showing swamp milkweed and grasses in the foreground and the mixed forest in the background (Right).

Site 3 – End of King Street (N 44°43.586', W 079°51.830')

At the end of a poison ivy covered path, this site is long and narrow and consists of many small vernal pools with cattails and tall grasses all around. Farther out, surrounding the small site is a mixed forest containing many pine and ash trees. Joe-pye-weed plants dot the entire site area giving a bit of colour to the green grasses.


Figure 8: Arial photograph taken from a helicopter flying over the Wye Marsh, showing the vegetation and topography of Site 3 (Left). Photograph taken on the ground at Site 3, showing joe-pye-weed, tall grasses and cattails with mixed forest along the edges (Right).

Site 4 – End of Brebeuf Road (N 44°42.435', W 079°52.779')

A very dried up marsh habitat rests just off to the east of Brebeuf road, surrounded by many large beech trees. Dead fallen trees are found in the middle of the site with a small, very shallow pond along the west side. A few cattails and tall grasses can be found along the shore of the shallow pond, but the most predominant plant is jewelweed which is found throughout the site. There is also some goldenrod, joe-pye-weed and forget-me-nots that grow around the area, and large quantities of crane flies were observed flying around the site.


Figure 9: Arial photograph taken from a helicopter flying over the Wye Marsh, showing the vegetation and topography of Site 4 (Left). Photograph taken on the ground at Site 4,

showing tall grasses, fallen dead trees and the very shallow water surrounded by beech trees (Right).

Site 5 – End of Marsh Lane / Preston Cell (N 44°42.064', W 079°52.450')

A very large meadow habitat is found at this site, consisting of many different tall grasses, a few small shrubs and some swamp milkweed dotting the area. Along the far south eastern side is the Wye River flowing towards the marsh, while the south western side is bordered by deciduous trees. The open marsh just touches the northern end of the meadow.


Figure 10: Arial photograph taken from a helicopter flying over the Wye Marsh, showing the vegetation and topography of Site 5 (Left). Photograph taken on the ground at Site 5, showing tall grasses, swamp milkweed and the large trees bordering the south side of the meadow (Right).

Site 6 – Off Forget Road (N 44°41.635', W 079°51.636')

About 200m down the path from Forget road there is a clearing within the dense hardwood forest. An open area consisting of rough horsetail, Queen Anne's lace, poison ivy and swamp milkweed can be seen as a big change in habitat. The site is surrounded by staghorn sumac bushes and to a greater extent, maple, oak and red pine trees. A rare hummingbird moth was seen getting nectar from some of the flowers in the site area.

Figure 11: Photograph taken on the ground at Site 6, showing rough horsetail, Queen Anne's lace and poison ivy with surrounding red pine trees. Arial photograph was not taken of Site 6 due to the fact that the small clearing was not visible from the helicopter.

Site 7 – Fen to the East of Hall's Pond (N 44°42.393', W 079°51.487')

A large fen habitat comprises this site where pitcher plants and long *Phragmites* grass can be seen throughout the area. A very narrow stream flows through the wet fen site, and very little dry land was seen at this location. The open marsh area of Hall's pond is situated just to the west of the site.

Figure 12: Arial photograph taken from a helicopter flying over the Wye Marsh, showing the vegetation and topography of Site 7. A ground photograph was not taken at this location from fear that the camera would fall in the water along the unstable ground of the fen.

Site 8 – End of Wood Road (N 44°42.399', W 079°50.701')

A dirt road cuts right through this site with the predominant ground vegetation being poison ivy. There are also patches of Queen Anne's lace, rough horsetail and soapwort found along either side of the dirt road. Staghorn sumac is sparsely found through the fields of grasses, and larger ash and oak trees border the field on both sides.

Sampling

Sampling occurred on random days and at random times throughout the months of July, August and September 2007 due to a varying work schedule. The survey site would be chosen depending on the availability of the researcher's time and the amount of time already spent at a certain site. Once at the site, the date, weather and start time were all recorded on pre-made observation sheets before sampling would start. Within the site area, an attempt was made to identify any butterfly, dragonfly or damselfly seen and recorded on the observation sheet. A tally was kept for each species that was found, in order to be used later for abundance data. Once the field study period was finished, the finish time was recorded on the observation sheet. All data was then compiled and analyzed using Microsoft Excel.

Table of schedule??

Results

Table 2: Lepidoptera species found throughout the summer of 2007 at the Wye Marsh as compared to the Lepidoptera species found in the summer of 2001. An "X" indicates that the species was found in this study but was not found in 2001. A "0" indicates that the species was found in 2001 but was not observed in this study.

Family name	Species name	Change from previous study
Hesperiidae (Skippers)	*Ancyloxypha numitor* (Least Skipper)	0
	Epargyreus clarus (Silver-spotted Skipper)	
	Erynnis lucilius (Columbine Duskywing)	0
	Euphyes vestris (Dun Skipper)	
	Poanes hobomok (Hobomok Skipper)	0
	Pompeius verna (Little Glassywing)	X
	Thorybes pylades (Northern Cloudywing)	0
	Thymelicus lineola (European Skipper)	
	Wallengrenia egeremet (Northern Broken-dash)	X
Lycaenidae (Gossamer Wings)	*Celastrina ladon* (Spring Azure)	0
	Celastrina neglecta (Summer Azure)	0
	Everes comyntas (Eastern Tailed Blue)	
	Glaucopsyche lygdamus (Silvery Blue)	X
	Lycaena hyllus (Bronze Copper)	
	Lycaena phlaeas (American Copper)	
	Satrium acadica (Acadian Hairstreak)	0
Nymphalidae (Brush-footed Butterflies)	*Boloria Bellona* (Meadow Fritillary)	0
	Boloria selene (Silver-bordered Fritillary)	0
	Cercyonis pegala (Common Wood Nymph)	
	Coenonympha tullia (Common Ringlet)	
	Danaus plexippus (Monarch)	
	Enodia anthedon (Northern Pearly Eye)	0
	Euphydryas phaeton (Baltimore)	
	Limenitis archippus (Viceroy)	
	Limenitis arthemis (White Admiral)	
	Megisto cymela (Little Wood Satyr)	
	Nymphalis antiopa (Mourning Cloak)	
	Nymphalis milberti (Milbert's Tortoiseshell)	
	Nymphalis vau-album (Compton Tortoiseshell)	0
	Phyciodes selenis (Northern Crescent)	
	Phyciodes tharos (Pearl Crescent)	
	Polygonia comma (Eastern Comma)	0
	Polygonia interrogationis (Question Mark)	0
	Satyrodes eurydice (Eyed Brown)	
	Speyeria cybele (Great Spangled Fritillary)	
	Vanessa atalanta (Red Admiral)	

	Vanessa cardui (Painted Lady)	
	Vanessa virginiensis (American Lady)	0
Papilionidae (Swallowtails)	*Papilio Canadensis* (Canadian Swallowtail)	0
	Papilio glaucus (Eastern Tiger Swallowtail)	
	Papilio polyxenes (Black Swallowtail)	
Pieridae (Whites and Sulphurs)	*Colias eurytheme* (Orange Sulphur)	
	Colias interior (Pink-edged Sulphur)	X
	Colias philodice (Clouded Sulphur)	
	Pieris napi (Mustard White)	
	Pieris rapae (Cabbage White)	

Twenty-seven of the butterfly species that were found in the 2001 Wye Marsh Bioinventory (Bowles, 2002) were again seen in this study. The Hesperiidae and Lycaenidae families seem to be the most variable between the two study periods, where approximately half of the species found in 2001 were not seen in 2007, and three new species were seen. No new species of Nymphalids were observed in this study, however seven species seen in 2001 were not seen in 2007. The Papilionidae and Pieridae families remained fairly similar over the years, with only one new sulphur found in 2007. Of particular note are *Pompeius verna*, *Wallengrenia egeremet*, *Glaucopsyche lygdamus* and *Colias interior* which are the new Lepidoptera species to add to the Wye Marsh biodiversity list. A total of thirty-one Lepidoptera species were observed during this study.

Table 3: Anisoptera species found throughout the summer of 2007 at the Wye Marsh as compared to the Anisoptera species found in the summer of 2001. An "X" indicates that the species was found in this study but was not found in 2001. A "0" indicates that the species was found in 2001 but was not observed in this study.

Family name	**Species name**	**Change from previous study**
Aeshnidae (Darners)	*Aeshna canadensis* (Canada Darner)	
	Aeshna constricta (Lance-tipped Darner)	
	Aeshna eremita (Lake Darner)	X
	Aeshna umbrosa (Shadow Darner)	0
	Aeshna verticalis (Green-striped Darner)	0
	Anaz junius (Common Green Darner)	
	Boyeria grafiana (Ocellated Darner)	X
	Boyeria vinosa (Fawn Darner)	0
	Epiaeschna heros (Swamp Darner)	X
Gomphidae (Clubtails)	*Gomphus borealis* (Harpoon Clubtail)	X
Corduliidae (Emeralds)	*Cordulia shurtleffii* (American Emerald)	X
	Epithica canis (Beaverpond Baskettail)	0
	Epitheca cynosure (Common Baskettail)	0
	Somatochlora walshii (Brush-tipped Emerald)	0
	Somatochlora williamsoni (Williamson's Emerald)	X
Libellulidae (Skimmers)	*Celithemis elisa* (Calico Pennant)	0

	Erythemis simplicicollis (Eastern Pondhawk)	X
	Leucorrhinia frigida (Frosted Whiteface)	X
	Leucorrhinia intacta (Dot-tailed Whiteface)	
	Leucorrhinia proxima (Red-waisted Whiteface)	
	Libellula julia (Chalk-fronted Corporal)	
	Libellula luctuosa (Widow Skimmer)	
	Libellula lydia (Common Whitetail)	
	Libellula pulchella (Twelve-spotted Skimmer)	
	Libellula quadrimaculata (Four-spotted Skimmer)	
	Nannothemis bella (Elfin Skimmer)	
	Sympetrum internum (Cherry-faced Meadowhawk)	X
	Sympetrum obtrusum (White-faced Meadowhawk)	
	Sympetrum semicinctum (Band-winged Meadowhawk)	0
	Sympetrum vicinum (Yellow-legged Meadowhawk)	

Of the three insect groups that were observed during this study, the dragonflies demonstrated the most fluctuation between 2001 and 2007. Libellulidae was the only family that seemed fairly consistent and it too had two species not observed in 2007 and three species that are new to the list. In the Corduliidae family, all three species observed in 2001 were not found again but two new emeralds took their place. The Gomphidae family is new for 2007, with *Gomphus borealis* being the sole clubtail observed. Within the Aeshnidae, three species have remained steady over the years, with another three that were no longer seen and two new species to augment the Wye Marsh's biodiversity. A total of twenty-two Zygoptera species were observed during this study.

Table 4: Zygoptera species found throughout the summer of 2007 at the Wye Marsh as compared to the Zygoptera species found in the summer of 2001. An "X" indicates that the species was found in this study but was not found in 2001. A "0" indicates that the species was found in 2001 but was not observed in this study.

Family name	**Species name**	**Change from previous study**
Calopterygidae (Broad-winged Damsels)	*Calopteryx aequabile* (River Jewelwing)	0
	Calopteryx maculate (Ebony Jewelwing)	
Coenagrionidae (Pond Damsels)	*Chromagrion conditum* (Aurora Damsel)	0
	Enallagma carunculatum (Tule Bluet)	
	Enallagma civile (Familiar Bluet)	
	Enallagma divagans (Turquoise Bluet)	X
	Enallagma erbium (Marsh Bluet)	
	Enallagma exsulans (Stream Bluet)	X
	Enallagma hageni (Hagen's Bluet)	0
	Enallagma signatum (Orange Bluet)	X

	Ischnura posita (Fragile Forktail)	X
	Ischnura verticalis (Eastern Forktail)	
	Nehalinnia Irene (Sedge Sprite)	
Lestidae (Spreadwings)	*Lestes congener* (Spotted Spreadwing)	X
	Lestes disjunctus disjunctus (Common Spreadwing)	
	Lestes forcipatus (Sweetflag Spreadwing)	
	Lestes rectangularis (Slender Spreadwing)	
	Lestes unguiculatus (Lyre-tipped Spreadwing)	

The overall outcome for the damselflies seems to be an increase in diversity over the years. Only three species across two families were not seen in 2007, and five new species were observed. Special attention should be paid to the new sighting of *Enallagma divagans*, for its range does not usually extend as far north as the Wye Marsh (Lam, 2004). A total of fifteen Anisoptera species were recorded during this study.

Table 5: The amount of time spent at each study site collecting abundance data.

Study site	**Time spent data collecting (hrs)**
Site 1	4.25
Site 2	5.5
Site 3	1.25
Site 4	2.5
Site 5	4.75
Site 6	1.75
Site 7	2.5
Site 8	0.5
Total time spent	23.0

The total amount of time spent out in the field collecting abundance data was 23 hours. An attempt was made to spend an equal amount of time at each of the eight study sites, however some sites got more attention than others. Site 1, 2 and 5 received the most consideration and site 8 was visited during only one session and only for a short period of time.

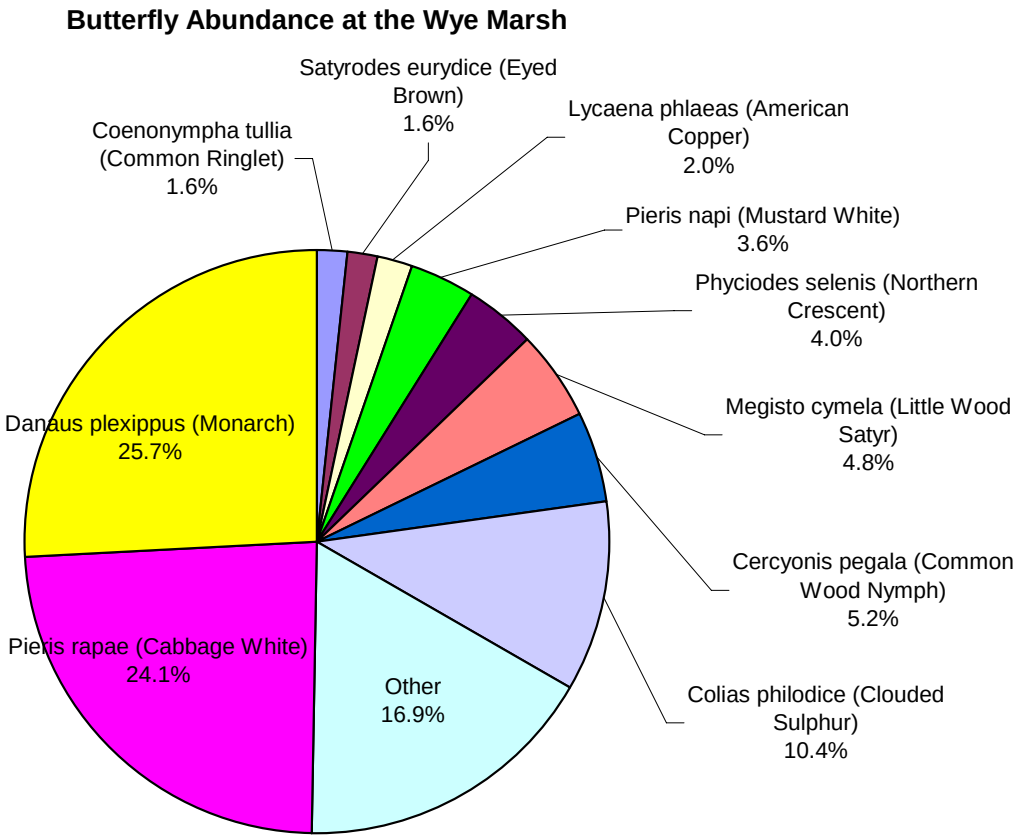

Figure 13: Pie chart showing the most abundant Lepidoptera species found at the Wye Marsh in the summer of 2007. Only the top ten most abundant species are shown, with the remaining species graphed together in the "other" heading. All species in the "other" category were seen fewer than four times throughout the study period.

The two most predominant species of Lepidoptera at the Wye Marsh are *Pieris rapae* and *Danaus plexippus*, together making up approximately half of the butterfly sightings. *Colias philodice*, *Cercyonis pegala* and *Megisto cymela* were also seen frequently at various sites. For a complete list of all Lepidoptera species, exact number counts and at which sites the species were observed, see Appendix 1.

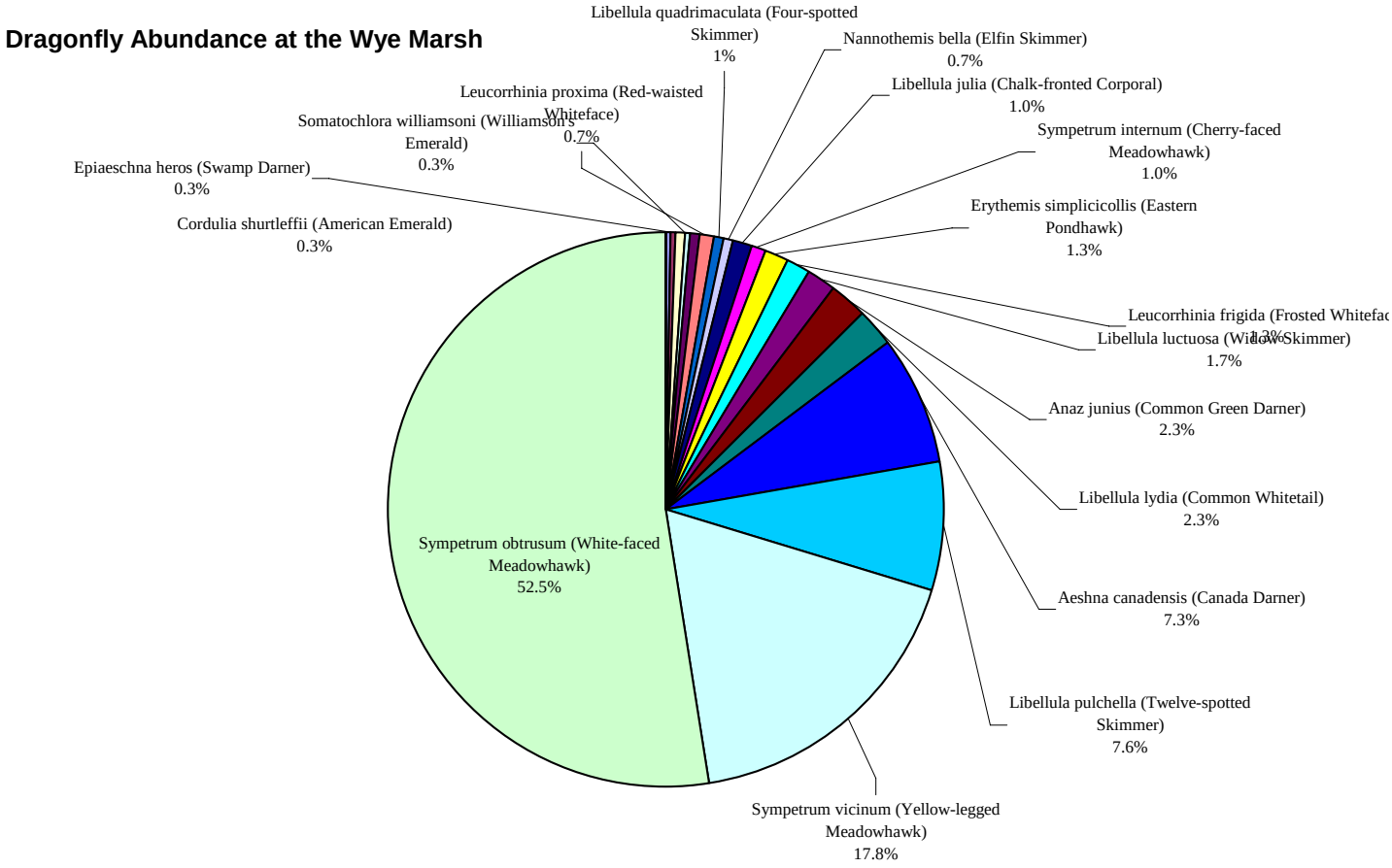

Figure 14: Pie chart showing the most abundant Anisoptera species found at the Wye Marsh in the summer of 2007. All species are shown except for those that were only observed in the NWA.

By far, the most abundant Anisoptera species is *Sympetrum obtrusum* which accounts for more than half of the overall dragonfly sightings. *Sympetrum vicinum* was also very abundant but was only seen in the latter portion of the study, as they have a late emergence (Mead, 2003). *Libellula pulchella* and *Aeshna canadensis* were also seen frequently at various study sites.

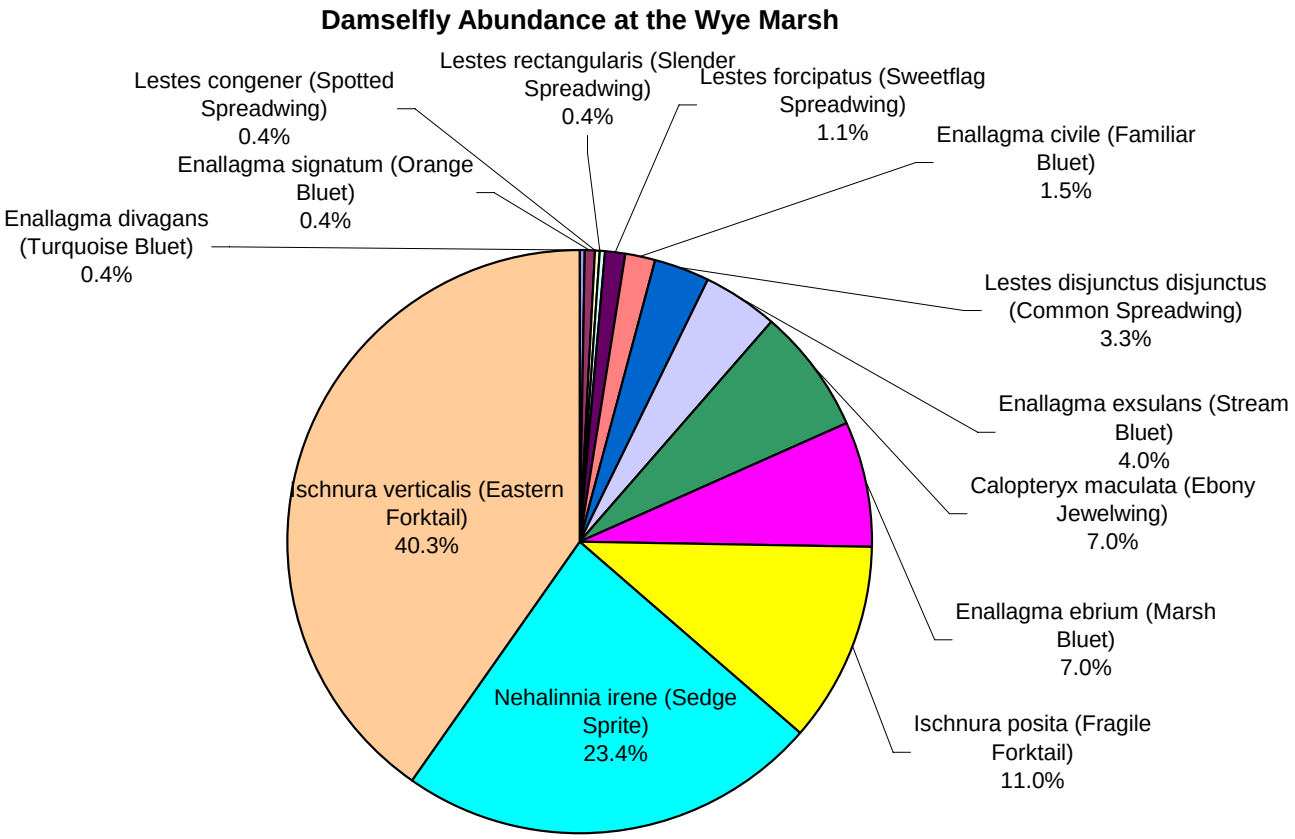

Figure 15: Pie chart showing the most abundant Zygoptera species found at the Wye Marsh in the summer of 2007. All species are shown except for those that were only observed in the NWA.

The three most common Zygoptera species were *Ischnura verticalis*, *Nehalinnia irene* and *Ischnura posita*, which alone account for 75% of the overall damselfly abundance. Despite some of the remaining ten species being seen at multiple study sites, their numbers only make up the left over one quarter of the sightings. There was only one *Enallagma divagans* individual found and documented throughout the study period, and it was found at Site 5.

Table 6: Summary chart showing the biodiversity (number of species caught) and abundance (number of individuals caught) of the butterflies, dragonflies and damselflies at each study site.

Site #	Type of Insect	Biodiversity	Abundance
1	Butterflies	9	51
	Dragonflies	9	46
	Damselflies	7	84
	All	**25**	**181**
2	Butterflies	6	13
	Dragonflies	4	26
	Damselflies	9	36
	All	**19**	**75**
3	Butterflies	5	14
	Dragonflies	2	19
	Damselflies	1	1
	All	**8**	**34**
4	Butterflies	5	16
	Dragonflies	7	99
	Damselflies	8	56
	All	**20**	**171**
5	Butterflies	22	113
	Dragonflies	5	29
	Damselflies	6	37
	All	**33**	**179**
6	Butterflies	10	21
	Dragonflies	4	43
	Damselflies	0	0
	All	**14**	**64**
7	Butterflies	4	4
	Dragonflies	10	41
	Damselflies	4	59
	All	**18**	**104**
8	Butterflies	7	17
	Dragonflies	0	0
	Damselflies	0	0
	All	**7**	**17**

The site with the greatest biodiversity for butterfly species was found at site 5. The highest biodiversity value for the dragonflies and the damselflies was found at site 7 and site 2 respectively. The site with the greatest overall biodiversity was site 5, and it was close to having the highest overall abundance value as well, with 179 individuals seen, but site 1 has a slightly higher overall abundance at 181. The highest abundance value for the butterflies is at site 5, with an abundance of 113. For the dragonflies, site 4 shows the greatest abundance with a value of 99, and the damselflies highest abundance at one site reached a count of 84 at site 1.

Discussion

The Wye Marsh has many different habitat types that exist on its property. During a GIS survey done in the summer of 2007, it was noted that mixed forest, meadow, swamp, fen and open water habitats were all found on the grounds. Given that different species of butterfly and odonates frequent different habitat types, an attempt was made to survey as many different vegetation regimes as possible in order to collect the widest range of various species.

The majority of butterfly species prefer open plains/meadow habitat, but certain species, such as *Megisto cymela*, prefer woodlands and the woodland/clearing edge habitat. The most biodiversity found amongst the Lepidoptera was at Site 5 where there is a large meadow. The varieties of plant species that live within this area seem to be both a food source and an egg laying ground for many species. In particular, the Monarch butterfly, which is provincially and federally designated as a species of special concern (OMNR, 2007), was found in abundance at this site feeding and eggs were found under the leaves of the milkweed plants. This is excellent news, providing evidence that the Wye Marsh is a breeding ground for this rare species, and it was overall the most abundant Lepidoptera species seen during the study period.

While the wealth of *Danaus plexippus* found in the area is a great finding for both the species and the public, it should be noted that the abundance data found in this study has certain complications. Given that the sites were visited on more than one occasion and on different days throughout the summer, and no form of tagging or marking the specimens was done, there is the possibility that the individuals observed on one day could be the same individuals observed at a later date, and thus would have been recorded twice. There were also many instances when an insect was seen but could not be properly identified due to either a very brief observance or an observation at too great a distance for distinguishing characteristics to be apparent. This too would skew the abundance results by decreasing the count, given that these individuals could not be properly recorded.

Dragonfly species are found primarily around open water habitats where they feed on other insects and where the females go to lay her eggs. This being the case, the site with the greatest Anisoptera biodiversity was Site 7 which is a small fen habitat. Darners and skimmers were found flying about, feeding and mating among the reeds. Interestingly, while Site 7 had the highest biodiversity, it was not the location of the highest abundance value. Site 4 had the most Anisoptera observations, with *Sympetrum obtrusum* leading the way with 53 sightings (See Appendix 1). The next most abundant species was *Sympetrum vicinum* with a mere 26 sightings. This would seem to indicate that while certain habitats, like the fen, provide excellent territory for a variety of different species, some species will come out in greater numbers and dominate other habitats.

Again, there are certain problems that may be found in the abundance data in order to alter accuracy. As with the Lepidoptera, data may have been duplicated if the

same insect was seen at two different visits. However, the larger error for the Anisoptera is in the fact that they are a very quick flying insect and numerous individuals were seen racing by and no distinguishing characteristics were evident.

The Zygoptera species prefer to inhabit costal areas, perching on the vegetation along the shores of streams and ponds. Site 1 has the largest shoreline area as the berm is long and narrow, stretching throughout the marsh, so it seems obvious that the greatest abundance in Zygoptera would be seen at this site, as the results indicate. When we look at species richness, a different story unfolds, with Site 2 having the most biodiversity. This could be due to the fact that Site 2 has multiple habitat types in very close quarters, including open water, shoreline, tall grass meadow, cultural dirt road and mixed forest edge habitat. It could have also been because more time was spent at this site collecting data than at any other site, which brings forth yet another obstacle.

Another inherent issue with species abundance that all three insects would share, is the fact that certain sites were examined for longer periods of time. As Table 5 indicates, Site 1, Site 2 and Site 5 were all searched for more than 4 hours. Less than 3 hours of data collecting was done at each of the other sites, with an all time low of only a half hour at Site 8. The reason for this high fluctuation in time spent at each site comes from a variety of different factors. This research was being performed at the Wye Marsh at the same time as other projects and scheduling was often conflicting. All sites were chosen along the perimeter of the marsh and near access points in an attempt to reduce the travel time between them. Yet some sites were still closer and easier to get to than others, so this added to the discrepancy.

Site 1 was visited more frequently because of its close location to the base of operations, the Wye Marsh Wildlife Centre. Site 2 has more time logged because two researchers (Chris McIlhinney and Mike Majury) surveyed this area, and thus the data collection time had to be doubled. A lot of time was spent at Site 5 because upon the first visit to this site, an *Enallagma divagans* specimen was found and it has yet to be recorded for this area. *Enallagma divagans* has a range that it farther south than the Wye Marsh (Lam, 2004), but it was found this far north possibly due to the changing climate and warmer weather. This would not be the first time that an odonate has extended its range farther north this year, for a group of *Somatochlora hineana* (Hine's Emeralds) was found just south of the Wye Marsh by Colin Jones, another odonate enthusiast (Mason, 2007). More time was spent here in an attempt to locate more specimens of this rare species (unfortunately there was only the one sighting). Very little time was spent at Site 8 due the abundance of wasps, hornets and poison ivy that was found at the site. It should also be mentioned that there was a Site 9, deep within the mixed forest, but it was removed from the study because no specimens were observed for the hour that was spent at this location.

Further observation should be done around the Wye Marsh area over the next few years to assess the change in biodiversity and abundance. Odonates are an indicator species, so if any contaminants or pollutants are introduced into the marsh the odonate populations will be affected quickly and drastically and could act as a method of early

warning that the marsh is in danger and counteracting measures could be taken to preserve the marsh. The study sites that were used during this project are a very good representation of the varying habitats found at the Wye Marsh, however a few changes to the study should include, more time spent in the mixed forest (possibly as a control), a sight on the open water could be valuable, and strict scheduling for time and date to visit each of the sites in an attempt to reduce confounding variables that affect the abundance data.

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