## 2024 Ecological Monitoring Summary

Founded in 2001, the ***rare*** Charitable Research Reserve is a community-based land trust, nature reserve, and environmental institute that protects over 1,500 acres of natural landscapes in Waterloo Region and Wellington County, Ontario. We acknowledge and are grateful to all of the original stewards of the land where this monitoring took place (the Haldimand Tract, which spans six miles on either side of the Grand River and is the territory of the Onkwehon:we Peoples of the Six Nations of the Grand River). It is also the territory of the Anishinaabe Peoples Mississaugas of the Credit First Nation. In addition, monitoring projects took place on stewarded land at the border of the Upper Canada Treaty No. 3 and Treaty 19 from 1818, which is also the territory of the Anishinaabe Peoples Mississaugas of the Credit First Nation. We honour and respect the sovereignty of these First Nations and their ancestors. The lands we steward are home to many other First Nations, Métis, and Inuit who have moved to the area from across Turtle Island.

The following is a summary of highlights from 2024 ecological monitoring programs.

### Butterfly Monitoring

Prepared by: Annika Wilcox

Butterfly monitoring has occurred at ***rare*** since 2006, with consecutive and consistent efforts since 2010. Butterflies are extremely susceptible to environmental changes, and their short lifespans allow responses to these changes to be seen across generations - this makes them a very valuable group of organisms to study.

When butterfly monitoring began, it took place along two transects. By 2010, the project had grown to four transects, and 2024 marks the 15th year that these transects have been surveyed. Ecological Monitoring Assessment Network (EMAN) protocols are used, which standardizes the data and thus allows it to be compared with data collected nation-wide to better understand the health of the ecosystems at ***rare***.

Monitoring began on May 13th and concluded on August 22nd. Each of the surveyed transects (Cliffs and Alvars, Southfield, Thompson Tract, and Blair Flats) contain different ecozones, allowing us to collect data on butterflies using forests, restored prairies, cliffs, and globally-rare alvar habitats. Each transect was monitored once a week for 13 consecutive weeks, and during times and environmental conditions where butterflies are most likely to be active. Following EMAN protocols, this includes the hours between 10:00 am and 3:00 pm, and when temperatures are above either 13 degrees Celsius (when sunny) or 17 degrees Celsius (when cloudy).

This year, 3319 individuals of 41 species of butterflies were observed during the monitoring season. This marks a 28% decrease in abundance from last year's total of 4613 individuals, and a 25% decrease in abundance from the average over the past five years. The

41 species seen this year demonstrate an 11% decrease in richness from last year's 46 species observed, and a 15% decrease from the past five years' average of 48 species.

However, following EMAN protocols, the baseline data for comparison in future years is the first five years of data. Thus, when comparing this year's totals to the baseline data collected between the beginning of the 2010 season and the end of the 2014 season, we see a 34% decrease in the abundance data and an 11% decrease in the number of species observed. A full statistical analysis of the data is conducted every five years to identify significant changes in the butterfly population at ***rare***, with the next occurring in 2025.

The five most commonly encountered species throughout the 2024 monitoring season were the Inornate Ringlet (*Coenonympha tullia*; 20% of observations), Clouded Sulphur (*Colias philodice*; 17%), Cabbage White (*Pieris rapae*; 14%), Common Wood-Nymph (*Cercyonis pegala*; 10%), and Little Wood-Satyr (*Megisto cymela*; 6%). These are the same species that were most frequently seen last year, although their order in terms of their representation out of the total number of butterflies observed is different. Cabbage Whites have been the most commonly seen species for the previous five years, but this year it was the third most abundant species, making up only 14% of the butterflies seen. This is the lowest representation that Cabbage Whites have had in the past five years.

In the 2023 monitoring season, a decline in Monarchs (*Danaus plexippus*) was identified, with only 115 individuals seen relative to the previous five-year average of 230 Monarchs being observed in a season (50% of the average). Concerningly, this decline continued this year, with only 52 of these endangered butterflies being seen across the entire 13-week monitoring season. Although this year's number of observations is low, it is not the lowest recorded since monitoring began; in 2013, only 17 Monarchs were seen, and after three years of observation numbers in the 50s (57 in 2014, 53 in 2015, and 56 in 2016), the population rebounded. Thus, although the decline currently being seen is worrying, the population does have the potential to bounce back over the next few years as it has done before.

Inversely, Red Admirals (*Vanessa atalanta*) have demonstrated a significant increase in abundance. These butterflies were being encountered in incredibly low numbers in past years, with only seven individuals being seen in 2022. After 2022, their numbers began to rebound, and 76 individual Red Admirals were seen in 2023. This upward trend continued this year, with 153 being seen throughout the 2024 season. This demonstrates a 2086% increase from the 2022 total, and a 101% increase from last year's numbers. Although this species will continue to be closely monitored, this is great news for the species on ***rare*** properties.

Last year was quite an exceptional year for several species, with Silvery Blues (*Glaucopsyche lygdamus*), Eastern Tiger Swallowtails (*Papilio glaucus*), and Great Spangled Fritillaries (*Speyeria cybele*) showing notable population spikes, with numbers of observations far above the average being seen. However, each of these species showed a decline back towards their average this year, and in some cases even below the average (116 Great Spangled Fritillaries were seen in 2023, but only 12 were observed in 2024, for example). Last year also had several notable species being seen, including Broad-winged Skippers (*Poanes* *viator*), Baltimore Checkerspots (*Euphydryas phaeton*), Hackberry Emperors (*Asterocampa celtis*), and Spicebush Swallowtails (*Papilio troilus*). A White Admiral x Red-Spotted Purple intergrade (*Limenitis arthemis arthemis x astyanax*) was also spotted and photographed. Although none of these species were observed during the standardized butterfly monitoring this year, Baltimore Checkerspots, Hackberry Emperors, and White Admiral x Red-Spotted Purple intergrades were observed on ***rare*** properties in 2024 by a community science volunteer. There were also some additional notable sightings during the 2024 butterfly monitoring season: Tawny Emperors (*Asterocampa clyton*) were seen for the first time since 2021, White Admirals (*Limenitis arthemis arthemis*) were observed three times this year alone, despite only being observed three other times in the past 11 years of monitoring, and a Mulberry Wing (*Poanes massasoit*) was observed for the sixth time ever during ***rare*** butterfly monitoring.

In addition to the 13-week butterfly monitoring season conducted by ***rare*** staff and volunteers, the annual butterfly count was held on July 14th, 2024. There were 160 individual butterflies sighted and 20 species observed during the count. 13 volunteers participated, and a total of 6.5 kilometres were covered in various eco-types, including those found in the Butterfly Loop, Newman Trail, the ECO Centre, Thompson Tract, and South Field.

Overall, the butterfly population at ***rare*** appears to be variable. Some species are showing strong declines while others are demonstrating significant rebounds, and a varying suite of notable species are found from year to year. However, this year did generally seem to show a lower abundance and species richness of butterflies than average. This could be a result of many environmental disturbances, including climate change-related temperature changes, phenological mismatches, host plant displacement, and extreme weather events. The full statistical analysis conducted in 2025 will hopefully shed some more light on these trends. In the meantime, it is important to continue monitoring the butterfly population on ***rare*** properties each year to better understand the health of our habitats and ecosystems at ***rare***, as well as in the wider Wellington County and Waterloo Region.

Acknowledgements: Thank you to the following volunteers for donating their time and expertise to help monitor the butterfly population during the monitoring season and the annual butterfly count: J. Reid, A. Scire, A. Davis, M. Hulzebosch, A. Cryer, W. deVille, and U. Rushdee-Haque. In total, 159 volunteer hours were accumulated. Staff participation: A. Cooke-Baskier, P. Schoenwolf, A. Wilcox, A Dolezal, N. Timmerman, J. Robinson, and P. Torti.

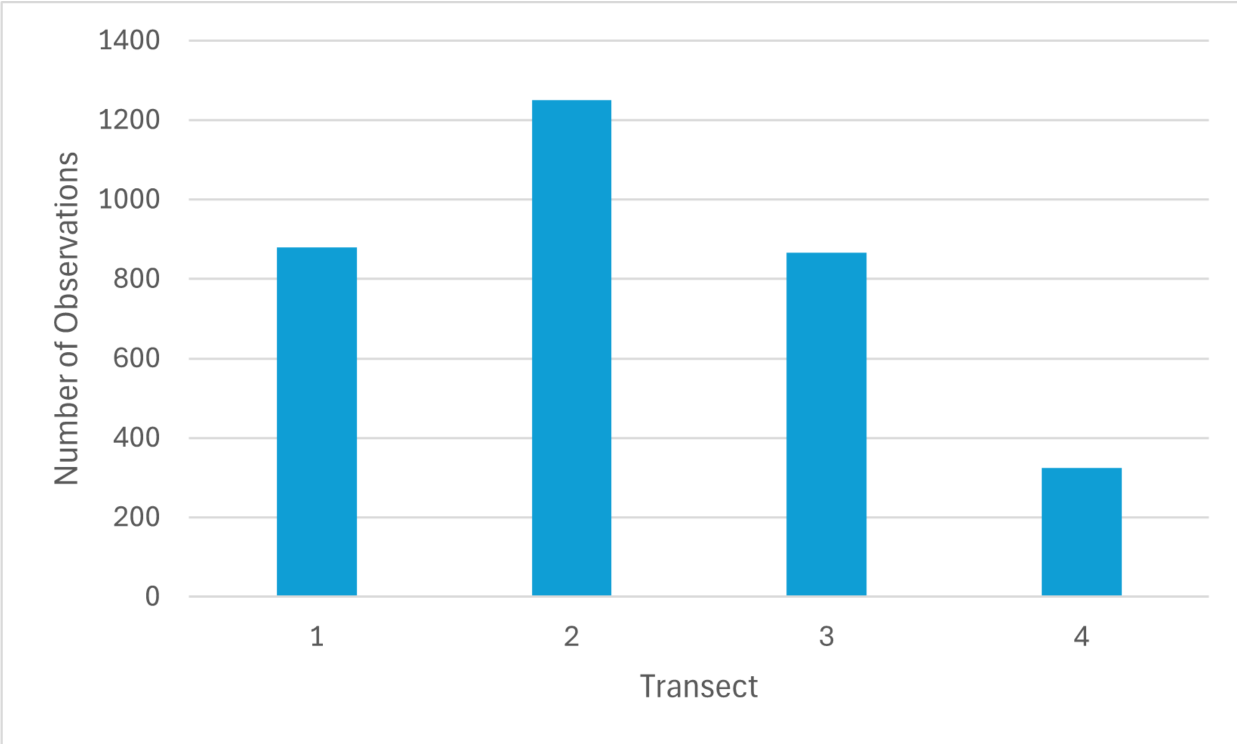


**Figure 1.** Abundance of butterflies within each transect in 2024.

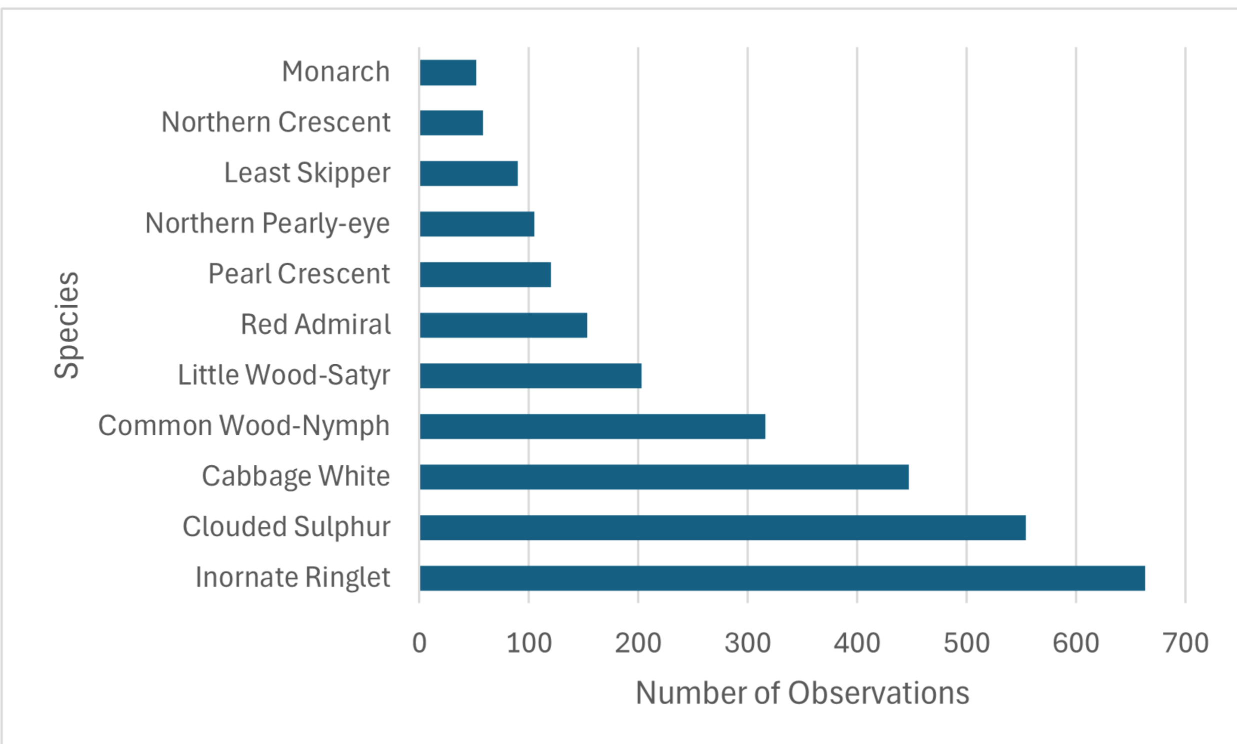


**Figure 2.** Comparison of species abundance for those exceeding 50 observations in the 2024 butterfly monitoring season.

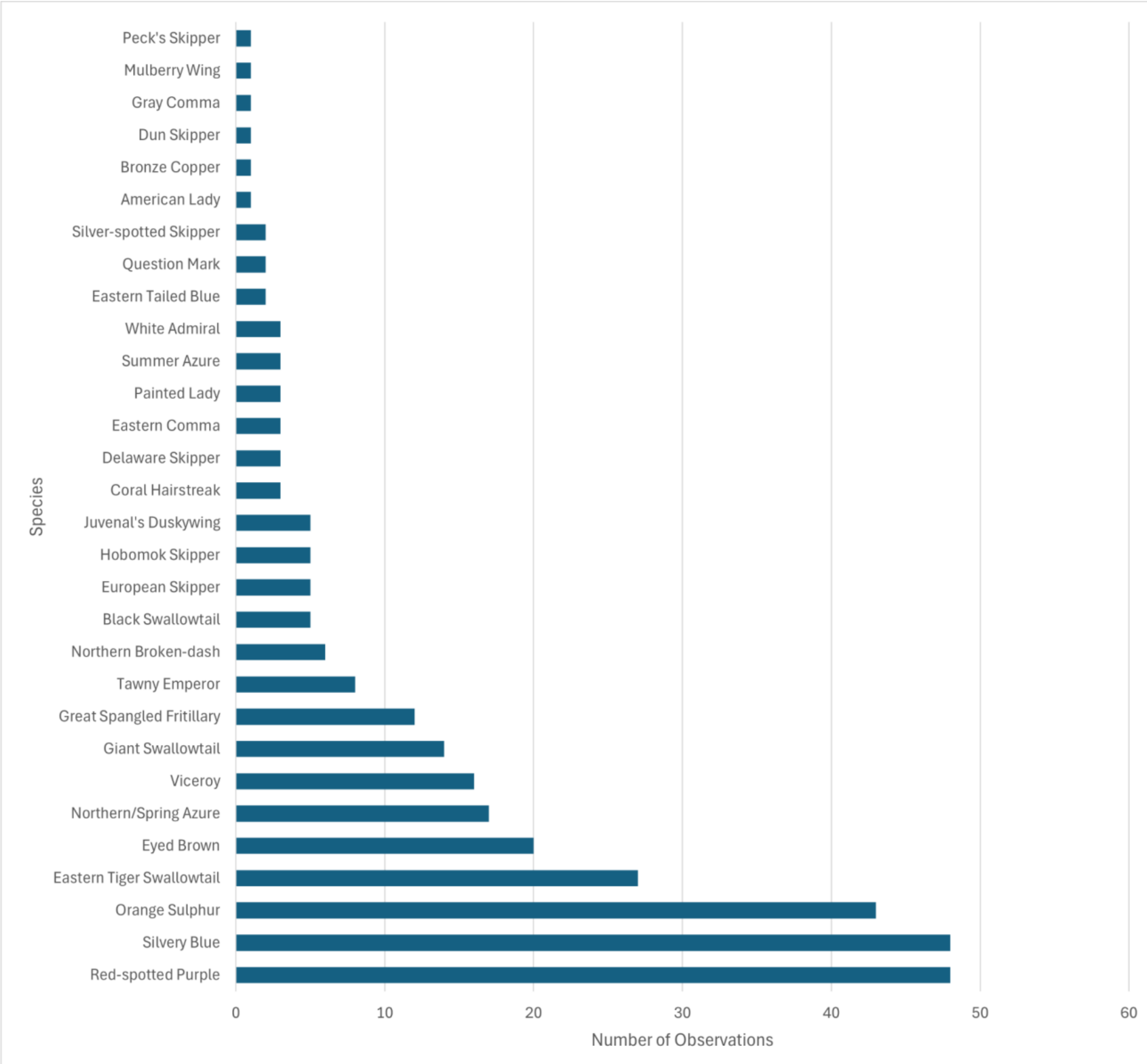


**Figure 3.** Comparison of species abundance for those with less than 50 observations in the 2024 butterfly monitoring season.

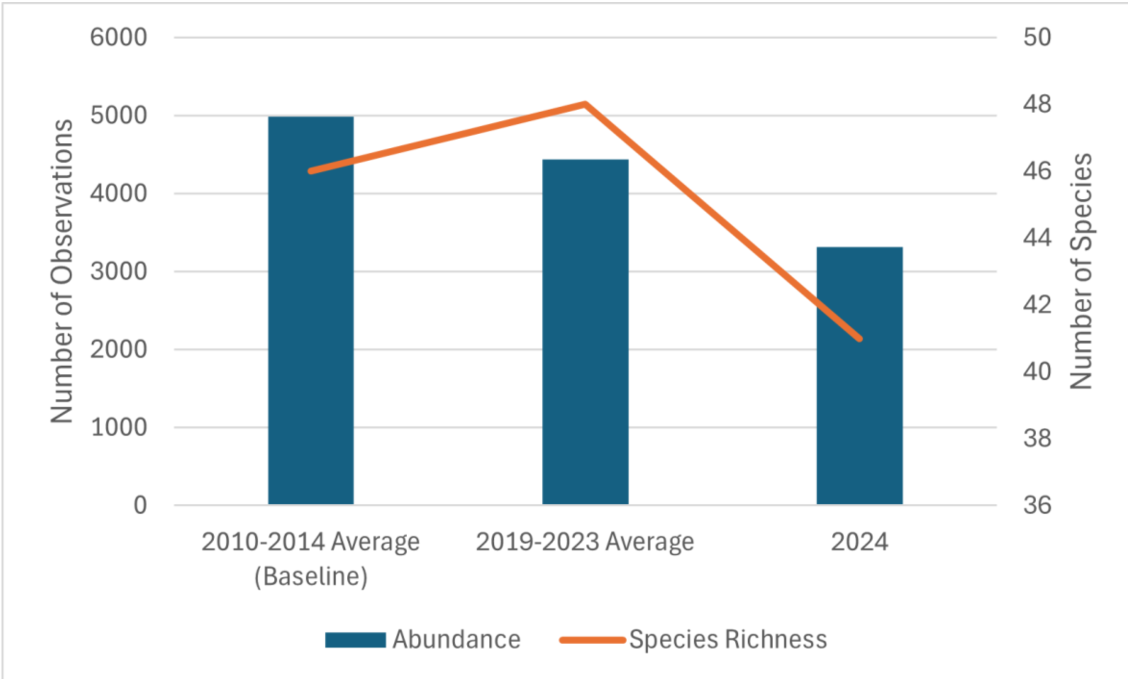


**Figure 4.** Graph showing the average community composition metrics for the monitored butterfly population in the baseline period (2010-2014), the most recent five-year period (2019-2023), and this year (2024). The number of species is reflected by the orange line relative to the right axis, and the number of observations is reflected by the blue bars relative to the left axis.

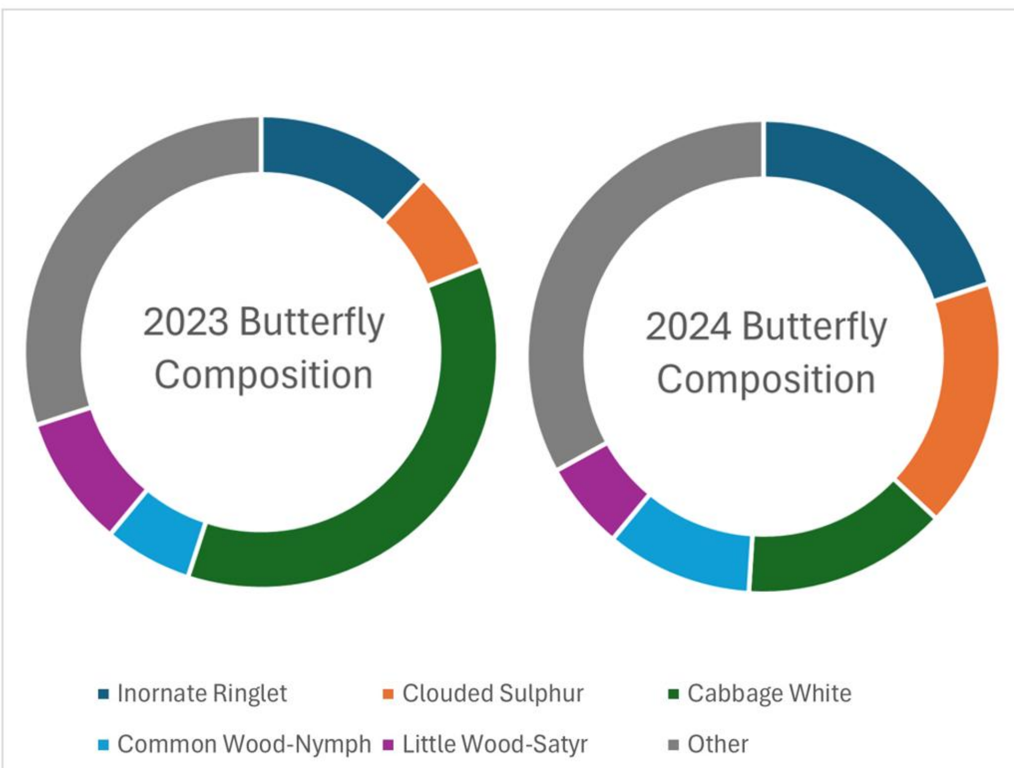

**Figure 5.** Chart showing the representation of each of the five most frequently encountered butterflies for the monitored population for the 2023 and 2024 monitoring seasons.

## Salamander Monitoring

Prepared by: Annika Wilcox

Since 2009, consistent salamander monitoring has occurred on ***rare*** properties every fall. This year, like previous years, the fall monitoring season spanned nine weeks. However, the 2024 season also marked the first year of an additional five-week spring salamander monitoring period. Thus, this year monitoring occurred from April 1st to May 1st and August 28th to October 28th. Salamanders were observed 179 times during the spring, and 300 times during the fall. That being said, due to the observed salamanders not being tagged, there were likely repeat observations of specific individuals over the course of the monitoring. The 300 salamanders seen during the fall monitoring period demonstrates a 26% increase from the 238 seen in 2023, and a 29% increase from the average since 2006. As 2024 was the first year that salamanders were monitored in the spring, there are no previous years to compare salamander abundance and species composition with.

This year, four species of salamanders were found during fall monitoring: Eastern Red-backed Salamanders (*Plethodon cinereus*; 278 individuals), including both the red-backed and lead-backed colour morphs, Spotted Salamanders (*Ambystoma maculatum*; ten individuals), Blue-spotted Salamanders (*Ambystoma laterale*; ten individuals), and Four-toed Salamanders (*Hemidactylium scutatum*; two individuals). Similarly to every other year of salamander monitoring, the Eastern Red-backed Salamander was the most abundantly encountered species in 2024 (making up 278 of the 300 observations). However, the proportion of lead-backed colour morphs decreased slightly from the previous year - in 2023, lead-backed salamanders made up about 13% of the Eastern Red-backed Salamanders encountered, while in 2024 they only made up about 10% of the Eastern Red-backed Salamander observations. Blue-spotted Salamander observations also decreased this year relative to last year, from 16 down to ten. Spotted Salamander and Four-toed Salamander observations doubled from last year's totals, with Spotted Salamander numbers jumping from five to ten, and two Four-toed Salamanders being seen as opposed to one last year. It is worth noting that although individual salamanders were not marked and thus some individuals were likely reencountered throughout the monitoring season, the two Four-toed Salamanders seen were different individuals (determined by size, tail length relative to body length, and the spot pattern on their undersides).

2023 marked the first year in many that a suspected Unisexual Ambystoma was encountered on ***rare*** properties. In the Waterloo Region, individuals belonging to this complex of mole salamanders can either be Blue-spotted Salamander- or Jefferson Salamander-dependent, meaning that they need either Blue-spotted Salamander or Jefferson Salamander sperm to trigger their reproduction. As Jefferson Salamanders and Jefferson-dependent populations of Unisexual Ambystomas are considered endangered on the Species at Risk in Ontario (SARO) list under the Endangered Species Act, 2007 (ESA), these species are protected from being harmed, harassed, or killed, and their habitat is protected from damage and destruction.  Under the Act, it is also illegal to collect these species from the wild, or to buy, trade, or sell them. Although genetic testing done in 2014 and 2015 confirmed the presence of Unisexual Ambystomas in both salamander monitoring forests, this testing is now around 10 years old. Thus, the possibility of a continuing presence of these salamanders on ***rare*** properties is of immense interest. However, the salamander observed last year did not undergo the genetic testing necessary to determine whether it did belong to a Jefferson-dependent population, so its status remains unknown. Unfortunately, no further suspected Unisexual Ambystomas were encountered during either of 2024's monitoring seasons.

A full monitoring report was written in 2020, which included salamander number thresholds for both monitored sites (Ancient Woods and the Hogsback). These thresholds were developed using EMAN protocols, which state that the first five consecutive years of monitoring will be considered the baseline (2009-2013). Future data can be compared to this data. The thresholds for Ancient Woods were 130 +/- 31, while the Hogsback's were 136 +/- 38. This year both thresholds were met, with 149 salamanders in Ancient Woods and 151 salamanders found in the Hogsback.

Other parameters measured alongside the abundance and species richness of the salamander populations included soil and air temperature. When comparing these temperatures to the number of salamanders observed in the fall, there does not appear to be a direct correlation (Figure 8). There has been an increase in both the average soil temperature and the average air temperature since 2009, while the number of salamanders observed have demonstrated drastic fluctuations. This suggests that the number of observations throughout the monitoring period is likely not correlated to air or soil temperature. A preliminary regression analysis was run to test the strength of the relationship between the temperature variables and the number of salamanders encountered, and as expected, no significance was found (for average soil temperature: p-value = 0.62, F-statistic = 0.24 on 1 and 14 DF, for average air temperature: p-value = 0.88, F-statistic = 0.024 on 1 and 14 DF). In the future, it may be worth measuring more parameters, like precipitation using a rain gauge, to determine other environmental factors that may affect the observed salamander populations.

In addition to soil and air temperatures, the moisture of the soil was recorded at each artificial cover object. The soil moisture was recorded on a scale of 1-10, where 1 indicated that the board was completely dry, and 10 indicated that the board was completely submerged in water. In Ancient Woods, the average soil moisture across the fall monitoring season was 2.1, and in the Hogsback the average soil moisture was 3.7. Both values are higher than the averages from the previous year (1.7 in Ancient Woods and 3.6 in the Hogsback). However, it is lower than the baseline average (from 2009-2013) of 2.96 in Ancient Woods and 4.88 in the Hogsback. The fact that the soil held more moisture during this year's fall monitoring period than in 2023 is surprising, as both forests' vernal pools remained completely dry throughout the entire fall 2024 monitoring period, while last year, both vernal pools held water at the beginning of the monitoring period.

Incidental observations of non-target reptiles and amphibians during the salamander monitoring included Eastern Garter Snakes, DeKay's Brownsnakes, Wood Frogs, American Toads, Gray Treefrogs, and Spring Peepers.

Acknowledgements: Thank you to the following volunteers for donating their time to help monitor the salamander population this field season: S. Colter, S. Cheung, K. Ballard, Y. Ahmed, and A. Van Esch. In total, 32 volunteer hours were accumulated. Staff participation: P. Schoenwolf, A. Wilcox, A Dolezal, S. Miller, and G. Salvadore.

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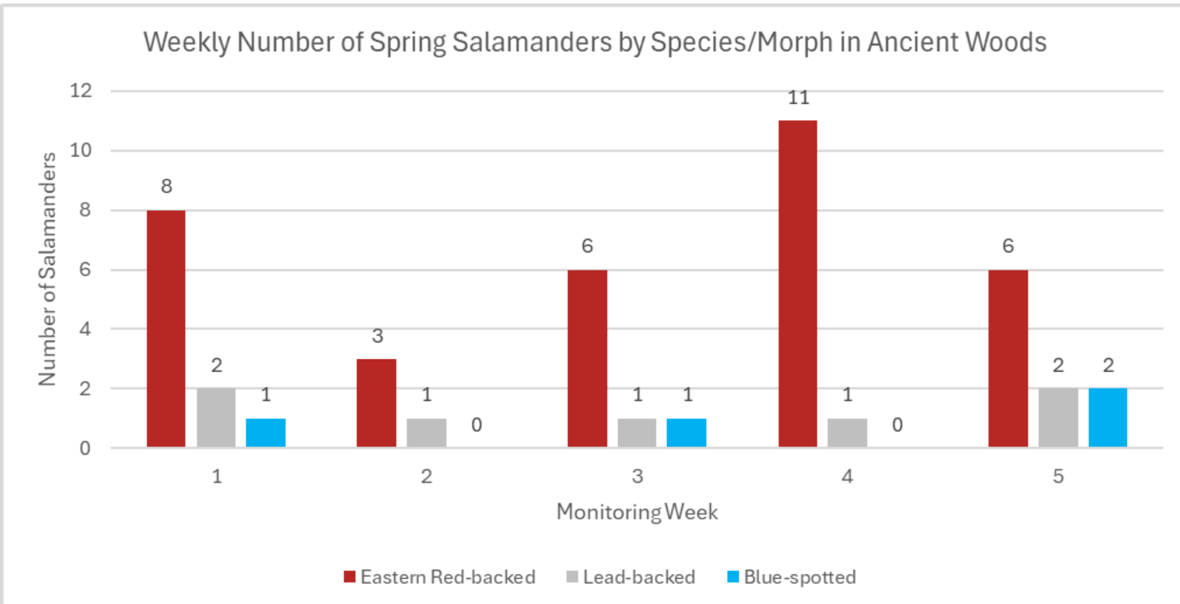


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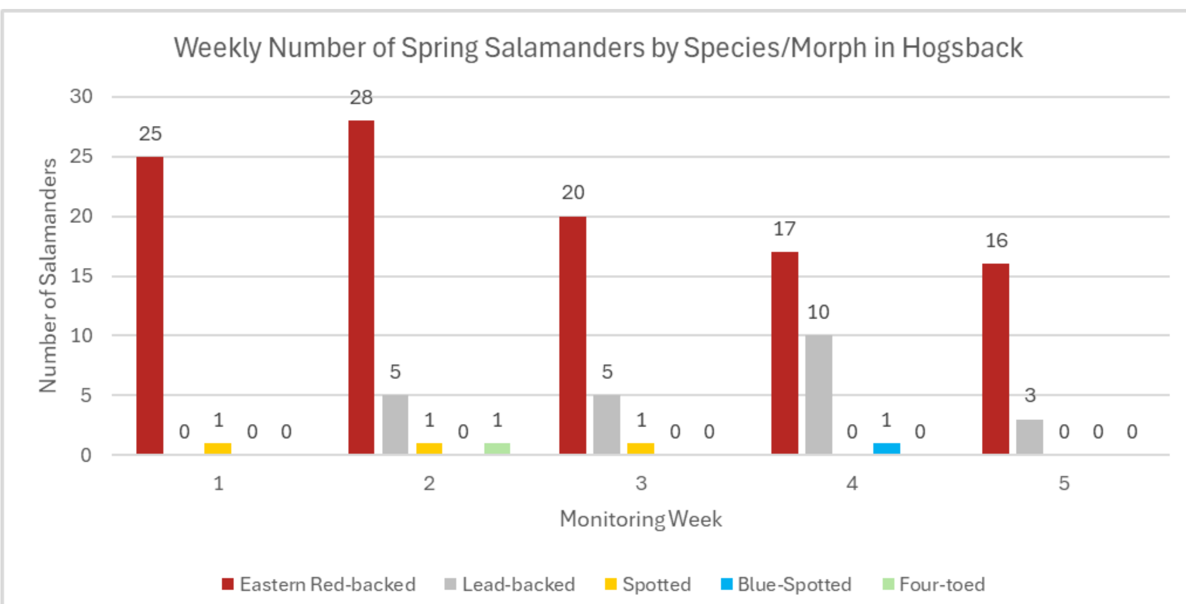

**Figure 6**. **A)** Total number of individual salamanders found in Ancient Woods during each week of spring monitoring (April 1 - May 1, 2024). **B)** Total number of individual salamanders found in the Hogsback during each week of spring monitoring.

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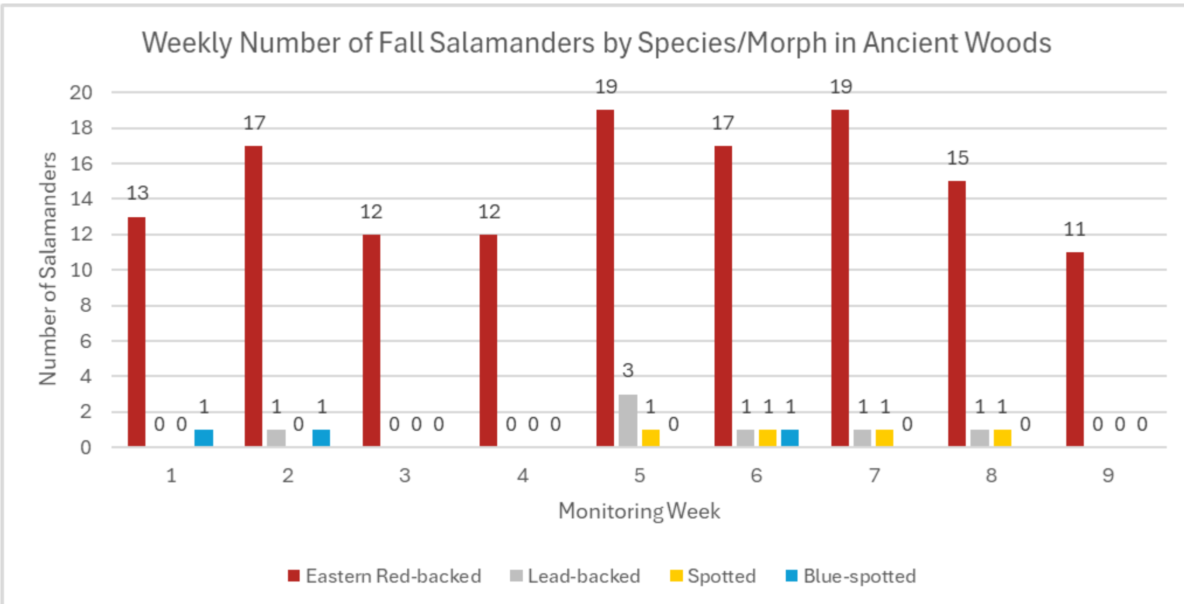


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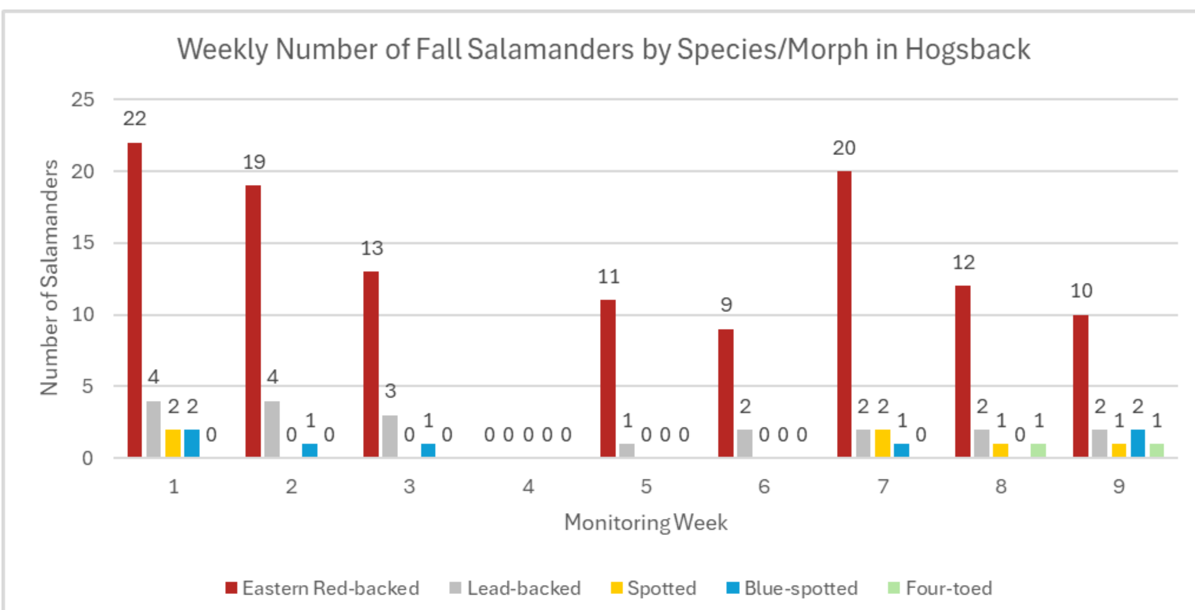


**Figure 7. A)** Total number of individual salamanders found in Ancient Woods during each week of fall monitoring (August 28 - October 21, 2024). **B)** Total number of individual salamanders found in the Hogsback during each week of fall monitoring.

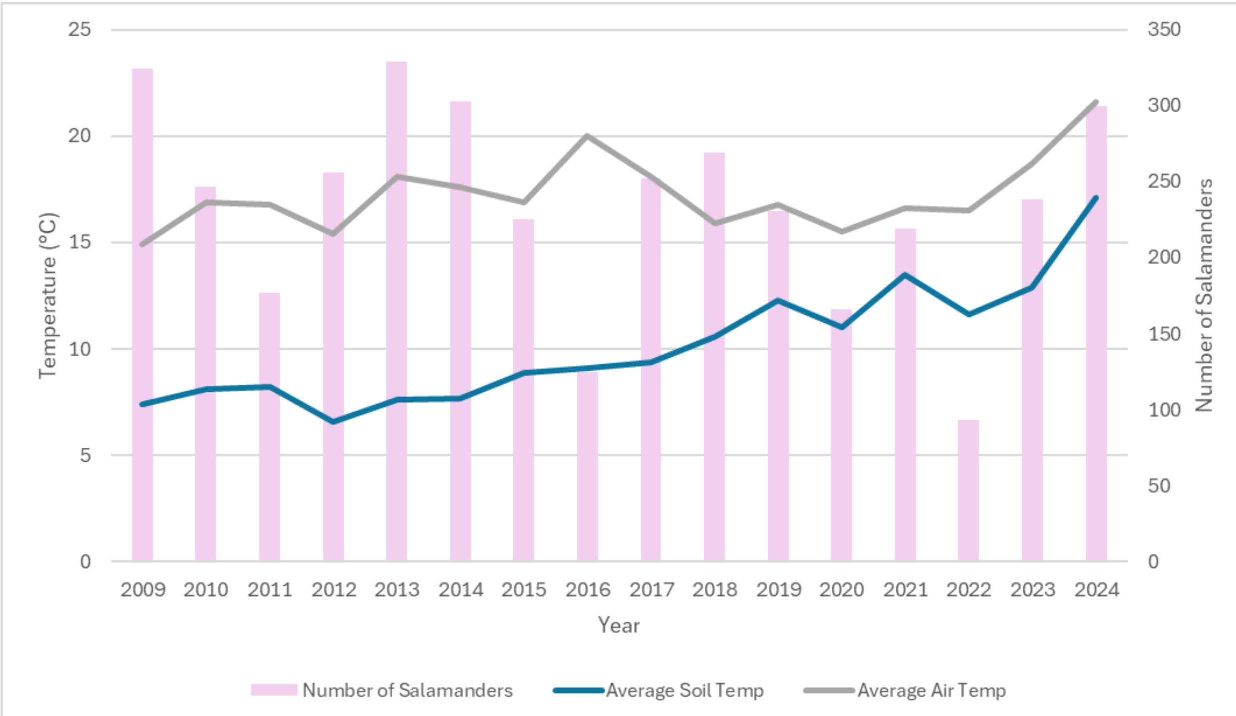


**Figure 8.** Graph showing the average soil temperatures and average air temperatures recorded during monitoring since 2009. This graph also illustrates the number of salamanders observed each year.

**Eastern Bluebird/Tree Swallow Nest Box Monitoring** Prepared by: Annika Wilcox

Since 2010, ***rare*** has been conducting nest box surveys with the aim to better understand how declining bird species, particularly Eastern Bluebirds (*Sialia sialis*) and Tree Swallows (*Tachycineta bicolor*), are utilizing replacement habitat in a time of rapid urban expansion. Nest boxes were installed in various ecozones (a restored tallgrass prairie, a community garden and its surrounding fields, the edges of a pristine forested area, and an old-growth forest and its adjacent active and retired agricultural fields) on conserved rare properties nearly fifteen years ago, and since have been annually monitored by a team of staff and volunteer community scientists. Since monitoring began in 2010, the installed nest boxes have directly supported the hatching and fledging of 112 Eastern Bluebirds and 1,003 Tree Swallows, as well as nine Black-capped Chickadees (*Poecile atricapillus*) and five House Wrens (*Troglodytes aedon*).

In addition to the inherent importance of providing permanent replacement nesting habitat for two declining bird species, the long-term nature of this monitoring project allows ***rare*** scientists to track local population fluctuations over time, determine ways to decrease predation and increase fledging success, assess the effectiveness of artificial habitat replacement, and have these charismatic birds engage dozens of community members about local avian conservation efforts.

This year, seven Eastern Bluebirds and 75 Tree Swallows successfully fledged from the monitored nest boxes. Both numbers are around the average number of birds annually fledged from ***rare*** nest boxes for each species. Additionally, the majority of deployed nest boxes (21 of 32) showed nesting activity from either of the target species throughout the season. This indicates that the nest boxes are doing a valuable job in providing suitable habitat to these important bird species, and we look forward to continuing to monitor their reproductive trends in years to come.

Acknowledgements: Thank you to the following volunteers for donating their time to help monitor the nest boxes this year: M. van Kleef, A. McLagan, S. Colter, K. Ballard, A. Scire, A. Davis, and M. Hulzebosch. Staff participation: P. Schoenwolf, A. Dolezal, A. Wilcox, A. Cooke-Baskier, N. Timmerman, J. Robinson, and P. Torti.

**Vegetation Monitoring** Prepared by: Aleksandra Dolezal, Annika Wilcox

Vegetation Sampling Protocol (VSP) is a way to collect qualitative and quantitative data on vegetation and ecosystem characteristics effectively, efficiently, and robustly. This protocol uses randomly selected geo-referenced fixed area 400m$^2$ circular plots combined with a modular data collection approach to ensure adequate surveying. Vegetation monitoring on ***rare*** properties during the summer of 2024 included the identification of vascular plant species and the estimation of their coverage within the plot, measurements of tree diameter and representative height, assessments of tree health, measurements of forest regeneration, measurements of coarse woody debris, and descriptions of plot surface components, hydrological features, and natural and anthropogenic disturbances. The collection of this information provides high-quality and comprehensive data on the status of vegetation communities on ***rare*** properties and will help inform future management and land use decisions, with a particular focus on invasive species management.

Vegetation monitoring using VSP began at ***rare*** in 2018 at the Blair Property. In 2024, VSP monitoring work was conducted on two forested properties: Ancient Woods/Thompson Tract (generally referred to as Ancient Woods) and the Hogsback. In total, 33 plots were surveyed between June 4th and August 28th. 22 of the sites were within Ancient Woods (Figure 9), and the remaining 11 were in the Hogsback (Figure 10). Each plot was marked with uncoated rebar stakes, and central trees within the plot were denoted with orange flagging tape.

Ancient Woods consisted primarily of mid-aged, open-canopy mixed forests dominated by Sugar Maple (*Acer saccharum*), White Ash (*Fraxinus americana*), White Spruce (*Picea glauca*), Eastern White Cedar (*Thuja occidentalis*) and American Beech (*Fagus grandifolia*). The Hogsback is primarily made up of mature, closed-canopy mixed forests dominated by Sugar Maple (*Acer saccharum*), Red Maple (*Acer rubrum*), Ironwood (*Ostrya virginiana*), Red Oak (*Quercus rubra*), and Eastern White Pine (*Pinus strobus*). This site is wetter than Ancient Woods, with damp areas containing Asters (*Aster sp.*), Marsh Marigold (*Caltha palustris*), and Jewel-weed (*Impatiens sp.*). Notably, this year's VSP surveying confirmed the presence of

American Elms (*Ulmus americana*) in the Hogsback, a species that was almost entirely killed-off by the invasive Dutch Elm Disease.

Priority invasive species found within these forested plots include Common and Glossy Buckthorn (*Rhamnus cathartica, R. frangula*), Garlic Mustard (*Alliaria petiolata*), and Japanese Barberry (*Berberis thunbergii*). Other notable invasives include Coltsfoot (*Tussilago farfara*), European Cranberrybush (*Viburnum opulus*), Helleborine (*Epipactis helleborine*), and Bittersweet Nightshade (*Solanum dulcamara*). At both sites, invasive species were present near paths as well as in pockets of light in the forests.

Acknowledgements: Thank you to the volunteers and staff who donated their time and expertise to the 2024 VSP field season. Volunteers: M. Hulzebosch. Staff: P. Schoenwolf, A. Dolezal, A. Cooke-Baskier, N. Timmerman, J. Robinson, P. Torti, and E. Fan.

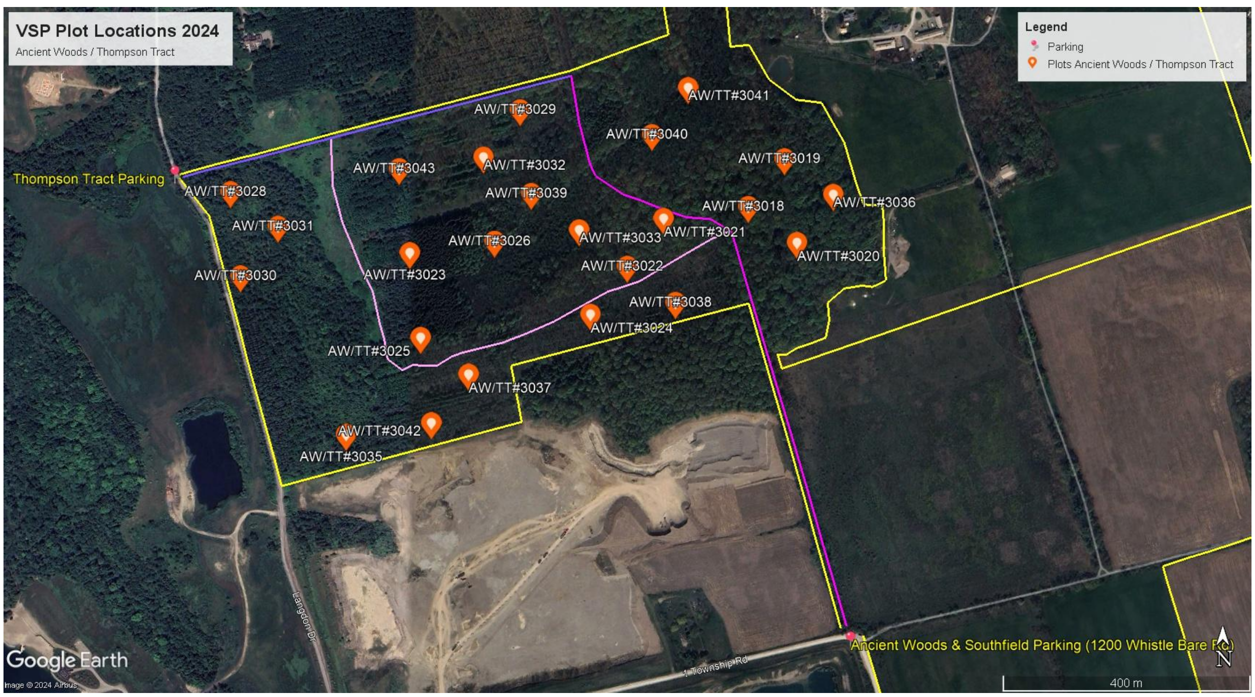


**Figure 9.** A map of the surveyed VSP plot locations in Ancient Woods/Thompson Tract.

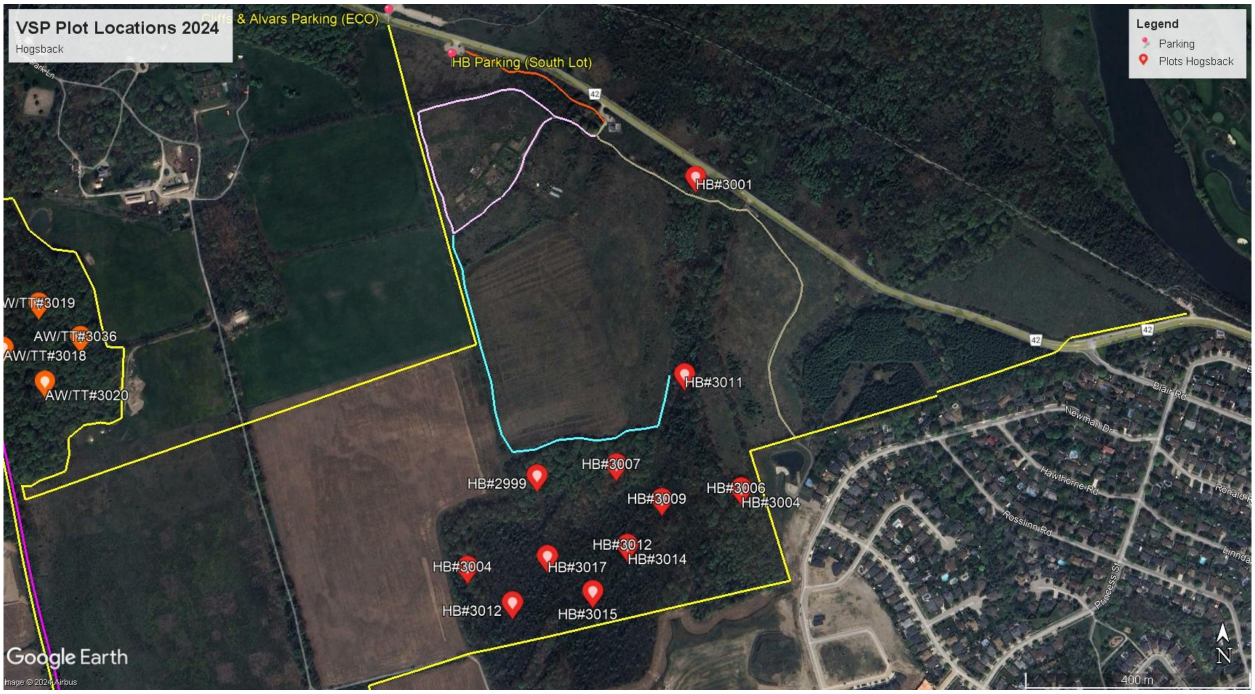


**Figure 10.** A map of the surveyed VSP plot locations in the Hogsback.

**Snake Monitoring** Prepared by: Annika Wilcox

2024 marked the first year of a new long-term monitoring project on ***rare*** property: snakes! From mid-May to mid-July, surveyors looked for snakes under artificial cover objects (ACOs) in a semi-open forest edge habitat. This year, four individual snakes of two species were found: three Eastern Garter Snakes (*Thamnophis sirtalis sirtalis*), and one DeKay's Brownsnake (*Storeria dekayi*). Although the snakes encountered during surveying are not tagged and thus it is possible to have repeated observations of specific individuals over the course of the monitoring, the three Eastern Garter Snakes that were encountered varied in location and age class, making it likely that they were distinct individuals.

Although these numbers are lower than expected, it was the first year that the ACOs were deployed and monitored. It is possible that the low number of observations could be a result of the ACOs being very new, as some reptiles and amphibians show preference for older and more degraded cover objects (as is anecdotally demonstrated through ***rare***'s salamander monitoring), or perhaps only a small proportion of the snake community present in the area found and began using the ACOs. As 2024 was the first year of this project, there are no previous years to compare the snake numbers observed this year with. We look forward to continuing our monitoring efforts over the next several years to better understand the population trends of this understudied group of animals.

Acknowledgements: Thank you to the following volunteers for donating their time to help monitor the salamander population this field season: L. Harwada, K. Ballard, S. Colter, M. Girardo, S. Mathers, and A. Davis. In total, 7.5 volunteer hours were accumulated. Staff participation: P. Schoenwolf, A. Dolezal, E. Fan, G. Salvadore, J. Robinson, and P. Torti.

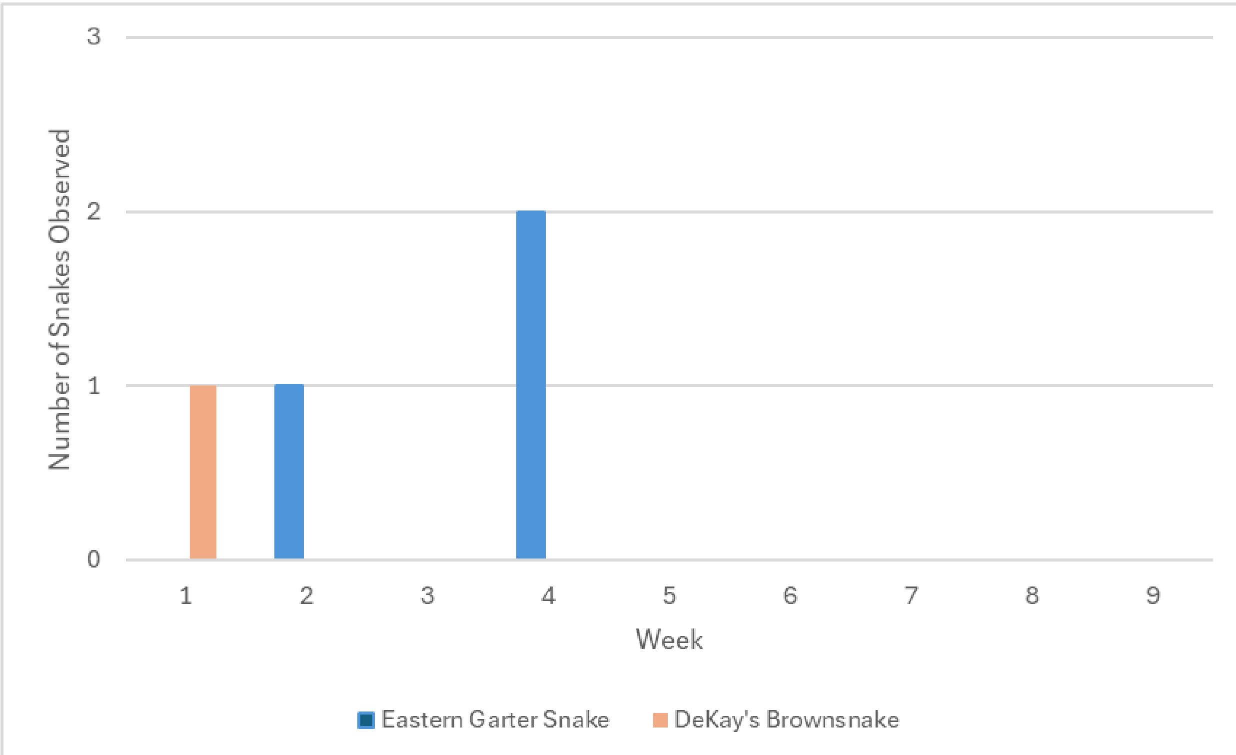


**Figure 11.** Graph showing the number of snakes observed across all nine weeks of 2024's snake monitoring season.

**Benthic Macroinvertebrate Monitoring** Prepared by: Annika Wilcox

To determine the health of aquatic ecosystems, benthic macroinvertebrates (the invertebrates that live at the bottom of bodies of water) are one of the most valuable groups of organisms to study. This is largely due to their role as effective bioindicator species; because each type of benthic macroinvertebrate has unique habitat preferences and tolerances to different water quality metrics (including pollutants), the presence of specific macroinvertebrates can tell you much about the health of the habitat.

At ***rare***, benthic macroinvertebrate monitoring is conducted to provide insight into the health of Bauman Creek, Newman Creek, Cruickston Creek, and the Preston and Blair Flats Wetlands. Monitoring began in 2006, and has occurred every three years since, with 2024 marking the seventh survey year. Although both spring and fall monitoring were conducted, the fall data is still being compiled and analyzed. Thus, the following report will solely discuss the spring monitoring season.

Between June 12th and June 26th, 10 sites along Bauman Creek, Cruickston Creek, and the Blair Flats Wetlands were sampled for benthic macroinvertebrates using the kick-and-sweep method described in the Ontario Benthos Biomonitoring Network (OBBN) protocols. After being caught in a D-net, the invertebrates were moved into a temporary holding container filled with water from the body of water being sampled, and then were visually identified and tallied until the 100-organism-per-replicate goal was met. After being tallied, all organisms were released back into the area where they were collected from. As the standard for sampling benthic macroinvertebrates has been to put the collected organisms into a jar filled with a preservative and identify them in a laboratory setting, this is the first year that benthic invertebrates were monitored live in the field at ***rare***, preventing invertebrate mortality just for the sake of monitoring.

Following OBBN protocols, all encountered benthic macroinvertebrates were identified to the following 27 major taxonomic groups: Coelenterata (hydras), Turbellaria (flatworms), Nematoda (roundworms), Oligochaeta (aquatic earthworms), Hirudinea (leeches), Isopoda (sow bugs), Pelecypoda (clams), Amphipoda (scuds), Decapoda (crayfish), Trombidiformes-Hydracarina (mites), Ephemeroptera (mayflies), Anisoptera (dragonflies), Zygoptera (damselflies), Plecoptera (stoneflies), Hemiptera (true bugs), Megaloptera (fishflies, alderflies), Trichoptera (caddisflies), Lepidoptera (aquatic moths), Coleoptera (beetles), Gastropoda (snails, limpets), Chironomidae (midges), Tabanidae (horse and deer flies), Culicidae (mosquitos), Ceratopogonidae (no-see-ums), Tipulidae (crane flies), Simuliidae (black flies), and miscellaneous Diptera (miscellaneous true flies). The most valuable of these groups as bioindicators are the Ephemeroptera, Plecoptera, and Trichoptera (EPT): the mayflies, stoneflies, and caddisflies, as they only occur in water with low pollution loads.

This spring, individuals were found from 22 of the 27 major taxonomic groups, only missing organisms from Coelenterata, Lepidoptera, Culcidae, Simuliidae, and miscellaneous Diptera. Notably, members of the EPT group were found in all three sampled bodies of water (Bauman Creek, Cruickston Creek, and the Blair Flats Wetland), only not being found at two of the five Bauman Creek sampling sites. For a full breakdown of the community composition of each of the three bodies of water sampled, refer to Figure 13, Figure 14, and Figure 15. Aside from data collected on the benthic macroinvertebrate community composition, flow metres and YSI equipment were used to inform each sampling site's water temperature, dissolved oxygen, conductivity, pH, turbidity, and flow rate. The surveyors also characterized the dominant substrate and the vegetation communities in and around the water, and took various measurements around the sampling area. The results from this spring's benthic macroinvertebrate monitoring will help to inform long-term trends of aquatic health around ***rare*** properties, and will be undergoing further analysis in combination with the fall monitoring data by a team from the University of Guelph.

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**Figure 12.** A map of the bodies of water surveyed during ***rare***'s benthic macroinvertebrate monitoring.

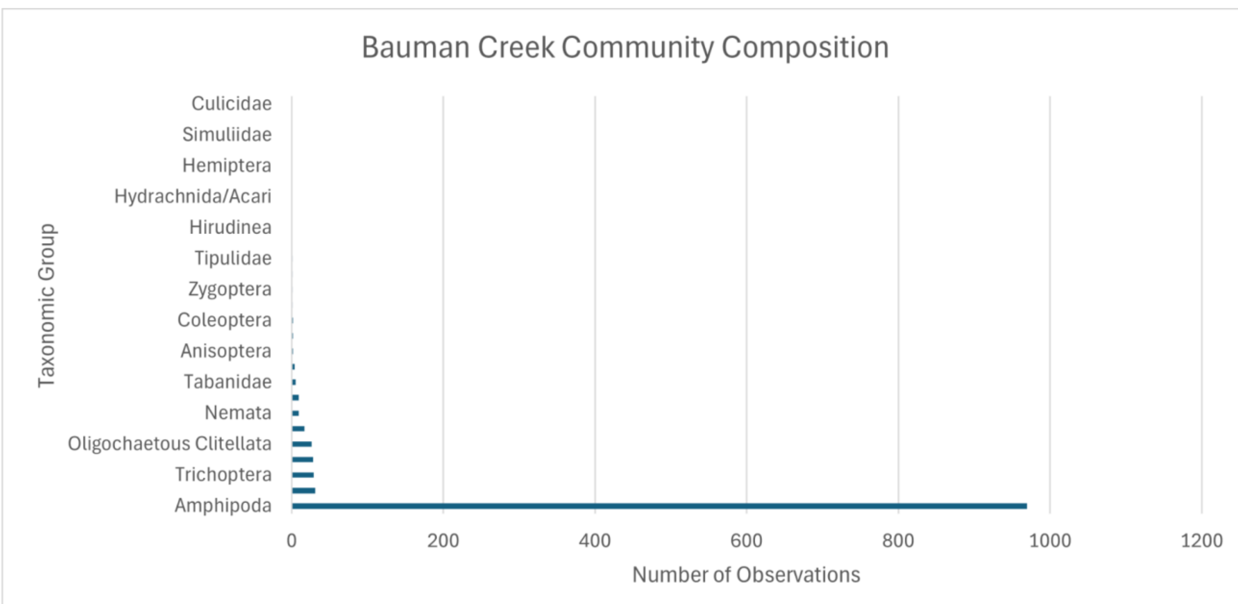


**Figure 13.** Comparison of taxonomic group abundance in Bauman Creek in the 2024 benthic macroinvertebrate spring monitoring season.

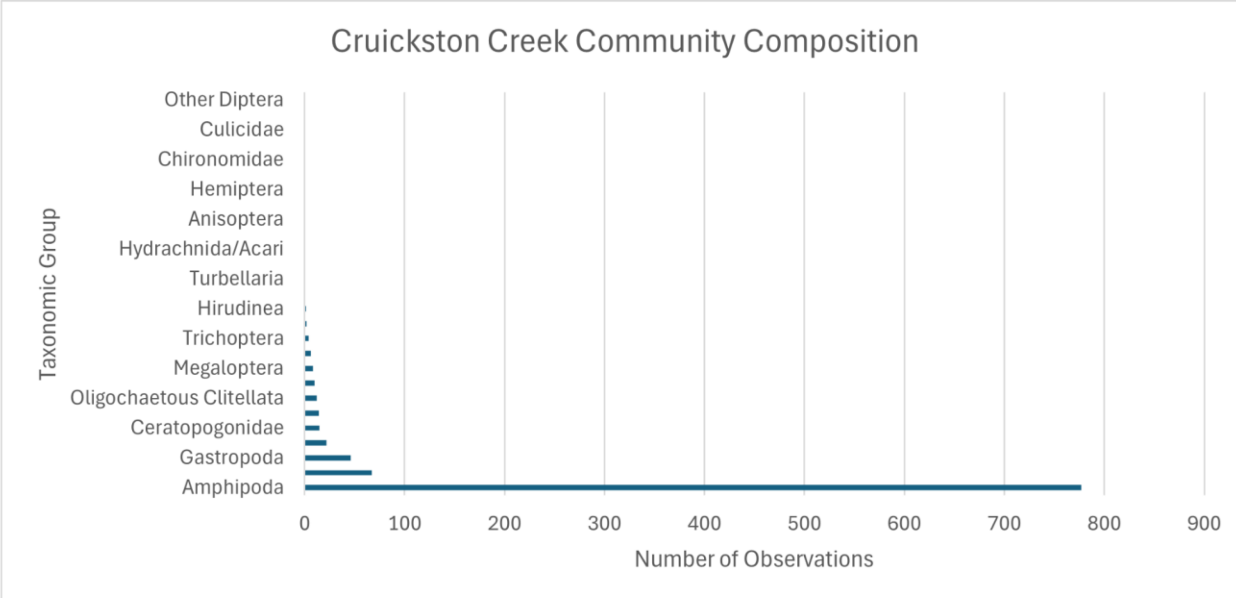


**Figure 14.** Comparison of taxonomic group abundance in Cruickston Creek in the 2024 benthic macroinvertebrate spring monitoring season.

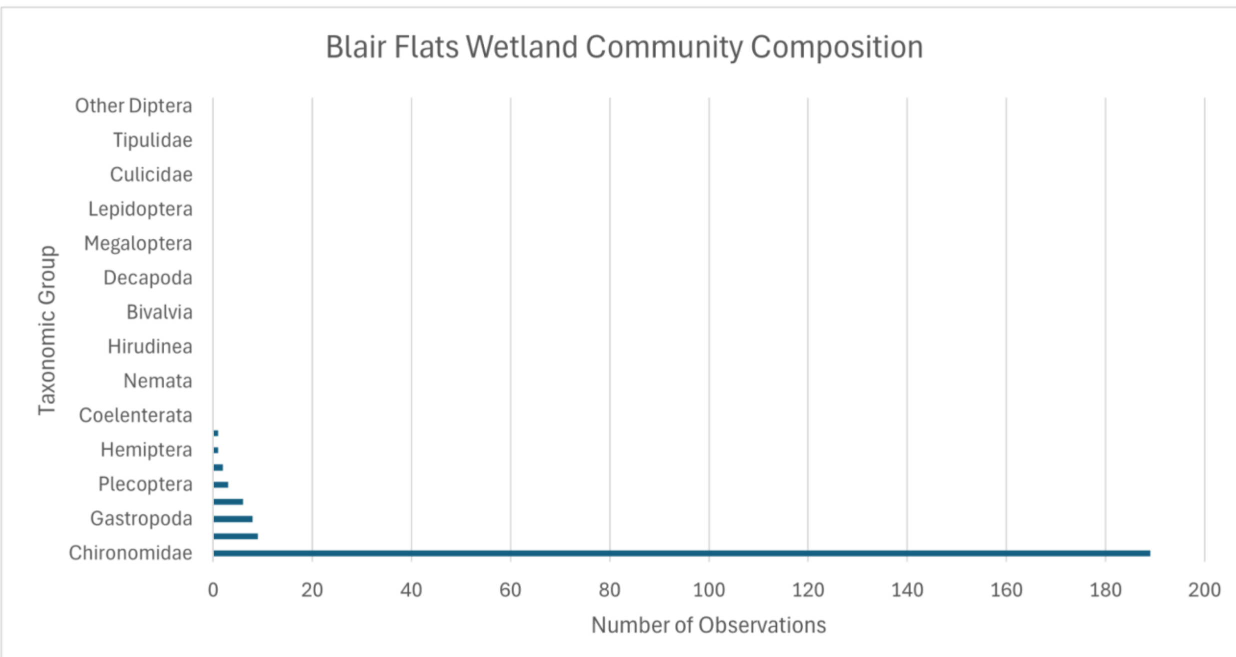


**Figure 15.** Comparison of taxonomic group abundance in a Blair Flats Wetland in the 2024 benthic macroinvertebrate spring monitoring season.

## Bird Migration Monitoring

Prepared by: Annika Wilcox, Paige Schoenwolf

Since the fall of 2019, community science volunteers have conducted bird monitoring surveys across ***rare*** properties during migration season. This year, 15 volunteers monitored

Property 1, Property 2, and Edgewood during both the spring (April 5th to June 24th) and the fall (August 16th to November 3rd) to better inform the species richness and abundance of birds using ***rare*** land.

Collectively in the spring, monitors observed 3544 individual birds of 110 different species, tallied over 64 survey hours, and walked over 90 kilometres in the approximately 12 weeks of spring monitoring. Highlight bird sightings from each property include Mourning Warbler (*Geothlypis philadelphia*), Northern Shrike (*Lanius borealis*), and Canada Warbler (*Cardellina canadensis*) at Property 1, Broad-winged Hawk (*Buteo platypterus*), Magnolia Warbler (*Setophaga magnolia*), and Eastern Towhee (*Pipilo erythrophthalmus*) at Property 2, and Black-billed Cuckoo (*Coccyzus erythropthalmus*), Blue-headed Vireo (*Vireo solitarius*), and Sharp-shinned Hawk (*Accipiter striatus*) at the Edgewood property.

In the fall, volunteer monitors made 6993 individual bird observations of 108 different species, tallied 59 survey hours, and walked over 82 km in the 12 weeks of fall monitoring. Highlight bird species found on each property during the fall monitoring season include Horned Lark (*Eremophila alpestris*), Northern Harrier (*Circus hudsonius*), and Fox Sparrow (*Passerella iliaca*) at Property 1, Orange-crowned Warbler (*Vermivora celata*), Eastern Screech-Owl (*Megascops asio*), and Red-shouldered Hawk (*Buteo lineatus*) at Property 2, and Yellow-bellied Sapsucker (*Sphyrapicus varius*), Purple Finch (*Haemorhous purpureus*), and Green Heron (*Butorides virescens*) at the Edgewood property.

Acknowledgements: Thank you to the following volunteers for donating their time and expertise to help monitor the birds on ***rare*** properties this year: M. Paibomesai, S. Blacker, A. Bendall, D. MacNeal, G. White, J. Andrews, J. Rosa, J. Scott, N. Szpakowski, R. Dickson, S. Lawson Canning, A. Stevenson, S. Wi-Afedzi , M. White, and S. Delyea.

## Soil Humus Decay Rate Monitoring

Prepared by: Aleksandra Dolezal, Annika Wilcox

Changes in soil decay rates may indicate changes in temperature, moisture, substrate type, nutrient concentrations and availability, litter type and size, and soil organisms. Importantly, increased decay rates over decades can be an indication of climate change, as increased soil temperatures increase decay rates and the release of stored carbon. Decay rate monitoring occurred in late October and early November around one of the permanent forest canopy plots in each of the three main forest stands at ***rare***. Decay rates are determined by burying wooden tongue depressors below the soil surface and comparing their mass lost over a period of a year to those left on the soil surface. Quantitative analysis was completed in 2020 and is scheduled to be repeated in 2025.

Acknowledgements: Thank you to the staff who donated their time and expertise. Staff: P. Schoenwolf, A. Dolezal, and A. Wilcox.