2023 Ecological Monitoring Summary

Founded in 2001, the ***rare* Charitable Research Reserve** is a community-driven urban land trust, nature reserve and environmental institute with its headquarters and first three locations comprising over 900 acres. We acknowledge and are grateful to all of the original stewards of the land where this monitoring took place, within 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 2023 monitoring programs.

Butterfly Monitoring 2023 Prepared by: Jade Anderson and Aleksandra Dolezal

Butterfly monitoring has occurred at ***rare*** since 2006 with consecutive and consistent efforts since 2010. Butterfly monitoring began with two transects but by 2010 the project had grown to four transects. These four transects have since been monitored yearly, making 2023 the 13th consecutive year of butterfly monitoring. Transects are monitored using Ecological Monitoring Assessment Network (EMAN) protocols. These protocols provide a standard way to compare data to better understand the health of the ecosystems at ***rare***. Butterflies are extremely susceptible to environmental changes and with their short lifespans, these changes can be seen through the generations.

Monitoring began on May 30th and concluded on August 25th. Four transects were monitored across different ecosystems, including Cliffs and Alvars, Southfield, Thompson Tract and Blair Flats. Each transect was monitored once a week for 13 weeks consecutively. Transects must be monitored between the time of 10 am and 3 pm, with temperatures above 13 degrees Celsius during sunny weather or 17 degrees Celsius when cloudy.

This year, there were many wildfires in Northern Ontario and across the province that resulted in smoke or haze during monitoring. Air Quality Health Index (AQHI) numbers were recorded during days when the smoke was affecting the air quality. These numbers were recorded in the comments section of the data and should be recorded in the future to understand how wildfire smoke affects butterfly populations. Some days were deemed unsafe to stay outside for extended periods of time and therefore the monitoring schedule was rearranged to account for this. These dates included June 6th-June 7th and June 28th- June 30th.

This year there were 46 species observed during the monitoring season with 4613 individuals sighted. Comparing abundance to the last five years, there was a 5% decline from the average abundance of 4864 individuals. There was a 10% decline in species richness from the average of 51 species observed over the last five years. Overall, this means that species

richness and abundance have remained fairly stable over the last five years. However, EMAN protocols suggest that the first five years of data are considered the baseline data. When comparing this year to our baseline data (2010-2015) there was an 8% decrease in individuals and a 5% decrease in the number of species observed. A full statistical analysis of the data will be conducted in 2025 to determine if there are significant changes in the butterfly populations at ***rare***.

The top five species observed this year were the Cabbage White (36%), Inornate Ringlet (12%), Little-Wood Satyr (9%), Clouded Sulphur (7%) and Common Wood-Nymph (6%). Overall, the percentage of Cabbage Whites in 2023 returned to what was observed in previous years. In 2022 there was a major spike in Cabbage Whites, up to 54% of the total, compared to 31% in 2021 and 34% in 2020. Additionally, this marks the fifth year in a row the Cabbage White has been the most abundant species observed and the third year the Inornate Ringlet has been the second most abundant.

Another interesting trend observed during the 2023 monitoring season was the return of Red Admirals. With only 7 sightings during the entire 2022 monitoring season, there was concern for the health of this species. Luckily, this year 76 individuals were observed, almost ten times the number observed in 2022 (986% increase). Another species that had an overall increase in individual sightings was the Silvery Blue. This species was observed 76 times compared to 31 times in 2022. This was a 145% increase from 2022 and the highest number recorded since monitoring began.

There was an increase in the number of Eastern Tiger Swallowtails observed this year. The average number of observations over the last five years (2018-2022) was 27. This year a total of 45 Eastern Tiger Swallowtails were observed during monitoring. This was a 69% increase above the average.

In the last two years, there has been a large spike in the number of Great Spangled Fritillaries observed. With 116 observed in 2023, this is the highest number recorded since monitoring began. Last year 104 were sighted, which was the second-highest number recorded during monitoring for this species. This is in comparison to 35 observed in 2021, 22 in 2020 and just 23 in 2019. This species will be monitored closely to see if these trends continue into the 2024 monitoring season.

Some other noteworthy species that were observed in 2023 include the Broad-winged Skipper, Baltimore Checkerspot, and the Hackberry Emperor. The Broad-winged Skipper was observed for the first time since 2014. The Baltimore Checkerspot, a regionally rare species, was observed at ***rare*** for the fourth consecutive year. This may be an indication of this species' native range expanding. Finally, this marks the third year the Hackberry Emperor has been sighted. The first observation was in 2020, the second in 2021 and the third now in 2023.

There are two other important species that were sighted again this year, the Spicebush Swallowtail and the White Admiral x Red-Spotted Purple intergrade. This is the fifth year in a row that the Spicebush Swallowtail has returned to ***rare***. The White Admiral x Red-Spotted

Purple intergrade has been spotted and photographed for a second year. It appears ***rare*** has become a region where the two species overlap and are able to hybridise.

Finally, Monarch butterflies have had a decline compared to the last five years. The average number sighted over the last five years was 230. With only 115 individuals observed this monitoring season there was a decline of 50%. Although these numbers are low, they are not the lowest recorded since monitoring began. From 2013-2016, the lowest number of Monarchs were recorded for an average of 46 individuals sighted each year. There is potential that the Monarch population will bounce back over the next few years as they have done before.

This year the annual butterfly count was held on July 16th, 2023, which was the rain date. There were 455 individuals sighted and 21 species observed during the count. There was a total of nine volunteers that participated in the count. A total of 8 kilometres were covered in various eco-types such as the Butterfly Loop, Newman Trail, Eco Centre, Thompson Tract and South Field. Overall, the butterfly population at ***rare*** appears to remain stable. Species abundances and richness are similar when compared to the last five years and to the baseline years. It is important to continue to monitor the butterfly populations each season to understand the health of our habitats and ecosystems at ***rare***.

Acknowledgements: Thank you to the volunteers who donated their time and expertise to our annual butterfly count and butterfly monitoring efforts. Volunteers: P. Anderson, G. Bermonte, C. De Aquino, F. Gibson, O. Krulicki, S. Krulicki, S. Mathers, W. Poissant, E. Stevens, R. Unruh, N. Vanzanten, S. Wright. In total 47 volunteer hours were accumulated. Staff participation: T. Chen, A. Collier, K. Chhapyan, E. Emptage, E. Harper, Y. Hu, P. Schoenwolf.

Salamander Monitoring Prepared by: Jade Anderson and Aleksandra Dolezal

Salamander monitoring occurs every fall at ***rare*** for 9 weeks; this year monitoring occurred from August 29th to October 25th. Monitoring has continued consecutively since 2009 with consistent efforts. Due to individual salamanders not being tagged, there are likely repeat observations of specific individuals over the course of monitoring. The total number of salamanders found this year was 238. This was a 61% increase from the 93 found in 2022 and a 3.5% increase from the average since 2009.

This year there were five species of salamanders found during monitoring, the Eastern Red-backed and its lead-backed colour morph (*Plethodon cinereus*), Blue-spotted (*Ambystoma laterale*), Yellow-spotted (*Ambystoma maculatum*), Four-toed (*Hemidactylium scutatum*) and Unisexual Ambystoma salamanders. Total abundances for each of these species were 209 Eastern Red-backed salamanders (including 28 Lead-backed morphs), 16 Blue-spotted, 5 Yellow-spotted, and 1 Four-toed. Additionally, there were 7 salamanders that were sighted but not identified as they were in between the artificial cover objects (ACO).

As usual, the Eastern Red-backed salamander was the most abundant species in 2023, holding the top spot since monitoring began. The proportion of its Lead-backed colour morph was also typical of previous monitoring years. Similarly, Four-toed and Yellow-spotted salamanders had similar abundances to previous years. Although Yellow-spotted abundance

decreased from 2022 of 16 individuals, it remained close to the average of 5 individuals sighted per year. The average number of Four-toed salamanders was 1, which remained the same this year. There were some major differences however in 2023. The total number of Blue-spotted salamanders spiked to an over 1000% increase from the average number of 1 observed yearly since 2009. Finally, a new species was observed, the Unisexual Ambystoma, this was the first time this species has been observed at ***rare***. However, genetic testing would need to be done to determine if these were Unisexual Ambystomas that were Jefferson or Blue-spotted dependent. This is something to consider during future monitoring efforts. Unisexual Ambystomas that are Jefferson-dependent are listed as endangered on the Species at Risk in Ontario (SARO), 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. To learn more about how species at risk are protected in Ontario, please visit: https://www.ontario.ca/page/how-species-risk-are-protected.

In 2020, a full monitoring report was written including salamander number thresholds for both locations (Ancient Woods and Hogsback). These thresholds were developed using EMAN protocols, which state that the first 5 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 and Hogsback 136 +/- 38. This year both thresholds were met with 104 salamanders in Ancient Woods and 134 salamanders found in Hogsback.

Other parameters are measured along with abundance and diversity of the salamander populations such as soil and air temperature at each ACO. When comparing the soil and air temperature to the number of salamanders observed, there does not appear to be a direct correlation (Figure 1). There has been an increase in the average soil temperature over the last five years (since 2018) while the air temperature has remained the same. However, the number of salamanders has fluctuated over the last five years, indicating no direct correlation to temperature. It will be important to test these parameters in a statistical analysis to see if there are significant differences. Additionally, it might be worth beginning to measure other parameters such as precipitation using a rain gauge to determine if this is an environmental factor that affects the salamander populations.

Each week, soil moisture was measured at each cover board. The average soil moisture (recorded on a scale of 1-10 where 1= dry and 10= completely submerged) was 1.7 at Ancient Woods and 3.6 at Hogsback. This is higher than 2022 but is lower than the baseline averages (2009-2013) of 2.96 in Ancient Woods and 4.88 in Hogsback. It should also be noted that Hogsback retained water in the forested canopy during the first week of monitoring with 50.8 millimetres of water. Ancient Woods held water until week four with a final reading of 50.0 millimetres, this is like previous years.

Incidental observations of non-target reptiles and amphibians (herptiles) during salamander monitoring included Garter Snake, DeKay's Brown Snake, Wood Frog, Leopard Frog and Spring Peeper Frog.

Acknowledgements: Thank you to the following volunteers for donating their time to help monitor the salamander population this field season: M. Adachi-Amitay, J. Cardoso, E. Crosby, C. De Aquino, S. Mathers, S. McGuinness, J. Phoenix, N. Vanzanten In total 86 volunteer hours were accumulated. Staff participation: E. Emptage, D. Engering.

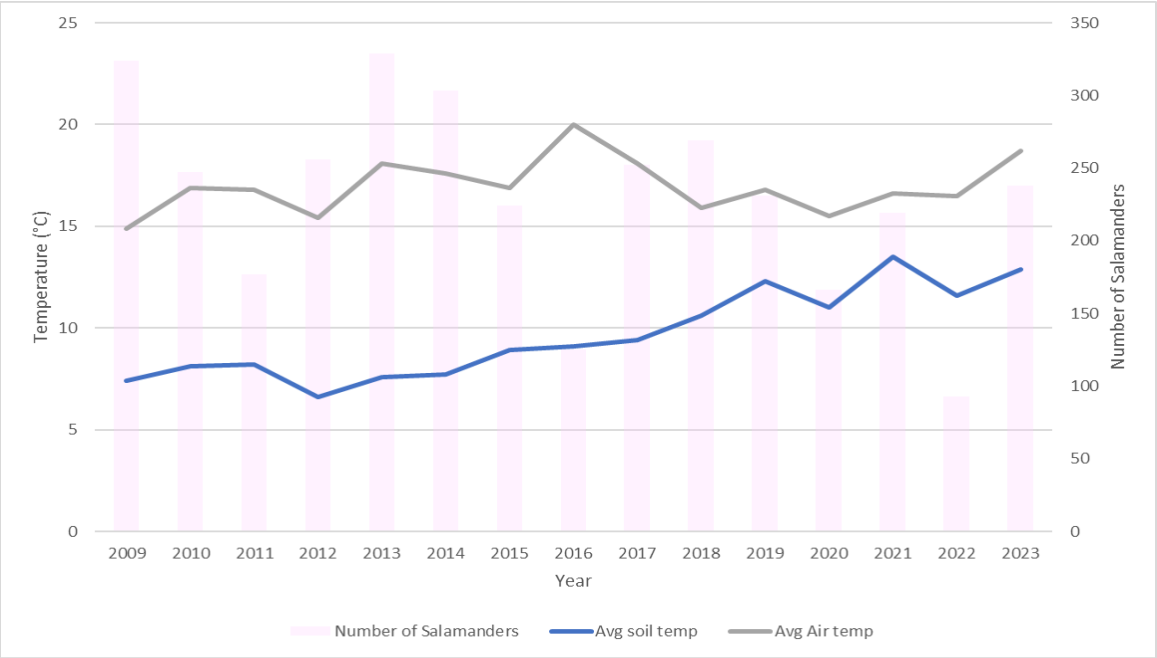

Figure 1. Average soil temperature and average air temperature recorded during monitoring since 2009. This graph also illustrates the number of salamanders observed each year in pink.

Vegetation Monitoring Prepared by: Aleksandra Dolezal

Vegetation Sampling Protocol (VSP) utilizes randomly selected geo-referenced fixed area 400 m^2 circular plots (11.28 m radius) combined with a modular data collection approach to collect qualitative and quantitative data effectively, efficiently, and robustly on vegetation and ecosystem characteristics. Vegetation monitoring on ***rare*** properties during the summer 2023 season 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 will provide 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. VSP 2023 monitoring work began on June 29, 2023, at Property 2 and concluded on September 14, 2023, at Property 1. In total, fifty-three plots were surveyed and staked between the two Eramosa Corridor properties. Thirty-nine VSP monitoring plots were completed at Property 1 (Figure 1) and fourteen VSP monitoring plots were completed at Property 2 (Figure 2). Property 1 excluded eight plots in the farm field within the property, which may be used in the future should the field become naturalized. A total of 5 tactical plots were completed, with the rest predefined, as several cliff drop-offs where original gridded points were unsafe to sample. Our GPS field

unit had a navigation dilution of precision (PDOP) ranging from 0.57 - 2.44. Plots at each site were staked with 1 m rebar stakes and trees were flagged with orange flagging tape in a triangular section.

Priority invasive species found at Eramosa Corridor properties include European and glossy buckthorn (*Rhamnus cathartica, R. frangula*), garlic mustard (*Alliaria petiolata*), and Tatarian honeysuckle (*Lonicera tatarica*); other notable invasives include coltsfoot (*Tussilago farfara*), reed canary grass (*Phalaris arundinacea*), common privet (*Ligustrum vulgare*), and wild grape (*Vitis vinifera*). At both sites, invasive species were present near paths as well as in pockets of light in the forests. Wherever there was an opening in the forest canopy, European buckthorn and, to a lesser extent, garlic mustard had invaded.

Property 1 plots had a mix of forest habitat and meadow habitat, as well as a few swamp areas. Property 1 consisted primarily of forests dominated by white cedar (*Thuja occidentalis*), paper birch (*Betula papyrifera*), trembling aspen (*Populus tremuloides*), and white spruce (*Picea glauca*). Property 2 plots mainly consist of forest and shrub habitats. Property 2 had a larger proportion of delineated wetland, which consisted of mature wet cedar forest and swamp, as well as previous black ash swamps which have died back. Upland areas consist of cedar stands which are partially invaded by non-native buckthorns, as well as open meadow areas. At the west end of the property are wet meadows characterized by reed canary grass, common cattail (*Typha latifolia*), spotted Joe-Pye weed (*Eutrochium maculatum*) and asters (*Symphyotrichum sp.*), as well as dogwood and buckthorn shrub thickets

Acknowledgements: Thank you to the volunteers and staff who donated their time and expertise for our 2023 VSP field season. Volunteers: S. Brown, G. Bermonte, B. Allen, D. McCrimmon, C. Dilly, C. De Aquino, and T. Podluka. In total 104 volunteer hours were accumulated. Staff: E. Harper, Y. Hu, J. Ciancio, D. Engering, T. Chen, P. Schoenwolf.

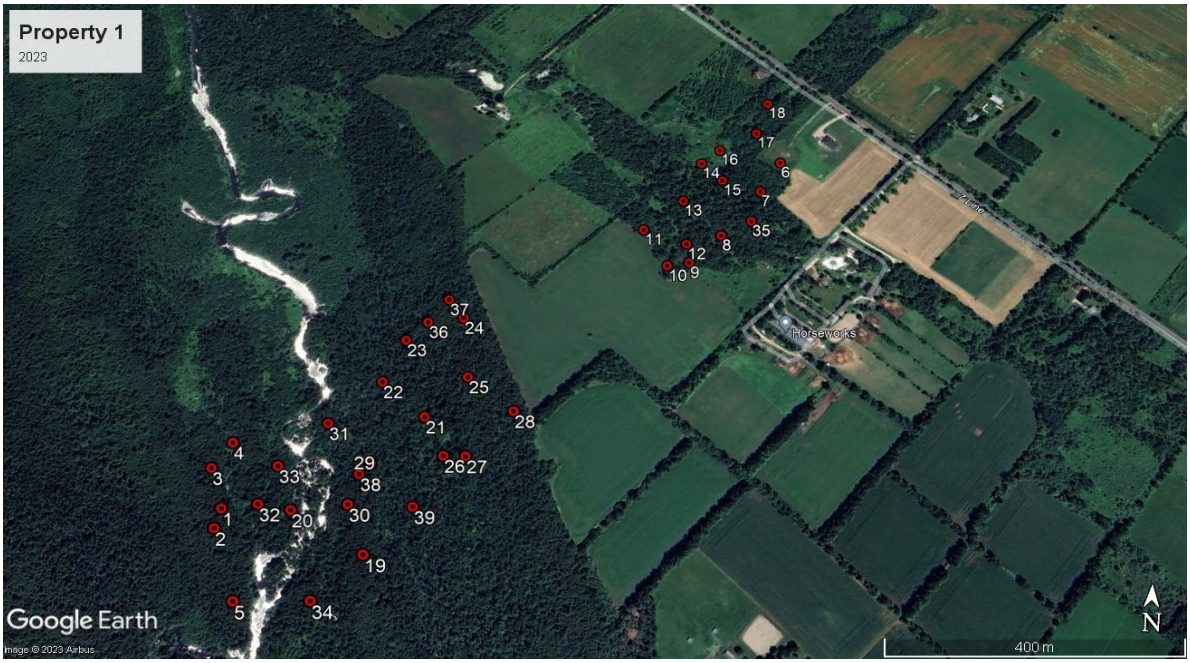

Figure 1: Map of VSP plots completed in 2023 at Property 1 (N= 39). Maps are labelled with plot ID.

Figure 2: Map of VSP plots completed in 2023 at Property 2 (N= 14). Maps are labelled with plot ID.

Soil Humus Decay Rate Monitoring Prepared by: Aleksandra Dolezal

Changes in 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 release of stored carbon. Decay rate monitoring occurred in 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 volunteers and staff who donated their time and expertise. Volunteers: E. Leiher, W. De Ville, S. Kropf. In total 35 volunteer hours were accumulated. Staff: M. MacMillan.