Lichen Pilot Project

Action Plan #19

Central Lake Ontario Conservation

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Central Lake Ontario Conservation

1. INTRODUCTION

Central Lake Ontario Conservation (CLOCA) has recently developed watershed plans for Lynde Creek, Oshawa Creek, Black/Harmony/Farewell Creek and Bowmanville/Soper Creek Watersheds. Documenting existing watershed conditions is an important component in confirming the ecological health of the watershed and gauging need for action in order to achieve desired watershed health objectives. In reporting on the existing conditions of these watersheds, air quality was identified as an on-going concern recognizing that improvements made to air quality will have a positive impact on environmental and human health. Monitoring air quality is currently undertaken by government agencies such as Environment Canada and the Ontario Ministry of the Environment. The focus of their monitoring efforts is on pollutants, smog, and ozone. While there is plenty of information regarding air quality, reporting on the effects of air-borne pollutants on the natural environment within CLOCA's watershed is non-existent. In an effort to address this and monitor the ecological impact of air quality in CLOCA's watershed, CLOCA proposed a Lichen Pilot Project (Action Plan #19). The objectives of this Action Plan are to generate a Lichen Map for CLOCA, develop a long-term Lichen monitoring program and reporting strategy, and make recommendations based upon data findings and future mapping updates. Watershed Action Plans are a means by which CLOCA can work towards implementing specific watershed health objectives utilizing in-house resources and expertise.

Why a Lichen Pilot Project to measure the ecological impact of air quality? Lichens are composite organisms consisting of a fungus and an algae or cyanobacterium growing in a symbiotic relationship. Lichens lack a protective cuticle; therefore moisture and substances from the atmosphere are absorbed directly into their cell structure. This makes Lichens particularly susceptible to airborne pollutants. Epiphytic Lichens (those that grow on trees and plants) are best suited to air quality monitoring as they are located above the ground and receive the majority of their inputs from atmospheric sources. (Blett, T., L. Geiser and E. Porter, 2003). Lichens have been used to map areas of poor air quality in many areas of the world since the 1970's (Leblanc and DeSloover, 1970; McCarthy 2005, McMullin and Ure 2008).

2. DISCUSSION

In an effort to gather more information regarding establishing a Lichen monitoring and mapping program, CLOCA staff carried out an extensive literature review, considered various methodologies and monitoring protocols, and spoke directly with professionals who have conducted similar projects.

This research found that Lichens vary in their response to air pollutants with some species being highly sensitive and others tolerant. As such, it is important to know species richness and abundance in the study area. Lichen community monitoring programs typically include monitoring

species richness and abundance. With this data the creation of an Index of Air/Atmospheric Purity (IAP) based on the frequency of occurrences of pollution intolerant species can be generated. A map of the distribution of IAP zones (based on ranges in IAP values) can also be developed to assess geographical variation in air quality through this method.

The Environmental Monitoring and Assessment Network (EMAN) which has since disbanded, recommends 3 Lichen Monitoring protocols depending upon study goals. These first 2 protocols require documenting species richness and abundance. They are:

- Lichen Mapping: Mapping the relative abundance and distribution of arboreal Lichens using a visual survey of the trunk for a select suite of indicator species;
- Mapping Lichen Diversity: Recording changes in arboreal species diversity in fixed plots over time, either through the use of grid or transects samples, using a standardized method developed by European lichenologists;
- Metal analysis: Determining the elemental content of Lichen tissue in relation to differing pollutant concentrations.

Arising from this research (Appendix 1) it became clear that to draw conclusions from the data collected that it would not be enough to track the presence/absence of pollution tolerant species; knowledge of the causal relations between air pollutants and species presence/absence is necessary. In other words, just monitoring the presence/absence of Lichen does not give an indication of exactly which pollutants are having a detrimental effect on the surrounding environment. Without this information it is difficult to identify specific environmental impacts. The following identifies other limiting factors to carrying out this Action Plan.

- Availability of a comprehensive list of pollution-intolerant Ontario Lichen species is required to support the development of an IAP for CLOCA's jurisdiction. This list does not currently exist, and to create such a list, even one adapted from a similar region, is not a simple task and would require the expertise of a range of professionals and academics.
- Identification of Lichen species requires years of training. Species verifications would require confirmation by a Lichenologist.
- Sampling and detection of Lichen is difficult at higher heights on trees, leading to the underrepresentation or omission of some species which prefer microhabitat conditions higher in the canopy.
- External expertise would be required to correlate the Lichen monitoring data to air quality and how it impacts ecosystem health as it can be difficult to distinguish between environmental influences (sunlight, moisture, nutrients) from pollution influences on Lichen communities.

3. CONCLUSION

The CLOCA Lichen Pilot Project (Action Plan #19) was identified as a potential means by which air quality and ecosystem health could be measured in CLOCA's watershed using Lichen populations as an indicator of Air Quality. However, in conducting the detailed research necessary to plan for and implement a scientifically defensible monitoring and mapping program, CLOCA staff determined this Action Plan cannot be fulfilled in accordance with a key consideration, the use of in-house resources and expertise. However, with appropriate funding and partnerships in place development of a CLOCA long term Lichen Monitoring and Mapping program could be undertaken.

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APPENDIX 1 – CLOCA Lichen Pilot Project – Feasibility Report

Central Lake Ontario Conservation (CLOCA) has recently developed watershed plans for the CLOCA jurisdiction. Within these documents Priority Action Plans were identified to achieve specific watershed health objectives. One Action Plan that was identified was a Lichen Pilot Project to monitor Lichen populations as an indicator of Air Quality. The feasibility of initiating this Action Plan was investigated.

The deliverables of this Action Plan were to develop a Lichen Map for the CLOCA jurisdiction to illustrate lichen populations, develop a long-term Lichen monitoring program and reporting strategy and make recommendations once enough monitoring data/ maps updates have been completed. In addition, the potential for stakeholder monitoring and reporting of Lichens was to be investigated.

CLOCA staff have evaluated the feasibility of implementing this Action Plan through a review of existing literature and personal communications with professionals who have conducted similar projects. Lichen monitoring programs typically include monitoring species richness and the creation of an Index of Air Purity (IAP) based on the frequency of occurrences of pollution intolerant species. A map of the distribution of IAP zones (based on ranges in IAP values) can also be developed to assess geographical variation in air quality.

Through this process CLOCA staff have found that there are several limiting factors to implementing such a project. These include and are not limited to:

- A comprehensive list of Lichen species of Ontario with specific pollution-intolerant species identified would be required to develop an IAP. This list does not currently exist and would need to be created or adapted from another region. This would be an extensive project requiring particular Lichen expertise of academics and professionals.
- Lichen species identification requires many years of training and typically a Lichenologist would identify the species. Therefore CLOCA would need to contract out identification work which could be expensive.
- Sampling and detection of Lichen can be difficult at higher heights on trees, leading to the underrepresentation or omission of some species which prefer microhabitat conditions higher in the canopy.
- Lichen presence/absence does not give an indication of exactly which pollutants are having a detrimental effect on the surrounding environment. Without this information it is difficult to identify specific environmental impacts.

- CLOCA has insufficient resources and limited staff expertise to accurately relate the Lichen monitoring data to air quality and how it impacts ecosystem health. Several resources indicated that it can be difficult to "separate environmental influences (sunlight, moisture, nutrients) from pollution influences on Lichen communities."

Through this review it was determined that directly measuring air quality is a simpler and more feasible approach, and allows for specific information about which pollutants are in the air and this information can be directly related to environmental impacts. The Ministry of the Environment has a network of 40 ambient (outside) air monitoring stations across Ontario that collect real-time air pollution data. This information is communicated to the public through Ontario's Air Quality Index (AQI) and has hourly concentrations of each pollutant. The Air Quality Index (AQI) is an indicator of air quality, based on air pollutants that have known adverse effects on human health and the environment. One of these monitoring stations is located in Oshawa. This station measures ozone, particulate matter and nitrogen dioxide, and based on the concentrations of these pollutants, reports an hourly AQI value. The atmospheric influence, or airshed, in CLOCA jurisdiction extends far beyond watershed boundaries; therefore this monitoring station is sufficient to give an overall indication of regional air quality.

Though this review, CLOCA staff have determined that the identification and monitoring of Lichen populations is not practical as an air quality monitoring program. It is therefore recommended that a future air quality monitoring program model "Humber River State of the Watershed Report – Air Quality" completed by the Toronto and Region Conservation Authority (2008). This report is based on measurements taken from Ontario air monitoring stations and reported AQI scores. Impacts of specific pollutants to human and environmental health are discussed and recommendations to address these impacts are made.