Using lichens to compare air pollution among different levels of urbanization

ABSTRACT

Among all bioindicators, lichens have been identified as the most useful to monitor the level of pollution in the environment (Ferry et al 1973). The purpose of this study is to observe the species diversity of lichens in different settings and use it as an indicator for air pollution. They can be used in two ways to monitor air pollution: 1) grouping the species of lichens present in a specific area 2) measuring the morphological changes or the accumulation of pollutants in the lichens (Richardson, 1991; Seaward, 1993; Gries, 1996). For this study, the first method will be applied to correlate the diversity of lichens to the air quality. It is imperative to pay close attention to the environment now more than ever, and so any step to detect and control a problem must be taken to find and implement a solution.

SPECIFIC AIMS:

The purpose of this study is:

1) **to observe the species diversity of lichens in different settings.**

2) **choose different settings - two different forest areas (while identifying factors that make them different from one another); forest vs. building; different rocks etc.**
3) **choose days when the weather is the same - lichens are easier to detect during a rainy/damp day.**
4) **correlate the diversity of lichens to the air quality.**

BACKGROUND:

Monitoring air quality has been a prime component in managing the atmosphere around us. As rapid urbanization spreads all over the world, it is vital to pay attention to how the air quality is being affected. Bioindicators are very often used to detect the level of air pollution (Tonneijck and Posthumus 1987). They can also be used to compare the levels between an area that is more densely populated with trees as opposed to an area that has more concrete establishments.

Among all bioindicators, lichens have been identified as the most useful to monitor the level of pollution in the environment (Ferry et al 1973). Lichens can be found in different areas starting from warm, tropical regions to cold, polar regions and even extreme conditions, which might be deemed as too harsh for other living organisms (Weerakoon 2015). The symbiotic relationship between an algae and fungus gives rise to

a lichen. The association involves the alga producing the nutrients since it has the chlorophyll to photosynthesize and the fungus provides water to the alga (Hale 1969, 1993). There are three bodies for lichens: crustose, foliose and fruticose (Brodo et al 2001). They can be used in two ways to monitor air pollution: 1) grouping the species of lichens present in a specific area 2) measuring the morphological changes or the accumulation of pollutants in the lichens (Richardson, 1991; Seaward, 1993; Gries, 1996).

RESEARCH DESIGN

The research study will require the following tools: 2 measuring tapes, plastic flags, a clipboard with a piece of paper, a pencil, a compass and a metal grid and push pins. These tools can be collected from the ecology department at UMASS. After collecting all of the tools, the experiment can begin. There are two sites that will be used to collect the data. The first location will be in the woods behind Orchard Hill dormitories. The other location will be in the woods behind Southwest dormitories. A map is provided below with the exact locations of these woods.In addition, we will use photos of specific lichen to aid in identification.

We will pick a location in these woods and measure out a 4 x 4 meter plot . This plot will be measured using the measuring tape. Flags will be placed at these points to outline the area of the plot. When the plot is identified, we will record how many trees are in the area. Shrubs will not be included in this recording (a shrub will have a diameter of less than 10 inches and a height of less than a meter).

We will tag each tree we assess with a colorful tape to mark it as completed. For each tree, we will measure out 1 meter from the ground to each tree, on the north facing side of the tree (the north facing side can be identified using the compass). A push pin will be placed at the top of the measured out 1 meter height. We will align the grid along the same line as the pushpin and repeat this step moving upwards until we reach the 1 meter push pin mark. We will count the amount of lichen in the grid. The grid has 100 squares and we will count how many times the certain lichen appear in those squares. The data will be recorded in this order, (Tree 1: Lichen: crustose 20/100, foliose 50/100, fruticose 10/100). Once each tree within that plot is scanned for lichens and all of the data is recorded, we will remove the flags from the plot. This process will be repeated in the southwest forest area. All of the data

will then be recorded in an excel spreadsheet and saved for later analysis.

The data will be recorded onto an excel spreadsheet. This spreadsheet will be categorized into two plots: A and B. Plot A consists of the information from behind Orchard Hill and Plot B will consist of information from behind Southwest. On each plot, each tree will be listed in a row, while the lichen types will be in a column. The numbers previously recorded will be entered for the amount of lichens within the 1m height. The numbers will be compared and run through the statistical analysis software 'R'.

IMPACT

The results will allow us to confirm the hypothesis that more urbanized areas will have a lower diversity in terms of lichens. This could be replicated to detect level of pollution in other places and further steps can be taken to control/maintain the air quality. It is imperative to pay close attention to the environment now more than ever, and so any step to detect and control a problem must be taken to find and implement a solution.