The Use of Image Analysis of Leaf Samples To Determine Vegetation Health at Lake Merrit Oakland, CA Lawrence Hall of Science **University of California, Berkeley**

Introduction:

The purpose of this research was to:

- determine the health of the vegetation surrounding Lake Merritt
- determine if tree health could be an indicator of environmental quality around the lake

This study is important because it will help find what environmental factors of Lake Merritt will affect the area's tree's health, as well as human health. Since trees are both a source of oxygen for humans and a user of CO₂, they are important component of a healthy environment. By exploring the health of the vegetation at Lake Merritt, we are essentially developing a new methodology to study environmental health.

Hypothesis/Prediction:

During our preliminary planning of the study, one of our first predictions was that trees closer to the street would demonstrate the most amount of damage due to pollution. We expected that the area with least amount of damage would be in locations with little interference from cars or other pollutants and with more foliage. An area that can support more vegetation is more likely to be healthy.



Sample Tree: Factors such as distance from the streets and pollution were considered in this study. This image shows that the presence of pollution from cars can serve as a probable factor to the tree's health.

Data Analysis:

The percentage of damage for each leaf was calculated using Image Analysis. For each tree, the leaf damage was averaged to arrive at the percent damage of the tree. Furthermore, percent tree damage was averaged for each area, thus finding the overall damage of respective areas. The following are the percent damages for each area:

- •Area one: 6.35%
- •Area two: 9.31%
- •Area three: 0.56%

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Methods:

Our selection process began with the division of areas of the park surrounding the lake. Three different areas were chosen based on proximity to the lake and to nearby streets:

•Area One was within close proximity to the lake. •Area Two was surrounded with vegetation. •Area Three was near a major street.



In order to use our Image Analysis software, we chose trees that had broad leaves. We picked leaves representative of the overall tree's health. Twelve trees in total were chosen for the study. Three representative leaves were chosen from each tree.

Digital images were taken of the leaves, while maintaining uniform light conditions. Image Analysis is the software program used to isolate and determine areas of leaf damage. Damaged leaves reflected yellow and brown colors, whereas healthier leaves reflected more green color. The program allowed us to calculate the percentage of damage on the leaves and infer about the overall health of the trees and respective areas.



Sample Tree: This specific tree was located in an area that had little interaction with traffic pollution. Chosen from Area 2, this broadleaved tree showed only .03% average damage.



This corresponding leaf shows minimal damage.



with highlighted damage.



Conclusion:

Area two, although supporting a large amount of vegetation and located furthest from nearby streets, showed the most amount of vegetation damage. We expected different results, as noted in our hypothesis. We previously speculated that those areas able to support vegetation would be most healthy. Area three, on the other hand, showed the least amount of damage, despite being within close proximity to nearby streets. We hypothesized that areas located nearest to the streets would be more affected by pollution.

The location of the trees was the only parameter in this study. However, there are other parameters that may be affecting the health of the vegetation. These parameters may include: •the age of the trees

- •the amount of sunlight available
- •the time of year
- •the species of the trees
- •how sensitive the trees are to pollution

Future studies should include testing of these additional parameters in order to isolate the significant variables. Specifically, trees of the same species that are known to be sensitive to environmental factors should be chosen for further research. Additionally, ozone analysis could provide possible correlation between health of trees and surrounding areas.

Sample Leaf Image Analysis

Using the original image of the leaf on the left, Image Analysis software was used to differentiate that damaged areas from the healthy areas. The image on the right shows the analyzed image

•how resistant they are to other negative effects.