Comparing Carbon Dioxide Levels to Lichen Diversity in Order to Determine the Overall Health of San Souci County Park in Sayville, New York

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Question

1. Do CO_2 levels impact the diversity of lichens found in San Souci County Park?
2. What does the diversity of lichens tell us about the overall health of the park?

Hypothesis

Hypothesis → Areas near the highway and on the fringes of the park will contain a lower diversity of lichens than areas in the middle of the park.

Alternative Hypothesis #1 → In areas where the CO_2 level is low, there will be a higher number of species of lichens found and it can be concluded that the park is healthy.

Background Research

- Lichens are a diverse group of organisms that have evolved a symbiotic relationship between a fungus and an alga or cyanobacterium

- Lichens are also known to be sensitive indicators of environmental health, as changes in air quality, temperature and humidity can affect their growth and distribution

- Despite their ecological significance, it is estimated that only a small fraction of all lichen species have been discovered and described

- Sans Souci County Park is a 316 acre nature preserve teeming with plants and animals

- Land bridges are found between each body of water

- The lakes were one continuous lake until the 1800"s when small dams were built to turn the land into cranberry farms

Background Research

- Approximately 260 species of lichen currently catalogued on LI

- Lichens can be found in a variety of environmental conditions

- Sensitive to air quality since they receive all their nutrients and water from wet and dry atmospheric deposition

- Poor air quality → cause the death of lichen algae, discoloration, reduced growth of the lichen fungus or even kill a lichen completely

- Poor air quality → limit the biodiversity of lichen species in an area

- Some lichen species are considered indicators of environmental health, while others are not

Materials

- Similar sized portions of lichens will be sampled using:
- Sterilized tweezers
- A pick or scraper,
- Sterile white envelope
- Gloves
- Equipment necessary to perform a DNA analysis

Note: Small samples of the total area/volume of lichen were collected, leaving the majority of the colony behind to regrow and repopulate.

Variables

Dependent Variables- The biodiversity of lichens found in San Souci and the CO_2 levels recorded

Independent Variable- The area of the park where the lichen was collected

Procedure

1. Samples were taken from lichens on rocks, woody vascular plants, soil, and other surrounding areas where lichens are observed

2. Similar sized portions of lichens were sampled using sterilized tweezers and a pick or scraper, only taking a small amount of the total area/volume of lichen, leaving the majority of the colony behind to regrow and repopulate

3. The samples were dried, placed directly into a sterile collecting container, and frozen until the DNA extraction could be performed using the steps from Barcodeli.
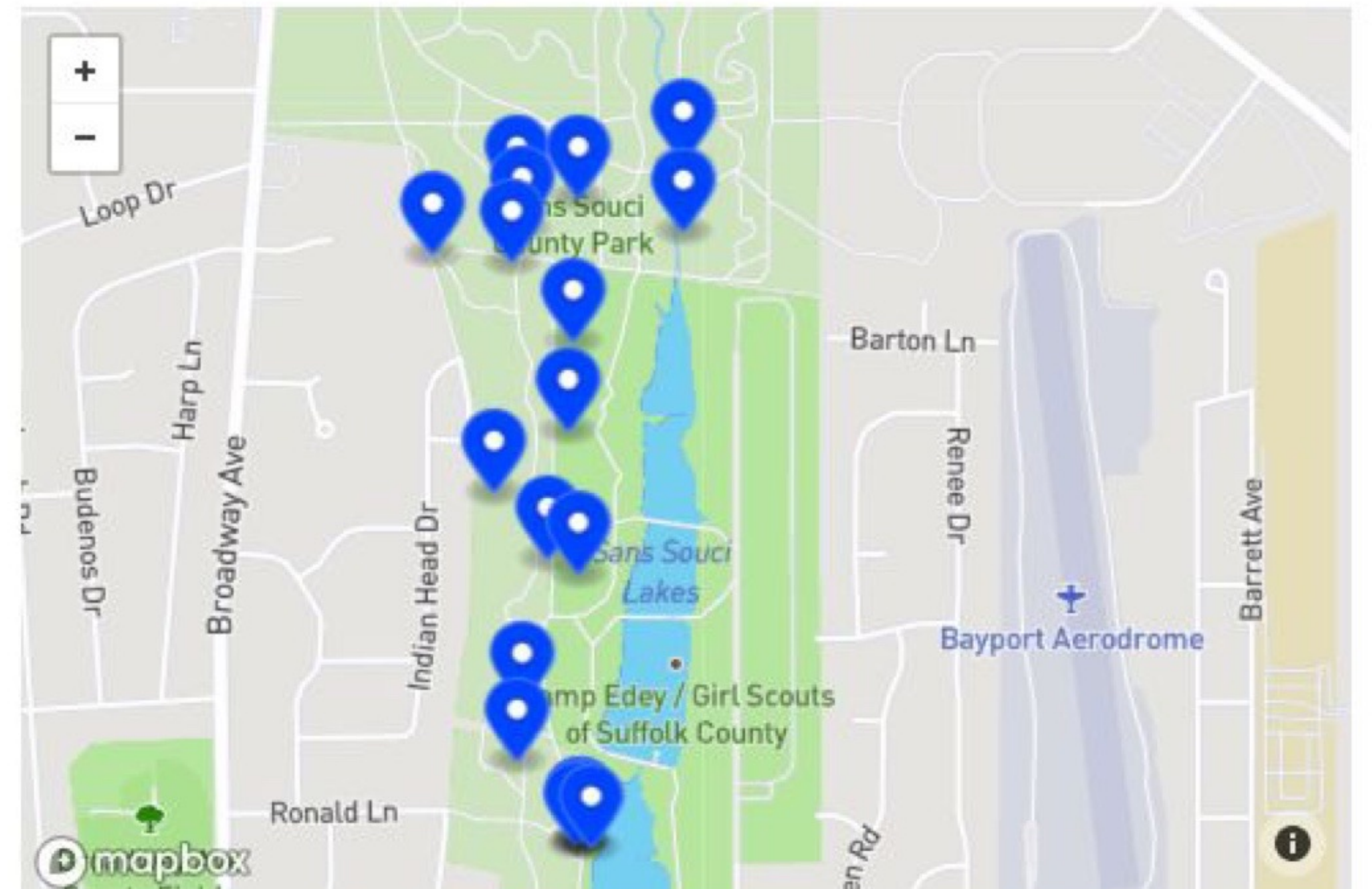
Results

- The average CO_2 concentration was 410 parts per million (ppm), with a standard deviation of 20 ppm.
- The minimum recorded CO_2 level was 395 ppm, while the maximum reached 430 ppm.
- A total of 6 different lichen species were identified among the samples.
- The species richness varied across the park, with certain areas exhibiting higher diversity compared to others. Specifically, the areas further away from the roads had a higher diversity of species.

Number of Lichens Found at Each Carbon Dioxide Level
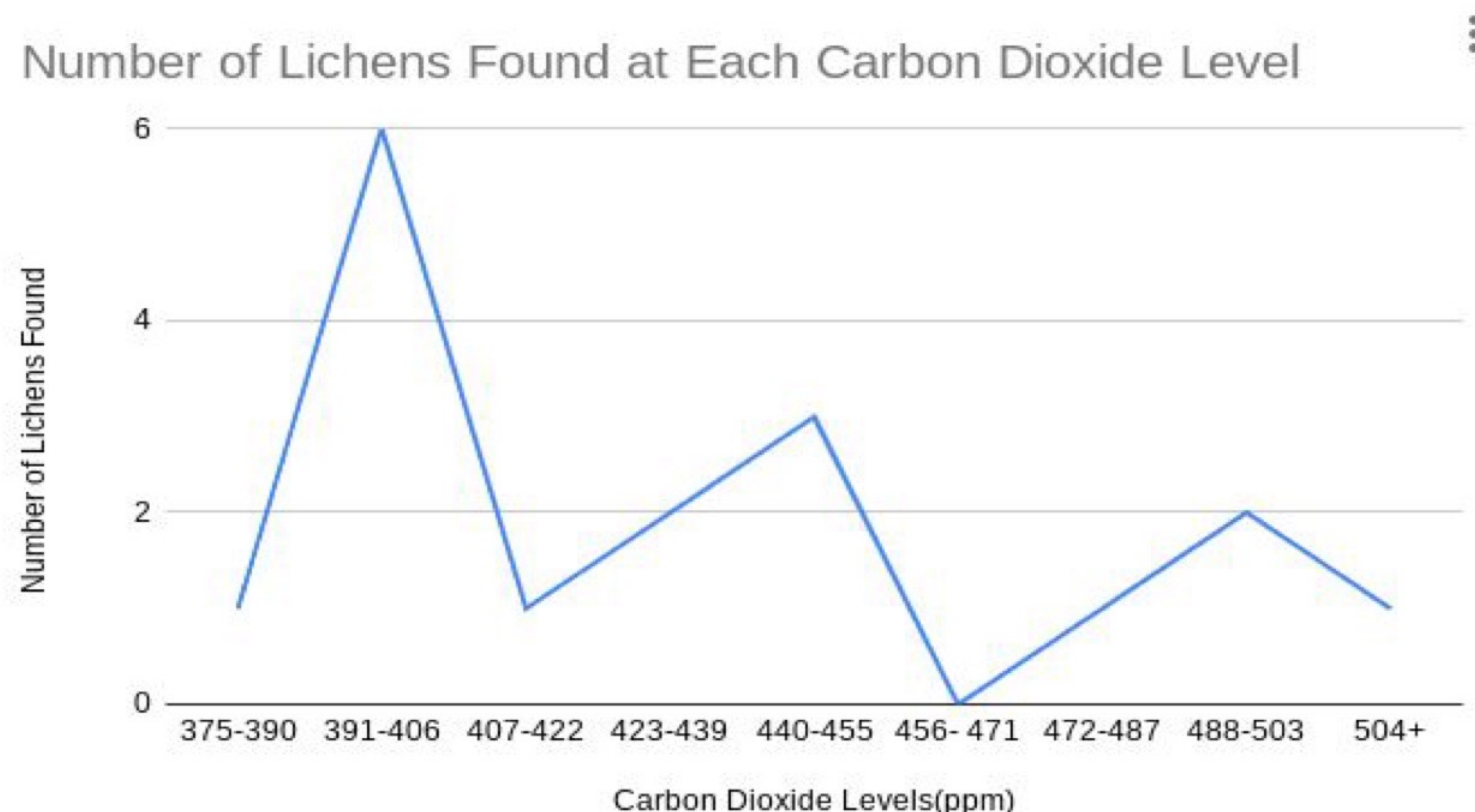
Conclusions

The low diversity of lichen species identified using DNA barcoding underscores the ecological value and health of the park's ecosystem.

Findings of this research indicates that lichens can serve as valuable bioindicators of air quality in San Souci County Park. The distribution patterns of lichen species in relation to carbon dioxide levels suggests that lichens can reflect changes in air quality and may be used in ongoing air quality monitoring programs. This has important implications for environmental assessments and management decisions, as lichens can provide valuable data on the impact of air pollution on ecosystems.

The use of DNA barcoding to identify lichens and assess air quality in San Souci County Park is a valuable approach with significant findings that the air quality in San Souci County Park is poor.

Future Work

In the future, a longitudinal study could be conducted. This would enable researchers to observe long-term trends, seasonal fluctuations, and potential impacts of climate change on the park ecosystem.

Over the period of time, the total number of lichens in the park could be identified and then applied to a lichen biodiversity index to designate a ranking regarding biodiversity in San Souci County Park. This study should be conducted again with a larger sample size to improve accuracy. Based on the conclusion that the air quality in San Souci County Park is not overly healthy, future work could focus on ways to improve air quality and reduce the carbon dioxide levels in areas around or within the park.

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