Snail Biodiversity in Central Park and Black Rock Forest

Bella Shao, Caroline Schell, Sophie Liang

Introduction

There are over 500 species of freshwater snails in North America, and over 100 species of snails live in New York City(Pond Snail, 2010). This Urban Barcoding project seeks to investigate the biodiversity of water snails in New York City, and the correlation between snail biodiversity and global warming. Gilled snails are reliant on the amount of dissolved oxygen in the water.

There are several factors that affect the quantity of dissolved oxygen in water. The first factor is the type of water source. Moving bodies of water like rivers and streams take in more oxygen as the oxygen gets trapped in the water due to the turbulence in the water after going over waterfalls and rocks (Water Science School, 2018). However, ponds do not have the turbulence to introduce more oxygen into a body. The second major factor for the quantity of dissolved oxygen is temperature. When it is cold the amount of dissolved oxygen is higher because the oxygen atoms have less energy and thus move slower. In the summer, however, the amount of dissolved oxygen decreases because the oxygen atoms have more energy and move around more, which causes more oxygen to escape back into the air. (Water Science School, 2018).

Global Warming is the heating of the earth's surface that has been going on for over a hundred years. The global average has risen 1.15°C over the last hundred years. (World Meteorological Organization, 2022). Therefore, global warming has negatively affected the amount of dissolved oxygen in the water(Water Science School, 2018).

In addition, factories and other places that produce pollution, also put small particles of metal into the air. Metals such as cadmium, mercury and lead are all extremely common air pollutants(Liu et al., 2019). All three of these metals are associated with detrimental health effects. These pollutants that permeate the air, also dissolve into water. The snails then breathe the dissolved oxygen and metals. Metals such as cadmium, mercury and lead are known to cause detrimental health effects on snails.(WHO/Convention Task Force on the Health Aspects of Air Pollution, 2007, p. 1).

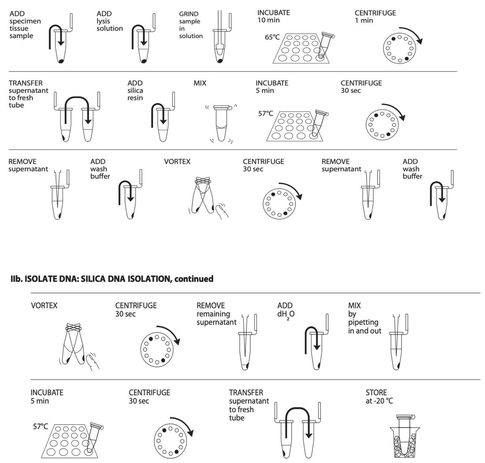
Purpose

This experiment aims to analyze the biodiversity of the freshwater snail populations in both Central Park and Black Rock forest, by collecting DNA samples from freshwater snails found in both environments, and analyzing the DNA in order to determine the diversity of samples collected. Through our analyses, we hope to gain an understanding of the effect of pollution on freshwater snail biodiversity, as well as use the freshwater snail population as an indicator of high levels of pollutants in a given body of water.

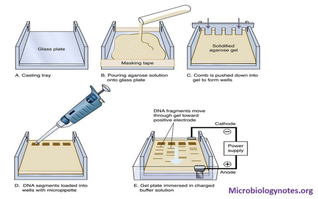
Method

Our group attempted to collect freshwater snails from Central Park and the Black Rock Forest, documenting the collection sites. We used specific equipment such as collection jars, tweezers, a scalpel, scissors, a smartphone with a camera, a field guide, an organism/documentation sheet, a pen/pencil, a clipboard, and a ruler. The collected samples were taken to the Spence School for analysis. We employed the Silica DNA isolation method from DNAbarcoding101, involving grinding the sample, incubating it, and centrifuging it. The supernatant was separated and mixed with silica resin, followed by further centrifugation. The pellet was washed, incubated, and centrifuged again. The resulting supernatant was transferred to a fresh tube.

Subsequently, we added COI invertebrate primer and DNA to a PCR tube, which was then subjected to amplification using a thermal cycler. Finally, we performed gel electrophoresis on the amplified DNA.



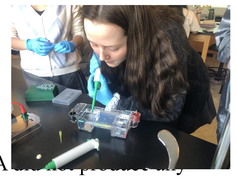
DNA Isolation



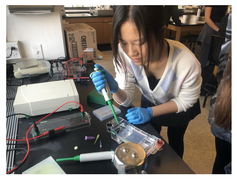
Gel Electrolysis

Results

The experiment in Black Rock Forest and Central Park, which aimed to collect snails, was hindered by cold weather conditions in February. Consequently, dragonfly larvae were substituted as subjects.



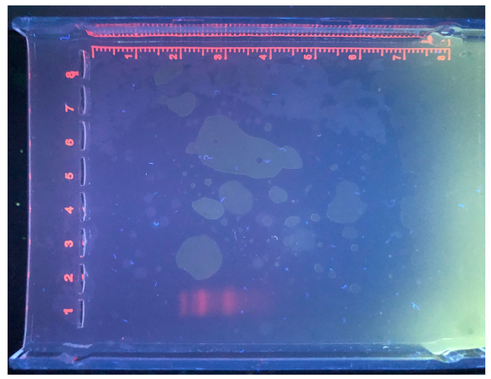
Three larvae were collected from Black Rock Forest and taken to the Spence School for DNA isolation, extraction and PCR. However, the isolated DNA [illegible] observable bands on the gel after undergoing gel electrophoresis.



This indicates that errors likely transpired during the isolation and extraction processes, preventing the next step which is the sequencing of the samples.

An error in sample storage prior to PCR could contribute to the lack of successful sequencing. The protocol specified storing the samples at either "4°C overnight or -20°C for a longer period." However, due to limited sample quantity, these samples had to wait for a week until other groups completed their lichen-focused PCR. It can be inferred that the samples were not adequately stored for PCR, resulting in sequencing failure.

A potential error could be an insufficient primer addition during PCR amplification that could lead to incomplete or non-specific amplification. The outcome of gel electrophoresis, which serves as the final step prior to sequencing, exerted the most substantial influence on the success or failure of the sequencing process.



Gel Electrophoresis Fails to Reveal DNA Presence

Looking for Dragonfly Larvae in Black Rock Forest

Conclusion

The anticipated results were that the Black Rock forest samples would have a greater diversity of species. In contrast the snails collected in Central Park would be less diverse. Aquatic snails are more sensitive to lower amounts of dissolved oxygen and an increase of toxic materials in their habitat. As seen in the introduction the snails in Central Park live in ponds which have lower amounts of dissolved oxygen in the water. In addition, the Central Park is in New York City which is near factories and thus has more pollution as compared to the Black Rock forest in the suburbs. Pollution leads to lead and mercury being absorbed into the water. The snails come into contact with these toxic metals and can become sick and die. Therefore the aquatic snail population suffers in Central Park.

Acknowledgements

We express our gratitude to Mrs. Aidoo and Ms. Chavali for their valuable assistance throughout this project, and we also extend our thanks to Black Rock Forest and CSHL DNA learning center for their support in sample collection and provision of resources for this endeavor.