The Effect of Vegetation on Leech Biodiversity in a Freshwater Pond

Ariel Greenberg , Olivia Pesso, and Emma Turley

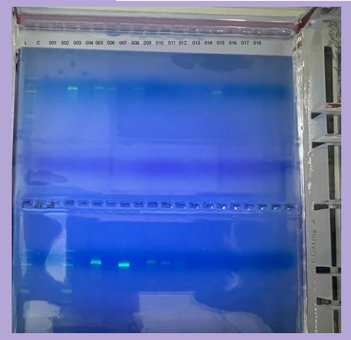
Abstract

Leech biodiversity is impacted by vegetation in a natural pond environment. The goal for this project is to determine whether vegetation increases, or decreases leech biodiversity in our school's freshwater pond. We will be extracting DNA from the specimens we collected for DNA barcoding analysis to determine whether there is a greater diversity in more highly vegetated areas or low vegetated areas. Information about vegetated areas will help us indicate what causes biodiversity gain or loss in certain leech species and indicate pond health.

Introduction

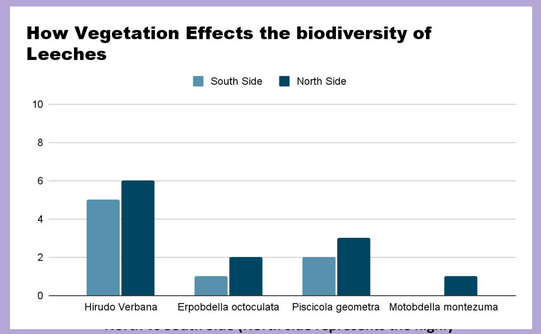
- The leech is a type of predatory worm that belongs to the Hirudinea subclass.
- Leeches have soft, muscular bodies that can contract and lengthen. Leeches are around 8 cm long, and live throughout freshwater lakes, streams, and ponds.
- Leeches are most commonly known for their suction mouths and their common color of either green, black, or brown.
- Inspecting vegetated areas in a man-made pond will indicate higher biodiversity levels due to recent analysis that claims, man-made ponds had 43% higher aquatic species richness and 33% higher aquatic species abundance than in natural ponds (Ruggiero 2008).
- Vegetated areas also affect the pH levels, oxygen dissolved, and nitrate levels which are included in our metadata. Vegetation can affect the healthiness of a pond, leading to the hypothesis that vegetation can also affect biodiversity amongst various leeches.
- Our goal is to preserve different species from different parts of the pond and find an end result as to the vegetation differences throughout the pond.

Metadata Results	Test 1	Test 2
PH	5	6
Dissolved Oxygen	6 mg/L	7 mg/L
Phosphate	4 ppm	4.5 ppm
Nitrate	0 ppm	0 ppm



Gel Electrophoresis of Leech Specimen DNA
Figure 7

Leech 18 being measured
Figure 6

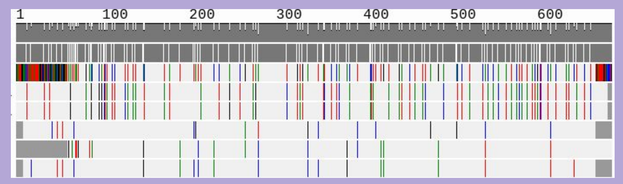


vegetated areas of the pond South represents the low vegetated areas of the pond) Figure 1

Campus Pond
Figure 2

table 3

Specimen	Identified specimen Identity:
Leech 1	*Hirudo verbana*
Leech 2	*Arhynchobdellida*
Leech 3	*Arhynchobdellida*
Leech 4	*Erpobdella punctata*
Leech 5	*Erpobdella Mexicana*
Leech 6	*Hirudo verbana*
Leech 7	*Hirudo medicinalis*
Leech 8	*Piscicola geometra*
Leech 9	*Piscicola geometra*
Leech 10	*Motobdella montezuma*
Leech 11	*Hirudo verbana*
Leech 12	*Hirudo verbana*
Leech 13	*Erpobdellidae*
Leech 14	*Erpobdella octoculata*
Leech 15	*Hirudo verbana*
Leech 16	*Arhynchobdellida*
Leech 17	*Hirudo medicinalis*
Leech 18	*Hirudo verbana*
Leech 19	*Piscicola geometra*
Leech 20	*Piscicola geometra*



Final alignment viewer of Leech 5
Figure 5

Table 4

Methods and Materials

- Started by puncturing holes in the bottom of coffee cans
- Attached empty water bottles by string to the top of the coffee cans so we could locate the cans when collecting
- Cut 4 pieces of raw chicken/beef liver and placed in the bottom of the cans
- Completely submerged the can inside of the water in the designated area of the pond selected
- Left idle for 1-3 days debating on material of coffee can (cardboard or metal)
- Took cans out, drained water and collected leeches inside
- DNA extraction, isolated COI (cytochrome c oxidase subunit 1) gene
- Extraction using the Chelex method
- DNA barcoding protocol
- Amplify
- PCR reactions using the COI gene and then Gel Electrophoresis to examine how adequately PCR worked
- Followed the directions of DNA subway to genetically identify our specimen

Discussion

- In observations of the leeches, longer and wider leeches were found around high levels of vegetation where smaller ones near low levels.
- This indicates bigger leeches need more abundant species of plants for unknown reasons.
- The pond in the 2023 school year had the highest biodiversity of leeches seen in the past 10 years.
- When comparing healthy pond water quality to the pond used to obtain the leeches most were in the ideal range except for phosphate which indicates low rates of algae growth.
- The adequate Nitrate levels indicate good feeding levels indicating more leeches survived this year because of good feeding habits since they're parasites.
- The adequate pH levels indicate the leeches were given a comfortable ecosystem to thrive off of.

Results

Based off our observations and experiments, we concluded that the higher biodiversity of leeches is located near the more vegetated areas. Most vegetation found around the edge of the pond consists of various species of trees, leaves, weeds, and marsh plants. Higher biodiversity near more vegetated areas indicates a adequate pond health. If leeches are able to grow in diverse bundles, then vegetation is able to which results from our ponds neutral pH, and average nitrate, phosphate, and dissolved oxygen levels represented in our metadata.

References:

Drinkwater, Rosie and Williamson, Joseph and Swinfield, Tom and Deere, Nicolas J. and Struebig, Matthew J. and Clare, Elizabeth L. and Coomes, David and Rossiter, Stephen J. (2019) Occurrence of blood feeding terrestrial leeches (Haemadipsidae) in a degraded forest ecosystem and their potential as ecological indicators. Biotropica . ISSN 0006-3606.

Qingwei Zhuang, Zhenfeng Shao, Deren Li, Xiao Huang, Orhan Altan, Shixin Wu, Yuzhen Li. (2022) Isolating the direct and indirect impacts of urbanization on vegetation carbon sequestration capacity in a large oasis city: evidence from Urumqi, China. *Geo-spatial Information Science* 0:0, pages 1-13.

Drinkwater , Rosie. "Occurrence of Blood-Feeding Terrestrial Leeches (Haemadipsidae) in a ..." *BioTropica* , Doi.org, https://onlinelibrary.wiley.com/doi/full/10.1111/btp.12686.

Schnell, I. B., Thomsen, P. F., Wilkinson, N., Rasmussen, M., Jensen, L. R. D., Willerslev, E., Bertelsen, M. F., & Gilbert, M. T. P. (2012). Screening Mammal Biodiversity using DNA from leeches. *Current Biology*, *22*(20), 1980. https://doi.org/10.1016/j.cub.2012.10.014