Benthic Biodiversity between Bay and Canal Environments

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Abstract

Benthic organisms occupy the bottom sediments of bodies of water, fill different niches of aquatic ecosystems and act as bioindicators due to their sensitivity to environmental changes like pollution. The aim of this research is to determine if bay ecosystems host a greater benthic invertebrate biodiversity than canal environments. We hypothesized that open-bay ecosystems have a greater biodiversity of benthic invertebrates than canal environments. This can be attributed to a greater concentration of houses and industries next to canals which can lead to pollution and a restricted flow of water. A shovel was used to collect sediment at a bay and canal and PASCO probes were used to collect metadata. DNA extraction, PCR for the CO1 gene, and electrophoresis were used to interpret results. We got 3 positive results and only 1 confirmed negative out of 20 tests. The remaining DNA bands were faint, so we needed to rerun DNA extraction and PCR for them. The significance of this project is to learn where benthic invertebrate biodiversity is most concentrated. We would do this by using sanger sequencing to compare the DNA and biodiversity of benthic invertebrates at the two locations by seeing how similar their DNA is. This data can lead to inferences of where there's higher amounts of pollution and chemicals and where there's the highest biodiversity due to their bioindicator nature. This tells where cleanups are needed and also helps to preserve benthic invertebrates because the loss of them can lead to a disruption of habitats.

Introduction

- Do open bay ecosystems host a greater biodiversity of benthic invertebrates than canal ecosystems?
- Benthic organisms are those which live in the bottom sediments of a body of water (Tagliapietra & Sigovini, 2010).
- Benthic marine life is hard to identify because of their cryptic, small, rare, and being part of not well-known groups making barcoding essential for the identification of benthic organisms (Leray & Knowlton, 2015).
- Benthic invertebrates can act as bioindicators because they are sensitive to environmental changes such as pollution. Due to this sensitivity, they can be used to track human impact on bodies of water and surrounding habitats ("Regional Aquatics Monitoring Program", 2007).
- The loss of benthic organisms in marine environments can result in a disruption and possible collapse of the habitat (Thrush & Dayton, 2002).

Materials & Methods

- A shovel or scooper was used to collect multiple muck samples from the canal bed. Then, a shovel or scoop was used to collect bay sediment from areas of shallow water.
- Once in the lab with the sediment from both locations, portions of both were placed on slides and in weigh boats and viewed under a microscope. If any organisms were found, they were labeled by the first letter or whole common name, with the number of that kind of organism collected and either a "B" or "C", depending on if they were from the canal 'C" or bay "B".
- For meta data, multiple instruments were used throughout this experiment. These instruments included: a PASCO wireless temperature sensor, a PASCO wireless optical dissolved oxygen sensor, and a PASCO pH sensor. These probes were all able to be connected to a smartphone where the data was collected and documented.
- Photos of organisms were taken with a ken-a-vision microscope with educam software.
- DNA extraction, PCR (for the CO1 gene), and gel electrophoresis were used to extract and copy the CO1 gene in the DNA of the samples to be sent for Sanger sequencing.

Results

- After electrophoresis 3 samples came back as confirmed positives, 1 came back as a confirmed negative and the rest were inconclusive.
- 2 positives came from the canal location and 1 came from the bay. The 1 negative result came from the bay.
- The bands on the remaining samples were faint so we were going to rerun DNA extraction, PCR and electrophoresis.
- We did notice that there was a lot more unique organisms within our samples collected from the bay than the canal. Many samples that we collected from the canal were small and similar in terms of colors and shape while the bay had a variety of different sizes and colored organisms.

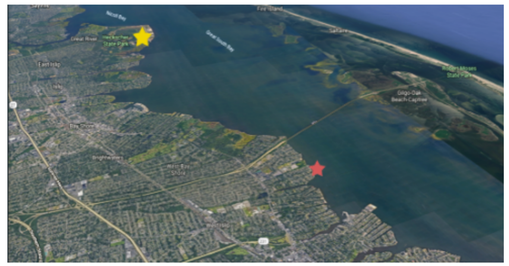

Figure: Photo of bay (yellow star) and canal (red star) locations, water temperature range was 14.3-18oC, Salinity range was 24-26ppt, Dissolved Oxygen range was 6-9mg/L, and pH was 7 in all sample locations.

Discussion

Based on our observations, open-bay ecosystems host a greater biodiversity of benthic invertebrates than canal ecosystems. Because of their sensitivity to the environment, a higher concentration of oil and gasoline within canals may be direct causes of the less diverse benthic population. For some samples, DNA extraction was difficult because of how small the organism was which might have affected whether or not we got a positive result. In the future, the next step would be sanger sequencing which would allow us to compare and contrast the biodiversity of our samples in order to make more evidence-based conclusions about biodiversity.

Table: Sample Information and Results of DNA Extraction and PCR

Sample ID	Location	Common Name	DNA Extraction and PCR Results
PWB-001	Bay Shore Bay	Marine Worm	Negative
PWB-002	Bay Shore Bay	Limpet	Negative
PWB-003	Bay Shore Bay	Limpet	Positive
PWB-004	East Islip Bay	Sea Cucumber	Negative
PWB-005	East Islip Bay	Coral	Negative
PWB-006	East Islip Bay	Polyp	Negative
PWB-007	East Islip Bay	Polyp	Negative
PWB-008	East Islip Bay	Polyp	Negative
PWB-009	East Islip Bay	Polyp	Negative
PWB-010	East Islip Bay	Marine Worm	Negative
PWB-011	West Islip Canal	Marine Worm	Negative
PWB-012	West Islip Canal	Marine Worm	Negative
PWB-013	West Islip Canal	Marine Worm	Negative
PWB-014	West Islip Canal	Marine Worm	Positive
PWB-015	West Islip Canal	Hydra	Negative
PWB-016	West Islip Canal	Shrimp/ water flea	Negative
PWB-017	West Islip Canal	Hydra	Positive
PWB-018	West Islip Canal	Marine Worm	Negative
PWB-019	West Islip Canal	Marine Worm	Negative
PWB-020	West Islip Canal	Hydra	Negative

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