Using eDNA to Study the Impact of Fertilizer Pollution on Aquatic Biodiversity

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Abstract

eDNA extraction consists of locating DNA strands from organisms without finding actual biomatter from the organism itself. Phosphorus and nitrogen pollution often stem from fertilizer runoff, contaminating the Great South Bay's ecosystems. eDNA barcoding allows us to gain a better understanding of the impact fertilizer pollution has on fish biodiversity. It was hypothesized that increased levels of phosphate and nitrate in water will decrease fish variation in the Great South Bay. Water samples were collected from the bay adjacent to two golf courses and a park. We extracted DNA from the samples using the MoBio Powersoil procedure. We used PCR to amplify the 12S rRNA gene and then ran the amplicons through gel electrophoresis. Amplifications of all samples and controls were confirmed and sent for illumina sequencing. Upon receipt of the sequence data, the DNA Subway purple line will be used to analyze results in order to identify the fish present in the water and make inferences regarding fertilizer impacts on biodiversity.

Introduction and Hypothesis

- eDNA is a novel method to detect organisms in a given environment, that may otherwise be hard to find (Ficetola et al., 2008). It consists of locating strands of DNA from organisms, without having to find the actual organism or any biomatter from the organism itself.
- Various nutrient pollution sources, such as phosphorus and nitrogen pollution, often stem from fertilizer runoff, coming from lawns which contaminate the ecosystems of the Great South Bay. This runoff increases the levels of these elements that can be found naturally in aquatic ecosystems of the Great South Bay (Beman et al., 2005).
- These increased levels can alter the environment, resulting in damaging effects on organisms' populations, thus limiting biodiversity. A change in biodiversity will impact all the other organisms within the ecosystem, as well as significantly impact humans in the surrounding area.
- The significance of the experiment is that the variation of biodiversity in the Great South Bay impacts humans. Long Island residents depend on the bay for both food, as well as for the economical benefits which the bay's ecosystem provides.
- **How does the presence of fertilizer, in aquatic ecosystems, impact the biodiversity based on eDNA results?**
- It is hypothesized that in areas of high phosphorus and nitrogen levels, there will be less biodiversity. The nutrient pollution present in the aquatic ecosystems will disrupt the balance of their environment and negatively impact various populations of organisms.

Sample Collection

Table: Metadata

Sample ID	Location	Water Temperature (°C)	Water Current (ft/sec)	pH	Salinity (ppt)	Nitrate (ppm)	Phosphate (ppm)	Dissolved Oxygen (ppm)
GP-1	Gardiners_Park	14.5	0.2	6	22	0.5	1.0	1.0
GP-2	Gardiners_Park	14.5	0.2	6	22	0.5	1.0	1.0
GP-3	Gardiners_Park	14.5	0.2	6	22	0.5	1.0	1.0
GP-4	Gardiners_Park	14.5	0.2	6	22	0.5	1.0	1.0
GP-5	Gardiners_Park	14.5	0.2	6	22	0.5	1.0	1.0
GP-6	Gardiners_Park	14.5	0.2	6	22	0.5	1.0	1.0
GP-7	Gardiners_Park	14.5	0.2	6	22	0.5	1.0	1.0
TP-1	Timber_Point	7.2	0.3	6	19	2.0	1.5	1.0
TP-2	Timber_Point	7.2	0.3	6	19	2.0	1.5	1.0
TP-3	Timber_Point	7.2	0.3	6	19	2.0	1.5	1.0
TP-4	Timber_Point	7.2	0.3	6	19	2.0	1.5	1.0
TP-5	Timber_Point	7.2	0.3	6	19	2.0	1.5	1.0
TP-6	Timber_Point	7.2	0.3	6	19	2.0	1.5	1.0
TP-7	Timber_Point	7.2	0.3	6	19	2.0	1.5	1.0
BP-1	Bergen_Point	5.8	0.4	6	23	2.0	1.5	1.0
BP-2	Bergen_Point	5.8	0.4	6	23	2.0	1.5	1.0
BP-3	Bergen_Point	5.8	0.4	6	23	2.0	1.5	1.0
BP-4	Bergen_Point	5.8	0.4	6	23	2.0	1.5	1.0
BP-5	Bergen_Point	5.8	0.4	6	23	2.0	1.5	1.0
BP-6	Bergen_Point	5.8	0.4	6	23	2.0	1.5	1.0
BP-7	Bergen_Point	5.8	0.4	6	23	2.0	1.5	1.0
KNC	Negative_Control	20.0	0.0	7	0	0.0	0.0	1.0
CHC	Negative_Control	20.0	0.0	7	0	0.0	0.0	1.0

Data

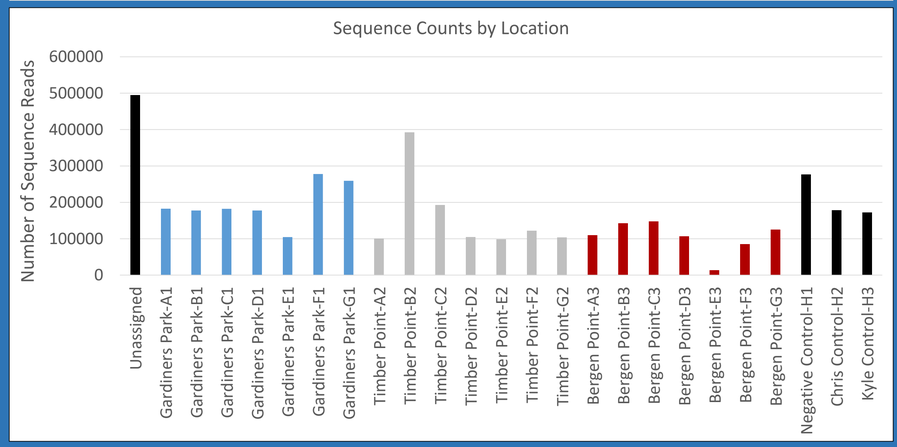
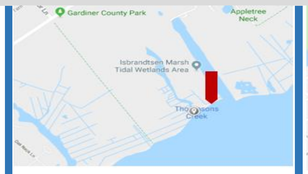


Figure 5: Preliminary results of demultiplexing reads (sorting indexed data into separate files) shows a large number of sequences in each sample location.

We are currently working in DNA Subway Purple Line to process our data. This section of our printed poster tomorrow will hopefully contain alpha and beta diversity as well as taxonomic diversity for our samples OR we will include explanations of what this data will tell us once our data analysis is complete.

Methods



(Figure 1) Sample Location at Gardiner County Park

Google Maps, October 17, 2018

(Figure 2) Sample Location at Bergen Point Golf Course

Google Maps, October 17, 2018

(Figure 3) Sample Location at Timber Point Golf Course

Google Maps, October 17, 2018

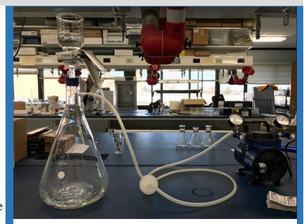


Figure 4: DNA filtration setup.

References

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GoogleMaps, 2018

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