Using Diatoms to Assess the Health of the Mad River, Waterbury, CT .

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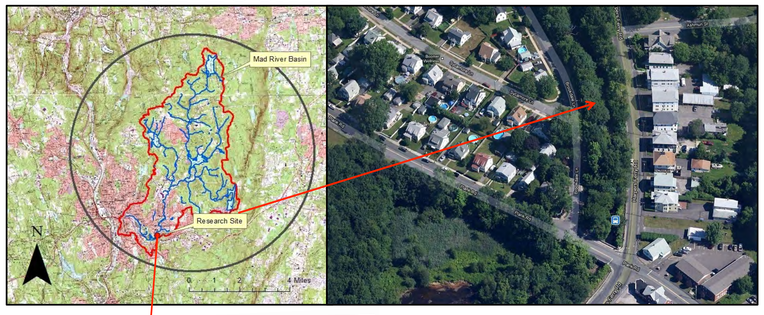
ABSTRACT

The purpose of this study was to use diatoms to assess the health of the Mad River in Waterbury, CT. Diatoms are used as environmental indicators. On November 20, 2012, samples of diatoms were obtained from the Mad River. They were preserved in iodine and cleaned. Once cleaned the diatoms were identified to genus. Using the Pollution Tolerance Index (PTI) value for each genus, an overall PTI value for the river was calculated at 2.26. According to the Scaled Van Dam indicator values, a PTI of 2.26 indicates that the Mad River is a "moderately healthy river".

INTRODUCTION

The purpose of this study was to use diatoms to assess the health of the Mad River in Waterbury, CT. Diatoms are used as a biological indicator to give a comprehensive overview of the health of the river (Project Periphyton). Diatoms are a type of algae composed of silica. Diatoms play a key role in the food web and are a food source for many organisms living in the river. The diatoms collected were Periphyton; which are diatoms that adhere to rocks. The samples were collected on November 20, 2012 at 1600 hours. The latitude and longitude of the location is 41.54213N and 73.0096W, on Brookdale Lane, a residential section in Waterbury, CT.

RESEARCH LOCATION



Maps & Pictures: Top Row:
The left side picture is a topographic map of the Mad River Basin showing the research site. The photo to the right is an aerial view of the residential and industrial area surrounding the research site.
Maps & Pictures: Bottom Row:
The left side map shows the location of the research site in relation to the whole state of CT. The photo to the right was taken when Caroline Infante assisted me in collecting stones from the bottom of the Mad River.

MATERIALS AND METHODS

COLLECTING AND PRESERVING THE SAMPLES:

1. **Five stones (close to the size of a fist) were collected from the bottom of the Mad River in Waterbury, CT.**
2. **A small amount of distilled water was poured into a pan in order to clean the stones.**
3. **A wet tooth brush was used to scrub the 5 stones, repeatedly rinsing the toothbrush in the water to save any Periphyton that was scrubbed off the stone.**
4. **After scrubbing all five stones the contents of the pan were emptied into a glass container.**
5. **Iodine solution was added to the jar in order to preserve the diatoms.**

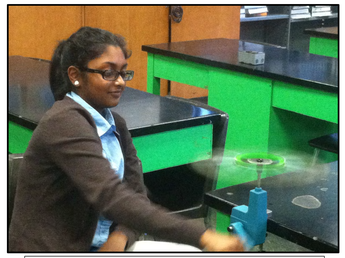
MATERIALS AND METHODS CONTINUED

CLEANING THE DIATOM SAMPLES:

7. **The diatom sample was mixed and a small amount was placed into 4 centrifuge tubes.**
8. **The diatoms were spun in the centrifuge for approximately 4 minutes until the diatoms were able to be seen at the bottom of the tube.**
9. **The left over water was removed out of the centrifuge tubes using a plastic pipette, leaving the diatoms alone at the bottom of the tube.**
10. **7.5 mL of Clorox was added to the centrifuge tube and mixed for approximately 4 minutes.**
11. **After allowing the diatoms to settle for 20 minutes, the Clorox was removed and the diatoms were cleaned using the same technique, except with distilled water. This process was repeated 3 times.**
12. **The clean samples of diatoms were placed into a clean glass container with distilled water.**

COUNTING AND IDENTIFYING DIATOM SAMPLES:

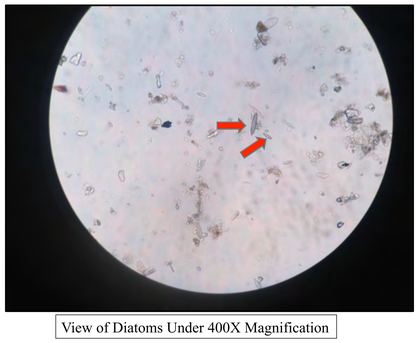
13. **After shaking the sample, a regular plastic pipette was used to carefully place a drop of the sample onto a clean microscope slide, along with a glass cover slip. The top of the coverslip was gently tapped to evenly distribute the diatoms throughout the slide.**
14. **At 400x magnification, the diatoms were counted and the total number of diatoms per slide was recorded. A total of ten slides were processed.**
15. **The diatoms were identified per slide, using the diatom key.**
16. **The data was recorded in a data table.**



Bhageloo Spinning the Diatoms in A Centrifuge

Bhageloo and Infante Scrubbing River Stones With A Toothbrush To Remove Periphyton

Bhageloo Identifying Diatoms in the Lab



View of Diatoms Under 400X Magnification

RESULTS

Table 1: Number of diatoms for each genus found per field view Slides 1-5

	Slide 1	Slide 2	Slide 3	Slide 4	Slide 5
Genus	**# of diatoms**	**# of diatoms**	**# of diatoms**	**# of diatoms**	**# of diatoms**
Synedra	8	8	7	4	3
Achnanthes	2	1	2	0	1
Navicula	1	0	0	0	0
Cymbella	1	0	0	0	0

Table 2: Number of diatoms for each genus found per field view slide 6-10

	Slide 6	Slide 7	Slide 8	Slide 9	Slide 10
Genus	**# of diatoms**	**# of diatoms**	**# of diatoms**	**# of diatoms**	**# of diatoms**
Synedra	4	4	2	3	3
Achnanthes	2	0	2	2	2
Navicula	0	0	0	0	0
Cymbella	0	1	0	1	1

RESULTS CONTINUED

Table 3: Total Number of Diatoms for each genus multiplied by each genus' Pollution Tolerance Index

Genus	PTI	Total # of diatoms	(# x PTI)
Synedra	2	46	92
Achnanthes	3	14	42
Navicula	2	2	4
Cymbella	3	3	9
Total		**65**	**147**

Calculation for Pollution Tolerance Index (PTI)
$PTI=\sum(n_i t_i)/N$
n_i=number of diatoms collected from a given genus
t_i= PTI for that genus
N= the total number of diatoms counted
PTI= 147/65 = 2.26

After multiplying the total number of diatoms from each genus by its PTI value, the totals were added together to get a grand total of 147. The number, 147, was then divided by the total number of diatoms collected, 65, to get an overall PTI of 2.26 for the Mad River. This number was then compared to the Scaled Van Dam indicator values (see below) indicating the Mad River contains moderate tolerance level diatoms.

The Scaled Van Dam indicator values based on the Kentucky River

#	Nitrogen Uptake Metabolism	Oxygen Requirements	Saprobity				Trophic State
				Wq Class	O_2	BOD_3^{20}	
1	N-autotroph, low tolerance for organic N	High (>75%saturation)	Oligo- β-meso-	I, II	70-85	<2-4	Oligotrophic Oligo/meso
2	N-autotroph, Elevated tolerance For organic N	Moderate (>50% saturation)	α-meso-	III	25-70	4-13	Mesotrophic
3	Facultative N-heterotroph needing periodically elevated N concentrations	Low (>30% saturation)	A-Mesopoly	III-IV	10-25	13-22	Meso-eutrophic
4	Obligate N – heterotroph needing constantly elevated N concentrations	Very low (~10% saturation)	Poly	IV	<10	>22	Eutropihc hypereutrophic

CONCLUSION

Based on the genera of diatoms found in the Mad River, the Pollution Tolerance Index (PTI) value is 2.26. The calculated PTI value indicates that the Mad River has limited pollution. According to the Scaled Van Dam indicator values, the diatoms found in this river have a moderate tolerance to organic Nitrogen. The diatoms are mesosaprobic, meaning they can survive in nutrient rich waters and require an environment of greater than 50% oxygen saturation (Muscio 2002).

Waterbury is an urban environment; therefore this section of the Mad River is not directly impacted by agricultural runoff. The area surrounding the test site is both residential and industrial; which gives the impression that the river would be unhealthy. However, there is public sewage treatment in the city of Waterbury, thereby limiting the amount of pollution coming from household human waste. In the state of Connecticut, businesses must adhere to strict laws that prohibit the disposal of industrial waste into bodies of water. Any organic matter affecting the Nitrogen levels of the river is mainly due to the runoff from local roads and fertilized lawns.

Another factor contributing to the overall health of the Mad River is the substrate, which includes cobble stone and gravel. Cobble stone displaces the flowing water causing it to mix with the air; thereby increasing the oxygen level in the river.

REFERENCES

Hansmann, Eugene W. Diatoms of the Streams of Eastern Connecticut. Hartford: Department of Environmental Protection, 1973. Print.

Muscio, Cara. "The Diatom Pollution Tolerance Index: Assigning Tolerance Values." Watershed Protection Development Review (2002): 1-17. Print.

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