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### The Quashnet River Project: Assessing the Health of a River Using Water Chemistry and Biomonitoring Data

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#### Recommended Citation

Mashpee High School, Mashpee, Massachusetts (2009). *The Quashnet River Project: Assessing the Health of a River Using Water Chemistry and Biomonitoring Data*. In Watershed Access Lab Projects. Project 66.  
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## The Quashnet River Project: Assessing the Health of a River Using Water Chemistry and Biomonitoring Data

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## Research Objectives

- Assess the water quality of a local freshwater body.
- Understand the chemical properties of healthy waterways.
- Identify different species and understand how animals are used to assess changes in water quality.
- Recognize general habitats of macroinvertebrates.
- Draw conclusions about the water quality of Quashnet River based on the chemistry and macroinvertebrate communities of the river.

## Information on the Quashnet River

- The **Quashnet River**, also known as the **Moonakis River**, is in Mashpee, Massachusetts.
- The river rises out of John's pond, and empties into Waquoit Bay.
- It is home to alewife, eels, brook trout, and herring.
- Before the 1970's the river was used as a cranberry bog, which hurt the trout population.



## Quashnet River

- During colonial times the Quashnet was known for its abundant brook trout but its waters were manipulated for decades as a source for the cranberry industry. When cranberry production changed in the 1970s, Trout Unlimited and other organizations began to restore the river's trout.

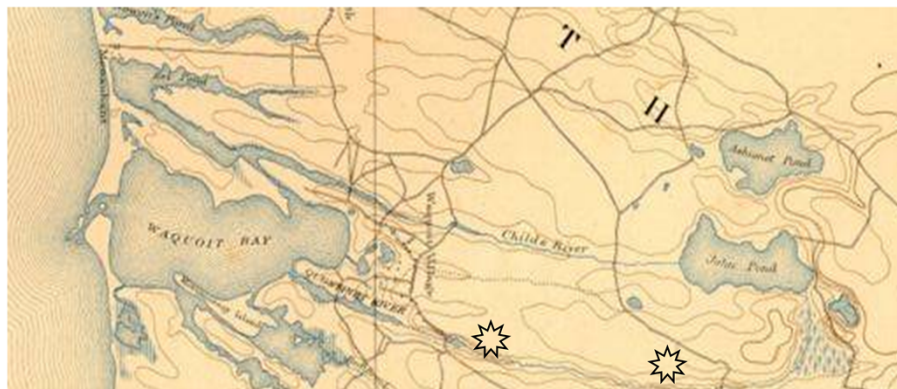
**Where did our  
studies occur?**



**Mashpee, MA**

Point out the two sample locations as well as Waquoit bay and Nantucket Sound

## Quashnet River



The sample sites are clearer on this map

## Quashnet River Close Up as it Flows Through a large cranberry bog.





A large cranberry bog

## Monitoring Location

- The data collected is from the Quashnet River, located in Mashpee and Falmouth, MA
- Macro invertebrate sampling occurred on March 4<sup>th</sup> 2009 3:00pm
- Water chemistry information was collected on September 15<sup>th</sup> 2008.

### March 24<sup>th</sup> USGS Data

- Average Gage Height- 2.34 ft
- Discharge- 22 cubic feet per second
- Median daily Statistic Discharge (19 yrs.)- 17 cubic feet per second

Macroinvertebrate sampling occurred on March 4<sup>th</sup>, and the water chemistry data was collected last Fall on the 15<sup>th</sup> of September.

There is a USGS stream gage station adjacent to the macroinvertebrate sample site. Average discharge is about 17 cubic feet of water per second.

This is a small coastal stream about 10 feet wide and 2 to 3 feet deep.

**A water quality index provides a single number (like a grade) that expresses overall water quality at a certain location and time based on several specific water quality parameters.**

- Each parameter is weighted based on its perceived importance in terms of protecting water for humans and other natural life forms living within a water body.
- Parameters may include any of the following nine tests. If not all are done, the WQI can be approximated:

Parameter	Weighting Factor
Dissolved Oxygen	0.17
pH	0.11
Temperature Change	0.10
Fecal Coliform	0.16
Biological Oxygen Demand	0.11
Nitrate	0.10
Total Phosphates	0.10
Total Dissolved Solids	0.07
Total Suspended Solids	0.08

Point out that 9 parameters could be judged as part of the water quality index, we however collected data on a subset of them

## Water Quality Index Results Table:

After collecting the data, graphs and parameter weights are used to obtain an overall WQI ranging between 0-100.

● Range	Quality
● 90-100	Excellent
● 70-90	Good
● 50-70	Medium
● 25-50	Bad
● 0-25	Very bad

This is the Range of Indices that could be calculated. As you can see anywhere from 0 to 100 is possible, the higher the value the better the water quality.



## Quashnet River WQI

- Weighted parameter values assessed in the Quashnet River:
  - pH = 6.71
  - Dissolved Oxygen = 13.94
  - Bio. Oxygen Demand = 6.05
  - Nitrates = 9.7
  - Turbidity = 4.96
  - Temperature Change = 7.8
- Overall WQI (Total weighted value for each parameter/total of the weighting factors used) =  $49.16 / .67 = 73.4$  (Good Water Quality)

Our six parameters include pH, DO., BOD, Nitrates, Turbidity, and Temperature Change and our overall Water Quality Index is 73.4 which corresponds to Good Water Quality

# What is Biomonitoring?

The monitoring of the organisms that live in a particular environment in order to assess the continuing quality of the ecosystem.

Non-government organizations that have been developing biomonitoring protocols based on regional biotic indices include, among others: River Watch Network, River Network, Watershed Access Lab of Bridgewater State College (BSC), and Izaak Walton League.

We followed guidelines and utilized information largely from the River Watch Network out of Montpelier, VT and BSC's Watershed Access Lab.

point out that we used guidelines from Riverwatch and Bridgewater State College

## Why Use Macro invertebrates to monitor Water Quality?

- Macro invertebrates are strong indicators of water quality.
- Using information about tolerance and intolerance values, we can judge water quality.
- The lower the tolerance index, the higher water quality is.

## Bugs Found in Quashnet River



## Plecoptera Perlodidae (Stoneflies)



# Ephemeroptera (Mayflies)

- Baetidae



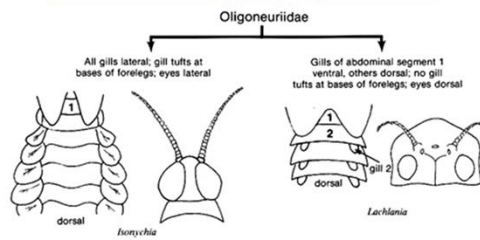
- Heptageniidae



- Leptophlebiidae



- Oligoneuriidae



# Trichoptera (Caddisflies)

- Brachycentridae
- Hydropsychidae
- Lepidostomatidae
- Leptoceridae
- Limnephilidae
- Odontoceridae



## Diptera (Midges)

- Chironomidae



- Tipulidae





## Odonata (Dragon flies)



## Coleoptera (Beetles)



## Amphipoda (Scuds)

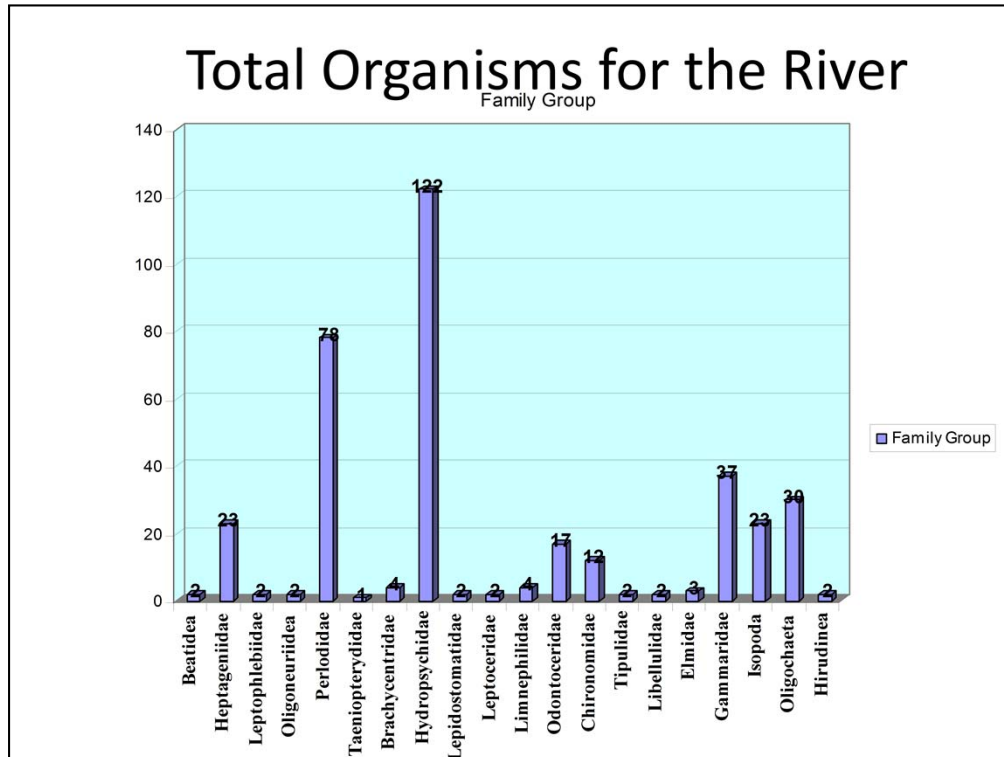


## Isopoda (Sowbugs)



## Oligochaeta (Aquatic Earthworm)





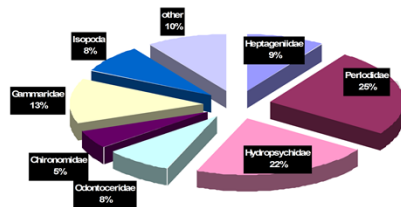
This graph displays the families and how many individuals within each family that we found.

## Total Organisms for the River

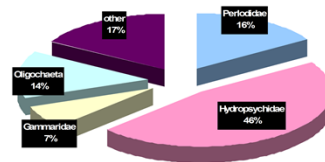
- The graph on the previous slide breaks down all the species we found into families. In total there were 362 organisms.
- Out of these 362 organisms we had a total of 20 families.
- Out of these 20 families the six most abundant were Hydropsychidae, Perlodidae, Gammaridae, Oligochaeta, Heptageniidae, and Isopoda.

## The Quashnet's Most Common Macroinvertebrates: (families that represented >5% of the total for each site.)

% Composition of Upstream Families



% Composition of Downstream Families



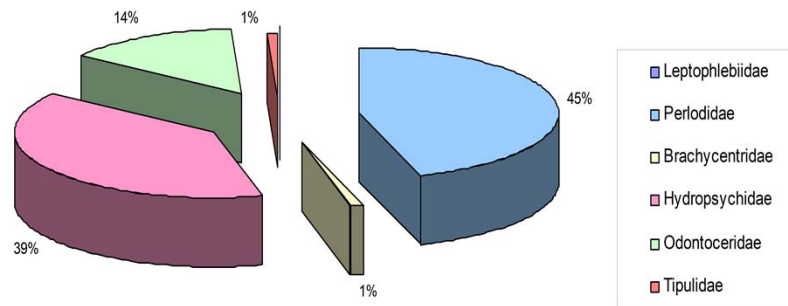
Again our most common families suggest we have a balanced community of macroinvertebrates in the river. Of note are the relatively high concentrations of hydropsychidae and perlodidae families – both of which are fairly sensitive to changes in water quality.



## Tolerant vs. Intolerant Families

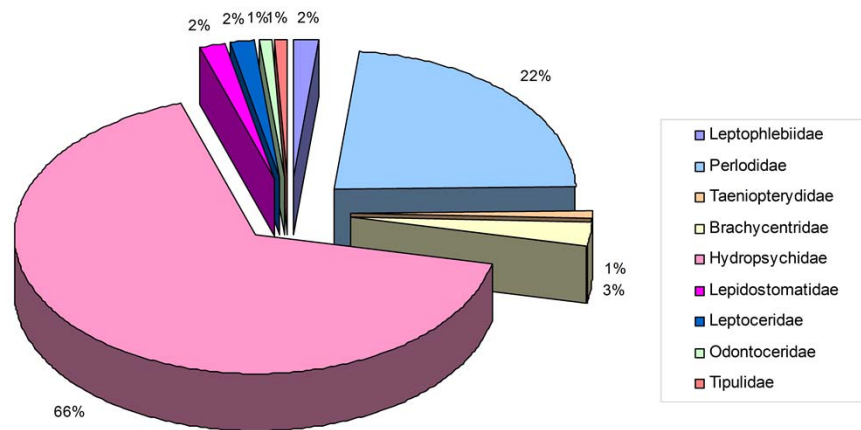
- To get a feel for how balanced a macroinvertebrate community is, look at the percent of tolerant vs. intolerant species.
- Should the communities be overwhelmingly dominated by groups that are tolerant to pollution, there is likely a problem affecting the health of the water.
- As you can see in the next series of slides, both of our sites support large percentages of intolerant families!

## Percent Intolerant Families Upstream



These are the organisms that have a tolerance interval of 0-3 for the upstream site. 56 percent of all the organism found were intolerant to pollution.

## Percent Intolerant Families Downstream

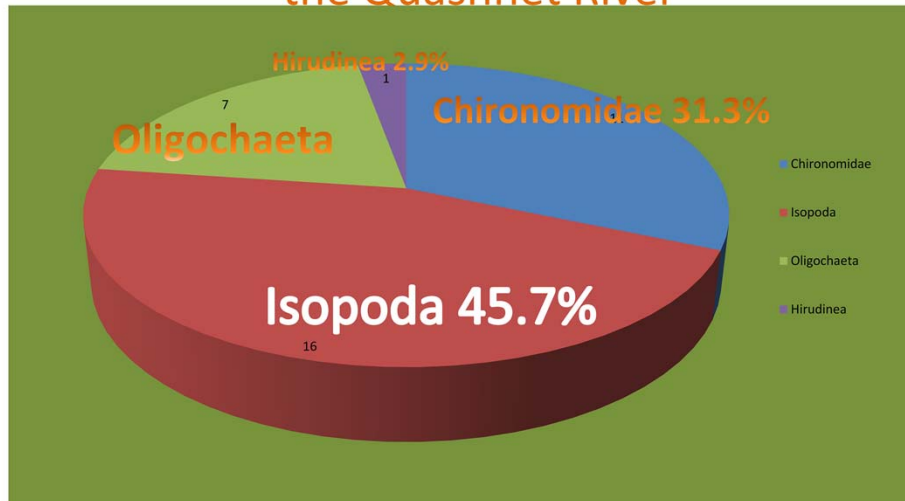


These are the organisms with a tolerance interval from 0-3 for the downstream site. 70 percent of all the organisms found were intolerant to pollution

## Tolerant Groups

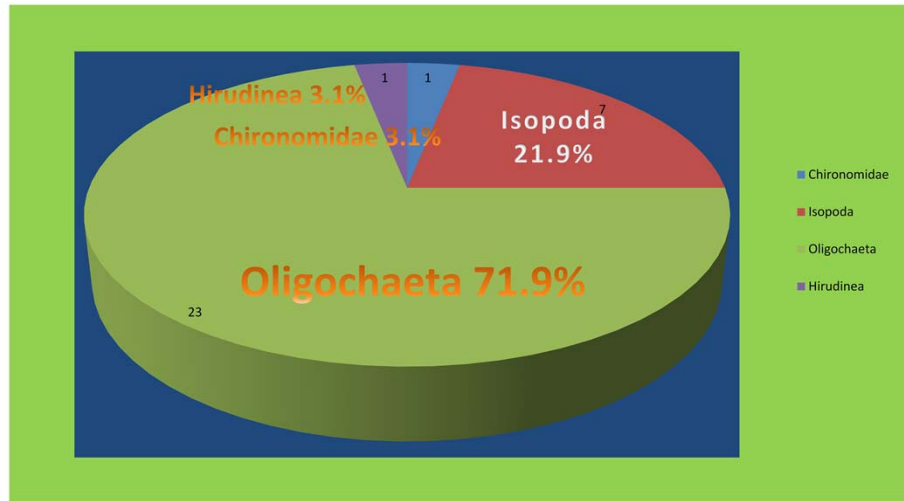
- In addition to sensitive groups of organisms the Quashnet River contains many families that are considered tolerant to pollution.
- Tolerant families were identified based on a group having a tolerance value of 7 or above.
- Overall 29% of families identified in our upstream site are tolerant of pollution, while 19% of the downstream cohort were tolerant.

## Tolerant Families Found at the Upstream Site in the Quashnet River



Our most common tolerant families include : Isopods, Midges, Leaches and aquatic earth worms.

## Tolerant Families Found at the Downstream Site in the Quashnet River



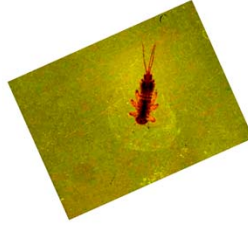
We found the same tolerant families downstream but many more aquatic earthworms.

## EPT Index

- EPT Index: **E**phemeroptera, **P**lecoptera and **T**richoptera are three groups that include many species sensitive to changes in water quality.
- As such they are often used when evaluating the health of a river.
- In general, the more families within these three groups that are present within a water body, the better.

## What are the EPT families?

An Ephemeroptera is a mayfly



A Plecoptera is a insect known as a stonefly

A Trichoptera is an order of insects consisting of caddis flies





## What is the Quashnet's EPT Richness?

Ephemeroptera	Upstream	Downstream
Baetidae	2	
Heptageniidae	19	4
Oligoneuriidae	2	
Leptophlebiidae		2
<b>Plecoptera</b>	-	-
Perlodidae	51	27
Taeniopterygidae		1
<b>Trichoptera</b>	-	-
Brachycentridae	1	3
Lepidostomatidae		2
Leptoceridae		2
Limnephilidae	2	2

River

Upstream  
Downstream

EPT

6  
8

Our EPT richness for the river was 10 families, we found 6 upstream and 8 at the downstream site.

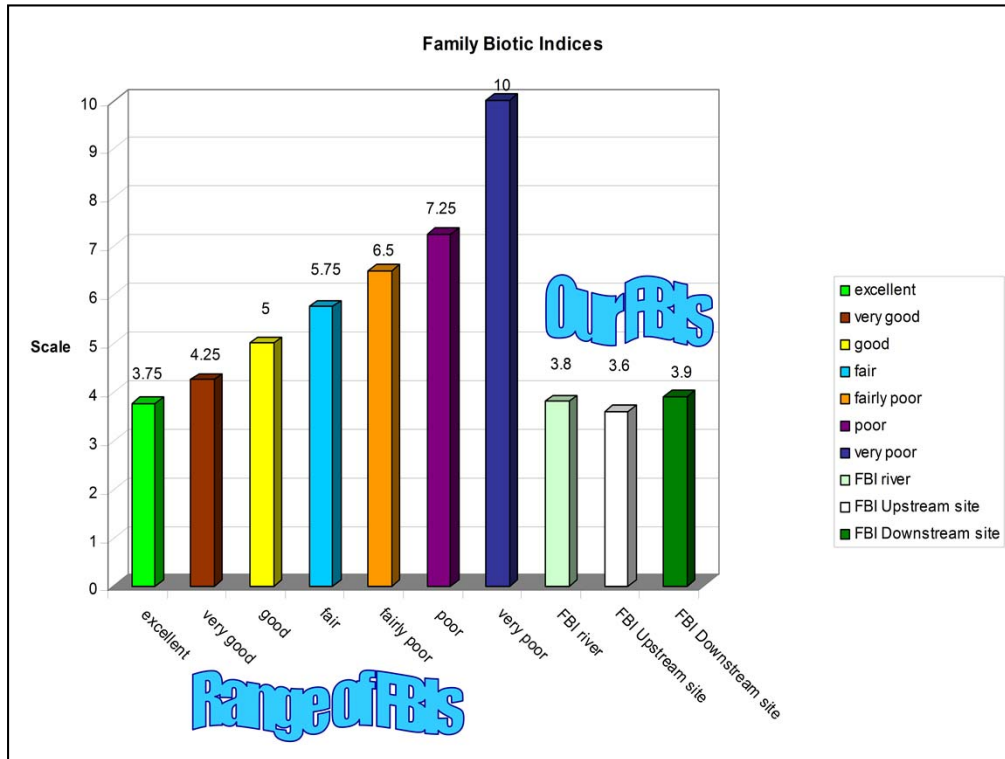
## Family Biotic Indices

- Another way to use pollution tolerance values to help assess a river's health is to calculate an index.
- We identified macroinvertebrates to the Family level in order to calculate Family Biotic Indices for each site as well as the River in general.
- The lower the index, which ranges from 0-10, the more likely the water is healthy.

## Data Interpretation: Family Biotic Index

- F.B.I. For Upstream:  
3.62
- F.B.I. For Downstream:  
3.95
- FBI Overall River: 3.8

HBI Score Range	Water Quality Rating
0.0-3.75	<b>Excellent</b>
3.76-4.25	<b>Very Good</b>
4.26-5.00	<b>Good</b>
5.01-5.75	<b>Fair</b>
5.76-6.50	<b>Fairly Poor</b>
6.51-7.25	<b>Poor</b>
7.26-10.00	<b>Very Poor</b>



Here's a graphic display of our Family Biotic Indices along with the ranges and various classifications.

## Quashnet River Flowing out of a National Wildlife Refuge



A couple of shots taken from the sample sites

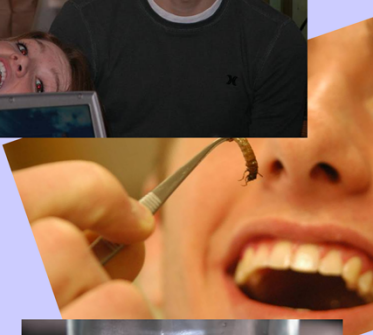
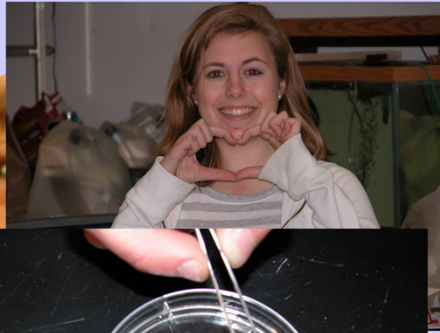


## Conclusions



- The Quashnet River is Healthy!
  - WQI = Good
  - Well Balanced Distribution of Macroinvertebrate Families
  - EPT = okay particularly for a small coastal river
  - FBI = Very Good to Excellent
  - Water Quality Studies are Fun!!







# Collections and Presentations May Be Useful



## New Questions

- How do these results compare to other rivers in adjacent watersheds?
- What can we do to improve the quality of this river?
- Are there any easier ways to look at water quality?
- How does these test compare to other tests that could be done?
- Would similar water quality be found through other tests?