Eel River Examination, 2011

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Eel River Examination

Plymouth South Middle School
Overview

The purpose of our study was to measure and observe the changes in the profile, flow, and chemical composition of Plymouth’s Eel River over the course of the school year from October 2010 to April 2011.
Why the Eel River?

The Eel River is Plymouth’s largest River. It had been the center of population and business growth until the 20th century. It has played an important role in history. The Pilgrims chose wisely to make their town on the banks of this river like the Native Americans who were already there.

The river is fed mostly by water seeping through coarse sand and gravel from kettle ponds that have no river connections. The Plymouth-Carver Aquifer, a “sole source” aquifer, is the water supply for the entire SE MA region. Plymouth alone withdrew 59.6 million gallons per day in 1985 and the population has increased significantly.
Why the Eel River?

The Eel river watershed has had cranberry bogs in it for decades. The chemicals used on the bogs filter through to the groundwater and then end up in the river. Some of these chemicals contain nitrogen and phosphorus.

There are currently 5 golf courses in the watershed. These impact the water with chemical pollution from maintaining the greens, but they also place large demands on our water supply, which shows up in lowered river water.
Why the Eel River?

The town’s wastewater treatment plant, which began operation in 2002, was constructed within the watershed. It was projected that the plant would introduce at least .75 million gallons of treated effluent every day into filtering beds. The water will then flow underground and seep into the Eel River.

Since the Eel River gives us a visual idea of what is happening to our water supply we decided to study what it “looked” like this year.
USGS Topographic Map

Eel R. stream gauge site - at the road crossing (Sandwich Rd.)
The Wonders of Phosphates

- Phosphate is a chemical compound from the element phosphorus.
- Occurs naturally
- Is required by cells in order to function

←Phosphates are commonly found in plant fertilizers
 Promotes the growth of plant life
 Helps fish prosper

Photo: Andy Martinez
The Dangers of Phosphates

• Too much phosphates causes algae to grow excessively
• Algae blooms on surface

← A river with excess algae growth
How Do Phosphates Get into the River?

- Fertilizers contain phosphates. When the fertilizers on golf courses get washed away in the rain; the runoff carries the phosphates into the river.
Healthy… or Not Healthy?

• 0.5 parts per million (ppm) is the point where phosphates are bad for the river.
• It is the amount of phosphates that cause algae to bloom, and the fish to die.
• Fish die because the algae takes up all the oxygen and sun light at night.
• Plants under algae die and need to be decomposed
• Decomposition process requires oxygen
• Oxygen is drawn from lake

← The cycle of gases in a river. Number 8 is the movement of oxygen going from plants to the fish.
• A river without oxygen is an unhealthy river
• Unhealthy rivers cannot produce and support plant and animal life

A dead fish in a river→
• Major causes of extra phosphate
  • Fertilizers that wash off land due to rain (cranberry bogs ect.)
  • Industrial and domestic waste

Waste that can easily be washed into a river by rain and cause extra phosphate growth
Eutrophication

Too much phosphates in a river can cause a Problem. This problem is eutrophication.

Eutrophication:
• excess plant nutrients (especially phosphorus) get into rivers & lakes, nutrients increase the amount of nutrients available for plant growth………
• This causes excessive growth of plants such as algae, causing what is known as algal bloom and appearing to turn the lake green.
What we did at Eel River

We left a programmed Sigma 900 Sampler to draw samples of water every hour for 24 hours.

The next day we removed and filtered the water and bottled it. The samples were frozen and sent to the WAL lab to be analyzed.
Phosphates in the Eel River

Sample ID

mg P/L

10/28 5pm 10/28 7pm 10/28 9pm 10/28 11pm 10/29 1am 10/29 3am 10/29 5am 10/29 7am 10/29 9am 10/29 11am 10/29 1pm 10/29 3pm 10/29 5pm 10/29 7pm Average
Dissolved Oxygen
Air in the Water!

- Microscopic bubbles of oxygen gas in the water
- Put into the water by plants
Who Needs It?

• All breathing plants and animals in the water.
• Algae and microorganisms also require it.
Amounts of Dissolved Oxygen

- Water is less than 1% oxygen
- Cold water can hold more DO than warm water.

More Dissolved Oxygen

Less Dissolved Oxygen
How Much is Enough?

• Dissolved Oxygen is measured in either milligrams per liter or "percent saturation."
• In the Eel River the average dissolved oxygen level is about 10.5 mg/l.
Requirements

• Cold Water Fisheries (CWF): no less than 6.0 mg/l.

• Warm Water Fisheries (WWF): no less than 5.0 mg/l unless background conditions are lower levels not lowered below 75% saturation due to a discharge in CWF or 60% saturation for WWF.
Dissolved Oxygen of Eel River: October 28, 2010
Cycle of Oxygen
Eureka Manta Data Logger
(left: side view)
(down: diagonal view)
Eel River

Eel River is alive with aquatic organisms, but too many nitrates will destroy it. They have:

- 31 state and federal rare species
- 3167 acres of land
- Over 500 acres are priority habitats
- Nitrogen limited
Nitrates
Plants & Algae

- Plants and algae use sources of nitrates for food
Nitrates in Our Groundwater

Nitrates that are in our groundwater usually come from:

- Fertilizers
- Manure
- Septic Systems
- Human Waste
- Animal Waste
- Aquatic Organisms (both dead and alive)
- Organic Matter
Nitrates in Rivers

- Effect aquatic insects or fish
- Difficult for them to survive
- Source of nutrients
- More Algae
- Extreme Changes in dissolved oxygen
Does the Presence of Nitrates Effect the Water Quality?

Nitrates do not effect:
- plants
- wildlife
- aquatic insects
- fish

If levels are limited

Excess levels can cause damage
The Eel River is nitrogen limited to help protect aquatic organisms in the river.

1. **Overabundance of Algae**
   - Lower vegetation dies
   - Velocity of the stream slows down
   - Oxygen levels drop at night
   - Aquatic life leaves or dies
Sources of Nitrates

- Sewage
- Human waste
- Feces
- Fertilizer
- Chemicals
Nitrates in the Eel River Oct 2010

mg/L

5pm 7pm 9pm 11pm 1am 3am 5am 7am 9am 11am 1pm 3pm 5pm

Time
Damages

• Fluctuations in dissolved oxygen

• Sunlight depletion towards plants

Oxygen stress on animals

• Less oxygen production
DANGER- CONTAMINATION!

Check Drinking Water Levels!
What Can You Do?

Do not pollute

Stop chemicals from entering water
Equipment Used

Flo Mate Flow Meter
Fecal Coliform
What is Fecal Coliform?
How They Can Spread

• Failed home septic systems

• Many animals, mostly dogs, can contribute to fecal coliform spreading

• Agriculture
Hazards

- Increased levels of fecal coliforms
- Large amounts of fecal coliform
Treatment if Contaminated

• Fecal like other bacteria can usually die from boiling or rinsing with chlorine
  
  • Washing with soap can also help prevent infections
  
  • It is also important to wear gloves when testing fecal coliform
10ml = 11
10ml = 100ml = TNTC
10ml = 0
100ml = 15
10ml = 3
100ml = 20
10ml = 5
100ml = TNTC

10ml = 1
100ml = 48

10ml = 1
100ml = 34
10ml = 0
100ml = 20

10ml = 0
100ml = 98

10ml = 1
100ml = 15
10ml = 0
100ml = 17

10ml = 0
100ml = TNTC

10ml = 0
100ml = 19
About the Graph

• This graph shows that 1/2 of our Fecal Coliform Petri dishes are Class A (not exceeding 20 e-coli organisms)
• It also shows that 1/4 of our dishes are Class B (not exceeding 126 e-coli colonies)
• Lastly, 1/4 of our dishes of Fecal are Class C (not exceeding 630 e-coli colonies) or (TNTC)
Summary for October 28 & 29, 2010

- Nitrates range 0.26 to 0.22 mg/l. Within limits of a healthy stream.
- Phosphates range 0.005 to 0.015 mg/l with a spike to 0.27 at 7:00am. Within limits of a healthy stream.
- Dissolved oxygen average 10.5 mg/l. Within limits of a cold water fishery.
Summary for October 28 & 29 2010

- Fecal coliform – half petri dishes showed less than 20 colonies per dish. One quarter showed less than 126 colonies per dish and one quarter showed very high numbers of colonies.

- We don’t know the reason for the high levels. It could be due to contamination during preparation.
What we could do differently next time

• Keep a journal of what kind of aquatic invertebrates and vertebrates we observe as well as plant species in the area.
• Include temperature and pH data.
• Get a second set of data in the spring and compare with first.
• Analyze data from past years to show any changes.
Sources!

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