Second Herring Brook: An Analysis of Our Watershed

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Second Herring Brook
An Analysis of Our Watershed
Our Mission

- To observe and analyze Second Herring Brook in Norris Reservation
- Seek a better understanding of our surroundings and environment
- We investigated the
  - condition of the water
  - macroinvertebrates living in the area
  - different elements of the reservation that may affect the condition of the watershed
Our watershed is in Norwell, Massachusetts in Norris Reservation.

The reservation is secluded from houses, roads, and industrial areas.
Our Watershed Area

Dark green = Forestry.
Lime green = Open land.
Light Green = Pasture
Light Yellow = Residential areas.
Green Spots = Non-Forested wetlands.
Magenta = Recreation
Teal = Urban open area
Turquoise = Water body
Blue = Stream
Red = Commercial Area
Experiments, Observations, and Collections

- Nitrates
- Phosphates
- Dissolved Oxygen Levels
- pH Levels
- Temperature
  - Water
  - Air
- Water Flow
- Fecal Coliform Bacteria
- Macroinvertebrates
Nitrates and Phosphates

- **Nitrates**
  - bi-products of animal waste and fertilizers
  - An excess could be harmful to life in the area.
    - *Standard amount of nitrates in clean water is <1.0ppm.*
  - EPA has set a drinking water Maximum Contaminant Level (MCL) of 10 mg/l for nitrates.

- **Phosphates**:
  - plant nutrients, present in low levels in nature
    - Sources: detergents, sewage, and cattle feedlot runoff
  - A presence of this may disturb plant life levels.
  - Phosphate levels greater than 1.0 mg/l may interfere with coagulation in drinking water treatment plants.
Our watershed does not have excess amounts of nitrates or phosphates. This indicates our water is clean. *Calculations on following slide*
Nitrates and Phosphates: Site B

<table>
<thead>
<tr>
<th>Time</th>
<th>Phosphates</th>
<th>Nitrates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.009</td>
<td>0.15</td>
</tr>
<tr>
<td>3</td>
<td>0.008</td>
<td>0.12</td>
</tr>
<tr>
<td>5</td>
<td>0.007</td>
<td>0.13</td>
</tr>
<tr>
<td>7</td>
<td>0.006</td>
<td>0.13</td>
</tr>
<tr>
<td>9</td>
<td>0.013</td>
<td>0.12</td>
</tr>
<tr>
<td>11</td>
<td>0.006</td>
<td>0.13</td>
</tr>
<tr>
<td>13</td>
<td>0.011</td>
<td>0.1</td>
</tr>
<tr>
<td>15</td>
<td>0.01</td>
<td>0.1</td>
</tr>
<tr>
<td>15</td>
<td>0.007</td>
<td>0.1</td>
</tr>
<tr>
<td>17</td>
<td>0.016</td>
<td>0.1</td>
</tr>
</tbody>
</table>
Comparison of Site A and Site B:

<table>
<thead>
<tr>
<th>Sample Number</th>
<th>Amount in Water (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Phosphates Site B</td>
</tr>
<tr>
<td></td>
<td>Nitrates Site B</td>
</tr>
<tr>
<td></td>
<td>Phosphates Site A</td>
</tr>
<tr>
<td></td>
<td>Nitrates Site A</td>
</tr>
</tbody>
</table>

**Graph: Comparison of Site A and Site B:**

- Phosphates Site B
- Nitrates Site B
- Phosphates Site A
- Nitrates Site A

**Axes:**
- Y-axis: Amount in Water (mg/L)
- X-axis: Sample Number (1 to 10)
Nitrates and Phosphates Calculations

N/L: 0.118 mg/L discharge 43.6 L/sec
Load = 0.118 \times 43.6 = 5.1 \text{ mg/sec}
(5.1 \text{ mg/sec}) \times (86.4) = 441 \text{ g/day}

P/L: 0.01 mg/L discharge 43.6 L/sec
Load = 0.01 \times 43.6 = 0.436 \text{ mg/sec}
(0.436 \text{ mg/sec}) \times (86.4) = 37.7 \text{ g/day}
Dissolved Oxygen

- Tested dissolved oxygen levels with Lamotte kits and a Hydrolab Multiprobe
  - Expected about 5-6 ppm
    - Amount necessary to support a diverse ecosystem
- Our testing area has a number of riffles
  - Brook is constantly infused with oxygen
    - More water is coming into contact with the air
- Temperature affects the dissolved oxygen levels.
  - Colder temps = higher levels of dissolved oxygen in the water
Dissolved Oxygen (Continued)

- Measured temperature during trips to stream
- Sought correlations between temperature and dissolved oxygen

*No bar = data not collected on day
Dissolved Oxygen (Continued)

Temp v. Dissolved Oxygen over 19 hours from Hydrolab Multiprobe

- Temperature (Temp) in degrees Celsius vs. Dissolved Oxygen in mg/L over 19 hours.
- The graph shows a consistent trend of temperature and dissolved oxygen levels over time.

- Temperature remains relatively stable, with minor fluctuations.
- Dissolved oxygen levels also remain consistent, with slight variations.
Temperature of Stream

Temperature of Water on October 15-16, 2004

Time of Day

Temperature (Degrees Celsius)

Temperature

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

<table>
<thead>
<tr>
<th>Day</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/16/2004</td>
<td>5.6</td>
</tr>
<tr>
<td>9/23/2004</td>
<td>5.8</td>
</tr>
<tr>
<td>9/30/2004</td>
<td>6</td>
</tr>
<tr>
<td>10/7/2004</td>
<td>6.2</td>
</tr>
<tr>
<td>10/14/2004</td>
<td>6.4</td>
</tr>
<tr>
<td>10/21/2004</td>
<td>6.6</td>
</tr>
<tr>
<td>10/28/2004</td>
<td>6.8</td>
</tr>
<tr>
<td>11/4/2004</td>
<td>7</td>
</tr>
<tr>
<td>11/11/2004</td>
<td>7</td>
</tr>
<tr>
<td>11/18/2004</td>
<td>7</td>
</tr>
<tr>
<td>11/25/2004</td>
<td>7</td>
</tr>
</tbody>
</table>
Go with the Flow

- Next we set out to find how many liters of water travel downstream over time.
- The flow indicates how many nitrates and phosphates travel down the stream over time.

<table>
<thead>
<tr>
<th>Segment</th>
<th>Avg. flow at 6 in. from surface</th>
<th>Segment Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0.65</td>
<td>0.163</td>
</tr>
<tr>
<td>3</td>
<td>1.05</td>
<td>0.368</td>
</tr>
<tr>
<td>4</td>
<td>0.92</td>
<td>0.367</td>
</tr>
<tr>
<td>5</td>
<td>1.28</td>
<td>0.64</td>
</tr>
</tbody>
</table>

**Total Discharge**: 1.54 cubic feet/sec

\[(1.54)(28.32) = 43.6 \text{ L/sec}\]
Fecal Coliform Bacteria

- A presence of FCB indicates that the water has been contaminated by animal waste products.
- An excessive amount of FCB poses a health risk for animals and people in the presence of it.

Standards Today:
- Recreation: Must be fewer than 200 colonies per 100mL
- Fishing & Boating: 1000 colonies per 100mL
- Domestic Water Supply: 2000 per 100mL
- Drinking Standard: fewer than 1 colony per 100mL
Fecal Coliform Bacteria Test Results

- To see how many colonies exist per 100.0 mL of Second Herring Brook water, we put the water over a medium where they’d grow in a petri dish after incubation
- Sample One: 17 colonies per 100.0mL
- Sample Two: 28 colonies per 100.0mL
- The average number of colonies per 100.0mL (22.5 colonies) shows us that it isn’t quite safe to drink from the brook, but it’s fine for recreational use.
Macroinvertebrates

- Collected insects twice using the kick method
- Counted and categorized in lab
  - Classified up to Order level
- Most abundant populations:
  - Trichoptera
  - Amphipoda
Macroinvertebrate Population

Macroinvertebrates

- Trichoptera: 81%
- Coleoptera: 0%
- Amphipoda: 7%
- Turbellaria: 2%
- Odonata: 6%
- Ephemeroptera: 2%
- Megaloptera: 2%
- Diptera: Chironomidae: 0%
## Data Summary

<table>
<thead>
<tr>
<th>Depth</th>
<th>Temp Degrees celsius</th>
<th>pH Units</th>
<th>Dissolved Oxygen (ppm)</th>
<th>Phosphate Discharge</th>
<th>Nitrate Discharge</th>
<th>MGBI</th>
</tr>
</thead>
<tbody>
<tr>
<td>.2 ft. (avg.)</td>
<td>13.43 (avg.)</td>
<td>6.28 (avg.)</td>
<td>8.4 ppm (avg.)</td>
<td>37.7 g/day</td>
<td>441 g/day</td>
<td>5.15 (Moderately Impaired)</td>
</tr>
<tr>
<td>Range: 0-.4 ft.</td>
<td>13.22-13.71</td>
<td>6.13-6.59</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Range: 0 - .4 ft.
Class B Waters Suitable For:

- Fish and wildlife habitat
- Primary and secondary contact
- Recreation
- Public water supply w/treatment
- Irrigation/agriculture
- Industrial cooling and process uses
- Aesthetic value
Reasons for Results

- Stream is a safe distance from roads, businesses, and homes.
- No definitive source of pollution in the area other than septic tanks and run-off from roads.
- Large population of animals
  - Proof that the ecosystem is healthy and able to sustain life.
Limitations

- Human error
- Substantial amount of data originates from LaMotte kits which are not always accurate
- Tests with advanced equipment not sufficiently repeated
- From October 2nd until October 25th our class collected and sorted data on macroinvertebrates and was unable to collect other data
- Sigma 900 failed to collect data hourly at times
  - Repeated some hours, skipped some