Assessment of the Lycoming Creek Watershed

by Brandon Ford
Overview

- Previous studies
  - Erosion Potential
  - Sediment Load
- My work
  - Water Chemistry
  - Macroinvertebrate study
Erosion Evaluation

- During the summer 2002, Lycoming college interns (Theresa Black and Amy Curry) walked or floated the entire stretch of Lycoming Creek between Roaring Branch (N 41° 34.294, W 76° 57.891) and lower Heshbon Road (N 41° 16.127, W 77° 03.036).
- Total of 28 miles
# Erosion Evaluation Form

**Stream Name:**

**Watershed:**

**Assessors:**

**Date Assessed:**

---

## Bank Erosion Potential

<table>
<thead>
<tr>
<th>Site #</th>
<th>Site Type</th>
<th>Bank Height</th>
<th>Bank Angle</th>
<th>Density of Roots</th>
<th>Particle Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td></td>
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<td>M</td>
<td>H</td>
<td>L</td>
</tr>
</tbody>
</table>

**Adapted from Oregon, 1990s**

**Comment:**

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## Site Characteristics

<table>
<thead>
<tr>
<th>Site #</th>
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</tr>
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<td></td>
<td></td>
<td>L</td>
<td>M</td>
<td>H</td>
<td>L</td>
</tr>
</tbody>
</table>

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**Stream Reach:**

**County:**

**Form adapted by:**

---

**Well Vegetated >60% Cover**

**Bedrock/Boulders**

**Flat-Sized Rocks**

**Sand/Clay**
<table>
<thead>
<tr>
<th>Site #</th>
<th>Site Type</th>
<th>Bank Height</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>RB I</td>
<td>M</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LB I</td>
<td>M</td>
<td>H</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LB</td>
<td>M</td>
<td>H</td>
<td>M</td>
</tr>
</tbody>
</table>

Adapted from Regone, 1996.

Width at Stream (Feet) | 0-10 | 10-20 | 20-30 | 30-50 | 50-100 | 100-200 | 200-500 | Over 500 |
<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Length at Site (Feet)</td>
<td>0-50</td>
<td>50-100</td>
<td>100-200</td>
<td>200-500</td>
<td>501-1000</td>
<td>1000+</td>
<td></td>
<td></td>
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</tbody>
</table>

Right Bank

Left Bank

- Height Bank
- Adjacent Land Use
- Perimeter Located
- Machine Accessible
- Rail
t- Accessible
- Stream Accessible
- Vegetation
- Stream Gradient
- Slope
- Steps
- Topography
- Position of Featured Feature

Comments

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<tr>
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Comments
### What they found

<table>
<thead>
<tr>
<th>Structure</th>
<th>Amount</th>
<th>Percentage out of 245</th>
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</thead>
<tbody>
<tr>
<td>Bridges</td>
<td>16</td>
<td>6.53%</td>
</tr>
<tr>
<td>Mid-channel Bars</td>
<td>28</td>
<td>11.42%</td>
</tr>
<tr>
<td>Deposition Bars</td>
<td>32</td>
<td>13.06%</td>
</tr>
<tr>
<td>Pipes</td>
<td>17</td>
<td>6.94%</td>
</tr>
<tr>
<td>Rip Rap</td>
<td>18</td>
<td>7.35%</td>
</tr>
<tr>
<td>Tributaries</td>
<td>8</td>
<td>3.27%</td>
</tr>
<tr>
<td>Concrete Walls</td>
<td>17</td>
<td>6.94%</td>
</tr>
<tr>
<td>Dried Creek bed</td>
<td>1</td>
<td>0.41%</td>
</tr>
<tr>
<td>Total Erosion sites</td>
<td>108</td>
<td>44.08%</td>
</tr>
<tr>
<td>Right banks</td>
<td>58</td>
<td>23.67%</td>
</tr>
<tr>
<td>Left banks</td>
<td>50</td>
<td>46.30%</td>
</tr>
</tbody>
</table>

*Study area between Roaring Branch and Lower Heshbon Road
**Completed by Lycoming College Clean Water Institute Interns*
Disturbances Along Lycoming Creek

<table>
<thead>
<tr>
<th>Structure</th>
<th>Number of Structures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridges</td>
<td>20</td>
</tr>
<tr>
<td>Mid-channel Bars</td>
<td>30</td>
</tr>
<tr>
<td>Deposition Bars</td>
<td>40</td>
</tr>
<tr>
<td>Pipes</td>
<td>15</td>
</tr>
<tr>
<td>Rip Rap</td>
<td>5</td>
</tr>
<tr>
<td>Tributaries</td>
<td>10</td>
</tr>
<tr>
<td>Concrete Walls</td>
<td>20</td>
</tr>
<tr>
<td>Dried Creek Bed</td>
<td>15</td>
</tr>
<tr>
<td>Total Erosion sites</td>
<td>100</td>
</tr>
</tbody>
</table>
LYCOMING CREEK WATERSHED GEOMORPHIC ASSESSMENT

- Rob Parker of Endless Mountains RC & D
- Walked all tributaries of Lycoming Creek with the help of Lycoming College Interns
- Surveyed all possible sites off erosion and took GPS location
PURPOSE

• Physically inspect the tributaries and main stem
• Determine sources of instability
  – i.e. watershed wide
• Development and prioritization of appropriate remediation strategies for each of the identified sites/reaches
Equipment

- All waypoints were recorded using a 3D Differential GPS unit (accuracy typically @6 ft.)
Way Points

Including
• Bridges
• Debris jams
• Sites of existing bank protection
• Erosion sites
Sediment Loads

- Determined by inserting erosion site lengths and stream discharge into a computer program (BEHI) that models sediment loads lost from erosion (tons/year)
- 86 Sites
- 31555’ Length
- 12862 Tons per year
My Work

- During Summer of 2004
- Collected water samples and macroinvertebrate samples from five sites on Lycoming Creek and from sites on 14 of its tribs.
- Samples were also taken from 3 control sites; Grays Run, Rock Run, and Pleasant Stream
Water Chemistry

- Samples were collected in plastic containers
  - Each container was rinsed twice before filling
- Several biological and metal tests were run on water samples including:
  - pH level
  - Aluminum
Lycoming Creek

- My data along with Amy and Theresa’s
  - Summer pH was generally higher than Spring pH
  - Large decrease in alkalinity between Summer and Spring sampling
  - Slight increase in pH from Summer ’02 to Summer ’04
## Averaged #’s for Water Chem.

<table>
<thead>
<tr>
<th>Stream Name (Site Number)</th>
<th>Roaring Branch</th>
<th>Ralston</th>
<th>Camp Susque</th>
<th>Powys</th>
<th>Bowmans Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH lab</td>
<td>7.03</td>
<td>6.60</td>
<td>6.66</td>
<td>6.77</td>
<td>7.00</td>
</tr>
<tr>
<td>Conductivity (us)</td>
<td>102.47</td>
<td>80.73</td>
<td>51.50</td>
<td>82.97</td>
<td>84.50</td>
</tr>
<tr>
<td>Alkalinity (ppm)</td>
<td>15.12</td>
<td>10.90</td>
<td>4.35</td>
<td>14.17</td>
<td>14.20</td>
</tr>
<tr>
<td>Orthophosphate</td>
<td>1.26</td>
<td>1.50</td>
<td>1.94</td>
<td>0.19</td>
<td>0.22</td>
</tr>
<tr>
<td>Phosphorous</td>
<td>0.31</td>
<td>0.27</td>
<td>0.84</td>
<td>2.05</td>
<td>0.33</td>
</tr>
<tr>
<td>Nitrate</td>
<td>9.62</td>
<td>9.95</td>
<td>8.01</td>
<td>7.67</td>
<td>6.38</td>
</tr>
<tr>
<td>Nitrite</td>
<td>0.02</td>
<td>0.02</td>
<td>3.29</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>DO (ppm)</td>
<td>8.97</td>
<td>10.72</td>
<td>10.62</td>
<td>10.88</td>
<td>10.48</td>
</tr>
<tr>
<td>Temp (C)</td>
<td>79.83</td>
<td>12.27</td>
<td>12.00</td>
<td>12.25</td>
<td>13.63</td>
</tr>
<tr>
<td>TDS (ppm)</td>
<td>57.40</td>
<td>43.63</td>
<td>45.23</td>
<td>47.03</td>
<td>47.53</td>
</tr>
</tbody>
</table>
Average pH levels

Average pH level of Pa streams 6.5 – 8.5
How pH Effects Stream Life

- Acidic water allows leaching of many toxic chemicals
- pH levels around 4 or below may destroy larva and eggs, result in fish kills, and/or cause mutations.
Tributaries with High pH Levels

- Many streams had a pH level under 5.0
  - Frozen Run, Red Run, Miners Run, Yellow Dog Run, Hound Run, Doe Run, and Upper Long Run

Average Summer Trib. pH's (Relative to 5)
Average Aluminum Levels

- Levels increase due to low pH levels
- Pa State Drinking Limit is 0.2 mg/L
How Does Aluminum Effect Stream Life

- Accumulates on gills restricting breathing
- Al levels of 0.5 mg/L combined with pH levels under 5.5 are lethal to most fish and aquatic macroinvertebrates
- A level of 0.1 mg/L Al, independent of pH, has been set as a “stress level” for aquatic organisms
Tributaries with High Levels (>0.1mg/l) of Al

- Several tribs had pH levels over 0.1 mg/l
  - Frozen Run, Red Run, Miners Run, Yellow Dog Run, Hound Run, Doe Run, Long Run, Abbott Run, and Upper Long Run
  - Abbott Run was above .5 mg/l
What do these measurements tell us?

- High levels of any of these measurements indicate some type of acid impact
  - Acid precipitation
  - Acid mine drainage
- Many of the sample trib. lie below abandoned mines
Acid Mine Drainage (AMD)

- Occurs in streams below old surface and deep mines
- Pyrite (FeS$_2$) is present in coal seams and the rock layers between coal seams
- Result of the reaction that occurs when pyrite encounters water and air
The Reaction

- $\text{FeS}_2 + 3.75 \text{O}_2 + 3.5 \text{H}_2\text{O} \leftrightarrow \text{Fe(OH)}_3 + 2 \text{H}_2\text{SO}_4$
  - Yielding iron hydroxide and sulfuric acid
- The acid increases pH which leads to the leaching of Al, Fe, and Mn from soils
- These metals dissolve in stream water but precipitate out when pH levels increase
  - Most of the tribss. with low pH values also had high Al levels
Metal Precipitates

- Fe leads to characteristic Red - Orange or Orange - Yellow color
  - Yellow Boy
- Al is White and Mn is Black
Metal Precipitates

- Precipitates fall to stream beds coating them and the rocks macroinvertebrates live under.
- Coating smothers macroinverts and restricts their breathing.
- Leads to fish kills as fish feed on the macroinverts.
Macroinvertebrate Collection

- Samples collected by means of a kick net
- Placed in plastic container and preserved w/ % ethanol
- Samples were then counted and identified
RBA of Macroinvertebrates

• Samples were analyzed using the EPA’s Rapid Bioassessment protocol

• Based on
  – # of taxa
  – # of EPT
  – Hilsenhoff Biotic Index
  – % Tolerant and % Intolerant Taxa
  – Shannon-weiner Diversity
RBA of Macroinvertebrates

- Categories are scored 1-5, 5 being good
- Add up the 6 category scores for a site score (0-30)
  - 6-10 – very poor
  - 11-16 – poor
  - 17-22 – fair
  - 23-30 - good
## Metrics for Red Run

<table>
<thead>
<tr>
<th></th>
<th>Red Run (S1)*</th>
<th>Red Run (S2)*</th>
<th>Red Run (S3)*</th>
<th>Red Run (S4)*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Taxa</strong></td>
<td>11</td>
<td>9</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td><strong>EPT Taxa</strong></td>
<td>6</td>
<td>4</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td><strong>Hilsenhoff Biotic Index</strong></td>
<td>2.43</td>
<td>1.76</td>
<td>2.79</td>
<td>5.93</td>
</tr>
<tr>
<td><strong>% Intolerant</strong></td>
<td>0.63</td>
<td>0.74</td>
<td>0.56</td>
<td>0</td>
</tr>
<tr>
<td><strong>% Tolerant</strong></td>
<td>0</td>
<td>0</td>
<td>0.04</td>
<td>0</td>
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<tr>
<td><strong>Shannon Diversity</strong></td>
<td>2.173</td>
<td>2.201</td>
<td>2.326</td>
<td>0.5237</td>
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</tbody>
</table>

**Metric Scores**

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>Total Taxa</strong></td>
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<td>3</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td><strong>EPT Taxa</strong></td>
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<td>3</td>
<td>5</td>
<td>1</td>
</tr>
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<td><strong>Hilsenhoff Biotic Index</strong></td>
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</tr>
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<td><strong>Shannon Diversity</strong></td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

**Site Score** | 28 | 26 | 30 | 12

**Relative Health** | Good | Good | Good | Poor
Average Site Score for Tributaries

Site Score

Bottle Run
Beauty's Run
West Hills Run
Little Gap Run
Hoagland Run
Frozen Run
Red Run
Miners Run
Yellow Dog Run
Hound Run
Doe Run
Abbott Run
Upper Long Run
Controls
Results

• Only one trib. (West Hills Run) had a fair health sore when its site scores where averaged

• However, many individual sites had fair scores and one had a poor score
  – Bottle Run 4, West Hills Run, Miners Run 2 & 3, and Doe Run 1 all had fair scores
  – Red Run 4 had a poor score
Results

- Although many streams appeared to be impaired when there waters are chemically tested, macroinvertebrate communities are relatively unimpaired.
Future Work

• More water testing is being performed this Spring
  – More severe pH levels are present in streams during the winter/spring melting/runoff process due to the high acidity of PA precipitation

• More work will also be performed this summer
Hound Run Summer/Spring

- pH dropped in spring and Al levels increased

<table>
<thead>
<tr>
<th>Site</th>
<th>Summer pH</th>
<th>Spring pH</th>
<th>Summer Al</th>
<th>Spring Al</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site 1</td>
<td>4.835</td>
<td>2.79</td>
<td>0.192</td>
<td>0.215</td>
</tr>
<tr>
<td>Site 2</td>
<td>4.78</td>
<td>3.34</td>
<td>0.275</td>
<td>0.35</td>
</tr>
<tr>
<td>Site 3</td>
<td>5.06</td>
<td>3.17</td>
<td>0.163</td>
<td>0.171</td>
</tr>
</tbody>
</table>
Acknowledgements

• Zimm and the rest of the Biology Staff
• Rob Parker
• Drew Zimmerman, Amy Curry, Jim Rodgers, and Heather Edelstein
• Matt