Maracuto Stream Project: Comparison of Total Phosphorus and Macro-Invertebrates and the Impact of Land Use on Water Quality

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The Streams Project is an effort by VT EPSCoR to collect data on streams. The recollected water quality data is placed in the VT EPSCoR database. These data are later combined with other stream’s data in order to find strategic solutions to the pollution problems and gain a greater understanding of our watersheds.
Objectives

- Find the correlation of macro-invertebrates, phosphorus and total suspend solid in Maracuto Stream.

- Determine how land use affect the physical condition and water quality in streams.

- Identify possible sources of pollution affecting the water quality.
The Maracuto stream is located in Carolina, PR.

This stream connects with the Río Grande de Loíza, one of the most important rivers in Puerto Rico, and supplies water for the SJMA.

Two sites were chosen based on the areas surrounding the stream.
By determining the sources of pollution that may affect the water quality we can make recommendations for interventions to improve water quality.

Urban development surrounding can alter the dynamic of the water flow, therefore may be causing damages to the macro-invertebrates habitat and the ecosystem in the stream.

If phosphorus levels increase more amount of particles will be found in the water.
The monitoring locations were identified using a GPS.

Phosphorus, and TSS were taken using sterile sample containers.

Samples were stored in a cooler during transportation and later frozen until analyzed.

Phosphorus was tested using a spectrophotometer.

For the TSS test a 0.45µm filter was used.

Streams Project database, GIS and Google Earth® program were used field for observations and aerial photo interpretation.
General Stream Site Assessment - The immediate surrounding landscape and the physical characteristics of the stream reach.

Detailed Habitat Assessment & Physiochemical Parameters - The biological condition of a stream system is determined through a visual assessment of in-stream and riparian habitat quality.
Methodology: Water samples

* **Phosphorus**
Via a persulfate digestion followed by analysis for orthophosphate concentration using the ascorbic acid reduction method on a UV 1800 spectrophotometer.

* **TSS**
A known volume of water is run through a 0.45µm filter. Solids collected on the filter cause a change in filter weight that is reported as total solids in mg/L.
Methodology: Macro-invertebrates

- Four replicates were collected from each site by the hand-scrub method.
- The samples were stored in a plastic bag with 100% ethanol for specimen preservation.
- Every insect was observed with a microscope to identify and classify the insects by family and specie with the Guide to Aquatic Invertebrates.
- They were separated and classified in laboratory by their physical characteristics.
It is used to see the regional land use practices and determine possible sources of pollution that may be affecting the water quality.

Such findings can be useful in the remediation of impaired watersheds, and in identifying unexamined watersheds with a high risk of impairment.
Results and Discussion: Assessments

80%  Upstream (forest area) status indicate “good” water condition to support aquatic life

66%  Downstream (urban area) status is “partial support” indicating not so good water conditions and possibly impaired water.

<table>
<thead>
<tr>
<th>Designated Use</th>
<th>Designated Use Group</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquatic Life</td>
<td>Fish, Shellfish, And Wildlife Protection And Propagation</td>
<td>Impaired</td>
</tr>
<tr>
<td>Primary Contact Recreation</td>
<td>Recreation</td>
<td>Good</td>
</tr>
<tr>
<td>Public Water Supply</td>
<td>Public Water Supply</td>
<td>Impaired</td>
</tr>
<tr>
<td>Secondary Contact Recreation</td>
<td>Recreation</td>
<td>Good</td>
</tr>
</tbody>
</table>

US EPA  2006 overall water status
Results and Discussion: Water samples

Phosphorus is a commonly found in agricultural fertilizers, manure, and organic wastes in sewage and industrial effluent. TSS is not only an important measure of erosion in rivers; it is also closely linked to the transport through river systems of nutrients, especially phosphorus.
The overall abundance of macro-invertebrates appears to be related to nutrient levels. Because of the levels of phosphorus were more in the downstream (urban) area larger quantities of benthos were found.
Results and Discussion: Macro-invertebrates

Juvenile mayflies require abundant dissolved oxygen and are very sensitive to pollution. They are typically found in good quality streams, along with riffle beetles, caddisflies, and some species of snails.
The quarry, urban development, runoff, organic wastes from septic tanks and the stable were identified as possible sources of pollution.

If phosphorus levels increase, TSS and the quantity of benthos also increase.

Conditions for water quality in upstream (rural) area were better than downstream (urban) area.
Conclusions

- We manage to find the total abundance, species richness and dominance in the stream. The *Coleoptera* family was the most abundant family in both sites.

- Larger amounts of macro-invertebrates were found in the urban area than the rural area. The levels of nutrients found on each site explain this.
Future Projects

- **Include other parameters to evaluate water quality.**
  - Currently, 13,308 residences are located <100 meters from the channel of a water body in rural areas in PR.
  - This residential areas can be a source of pollution because most of them use septic tanks, therefore, clearly having an impact on the stream.
-University of Vermont
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-VT EPSCoR Stream Project
-Declan McCabe, macro-invertebrate specialist
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-Yiria Muñiz, mentor
-José E. Aponte de la Torre School, Carolina, PR
Questions?