Ecological Flow Requirements for Aquatic Macroinvertebrates in the Arequipa Region, Peru
Paul Dawley¹, Fariborz Daneshvar², Laura Bowling³

¹Purdue University, Civil Engineering, ²Purdue University, Agricultural & Biological Engineering, ³Purdue University, Agronomy

Introduction & Motivation

Introduction:
- Aquatic macroinvertebrates are often investigated to assess the biological integrity of water bodies and stream health
- Instream sampling and identification of macroinvertebrates are costly and time-intensive, especially for large scale assessments

Goal:
- Develop a methodology to evaluate stream health in the Arequipa region as a function of macroinvertebrate diversity and environmental flow parameters

Objectives:
- Find a macroinvertebrate index relevant to the High Andes region
- Determine the macroinvertebrate taxa expected in the study area
- Create a macroinvertebrate index predictive model based on ecologically-relevant hydrologic flow parameters

Methodology

Macroinvertebrate Index Selection:
- Macroinvertebrate assemblages vary regionally, and many macroinvertebrate indices have been developed to reflect this variation
- The Andean Biotic Index (ABI) was selected for this study due to its focus on macroinvertebrates inhabiting Andean areas higher than 2,000 meters above sea level

Data Collection:
- Macroinvertebrate samples were taken at two sites in the lower Pulpera River and five sites in the upper Colca River. Samples were taken using Surber samplers
- Five samples were taken at each site, although due to time constraints, only one from each site was analyzed for this study

Study Area:
- Area: 3,215 km²
- Located in the Camaná River Basin
- 1 water diversion to the Quilca-Vitor-Chili River Basin
- Study watershed receives water from the Condorama reservoir

Soil and Water Assessment Tool (SWAT) Model Development:
- SWAT was used to delineate the watershed and stream network. Running the SWAT simulation resulted in streamflow data for all reaches in the study area

Results & Discussion

Study area

Table 1. Andean Biotic Index (ABI) Water Quality Classes

<table>
<thead>
<tr>
<th>Water Quality Class</th>
<th>ABI Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>&gt;74</td>
</tr>
<tr>
<td>Good</td>
<td>45 – 74</td>
</tr>
<tr>
<td>Moderate</td>
<td>27 – 44</td>
</tr>
<tr>
<td>Poor</td>
<td>11 – 26</td>
</tr>
<tr>
<td>Bad</td>
<td>&lt;11</td>
</tr>
</tbody>
</table>

Table 2. Andean Biotic Index (ABI) Score at Sampling Sites

<table>
<thead>
<tr>
<th>Water Quality Class</th>
<th>ABI Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>20</td>
</tr>
<tr>
<td>Good</td>
<td>16</td>
</tr>
<tr>
<td>Moderate</td>
<td>12</td>
</tr>
<tr>
<td>Poor</td>
<td>2</td>
</tr>
<tr>
<td>Bad</td>
<td>4</td>
</tr>
</tbody>
</table>

Most reaches were predicted to have poor water quality or worse. The root-mean-square error (RMSE) for the stream health predictive model was 0.04. This high correlation is likely due to overfitting caused by a limited number of inputs (7) compared to predictors (171)

Future Work

- Incorporate the four additional macroinvertebrate samples taken at each site to improve ABI score accuracy
- Collect macroinvertebrate data for a larger extent of the river to expand the reach of the predictive model
- Create a stream health predictive model for the Chili River, where macroinvertebrate samples were also taken

References


Acknowledgments: This work was supported and funded by the Arequipa Nexus Institute for Food, Energy, Water and the Environment at Purdue University and by the Lilly Endowment, Inc.