Land Usage near Waterways Affects Nutrient Content: A Study of Algal Communities

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Land Usage Near Waterways Affects Nutrient Runoff: A Study of Algal Communities

Introduction
The way we choose to use land near waterways impacts aquatic communities downstream. Farming and lawn fertilizing can cause water runoff containing nutrients like nitrogen, phosphorus, and potassium. Natural ecosystems may help to both slow runoff and absorb these artificial nutrients before they reach streams and rivers.

Green algae, single-celled photosynthetic organisms, live naturally in these waterways and use nutrients to survive and reproduce. Green algae are both the base of the aquatic food chain and a good indicator of the nutrient content of a waterway.

Objectives
1) Compare algal communities in Northeastern Indiana streams related to channel size and land use, and
2) Test the hypothesis that neighboring land use types influence algal diversity and abundance

Methods
12 waterways were sorted into small (up to 8 m wide; n=5), medium (8 to 20 m; n=4), and large (over 20 m; n=3) sizes.
40 mL water samples were taken monthly from May to August, 2013
Algal density was measured in ppm of chlorophyll a and algae morphospecies was recorded along with the count (figure 1).
Land usage was categorized in a .5 km buffer zone 2 km upstream of the sample location (figure 2). These proportions were compared with algal abundance.

Methods, continued
The total number of tributaries in the 2-4km buffer zone was recorded for each of the 12 sample sites.
An ANOVA test revealed that large waterways had significantly more tributaries than medium or small streams (p=0.044).

Results
A higher proportion of wetlands decreased algal biomass.
A higher proportion of developed land increased algal diversity.

Discussion
The effect of wetlands on algal biomass may be explained both through absorption of nutrient runoff from agricultural land and because wetlands are rarely fertilized. These actions would decrease the concentration of N, P, and K for the algae to use, thus inhibiting excessive algal growth.

Developed land likely had the opposite effect, increasing dissolved nutrient content. Paved surfaces are less effective than forest or wetlands at catch- ing runoff. Lawns on developed land are often fertilized and the runoff from over-fertilized lawns likely contributes to a higher nutrient content. The result of these two factors is higher algal diversity. When resources are more abundant, competition allows more morphospecies of algae to coexist.

These results highlight the importance of responsible land management near waterways to the health of aquatic communities. When algal communities become too prolific as a result of artificially high nutrient content, the aerobic process of decomposition uses up dissolved oxygen. This process, called eutrophication, leads to oxygen depleted zones where rivers empty into the ocean.

Acknowledgements
Thanks to my advisor Dr. Jordan Marshall for supervising data collection and helping to interpret the results.

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Figure 1. A photo of Six Mile Ditch, one of the medium size sample sites. Photo taken August 2013.

Table 1. Summary of multiple regression equations describing the relationship between algal biomass, species richness, and land usage.

<table>
<thead>
<tr>
<th>Model</th>
<th>F</th>
<th>d.f.</th>
<th>p</th>
<th>R²</th>
</tr>
</thead>
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<td>Chlorophyll a</td>
<td>51.78</td>
<td>2,3</td>
<td>&lt;0.001</td>
<td>0.99</td>
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<tr>
<td>Richness</td>
<td>1.64</td>
<td>5,7</td>
<td>0.021</td>
<td>0.80</td>
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</tbody>
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