The effect of bioretention media treatment of stormwater on Daphnia populations

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Untreated stormwater entering streams can result in contamination of drinking water supplies and shell-fishing waters, prohibition of recreational use (e.g., fishing, swimming, and boating), injury to aquatic biodiversity, danger to public health, and increased flooding. Total suspended solids, nutrients (including phosphorus and nitrogen), pathogens, and petroleum-based contaminants are common stormwater pollutants of concern. Bioretention cells are landscape features that may serve as stormwater-control measures by reducing the impact of non-point source pollutants through filtration, absorption, and flow velocity reduction. The purpose of this experiment was to examine the lethal effect of local stormwater runoff and to evaluate the influence of bioretention media on stormwater toxicity.

Adult Daphnia pulex (water flea) were exposed to stormwater runoff collected in Auburn, Alabama, to observe the effects of runoff toxicity. Comparisons in survivorship were made between D. pulex exposed to untreated stormwater runoff and runoff treated with bioretention media, respectively. We hypothesized the bioretention media would decrease the toxicity and increase survival across D. pulex populations.

Approximately 85% of D. pulex exposed to the stormwater runoff treated with the bioretention cell survived, compared to 54% exposed to untreated runoff. This difference in survivorship is statistically significant ($p < 0.05$) and indicates bioretention media may minimize stormwater toxicity that, in turn, benefits aquatic communities in urban areas.

Activity levels of the D. pulex were observed and recorded after 30 minutes, 12 hours, 24 hours, and 48 hours of exposure to the treated and untreated stormwater. Sixty-one percent exposed to untreated runoff died within the first 30 minutes of exposure; 0% of the D. pulex exposed to treated runoff died during the same time frame. 81% of the fatalities experienced from exposure to treated runoff did not occur until after 12 hours of exposure. Considering most storms in Alabama typically do not last longer than one hour, the likelihood of aquatic organisms being exposed to the same concentration of toxicity for over 12 hours is very low. This suggests bioretention media can be an effective solution to reduce toxicity of stormwater runoff and protect surrounding aquatic organisms from harmful polluted stormwater runoff. Future studies may evaluate different bioretention media, runoff from other impervious surfaces types (new asphalt, concrete, roof top), and sublethal impacts such as reproduction or movement.

Statement of Research Advisor:

Rachel's research is an important contribution to our understanding of how stormwater affects aquatic organisms, and it demonstrates the effectiveness of bioretention media on reducing stormwater toxicity and mitigating stormwater impacts on Daphnia pulex.
—Thorsten Knappenberger, *Crop, Soil and Environmental Science*