

TWRI Mills Scholarship Application 2011-2012

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4. Proposed research

Dissolved organic matter (DOM) is crucial in aquatic systems as it provides an energy source for biota and protects aquatic life from UV light (Leenheer and Croue 2003, Williamson and Zagarese 1994). It is also responsible for the complexation, solubility, and mobility of metals and contaminants in surface waters (Martell et al. 1988, Worrall et al. 1997). DOM concentration in surface waters varies according to the source of organic matter (autochthonous vs. allochthonous), temperature, ionic strength, pH, cation composition, surface chemistry of sediment, and photolytic and microbial degradation processes (Leenheer and Croue 2003). Terrestrial DOM is typically supplied to streams by soils and leaf litter (Aitkenhead-Peterson et al. 2003). Thus, the advance of global land use and climate change may continue to influence and increase concentrations of organic matter in surface waters (Findlay and Sinsabaugh 1999, Evans et al. 2005).

Surface water in Brazos County generally has extremely elevated concentrations of dissolved organic carbon (DOC), and some streams have higher mean annual DOC concentrations than any reported in the literature, which may be linked to interactions with bicarbonate (Aitkenhead-Peterson et al. 2009). Municipal tap water in the area has naturally high concentrations of bicarbonate and sodium (Aitkenhead-Peterson et al. 2011). I hypothesize that urban landscapes irrigated with municipal tap water may be responsible for bicarbonate outcompeting DOC for exchange sites within watershed soils, thus contributing to their release to surface waters. This is of vital importance because DOC has been shown to be an energy source for the recovery and regrowth of *E.coli* and many watersheds in Texas, as well as the nation, are currently impaired by high bacteria levels (Bolster et al. 2005).

My research is focused on developing a comprehensive understanding of the watershed sources and fates of DOC. This will be accomplished by analyzing a transition gradient of rural to urban watersheds in Brazos County. The first part of the study will be to examine the fate and source of DOC, including the extent of biodegradation or immobilization by microbes, the adsorption to soil minerals, or release to stream water. Water samples from seven streams are currently collected monthly and analyzed for biodegradability following the method of McDowell et al. (2006) which dictates a seven day incubation period. Biodegradability of DOC in watershed soil under different land cover will also be quantified. Soil in the study area will be sampled according to land use classification following the categorization used by the National Land Cover Data set put out by the United States Geological Survey. Soil will be sampled in different land uses and incubated for biodegradability analysis. Adsorption of DOC to soil will be analyzed using the same soil extracts to determine the extent of the ecosystem service of carbon sequestration.

The second part of my study will be to determine the age of DOC in rural and urban streams using carbon isotopes. This information would be valuable as I expect that streams in the study area will have mostly refractory and older DOC due to release from soils that are irrigated with high sodium bicarbonate municipal tap water. If DOC is older and thus more refractory, I would expect carbon biodegradability to be lower.

The third and final part of the study aims to determine the extent of the relationship between land use, biodegradability of DOC in stream water and soil, and carbon isotopes of DOC. Seasonality will also be investigated, as I expect that older, more refractory DOC is released from soil when subjected to intensive summer irrigation with municipal tap water. This will result in increased instream concentrations that will be significantly less biodegradable relative to DOC derived from streams downstream of waste water treatment plants or in rural watersheds. This section of the study is important as the Bryan/College Station area is experiencing rapid development as well as changes in land use and land cover that increase irrigation needs and may impact carbon cycling.

Establishing the fate of DOC will lead to increased understanding of the impacts of transitioning land use and irrigation water on water quality in Brazos County. This study incorporates both soil and surface water analysis, which allows for a more comprehensive and holistic view of carbon cycling within the region. This research will shed light on DOC fate, source, and cycling, and will be meaningful for understanding water quality issues in Texas. It is my hope that sound management decisions concerning irrigation water chemistry and urban development might eventually emerge to protect water quality as a result of this research.

5. Academic qualifications

Graduate GPR (Water Management and Hydrologic Science):

Undergraduate GPR (Environ. Sci. with Honors, magna cum laude Dickinson College):

GRE scores

Graduate coursework:

Ecohydrology, Ecological Restoration of Wetland and Riparian Systems, Methods of Plant, Soil, & Water Analysis, Fluvial Geomorphology, Applications in Hydrologic Science, Stat. in Res. I, Geochemistry (at Montclair State Uni., non degree seeking)

Undergraduate coursework:

Freshwater Ecology, Invertebrate Zoology, Toxicants in the Environment, Estuarine Management, Environmental Disruption and Policy Analysis, Analysis and Management of the Aquatic Environment, Geographic Information Systems, Marine Science (at the University of Queensland, Australia), Soil Science (at the University of Queensland)

Undergraduate research:

The Patterns of Distribution of Organochlorine Pesticides in Sediment in the Letort Spring Run, Cumberland County, Pennsylvania. Fall 2007-Spring 2008.

An Assessment of the Impacts of Two Point Dischargers on Mountain Creek, Cumberland County, Pennsylvania, Using Diatoms, Bacteria, and Water Chemistry as Indicators of Health. Fall 2006.

6. Proposed use of funds

Any funds received from this scholarship would go to the cost of carbon isotope analysis (Dr. Thomas Boutton, Ecosystem Science and Management, Texas A&M University). Funds would also go towards consumables, such as filters and chemical standards and reagents, in Dr. Aitkenhead-Peterson's laboratory. Any additional scholarship money would go towards travel to scientific conferences.

7. Intended career path

After completing my degree, I plan to pursue a career that combines watershed science with community education. I would like to work on building community capacity to protect, restore, and conserve water resources. Based on this, I am interested in having a career with the Cooperative Extension System.

References

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