1. Project Title: *What’s in the frogs’ water? Atrazine concentration in wetlands and associated landscape factors in the Upper Midwest.*

2. Jennifer Olker, Integrated Biosciences (IBS), Swenson College of Science and Engineering, University of Minnesota Duluth

3. Introduction

Atrazine (2-chloro-4-ethylamino-6-isopropyl-amino-s-triazine), a widely used herbicide in the U.S., has consistently negative impacts on vertebrates, including altered development, reduced immune functioning, and endocrine disruption. In my dissertation research, I am assessing impacts of atrazine exposure in two native amphibian species, as models for wildlife populations and risk to vertebrates, and indicators of wetland health. Because of its extensive use, persistence, and tendency to travel, atrazine could be a great environmental risk; however, there is little information about concentrations in wetlands in nonagricultural regions.

This project quantified spatial and temporal variation of atrazine concentration in Midwest surface waters and attempted to identify landscape factors associated with potentially detrimental concentrations. Funding from the Consortium on Law and Values in Health, Environment and the Life Sciences allowed sampling and analysis of wetland water in northeastern Minnesota, and spatial analysis of landscape correlates with atrazine concentration from over 150 wetlands across Minnesota, North Dakota, South Dakota, and Iowa.

4. Financial summary

$5000 stipend was used to support Jennifer Olker during summer and fall 2012, including the periods for collecting and analyzing water samples and landscape analyses.

$4949 spent for travel and supplies with the following specific expenses:
- $511 for 922 miles of travel to collect water samples from vernal pools across northeastern Minnesota.
- $360 for handheld GIS unit for locating, navigating to, and delineating wetlands
- $1247 in laboratory supplies to collect and process atrazine samples. All equipment for atrazine analysis and standard water quality in hand, but a
- $2830 for atrazine ELISA kits from Abraxis LLC, Warminster, PA

5. Results

A total of 31 northern wetlands were identified and water collected for atrazine concentration analysis (Aim 1). Each body of water was sampled 1-3 times during 2012. Sampling locations included 25 vernal pools in northern Minnesota (public and private property), 5 vernal pools in National Forest of northern Wisconsin, and one pond/wetland in Duluth, Minnesota. Atrazine concentration ranged from non-detectable (<0.011 μg/L) to 0.44 μg/L, which was higher than expected given the lack of agriculture in the region. During mid-summer (June 2012), only 10% (2/20) of the wetlands had non-detectable atrazine concentrations, compared to 62% (13/21) and 72% (21/29) in May and July, respectively.
These data from northern vernal pools were combined with previous sampling in the Prairie Pothole Region (PPR) to identify landscape factors associated with detrimental atrazine concentrations (Aim 2). Atrazine concentrations in vernal pools of the forested regions of Minnesota and Wisconsin were lower than in PPR wetlands, with all detections below 1 µg/L atrazine. With these two datasets combined, atrazine concentrations were not highly correlated with local and landscape characteristics in buffers surrounding wetlands; however, there were regional differences in atrazine concentrations detected, with more detections and greater range of concentrations measured in counties with high proportions planted in corn. Additionally, there were differences in atrazine concentration based on the immediate upland, with higher concentrations when corn was planted adjacent or nearby the wetlands.

These data provide support for the exposure experiments in my dissertation research and are part of on-going analyses for inclusion in my dissertation. These data were included in a poster presentation at the National Society of Environmental Toxicology and Chemistry meeting in November 2012.

Additionally, sampling in spring/summer 2012 highlighted the difficulty in studying and protecting vernal pools, as they are unmapped and not legally projected due to their small size. Several previously sampled vernal pools were highly modified or entirely filled in and locating previously unmapped vernal pools was very challenging due to lack of inclusion in the national wetlands inventory. These issues led me to collaborate on a proposal to better map vernal pools in north eastern Minnesota and start to identify potential risks to these essential aquatic habitats (pending funding: ‘Evaluating vital, small forested wetlands’, Minnesota’s Lake Superior Coastal Program).

6. Future project plans

This project strengthens my dissertation research through contributing additional environmental relevance and potential paths for future analysis of agricultural chemicals in wetlands. My goal date for dissertation completion is December 2013, and the data and analyses from this project will be included.

The atrazine concentration data collected as part of this project strengthen my previous research and provide a bridge into my future research. These data highlight a need to provide ecological relevance to toxicological research, and there are many additional agriculture chemicals that are potentially traveling to non-agricultural regions and impacting aquatic organisms. I am continuing to evaluate potential landscape and local characteristics that could be used to predict high atrazine concentrations. The pervasiveness of atrazine across the mid-west in low concentrations, leads to additional questions that must be investigated regarding the ability to use ‘reference’ or unimpacted field sites to compare to those with direct exposure to agricultural chemicals. Additionally, these results suggest that quantifying the impact of atrazine on organisms will require investigations of historical data or preserved specimens from before atrazine was applied widely.