Synthesis of Anti-microbial Analogs using IR and NMR Spectroscopy (05/2008 – 08/2008)

During my sophomore year, I worked on a project in an organic lab at UT that I had been introduced to in my honors lab course. My goal was to synthesize a potential drug from the class of 1,2,3-triazole oxazolidinone analogs, and then test its effectiveness by screening for antibiotic activity against Gram-positive bacteria. In developing the experimental methods, we determined that microwave chemistry could be used to bypass the first refluxing step of this 3-step synthesis. All products were analyzed with IR and NMR spectroscopy, providing me with my first exposure to analytical instrumentation. I presented a poster on this research at the Central Meeting of the American Chemical Society (CERMACS) in May 2008.

Protein Sequencing using Mass Spectrometry and X-ray Crystallography (08/2009 – 05/2011)

I became interested in bioanalytical research after my analytical chemistry lab course, where Dr. Wendell Griffith introduced me to his research regarding the physical and functional changes in red blood cells as they age or senesce. With his guidance, I carried a project of my own from topic selection, to developing a working research question, and finally to an honors thesis. The goal of my project was to sequence hemoglobin from the Cape Clawless Otter (*Aonyx capensis*) to further study the evolutionary role of hemoglobin in the underlying mechanisms involved with red blood cell aging, using a variety of analytical instrumentation and technology. I used reversed-phase HPLC to purify and isolate the protein chains and then used MALDI-TOF/TOF MS and ESI-MS/MS to sequence the resultant peptides obtained from digestion. With the help of sequence homology and database searching using Mascot, I achieved 95% and 76% sequence coverage for the α- and β-chains, respectively. Although crystallography and x-ray diffraction could then be used to obtain electron density maps, which would differentiate between isomeric and isobaric residues, resulting in 100% sequence coverage, crystal structures proved to be challenging to obtain. I funded this project by earning the merit-based Sullivan Research Fellowship from the Honors College at UT. In December 2010, I completed my oral thesis defense, and presented my research at the National Conference for Undergraduate Research (NCUR), as well as the ACS Spring National Meeting and Exposition in March 2011.

Soil Ecosystem and Ecology using Analytical Chemistry (11/2010 – present)

While preparing for my defense, I obtained a position in an ecosystem and soil ecology lab as a lab technician, to gain experience in fieldwork and contribute intellectually to a multitude of projects. Although the research is in soil ecology, I run analytical chemistry analyses using an array of instrumentation. I am responsible for managing data collection and instrument maintenance in the lab. I received training on a Shimadzu total organic carbon and nitrogen (TOC/N) analyzer and became proficient in running colorimetric absorbance and fluorescence assays using a spectrophotometric 96-well microplate reader (BioTek). Since we often run these analyses for collaborators and colleagues from other universities or organizations, I am accountable for the accurate and ethical collection of their data. Currently, I am assembling an HPLC system for normal-phase, hydrophilic interaction (HILIC) separation of carbohydrates and amino acids in soil extracts. As lab technician, I co-authored a manuscript with our project post-doc on one of the methods we use to analyze Arctic samples. With the growing demand in soil ecology for high-throughput analyses of amino acids and other small organic nitrogen compounds in soil, we adapted a fluorometric method based on σ-phthaldialdehyde and β-mercaptoethanol (OPAME) for use in 96-well microplates. While we started with an existing protocol, we made a critical change to the procedure and demonstrated that the OPAME reagent

fluoresces in the presence of primary amines other than amino acids. Transitioning from chemistry into ecology introduced me to a new and different culture of scientific research, and helped prepare me for what I may encounter in a doctoral program studying atmospheric chemistry.

Nitrogen Addition and Plant Litter Decomposition Chemistry (11/2010 – present)

In addition to my publication, I presented data from another project at the Ecological Society of America (ESA) meeting in August 2012. The objective of this work was to evaluate how elevated nitrogen affected litter decomposition at different stages of decay by monitoring microbial respiration, biomass, extracellular enzyme activities, and concentrations of inorganic nutrients throughout a 25-month laboratory incubation. In addition to becoming proficient with multiple infrared gas analyzers (LI-COR), this project introduced me to modeling and improved my abilities in ecological scientific inquiry and statistical analysis.

Soil Chemistry and Fieldwork in the Arctic Tundra (05/2011 – 08/2011 and 06/2012 – 08/2012)

Two summers at the Toolik Lake Field Station gave me the opportunity to explore my research interests more intimately, by interacting with multiple research groups, in addition to our own field team. Throughout the summer, I worked closely with undergraduate REU students, a PolarTREC high school teacher, graduate students, and post-doctoral fellows in addition to the team of principal investigators leading the project. Our project focused on the large stores of carbon in Arctic soils, and how they may act as a significant source of carbon dioxide with warming and changing seasonality. Working at a remote field station, I learned to be resourceful and flexible, and also how to accept critique and seek guidance at the appropriate times. In our final season, we wanted to develop a procedure to collect root exudates in the field. It was essential that I not only fine-tune my analytical skills, and apply my previous experience to come up with creative solutions to problems that arose, but also that I clearly communicate with team members back home, discussing possible areas of methodological improvement while always keeping the overall scientific goals in mind. The nature of my proposed work relies heavily on my ability to collect and analyze samples and data in the field as well as the lab.

Conference Proceedings

Ladd, M.; Rinkes, Z.; Weintraub, M.N. (2012) Effects of elevated nitrogen on the interaction between microbial activity and plant litter chemistry during decomposition of *Acer saccharum* litter. *97th Annual Ecological Society of American Meeting, Portland, OR*

Ladd, M.; Guo, J.; Griffith, W.P. (2011) Sequence Characterization of Otter Hemoglobin Using a Combination of Mass Spectrometry and X-ray Crystallography. *Spring 2011 National Meeting and Exposition of the American Chemical Society Anaheim, CA*

Ladd, M.; Guo, J.; Griffith, W.P. (2011) Sequence Characterization of Otter Hemoglobin Using a Combination of Mass Spectrometry and X-ray Crystallography. *Spring 2011 National Conference for Undergraduate Research, Ithaca, NY*

Ladd, M.; (2010) Honors Thesis Oral Defense: Sequence Characterization of Otter Hemoglobin Using a Combination of Bottom-Up Approach Mass Spectrometry and X-ray Crystallography. *University of Toledo Honors College Seminar, Toledo, OH*

Crowe, J.; **Ladd, M.**; McCann, S.; Mull, D.; Casarotto, V.; Lind, C.; Sucheck, S. (2008) To Nuke or Not to Nuke: The Joys and Pitfalls of Microwaves. *Central Regional Meeting of the American Chemical Society, Columbus, OH*

Publications

Darrouzet-Nardi, A.; **Ladd, M**.; Weintraub, M. (2012) Fluorescent microplate analysis of amino acids and other primary amines in soils. *Soil Biology and Biochemistry (in press)*