SOAR Research Proposal -- Summer 2015

Project Title: **Determination of heavy metal uptake by forb plants in the Lehigh Gap Wildlife Refuge remediation areas and analysis of the impact of prescribed burning on vegetative cover, diversity and metal uptake**

Faculty Mentor**:** **Dr. Diane Husic**, Professor and Chair
Department of Biological Sciences

Student: **Ms. Laura McBride**
Class Year: 2016 Major: Chemistry

Start Date: June 1st, 2015 (we may need to collect some plant samples earlier than this)
Project Duration: 10 weeks

Project Description:

Background: The Lehigh Gap Wildlife Refuge (LGWR) is a 750-acre reserve on the Kittatinny Ridge (Blue Mountain), along the Lehigh River in northern Lehigh and southern Carbon Counties, Pennsylvania. While approximately half the site is currently good wildlife habitat, including ponds, wetlands, bottomland forest, riparian zone, wooded slopes, cliffs, talus slopes, and savanna, the remainder of the site has been impacted by air pollution from former zinc smelters in Palmerton and is one part of the Palmerton Superfund site managed by the U.S. Environmental Protection Agency (EPA). In fact, this is the largest Superfund site east of the Mississippi River.

The soil in the Superfund section of the LGWR is contaminated from the zinc smelting operations that occurred in the area starting in the 1890s. Zinc levels of 20,000 ppm or higher have been recorded. Lower levels of lead and cadmium are also present. Acid deposition resulting from decades of sulfur-dioxide emissions from the smelters originally killed off much of the vegetative cover on the mountains. Subsequently, severe erosion of topsoil off the mountain and heavy metal contamination of the remaining soil kept most plant species from growing back. The smelting operations ended by 1980, but until relatively recently, the site lacked vegetation.

In 2003, an innovative plan to remediate the portion of the Superfund site at the LGWR began. Warm season native grasses (prairie grasses) were planted with the hopes that they could tolerate the metals based on observations of their ability to grow in soils that are naturally high in heavy metals. The grasses had the potential to re-establish new top soil and a functioning ecosystem. These grasses do not take up the metals from the soil, help prevent erosion, and they can also build healthy soil by adding organic matter to the existing low-quality mineral soil.

As was predicted at the early stages of the revegetation work, establishment of the grasses allowed other plant species to begin growing through natural succession processes. Studies conducted by Moravian College SOAR students in 2007, 2008, and 2012 showed that the most prominent successional species (gray and sweet birch and aspen tree species[1]) and some small flowering plants (wild bleeding heart[2] and non-native sandwort[3]) were taking up significant levels of metals. However, most of the forbs (herbaceous flowering plants other than a grass) have not been tested. These plants are sources of pollen, nectar, seeds, and vegetation for bees and other pollinators, birds, rodents, and deer, and if they are taking up the heavy metals, could be introducing the contamination into the food chain. Such uptake would also interfere with the remediation plan to immobilize heavy metals in the soil and to minimize the flow of metals through the food chain or into the Lehigh River at the bottom of the mountainside. In order to

[1] *Betula* and *Populus* species.
[2] A federally listed endangered species, *Dicentra eximia* (Ker Gawl.; wild bleeding heart) is for some reason thriving at the LGWR.
[3] *Minuartia patula* (Michx.) *mattf.* (sandwort) is not native to Pennsylvania, but the only place it grows in PA is on the zinc-contaminated slopes of the Lehigh Gap region .

understand the risk to wildlife, the EPA and responsible party for the Superfund site are interested in knowing if these plants are problematic.

Proposed studies for summer 2015: The goals of this SOAR project build on previous SOAR projects and include:

1. Analysis of metal uptake in a wide variety of plant species not yet tested from the site;
2. In plants where metal uptake is detected, determine if this increases over the growing season and identify which tissues (leaves, flowers, etc.) sequester the contamination;
3. Continue the successional monitoring to better understand the extent of the plant biodiversity in the restoration areas after the initial test plots were seeded and compare the growth and diversity in control areas as compared to a 10 acre test plot where a prescribed burn was conducted as a pilot management plan to control the grey birch which does take up the heavy metals (an outcome of previous SOAR projects);
4. Determination of metal uptake in plants in the burn area vs. control test plots.

Roles and Responsibilities: In order to collect and analyze plant tissue throughout the growing season, we will actually begin collecting plant tissue in April and May and possibly continue through fall until a killing frost. Samples are frozen until they are used for laboratory analysis. After proper orientation to the site and collection methods, Laura will be doing the sample collection, successional studies, and GIS location mapping in the field under the supervision of Diane Husic, along with Dan Kunkle, Executive Director of the LGWR, and Jenn Lansing, of Cardinal Directions (an environmental consulting firm representing the responsible party and the EPA). D. Husic will teach Laura the laboratory methods needed for the subsequent sample analyses using microwave digestion and atomic absorption spectroscopy – instruments available at the college. Results will lead to a better understanding of the biochemical, ecological, and management consequences of the contamination, revegetation efforts, and the value of a prescribed burn as a management tool and will be shared with the regulatory agencies to help determine the implications for adaptative management of the site, with biologists interested in introducing the endangered Regal Fritillary butterfly to the site, and scientists working on a native bee study at the Refuge. The data could lead to presentations for the Ecological Society of American, NCUR, and, of course, Student Scholarship Day at Moravian College.

Summary of Benefits: Due to this being a Superfund site, Laura will have the chance to be part of a unique conservation and restoration project that has received state and national attention and awards. She will, over the course of the summer, interact with representatives from the PA Department of Conservation and Natural Resources and Department of Environmental Protection, Fort Indiantown Gap biologists, the U.S. EPA, the National Park Service, a professional environmental consulting firm, and the responsible party (CBS Operations). Being a part of the ongoing collaborative restoration efforts at the Lehigh Gap has already led to publications (with several student contributors)[4] and national conference presentations, and it has been rewarding for the College since we are partners in this innovative remediation project at the only Superfund site in the country that has been converted to a public resource for recreation, education, conservation, and research.

[4] For example, see the extensive published ecological assessment available at http://lgnc.org/resources/reports/lgwr-assessment-ii.

Budget Items:

Student summer stipend: $300/week for ten weeks:	$3000
Faculty stipend for mentoring: $100/week for ten weeks:	$1000
Supplies: Laboratory materials (highly pure reagents for metal analysis and sample vessel chambers)[5]	$ 300
Mileage for several trips to the Lehigh Gap for field work and sample collection	$ 200
TOTAL:	**$4500**

Student campus housing for Laura

[5] The Department of Biological Sciences will provide support for other needed materials and the instrumentation is already available through the Department of Chemistry.