

SOAR Project Proposal
Summer 2015

**Assessing the Extent and Impact of Coliform Bacteria
in the Little Lehigh Creek**

Faculty Adviser: Frank T. Kuserk, Louise E. Juley Professor of Biological Sciences and
Director, Environmental Studies & Sciences Program

Student: Jennifer Francesco
Sophomore
Biology
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Title: *Assessing the Extent and Impact of Coliform Bacteria in the Little Lehigh Creek*

Start & End Dates: Tuesday, May, 26, 2015 to Friday, July 31, 2015 (10 weeks)

Project Description: In 2012 my two SOAR students, Brett Rentzheimer and Kaitlin Blair, and I conducted a study that monitored the extent of coliform bacteria pollution in the Little Lehigh Creek and its tributaries. This study, performed in conjunction with the Wildlands Conservancy (Emmaus, PA) and the Pennsylvania Department of Environmental Protection (PA-DEP), found significantly high levels of fecal contamination at 16 of the 19 sites that were sampled. As a result, the PA-DEP has now listed these sites as impaired for recreational use (Pennsylvania Integrated Water Quality Monitoring and Assessment Report-Streams, Category 5 Waterbodies, Pollutants Requiring a TMDL, 2014). As a result of this past collaboration, Ms. Kristie Fach, Director of Ecological Restoration at the Wildlands Conservancy, recently approached me to conduct a follow-up study of the Little Lehigh Creek in support of an update to their Lehigh River Watershed Management Plan (WCMP) that they are currently preparing. This plan, completed in 2003, is now twelve years old. Since then the WCMP has served as the Wildlands Conservancy's chief strategic plan of action for protecting and improving the waters of the Lehigh River Watershed. With this plan in place the Wildlands Conservancy has raised substantial financial resources for conservation and restoration, has completed large-scale water quality and aquatic habitat improvement projects, has permanently protected tens-of-thousands of acres of critical habitat and open space, has added trails and acquired key trail gaps, and has successfully engaged the community in the protection of the Lehigh River.

High coliform numbers are associated with fecal contamination and can indicate the presence of more serious human pathogens in the water and have been used as indicators of pollution since the early 20th century. *Escherichia coli* is the one bacterial species that is the most consistent representative of this group and the one that we will focus our efforts on quantifying. The study design that we have developed incorporates a watershed approach where 7 sites within the Little Lehigh Creek will be monitored for these bacteria during the 2015 summer season.

The sites will be sampled by employing the U.S. Environmental Protection Agency's (US-EPA) Bacteriological Sampling Protocol. The US-EPA recommends a standard based on *E. coli* (a 5-day geometric mean of 126 cfu per 100 mL) to measure recreational water quality use. Because we are interested in assessing the stream for chronic violations, two 30-day periods (containing 5 consecutive samples each) within a single swimming season are required to determine whether a particular stream is impaired for Recreational Use Status. In sum, we will be testing the 7 selected sites on the Little Lehigh Creek a total of 10 times each during the 2015 summer.

The specific assay that we will use was developed by IDEXX Laboratories (Westbrook, ME) and has been approved by the US-EPA for monitoring *E. coli* in freshwater (American Public Health Association *et al.* 2012). The Colisure[®] assay uses Defined Substrate Technology[®] (DST[®]) nutrient indicators chlorophenol red- β -D-galactopyranoside (CPRG) and β -glucuronidase to metabolize 4-methylumbelliferyl-beta-D-glucuronide (MUG) to detect total coliforms and *E. coli* in freshwater. Coliforms use their β -galactosidase enzyme to metabolize CPRG and change it from yellow to magenta. *E. coli* use MUG and create fluorescence.

This project is directly in line with the goals of the *2009-2013 Pennsylvania Statewide Comprehensive Outdoor Recreation Plan* (Pennsylvania Department of Conservation and Natural Resources, 2009) in that it will educate the community about the link between ecosystem protection and restoration and improved outdoor recreation opportunities, and how better access to outdoor, nature-based recreation can lead to improved physical and mental health, can bolster the local economy, and can foster a community-wide conservation ethic.

Roles and Responsibilities of Faculty and Student:

Faculty Role: I have been working with the Wildlands Conservancy since 2001 on stream monitoring and restoration projects in the Lehigh River Watershed. As a result, I have engaged many Moravian College students in assessment projects because of these collaborations. My previous work at the Stroud Water Research Center (Academy of Natural Sciences of Philadelphia) provides both theoretical and applied knowledge of the dynamics of stream ecosystems. I have published papers in the *Canadian Journal of Fisheries and Aquatic Sciences* and *Microbial Ecology* on the carbon dynamics of streams. I have also authored several technical reports for the Wildlands Conservancy based on collaborative projects and have published an article in *The American Biology Teacher* in which I describe how techniques developed as part of my research can be used in an undergraduate ecology class. For this project I will assist my research student, Jennifer Francesco, to develop a background literature search, provide expertise in how to conduct bacteriological assessments, assist in collection and analyses, and guide her in the preparation of results for presentation and publication.

Student Role: Jennifer Francesco will participate in pre-project planning with Ms. Kristie Fach, Ms. Kate Ebel and me, collect, and analyze water samples using established bacteriological protocols. Jennifer will assist me in the analysis of the data that we collect and in writing the final report that will be given to the Wildlands Conservancy. Finally, Jennifer will prepare and deliver presentations at scientific meetings including the Landmark Conference Summer Undergraduate Research Conference and the National Conference on Undergraduate Research. In addition, she will participate in next year's Moravian College Annual Student Scholarship and Creative Arts Day. Over the past five years I have had 21 of my SOAR and Honors research students present their findings at the annual National Conference on Undergraduate Research.

Timetable: Field sampling and laboratory work will consume the entire 10-week summer period. A report to the Wildlands Conservancy that provides an analysis of the data will be completed by October 1, 2015.

Benefits to the Student, Faculty Member and Moravian College:

Student Benefits: Jennifer will benefit by being part of a long-term ecological study that has great environmental importance. She will become part of a team of researchers and conservation scientists dedicated to improving stream quality. In this way she will experience how modern ecological research is a collaborative effort involving many people, each contributing in a specific way according to their expertise.

More importantly, her work will assist the Wildlands Conservancy in determining whether currently accepted mitigation techniques are still appropriate or require modification. Jennifer will need to operate both as a team player and as an individual charged with the responsibility of learning accepted sampling protocols, performing appropriate assessments, and conducting statistical analyses on the results. Additionally, she will gain experience in the writing of scientific reports and papers. She will additionally gain experience in public speaking as she presents her work at Moravian College's Annual Student Scholarship and Creative Arts Day and at scientific meetings such as the National Conference on Undergraduate Research.

Faculty Benefits: I am eager to continue a research program that actively involves undergraduates and collaborates with local and state environmental organizations and individuals. In recent years my work with the Wildlands Conservancy has provided me an opportunity to not only engage in scientific research, but also public policy. My past involvement with the PA-DEP has resulted in their designation of several streams as impaired for recreational use and this year I have made recommendations to the Allentown City Council and the South Whitehall Township Board of Commissioners on the removal of dams within their jurisdictions. These activities have enabled me to impart first-hand knowledge of how environmental policy decisions play out in my Environmental Policy (POSC 240) course that I co-teach with John Reynolds.

College Benefits: Continued cooperation with the Wildlands Conservancy will assist us in providing our students with meaningful field experiences. This organization has provided meaningful opportunities for students engaging in scientific research, environmental policy, environmental management, and environmental education. Our Biology and Environmental Studies & Sciences Programs rely on our ability to develop strong relationships with environmental organizations.

Literature Cited

- Pennsylvania Department of Conservation and Natural Resources. 2009. *2009-2013 Pennsylvania Statewide Comprehensive Outdoor Recreation Plan* (<http://www.paoutdoorrecplan.com/downloadlinks/parecplanpdf/index.htm>).
- Pennsylvania Department of Environmental Protection. 2014. *Pennsylvania Integrated Water Quality Monitoring and Assessment Report-Streams, Category 5 Waterbodies, Pollutants Requiring a TMDL* (<http://files.dep.state.pa.us/Water/Drinking%20Water%20and%20Facility%20Regulation/WaterQualityPortalFiles/2014%20Integrated%20List/2014%20Streams%20Category%205.pdf>).
- Rice, EW, RB Baird, AD Eaton, LS Clesceri (eds.). 2012. *Standard Methods for the Examination of Water and Wastewater* (22nd edition). American Public Health Association, American Waterworks Association and Water Environment Federation.

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Student Statement of Purpose

Project title: *Assessing the Extent and Impact of Coliform Bacteria in the Little Lehigh Creek*

Student name: Jennifer Francesco
Major: Biology
Graduation Date: May 2017
Faculty Mentor: Dr. Frank T. Kuserk
Campus Housing: Yes

Participation Rationale & Expected Outcomes:

There are several reasons why I want to participate in this summer SOAR project with Dr. Kuserk. The first is the opportunity that it will give me to engage in the process of science. Learning in the classroom provides me with the foundation that I need but actually engaging in scientific research will allow me to apply the knowledge that I have learned in the classroom to solving real world problems. This project especially intrigues me since I will have the opportunity to work with scientists with the Pennsylvania Department of Environmental Protection and the Wildlands Conservancy to try and solve some actual problems associated with water quality in the Little Lehigh Creek and its tributaries. The practical experience that I will gain will provide me with experience working with instruments, equipment and techniques that environmental professionals use. Learning to use appropriate statistical techniques and putting together a scientific report are also valuable skills that I will learn. Having the opportunity to present my research at a scientific meeting will enable me to gain practice in public speaking.

Another reason why I want to participate in this research project is that it may lead to further opportunities for other research projects in the future, such as an Honors project, that I might want to engage in during my Senior year. I want to find out if I really enjoy doing research and discovering new things. Learning how scientific research is conducted now will help me later to become more independent if I decide that this is what I want to do.

Finally, participating in this SOAR project will allow me to gain experience toward my future career goal. As of now I am interested in attending graduate school and then pursuing a career in an environmental science. This project will allow me to explore what aquatic microbial ecologists do. I may find that it is an intriguing area that I would like to pursue further, or perhaps I may decide to continue looking into other environmental areas. In any event, participating in such an endeavor now will allow me to mature as a young scientist.

Expense Proposal**Assessing the Extent and Impact of Coliform Bacteria
in the Little Lehigh Creek**

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\$ 400 Expendable supplies purchased from IDEXX Laboratories to enumerate *E. coli*
(bacteriological media, petri plates, collecting containers, membrane filters). Estimated cost of
these materials is approximately \$800. Additional costs over \$500 will be covered by the
Environmental Studies & Sciences Program budget. The equipment to perform bacteriological
testing currently exists in the department

\$ 100 Since this project involves extensive travel to conduct sampling at field sites we request funds
for gasoline. We will use the Environmental Studies & Sciences van for travel.

\$ 500 Total