NEBI (Water): Connecting N'dakinna (Land), Bilowagizegad (Climate), and Alnobak (People)

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Project abstract

The goal of this project is to provide Indigenous college students in New Hampshire with research opportunities that combine Indigenous knowledge of watersheds with empirically collected data from forested watersheds. Vital to life in N'dakinna (present-day northeastern United States) is access to clean and safe surface waters. For the Indigenous people of N'dakinna, the Abenaki and Pennacook, nebi (Abenaki for water) provides the interconnected web that organizes life, providing access to fish, clean drinking water, and a network of waterways for transportation, trade, and communication. The relationship to water throughout contemporary New Hampshire continues these relationships nebi is necessary for access to food and clean water and to support agriculture.

One contemporary challenge for Indigenous communities and water resource managers alike is the uncertain effects of global change. Critical local effects of global change include rising temperatures, shorter winters, extreme flooding, and prolonged drought. Human population pressures also impact water resources through changes in land use and degraded water quality. This project, Project Nebi for short, engages Abenaki college students to develop 1) a virtual storyboard that preserves and shares Indigenous knowledge, language, and history about regional watersheds and 2) a unique research project using long-term surface water chemistry data to understand the effects of climate change on forested watersheds.

Progress in 2021

Project Nebi focuses on the sustainability of freshwater ecosystems and water resources using perspectives and knowledge from traditional and current Indigenous perspectives and empirical science. The overarching objective of Project Nebi is to better understand how people interact with the land to influence water resources and how freshwater ecosystems respond to climate variability. The main focal study area is the Lamprey River watershed in southeastern New Hampshire, which occupies parts of N'dakinna, the traditional land of the Abenaki-Pennacook people.

Dowst-Cate Forest, a tributary to the Lamprey River, the focal watershed in this study. Photo: Lisle Snyder

The primary activities during this reporting period focused on honing research questions that reflected shared priorities to project PIs, recruiting student researchers, and identifying appropriate data sets. Three potential collaborative research questions were identified. 1) How is contemporary global change (measured as changes in land use and increased climate variability) affecting surface water chemistry of the Lamprey River and its associated tributaries? 2) How can we use watershed research modeling various levels of impact in a space-for-time substation design that is retrospective (rather than protections of the future) where low-impact watersheds represent landscapes of the past? 3) In exploring the utility of GIS-based methods to assess the 3-D bathymetry of reservoirs, can

we connect greenhouse gas inventories from reservoirs that contain large amounts of biomass due to flooding and burial of indigenous homelands? Methods, data sets, and potential collaborators were identified for each of these research questions.

One student was successfully recruited to participate in Project Nebi. Isabel Cole is an undergraduate Sustainable Agriculture major at the University of New Hampshire and is concurrently working on a minor in Indigenous Studies. Due to the availability of data, Isabel, under the mentorship of PI Wymore and post-doctoral researcher Dr. Hannah Fazekas, has learned coding skills in the computational language R, and is conducting initial analyses regarding question #1, examining how Lamprey River chemistry responds to changes in land use and climate extremes including drought. Isabel is also participating in the development of methods for questions 2 and 3.

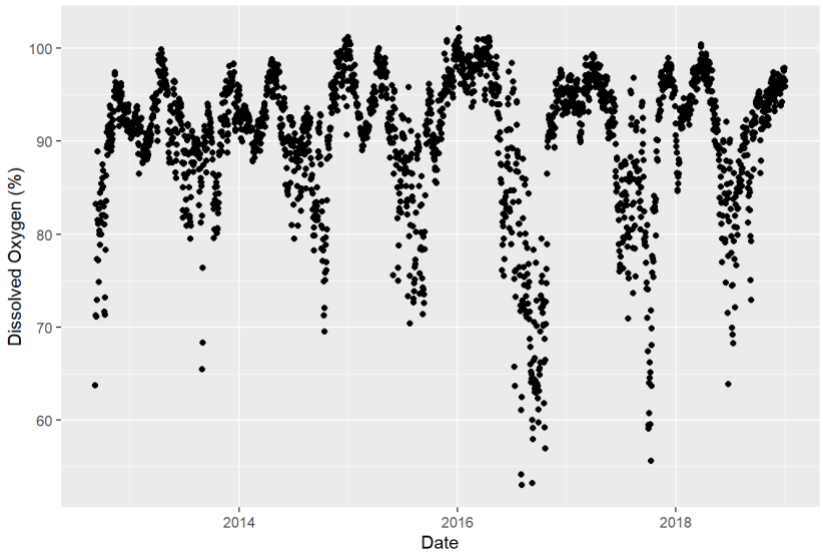

Figure 23: Student-produced graph using high frequency data on dissolved oxygen. Note the effects of the 2106 drought with respect to dissolved oxygen.

Plans for 2022

Project PIs continue to recruit a second student for the project. Recruiting a student from the Abenaki community has proven difficult, as it requires self-identification. Our plan is to still identify a second student, and we are considering broadening our participation to any student who identifies as Indigenous. Project Nebi is also leading an effort to develop a framework that environmental scientists can use to evaluate their impact on the environment that occurs through research. The development of this framework is motivated by the Indigenous concept of reciprocity. Similar protocols exist for the projection of animal (IACUC) and human subject (IRB), but no formal framework exists for the environment. As part of a semester project associated with PI Wymore's lab, students are developing a framework of environmental responsibility framed around 5-R's: *recognition, refinement, reduction, replacement, and restoration*. While we stress this framework has no legal ramifications, it does provide a framework by which scientists can evaluate protocols to minimize potential environmental impacts of their research.

Project Nebi student Isabel Cole will present this framework at the UNH Undergraduate Research Conference in April 2022. A manuscript also will be developed to share this framework with the broader research community and to promote a broader discussion about environmental responsibility and environment/ecological reciprocity.