Effects of soil and forest vegetation on mediating climate-fire relationships in the Apostle Islands.

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Objectives

Fire is a critically important earth-system process, and a natural disturbance that affects terrestrial ecosystems. However, differences in vegetation and soils likely affect wildfire frequency, and the relative sensitivity of fire to climate change. Such differences should be considered in fire management plans, and long-term perspectives are needed to determine natural fire frequencies in different ecosystems.

Stockton Island in northern Wisconsin contains one of the most undisturbed examples of the Great Lakes Barren community, a pine-dominated ecosystem that occupies sandy soils and is likely fire dependent. The island also supports mixed-deciduous forest on areas of glacial till soils, making it an ideal study site to contrast fire regimes in two ecosystems that are in close proximity. For my senior project, I will use paleoecological techniques to compare the frequency of historical fires on these two landscapes, by comparing sediment records of charcoal, testate amoeba, and pollen from bogs located in the two areas.

Hypotheses

1.) Fire frequency for the past 1000 years inferred from charcoal measurements at Brander Bog will indicate that the mixed-deciduous forest area has burned much less frequently than the Great Lakes Barren ecosystem area surrounding Stockton Bog.

2.) A closer relationship between drought and fire events existed within the mixed-deciduous forest than existed within the Barren ecosystem for the past 1000 years. I predict this because the barren ecosystem is much drier because of the well-drained soils and therefore vulnerable to fire much of the time, even during moist years, whereas a major drought is likely needed to dry fuels enough to carry the fire through the mixed-deciduous forest.

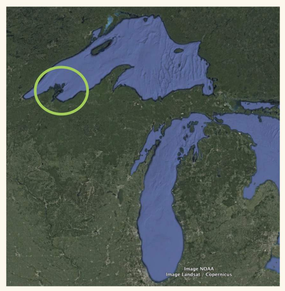
Stockton Bog

Brander Bog

Work Completed

In June of 2018, peat cores were collected from Stockton Bog (barren site) and Brander Bog (glacial-till site). Cores were wrapped in plastic wrap, tin foil, and 1 meter long PVC tubes. These cores were transported back to Lehigh University. Matt Huff (EES graduate student) is analyzing the Stockton Bog record as part of his MS thesis work, so my laboratory work was focused on the Brander Bog peat core.

During the remainder of summer 2018, I subsampled the Brander Bog peat core for testate amoebae, charcoal, loss-on-ignition, and pollen analyses. The core was sliced into 1-cm increments, and 1-2 cm^3 of peat was collected for each of these analyses.



Location of Stockton Island in Lake Superior.

Stockton Bog (circled in red), found on the tombolo, a sandy ridge that connects two older islands, has characteristics of barren vegetation and soils. Brander Bog (circled in yellow) is surrounded by mixed-deciduous forest and glacial till soils.

Measuring depth of Stockton Bog.

Using the Russian core in Stockton Bog.

Work Remaining

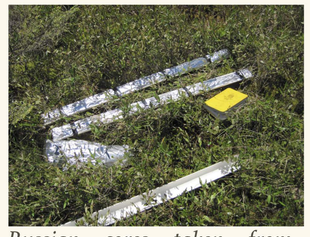
Charcoal analysis will be performed by treating the subsamples with 6% H_2O_2 for 24 hours followed by sieving to isolate particles >125 um in size. Charcoal fragments will be tallied in each sample. Total charcoal counts will be converted to accumulation rates and peaks associated with local fire events will be identified using standard statistical approaches.

Testate amoebae and pollen will be isolated at 1 cm intervals along the peat portion of the core using standard sieving methods. Water table depth will be reconstructed by using a large modern calibration dataset based on testate amoeba community composition (Booth 2008). Pollen will allow reconstruction of vegetation composition.

Samples will be collected from along the core for radiocarbon dating, and an age-depth model will be developed from these results.

Larger core taken from Stockton Bog.

Using the Russian core in Brander Bog (left).



Russian cores taken from Brander Bog.

Works Cited

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