Flooding and Paleoclimatology of Central New Hampshire Wetlands

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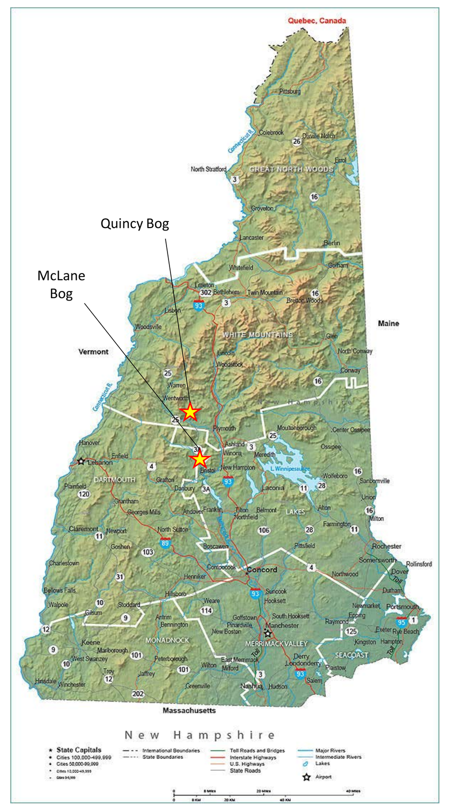
Introduction



NH State Map

Every watershed has its own local potential for flooding, but large-scale, regional events will affect multiple watersheds. By examining paleoflood records of multiple watersheds, we can determine the frequency of regional flooding and improve resilience

to them at the local scale. A number of factors influence resilience, including increased development or unsustainable management. These can lead to changes in local hydrology and increased flooding and erosion of the shore, enhancing sediment build up in lake/wetland basins and eutrophication. This project aims to enhance community preparedness by identifying the frequency of high magnitude flooding over several thousands of years in central NH.

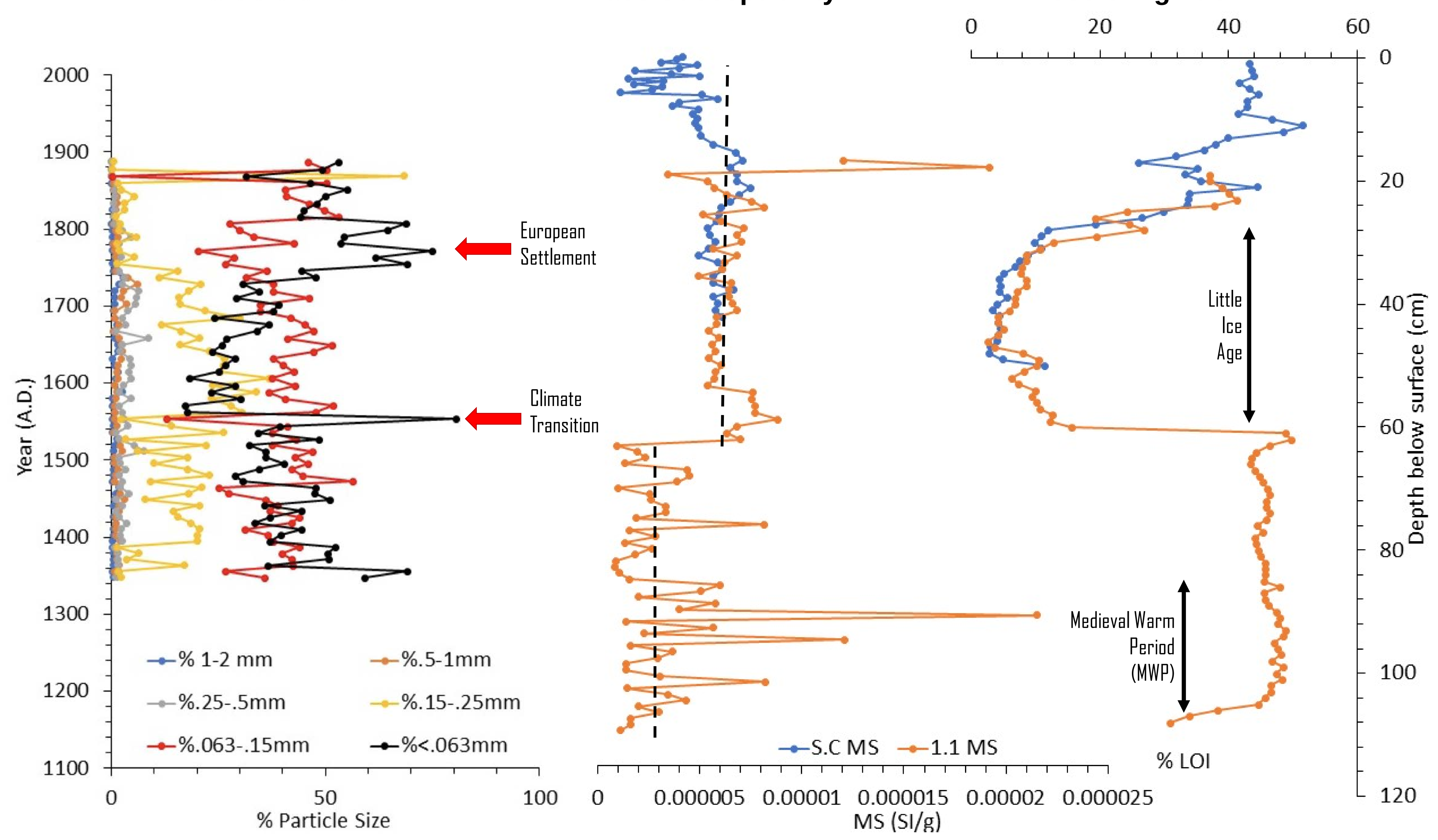
McLane Bog (star is coring location) Quincy Bog (star is coring location)

Methods

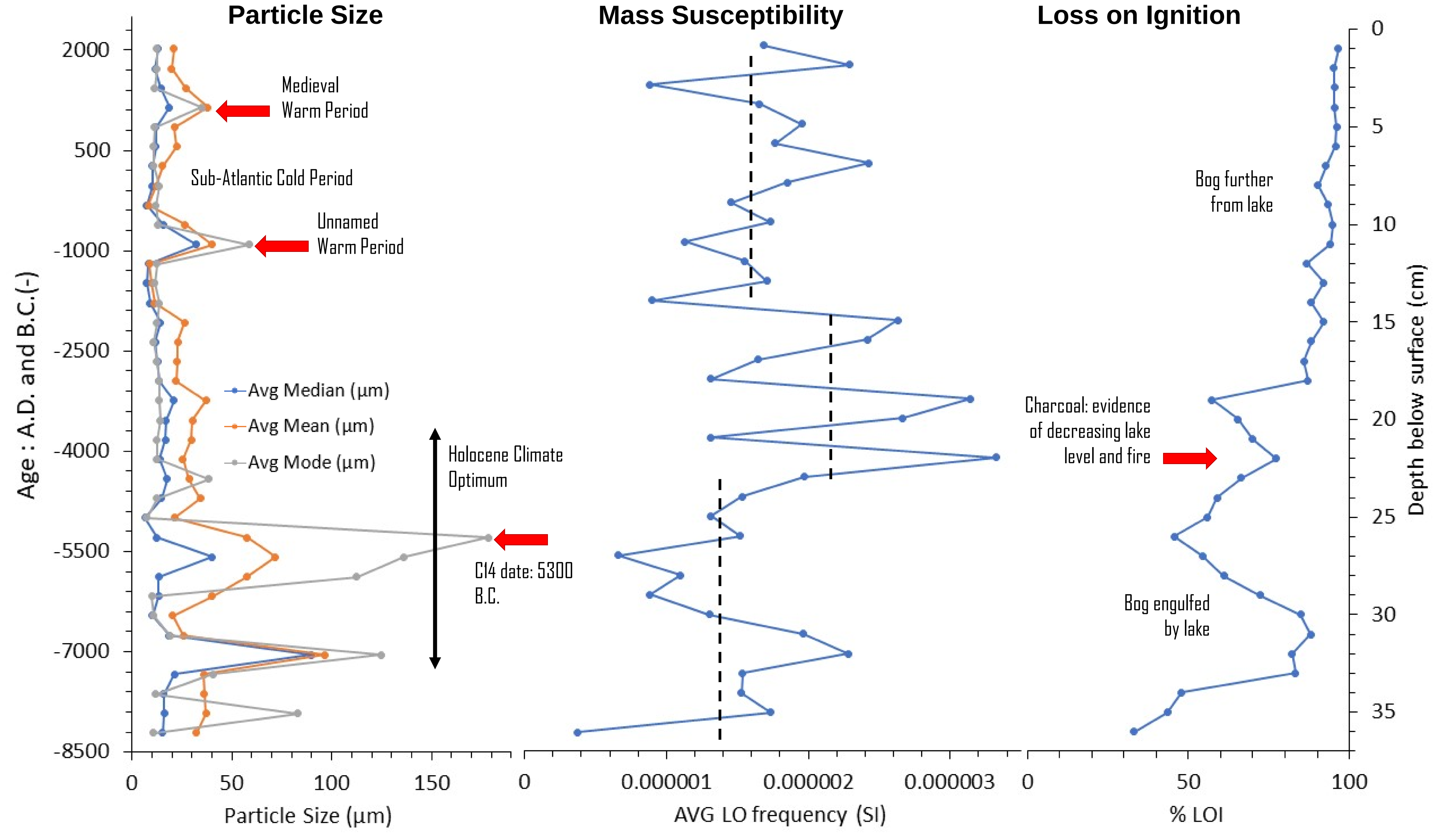
Multiple sediment cores have been extracted, described, and sampled from two flood-sensitive wetlands, Quincy Bog in Rumney, NH (in 2014) and McLane Bog at Newfound Lake (in 2018). My work on these cores in PSU's sedimentology laboratory has led me to develop multiple hypotheses related to flood prediction. **Hypothesis 1**: By analyzing physical characteristics in the cores' sediment records, I can identify past disturbance events within the watershed. **Hypothesis 2**: Within these disturbance events, I can distinguish ones caused by flooding through changes in particle size. **Hypothesis 3**: Flood sediments simultaneously deposited in multiple watersheds indicate regional flooding. Flood sediments deposited at only one site in the region signify local or small-scale events.

To test these hypotheses, I measured bulk density and water content, organic content (by loss on ignition), magnetic susceptibility to determine the extent of weathering/erosion of sediments, and particle size distribution (indicative of energy of transport and water flow rates). I have determined the timing and frequency of events using chronologies created from Carbon-14 and Lead-210 isotope data.

Quincy Bog



McLane Bog



Conclusions

Edge effects from shore erosion is greatest within one meter of the shore. As all the cores were taken outside of this zone, observed peaks in particle size are attributable to enhanced transport by currents, not just shore slumping. Also, although organic material accumulates in soils and small drainages and can wash in during strong flows, evidence of this organic input may be lost if inorganic inputs are high. Thus, floods may mobilize organic materials yet appear in the records as a decrease in organic content (lower LOI). Evidence of watershed disturbance can be identified in the graphs by rapid and large changes in particle size, mass susceptibility, and/or loss on ignition compared to the averages for each variable (dashed lines). The timing of apparent floods in these cores correlates very well with warm periods recognized in other work (Deng, et al. 2017; Grove and Switsur, 1994).

Quincy Bog is located high up in the flood plain (500 yr flood elevation). Its waters flow to the Baker River year round, but at peak flood, the river will reverse the flow in this outlet and introduce turbid water into Quincy Bog. This flood influx brings a proportionally large amount of fine particles to the bog. Because the water is flowing over a lar ge area, it has lower energy and so can only transport smaller grains (silts and clays), while courser material stays in the main river channel or near the banks.
Observed disturbance events:

- The most recent event occurs from A.D. 1755-1807. Rumney became incorporated during this time, with European settlements creating large-scale land disturbance. Deforestation increased flooding potential and set the stage for mobilization of fine particles until the end of the century.
- A Little Ice Age (LIA) signal is observed in this core (A.D.1580-1870), as less organic matter produced and/or greater inorganic influxes. These are often associated with colder climate and shorter growing seasons.
- Just before the LIA, a climate transition is identified with a peak in small particles and an increase in mass susceptibility. This is consistent with flooding of the Baker River into the Quincy Bog.

McLane Bog is located at the northern edge of Newfound Lake, currently within 100 m of the mouth of the Cockermouth River and the lake shore. Large particles could be introduced into McLane Bog by either river or lake flooding, because sand-sized sediments occur on nearby lake shore/beach and river banks. Thus, at McLane Bog, an increase in mean particle size would represent overwash into the bog by a flood in the Cockermouth River and/or by waves at elevated lake levels.
Observed disturbance events:

- 8200-4700 B.C., high amounts of larges particles suggest that bog was often submersed. This period encompasses the warmer temperatures of the Holocene Climatic Optimum (7050-3050 B.C), and seems associated with more frequent flooding. The greatest increase in particle size, at 5300 B.C., is associated with a decrease in organic matter. MS at this time is low, signifying heavier weathering and creation of soils, typical of warm climates. Charcoal is prevalent in the bog near the end of this interval and increases in MS indicate erosion.
- A particle size peak circa 900 B.C. also occurs during a known but unnamed warm period (Deng et al., 2017).
- In more recent times, the bog sediments contain more organic matter and few course sediments. MS is also lower, indicating greater chemical weathering and less physical weathering. This pattern is interrupted by a flood during the Medieval Warm Period (MWP), about 1140 A.D.

Acknowledgements

PSU Associate Professor Lisa Doner provided core material and guidance in analyzing them
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