Fire in Hell's Kitchen

A look at fire and vegetation in Northern Wisconsin over the last 5000 years

-John LeValley

Premise

- Climate, vegetation, and fire are closely linked.
- Weather and climate play an important role in the vegetation, ecology, and fire regimes of an area
- All deeply interconnected with each other.
- Vegetation has the power to modify the direct link between climate and fire by influencing the abundance, structure, and moisture content of fuels across space and time
- Earth's climate is subject to abrupt, severe and widespread changes including ecological effects, dune reactivation, forest fires and long-term changes in forest composition

Premise (cont.)

- Charcoal analysis coupled with pollen and macrofossil analysis provide useful tools for examining the dynamics of these events.
- applied CHARanalysis to address the following questions.
- During what time periods was charcoal abundance at its greatest?
- Are there substantial shifts in fire frequency over the last 5000 years?
- If so, do these shifts correspond with climatic and ecological shifts?

Outline

- Paleoecology Background
- Lab Technique
- Study site
- Methods
- Results
- Conclusion
- Questions?

Paleoecology

What is paleoecology?

-A variety of historical and paleontological tools that can be used to answer a variety of ecological questions (R.Jones)

Lakes and Ponds

Depositional environments.

Lakes and Ponds

Palynology: The study of pollen grains and spores.

Potential paleo-material

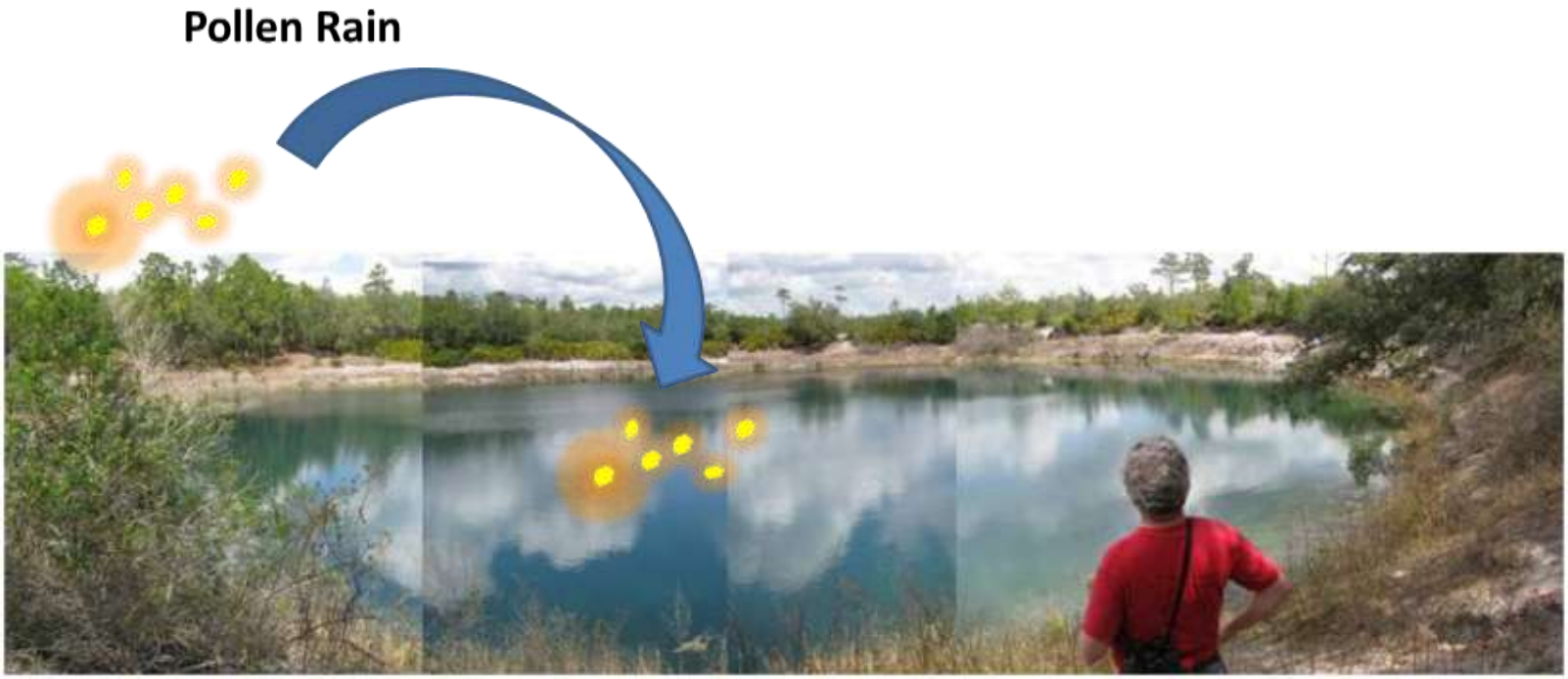
Pollen

Seeds (macrofossils)

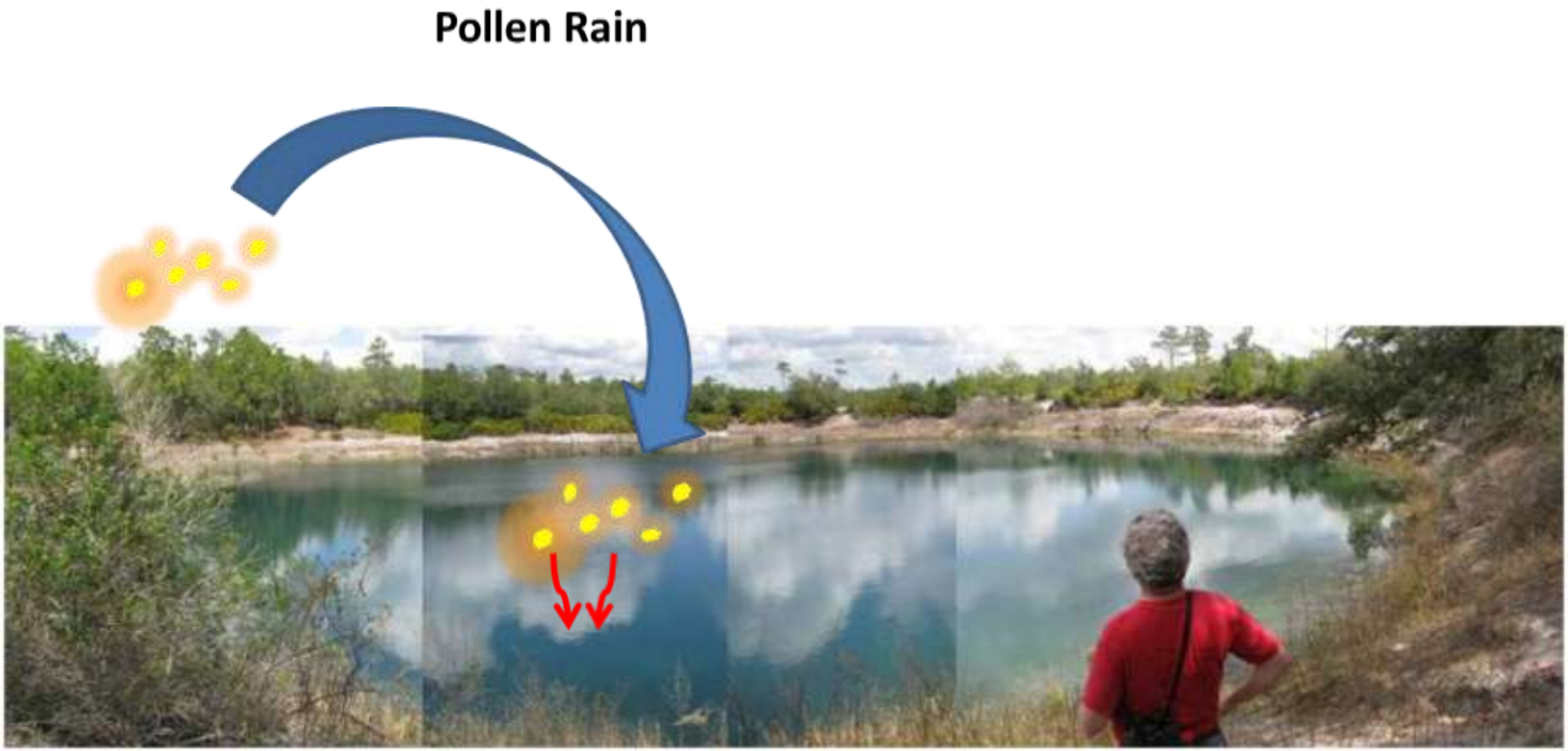
Charcoal from fires

Deposition

Pollen, seeds (macrofossils), and charcoal



Deposition

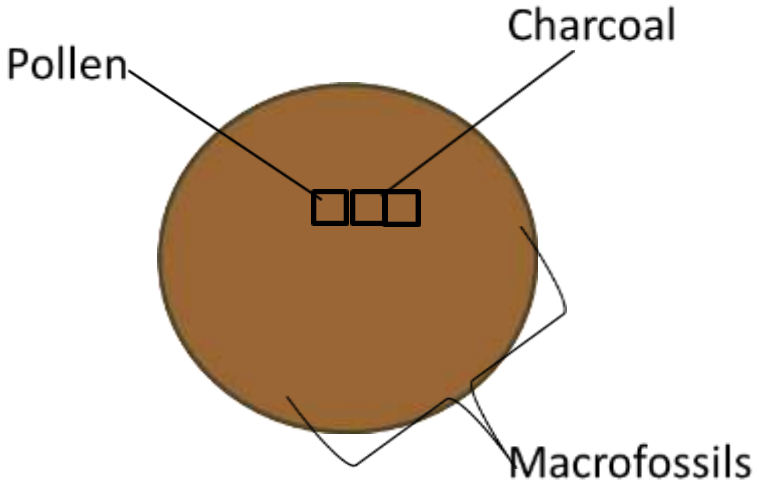


Coring

Lab (methods)

Sub – sampling

Process for pollen, charcoal, and datable material (macrofossils)



Study Site

- Hell's Kitchen Lake is part of an extensive kettle-moraine complex in north-central Wisconsin. This 3 hectare lake, surrounded by steep morainal slopes, lies at 46° 11.4 N; 89° 42.1W.

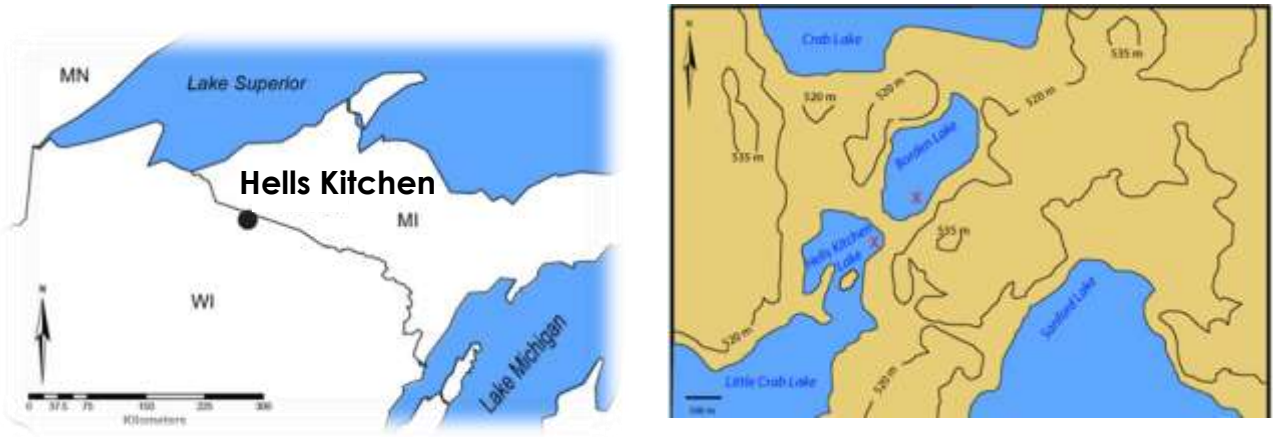


Figure1. Location of Borden Lake (approximate location of Hell's Kitchen Lake) in northern Wisconsin (left) and the adjacent Hells's Kitchen Lake study site (right)


Hell's Kitchen Lake

Methods

- A paleo-ecological approach was used to examine relationships between vegetation ecology and fire regimes.
- Macroscopic charcoal from lake sediments was utilized to reconstruct fire occurrence with CharAnalysis
- Sieved and counted charcoal (hundreds of samples!)
- pollen and plant macrofossils were used to infer the vegetation history of the lake and surrounding uplands (Urban 2008)
- Radio carbon dates as well as pollen and macrofossil data were obtained from Urban (2008).
- Data sets were then compared to examine the relationship between fire history and vegetative ecology.

Results

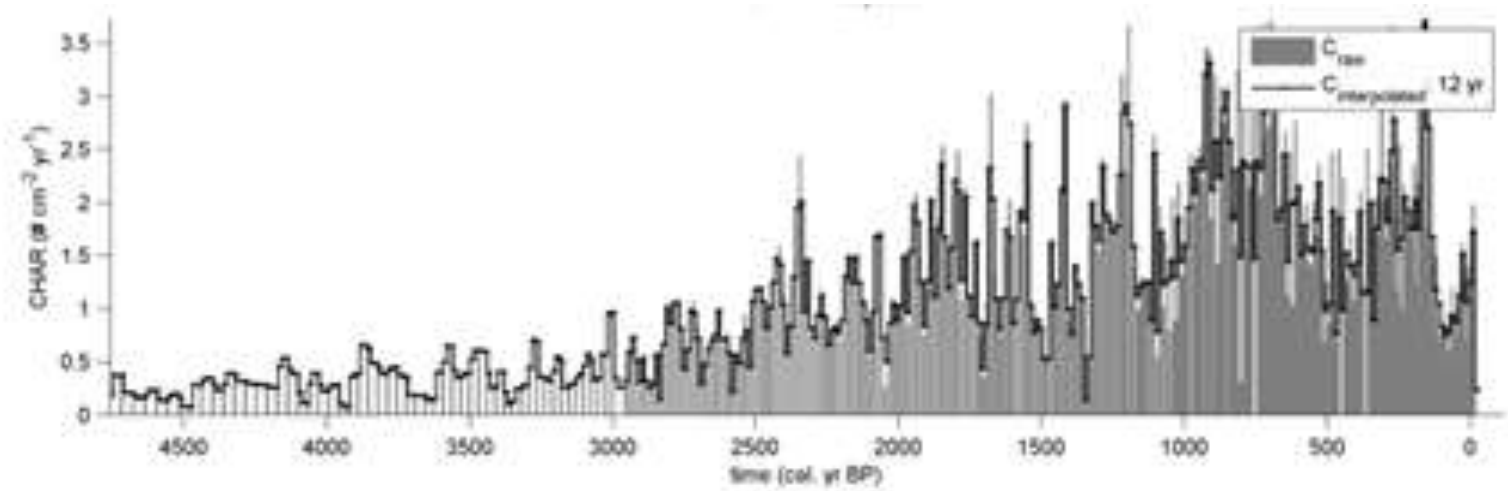


Figure 2. Raw charcoal counts as a function of time over the last 5000 years. ^{C}interpolated (interpolated data) is set at constant time step and data used in actual analysis.

Results

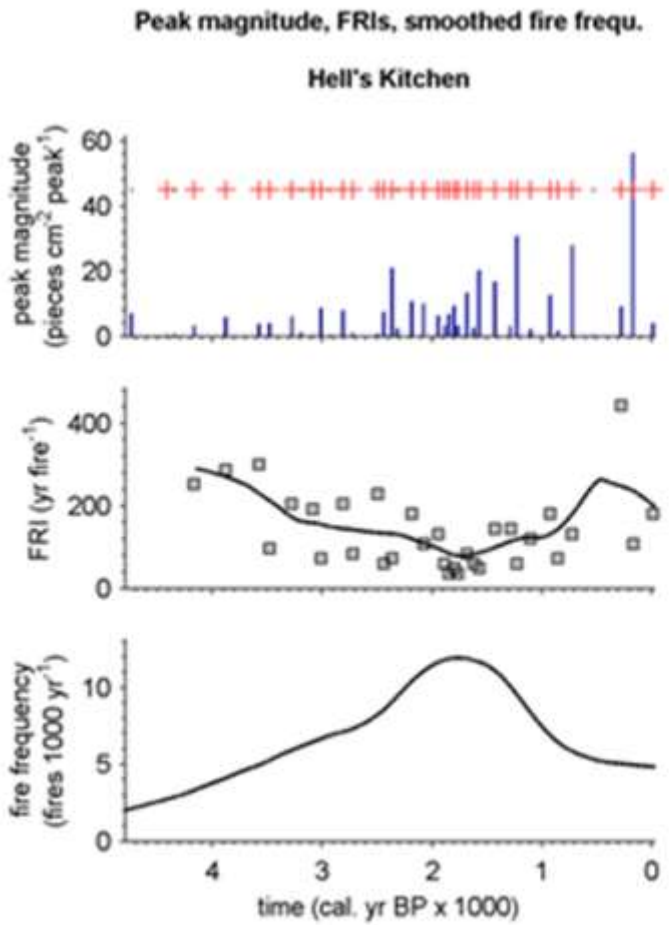


Figure 4. a) relative magnitude of fires, b) Fire Return Intervals (FRI) years per fire c) fire frequency as a function of time)

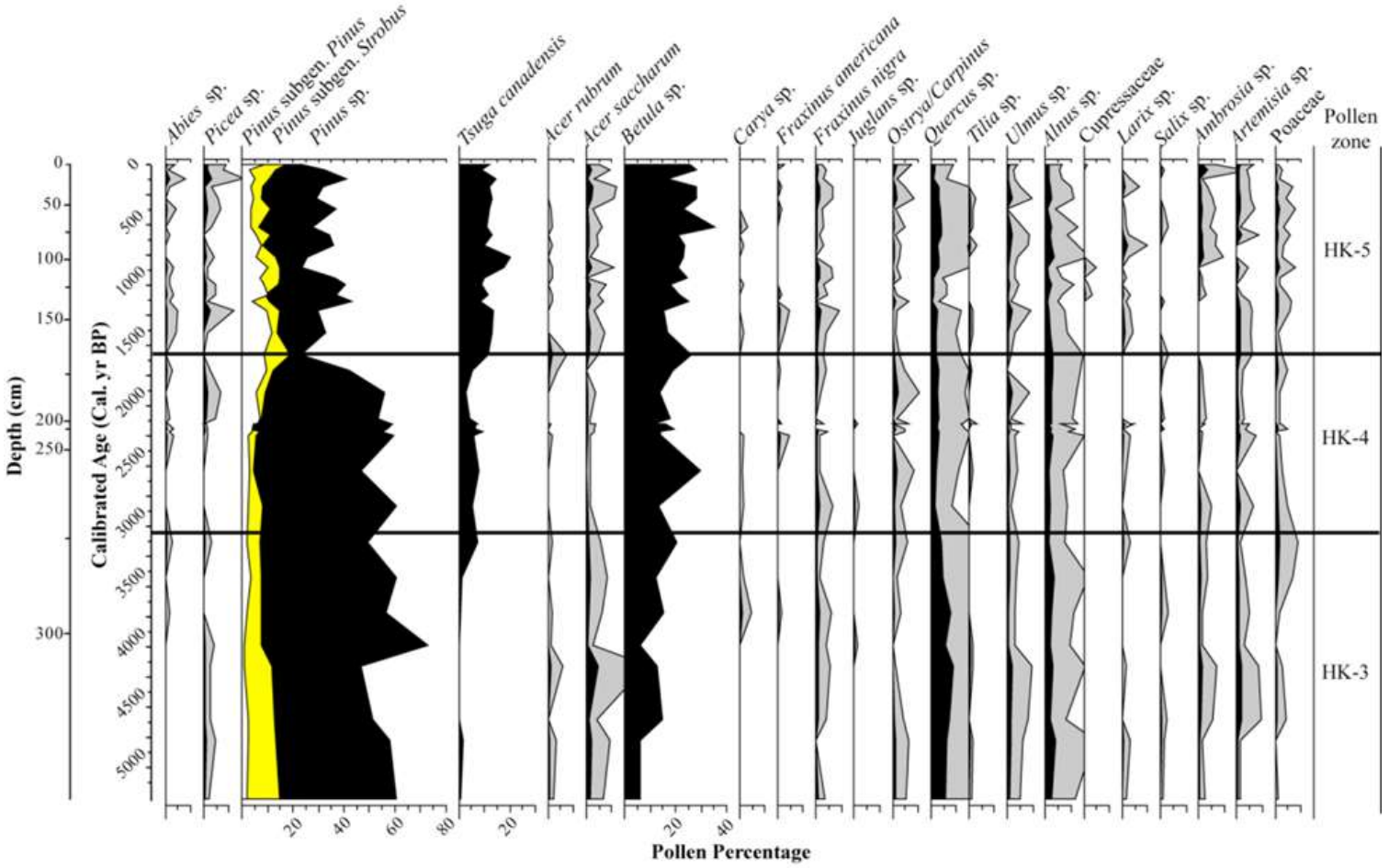
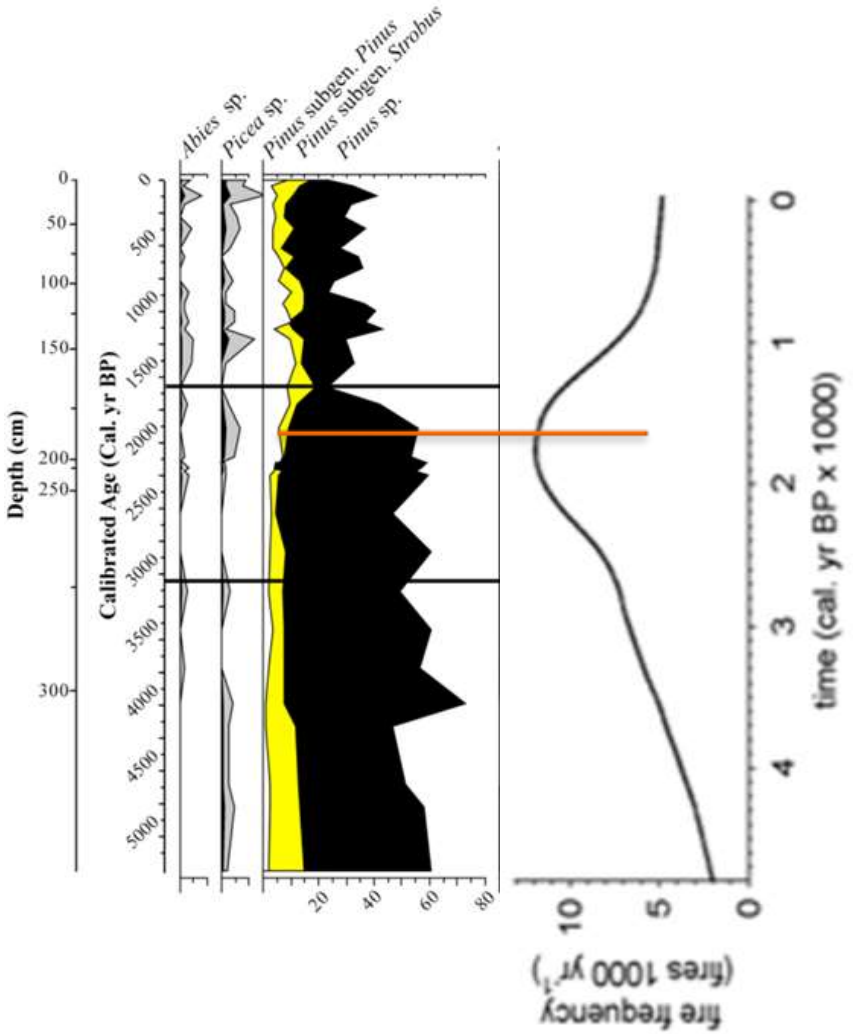


Figure 5. Pollen Percentage Diagram from Hell's Kitchen Lake (Urban 2008)

Results


Abies sp.
Picea sp.
Pinus subgen. Pinus
Pinus subgen. Strobus
Pinus sp.
Depth (cm)
Calibrated Age (Cal. yr BP)
0
50
100
150
200
250
300
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
20
40
60
80
10
5
0
fire frequency
(fires 1000 yr-1)
time (cal. yr BP x 1000)
0
1
2
3
4

Conclusions

- observed peak in fire frequency corresponds with pine pollen and a peak pine maximum
- primarily Pinus strobus (White Pine)
- substantial paper birch
- typical of drier periods and are well adapted to fire in that surface fires typically won't kill trees.
- Paper birch is also well adapted to fire disturbances and severe fires.
- Hemlock, a species more suited to wetter conditions, was low during this period of high fire and pine abundance.
- Thus these correlations may represent a transient dry phase in the area of Hell's Kitchen characterized by increased fire frequency.

Conclusions (cont.)

- Prior studies suggested large-scale droughts during the Holocene, in particular around 4200 years ago (Booth et al. 2005).
- Fire frequency, though increasing, was relatively low around 4200 years ago
- trend towards increasing fire frequency in the late Holocene that peaks about 2000 years ago
- Sharp decline about 1400 years ago.


Questions?
Thank You