Paleolimnology and Urbar Sediments: What's in the Bottom of Urban Basins

AUBURN
UNIVERSITY

Dr. Matt Waters, Associate Professor, Environmental Science
Savanna Wooten - PhD Candidate, Auburn University
Dr. Benjamin C. Webster, Postdoctoral Fellow, USDA

How are populations moving?

Urbanization

1900 | 2 out of every 10 people lived in an urban area

1990 | 4 out of every 10 people lived in an urban area

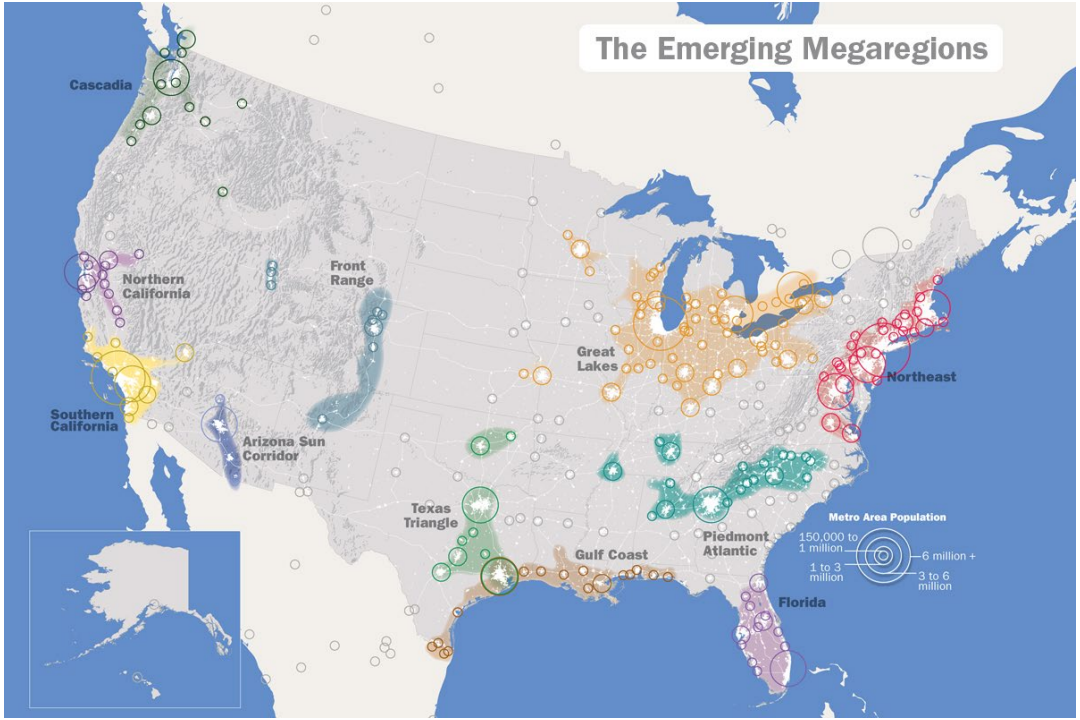
2010 | 5 out of every 10 people lived in an urban area

2030 | 6 out of every 10 people will live in an urban area

2050 | 7 out of every 10 people will live in an urban area

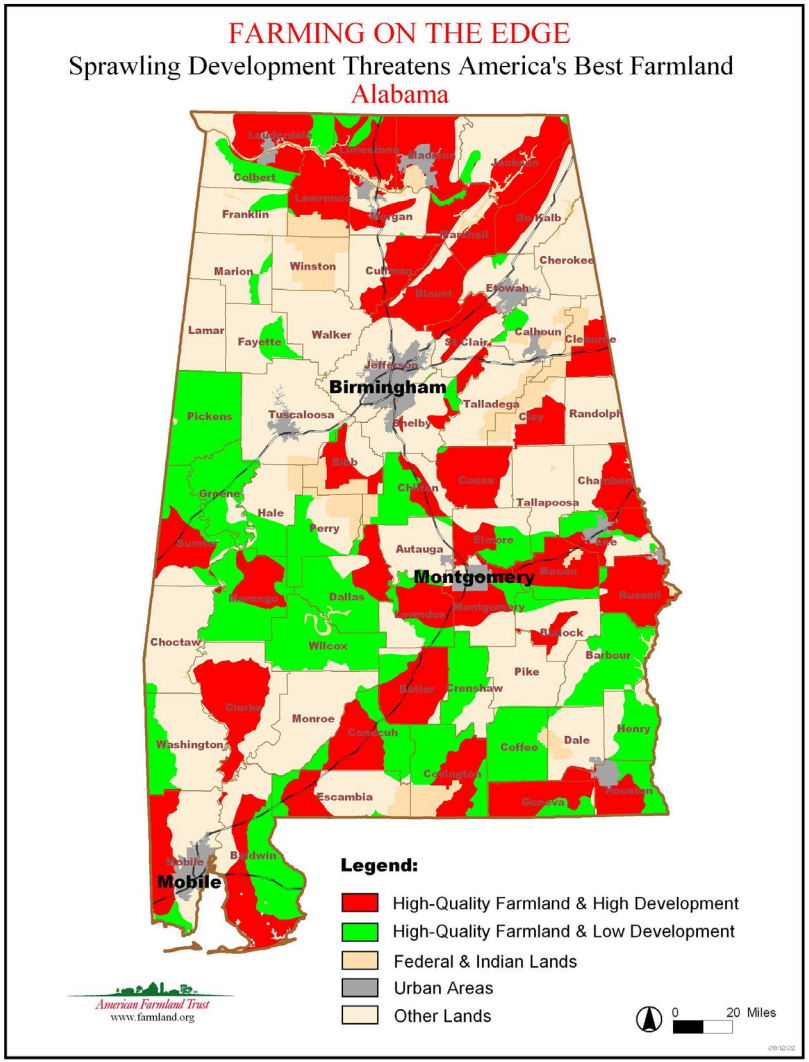
Defined by UN HABITAT as a city with a population of more than 10 million

Urban Expansion in the US

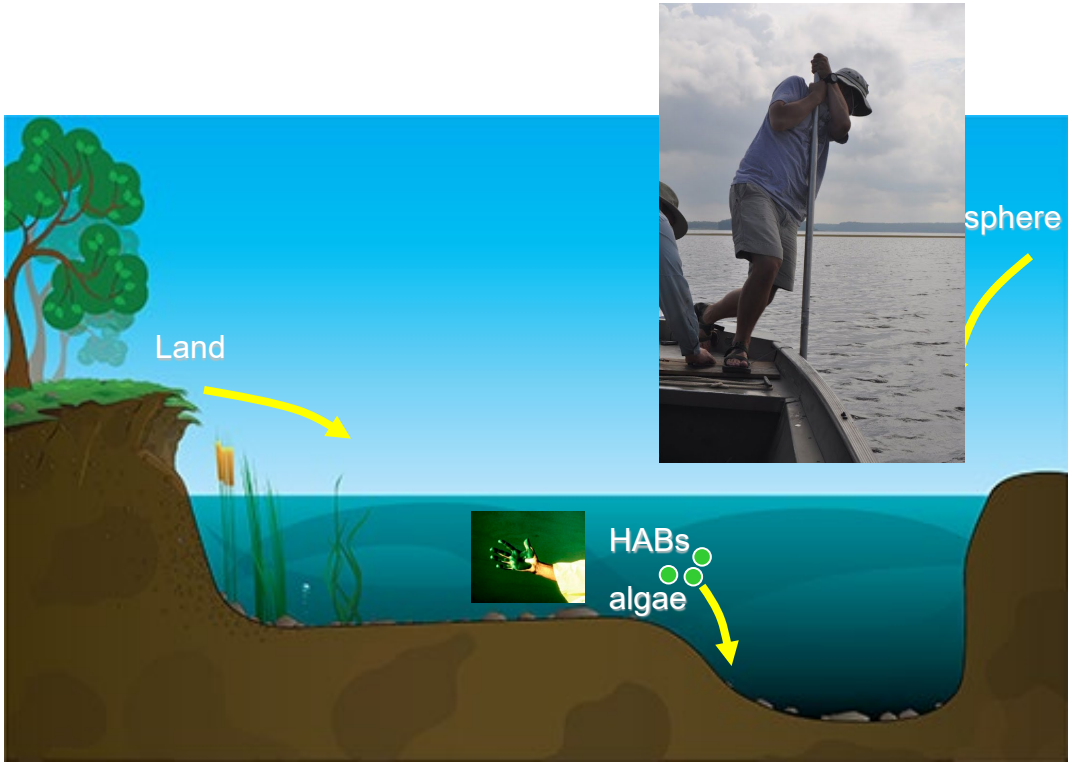


Alabama Land Use (1950 1997) USDA Stats

The need to better understand the connections of urban landscapes and water through time



Paleolimnology



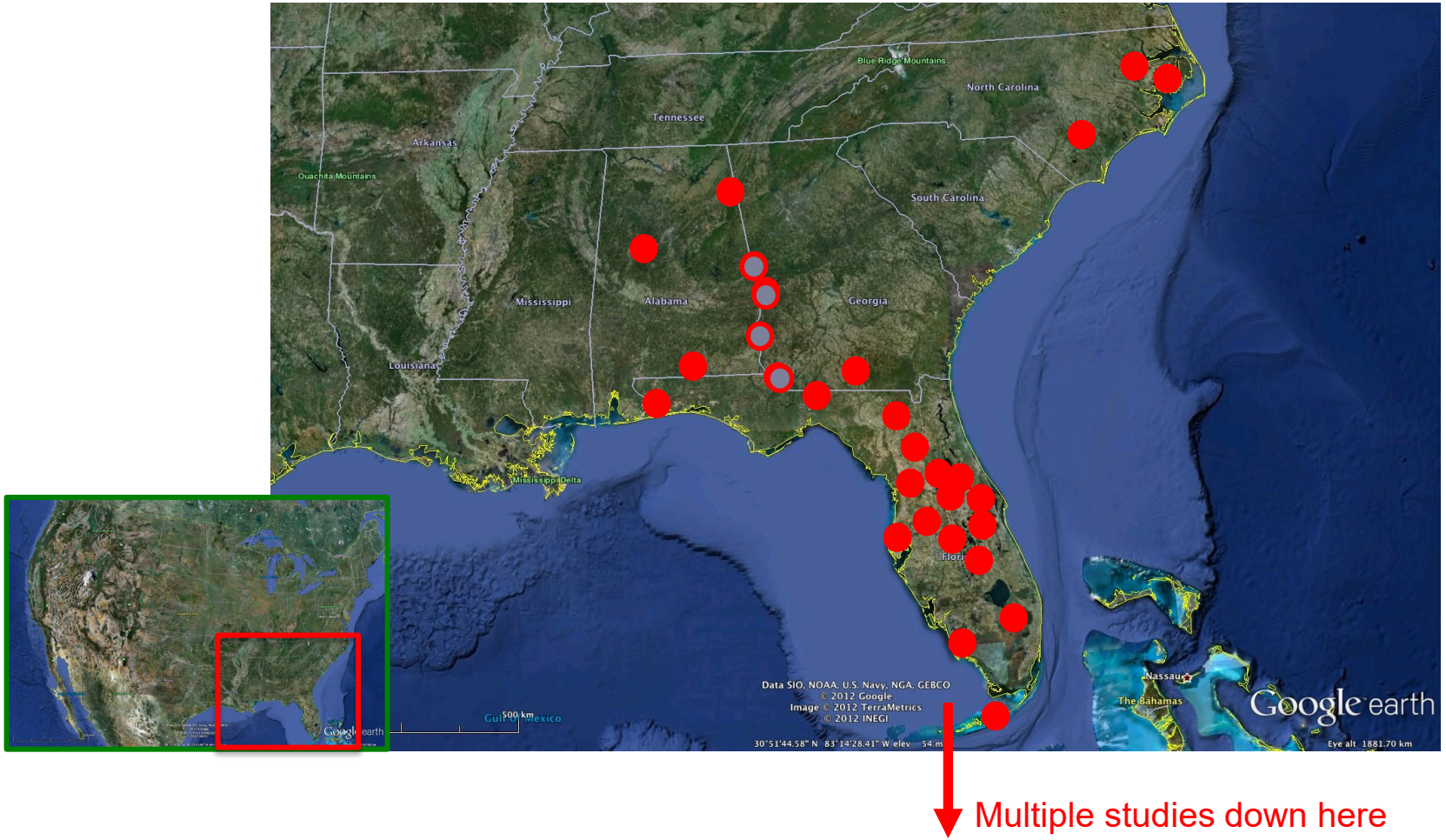
Nutrients (C,N,P)

Heavy Metals

Cyanobacteria-Pigments

Cyanotoxins-toxins

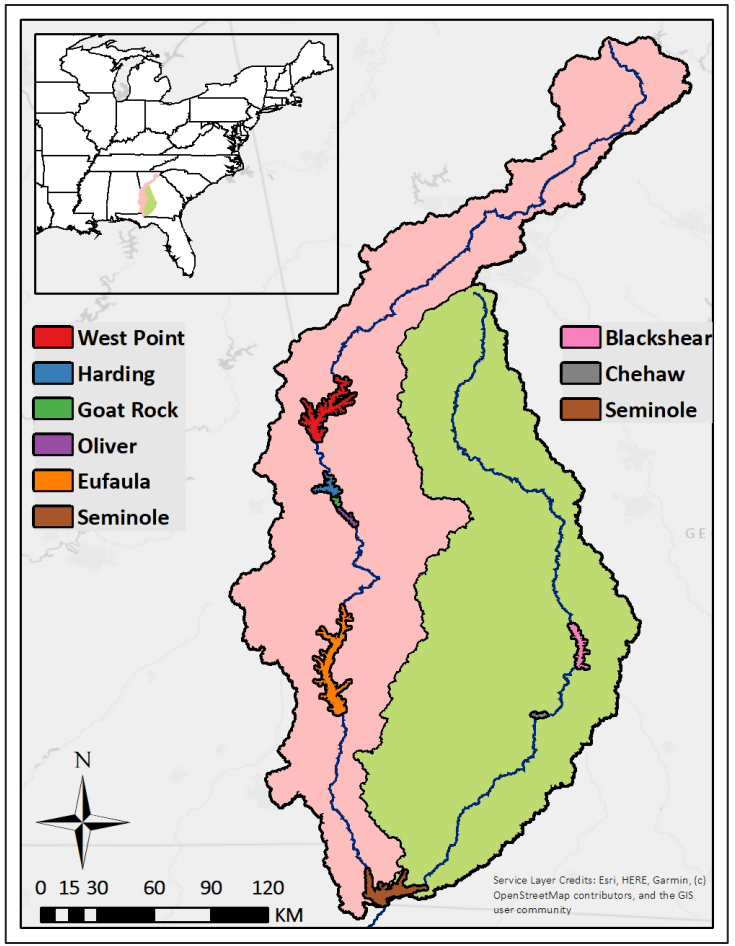
Auburn PaleoEnvironmental Lab: Where we work



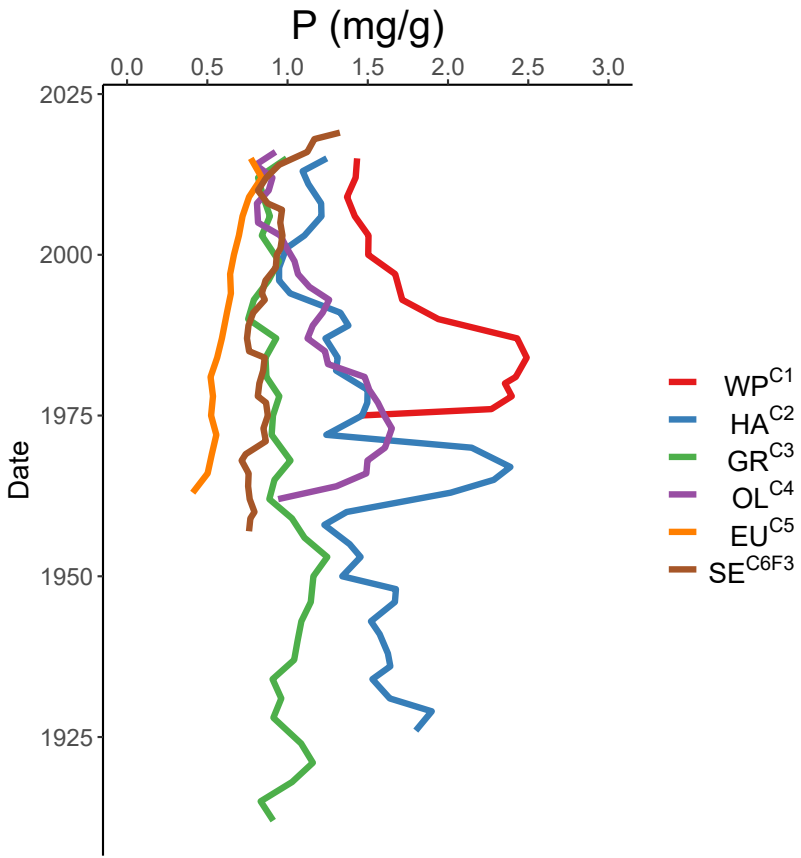
Multiple studies down here

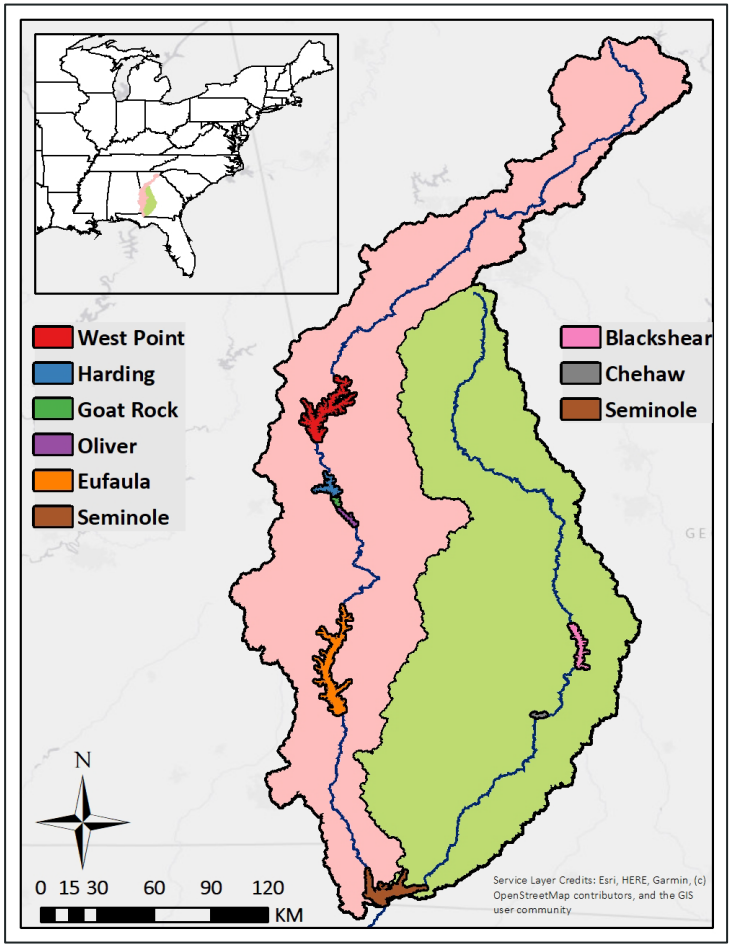
ACF Reservoir System

- West Point Lake (WP^{C1})- 1975
- Lake Harding (HA^{C2}) - 1926
- Goat Rock Lake (GR^{C3})- 1912
- Lake Oliver (OL^{C4}) – 1962
- Lake Eufaula (EU^{C5}) – 1963
- Lake Seminole (SE_Chatt^{C6})-1957



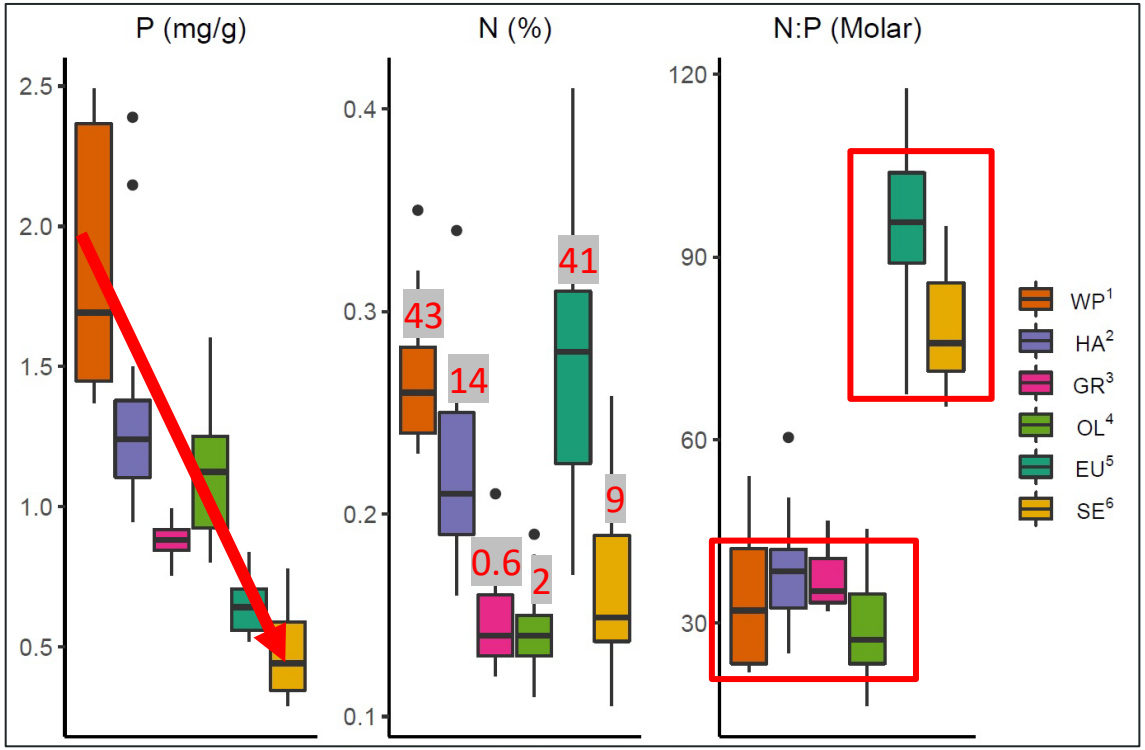
Chattahoochee





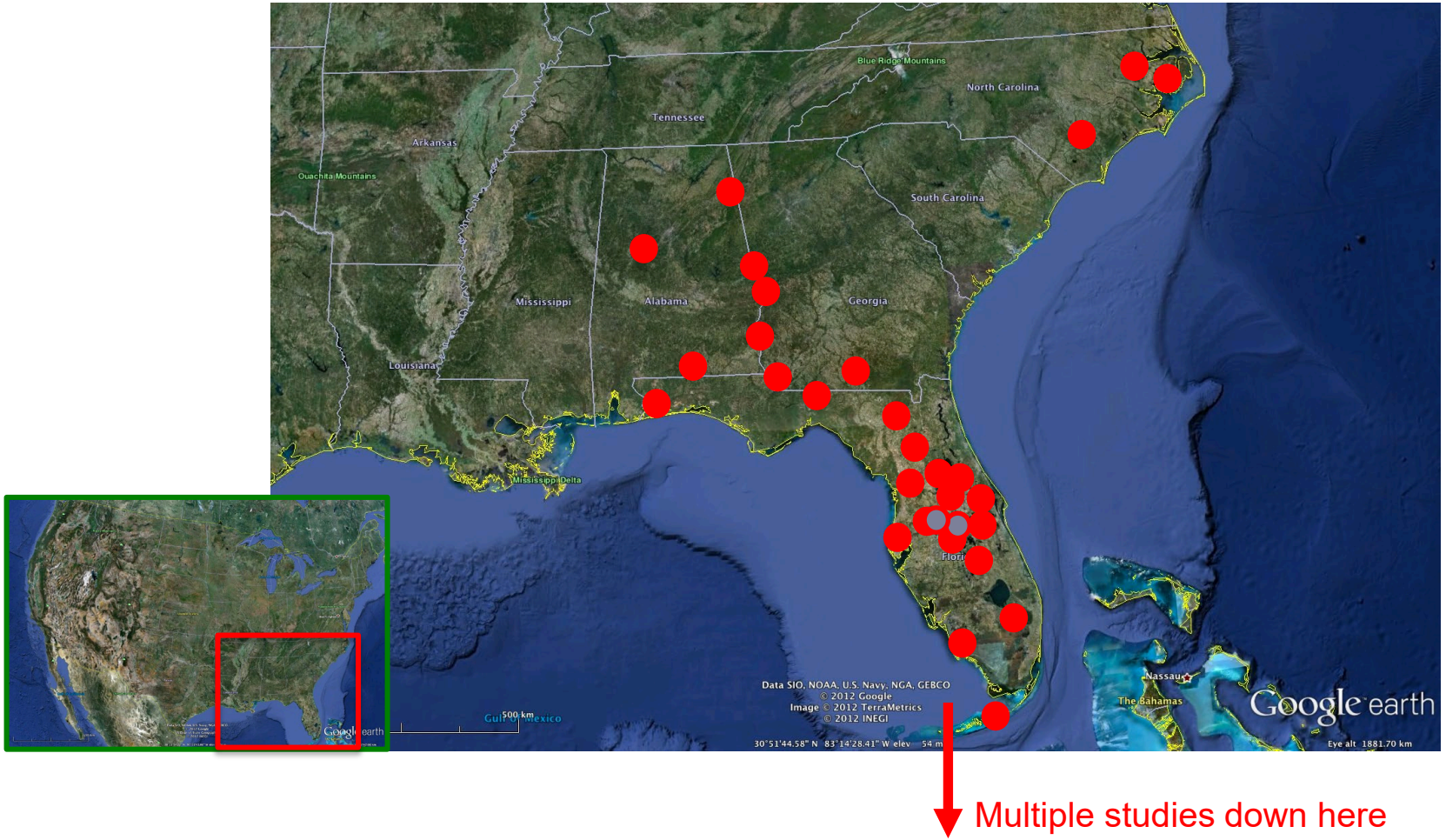
Urban Watershed Trends

- P driven by geographic order (initial reservoir)
- N driven by retention time
  - Finlay et al. 2013
  - Webster et al. 2024
- Possible relationship of N:P indicates differences between land use and processing



Webster et al. 2021

Auburn PaleoEnvironmental Lab: Where we work



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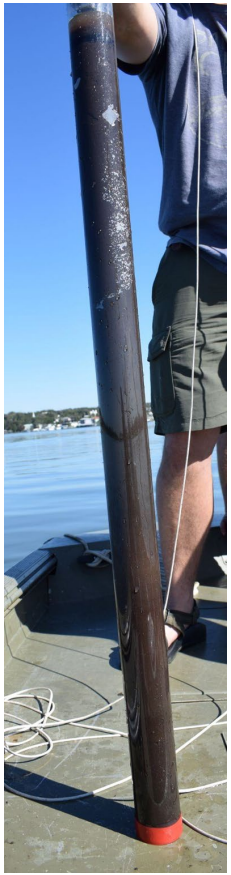
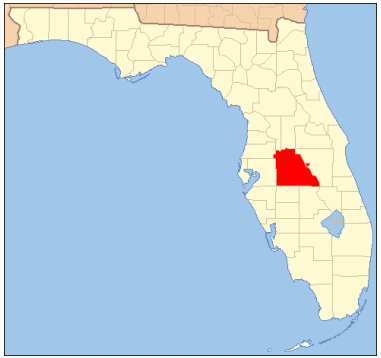
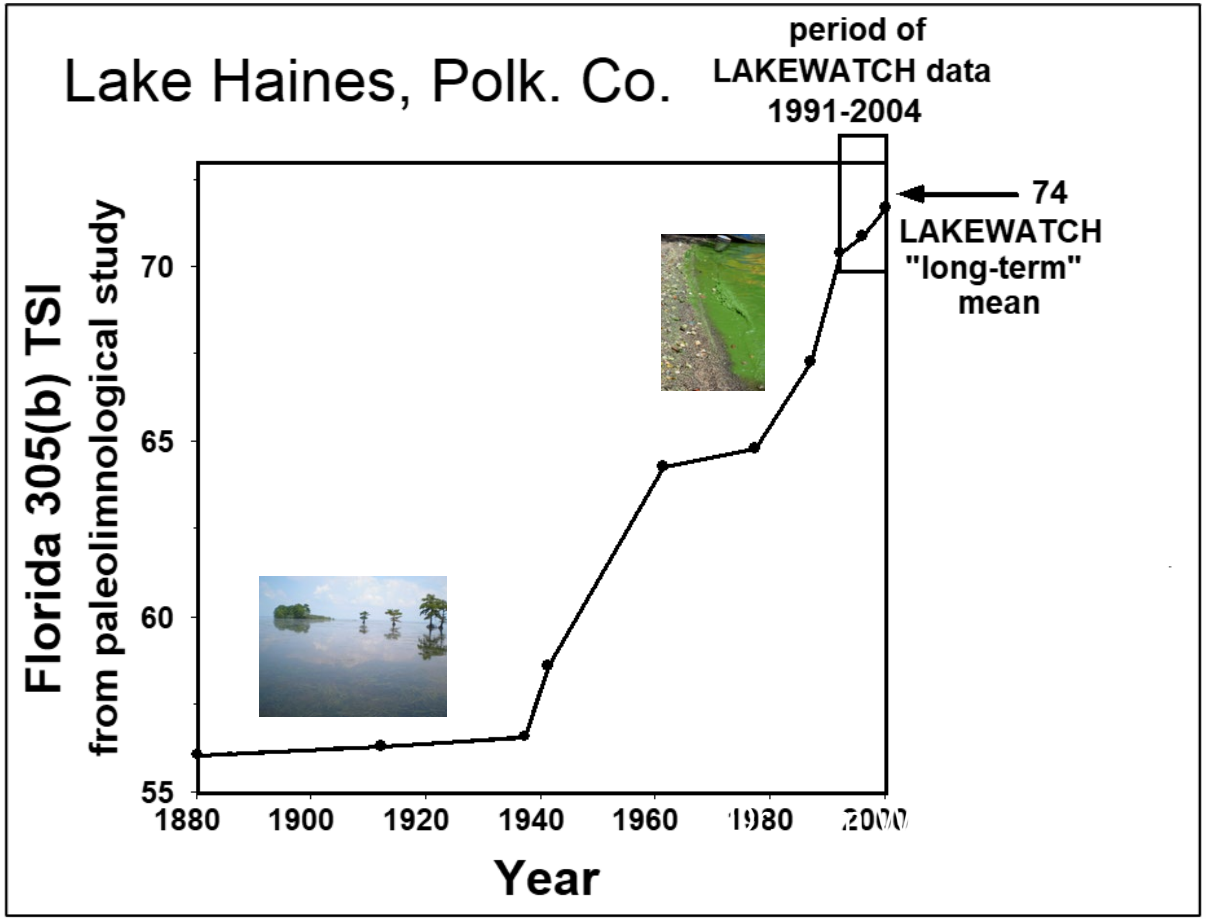
CONTEXTUALIZING URBAN CHANGE: Polk Country Florida

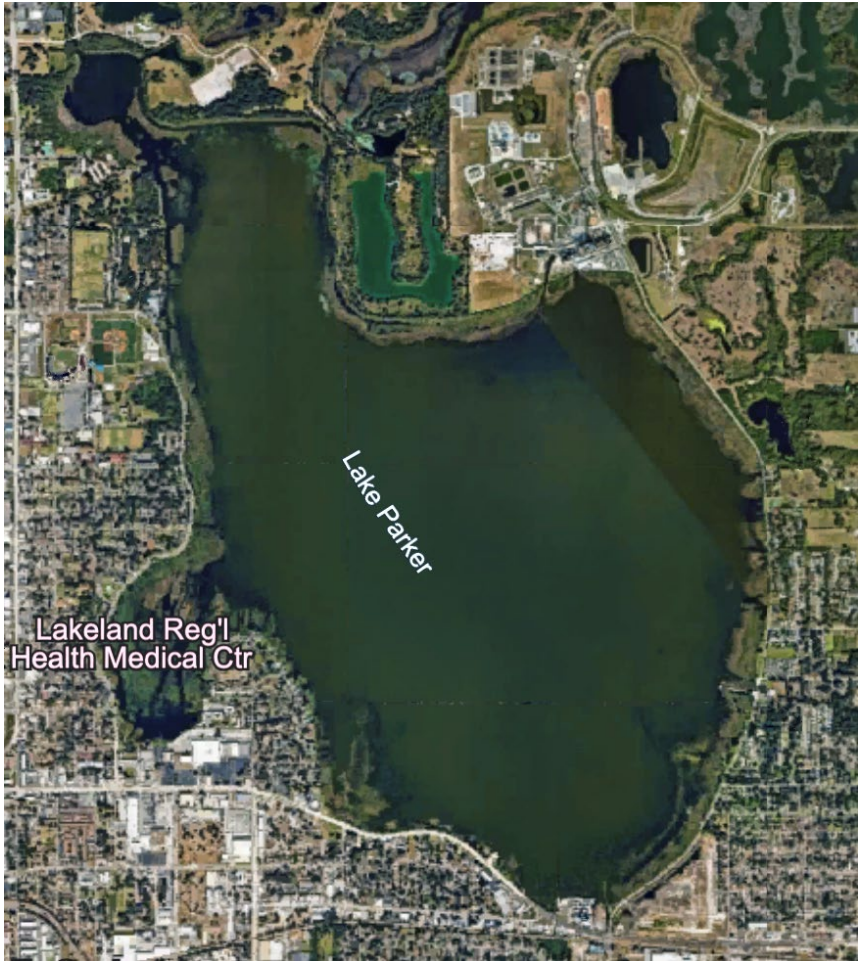




The Need for Time



LAKE PARKER



LAKE HOWARD

LAKE PARKER

- SA = 853 ha
- Mean depth = 1.5 m
- 63.4% of watershed anthropogenic land use
- Phosphate mining (1967-1983)
- Power plant outflow (1978-present)
- Wastewater plant outflow (1986-present)
- Stormwater retrofit (2004)
- Hydrilla herbicide treatment (2019)

LAKE HOWARD

- SA = 251 ha
- Mean depth = 3.4 m
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- Point source discharge from Jan Phyl Village (1953-1977)
- Alum injection (1999-present)
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Urban

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Impacts

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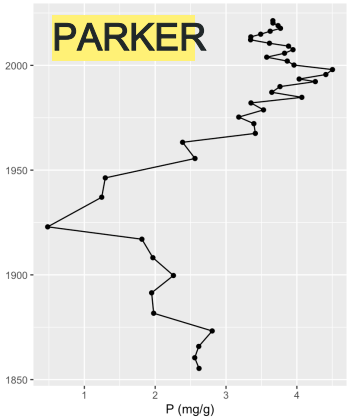
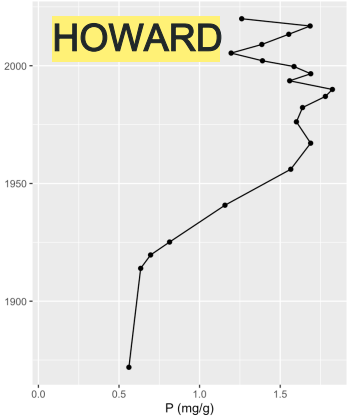
Management

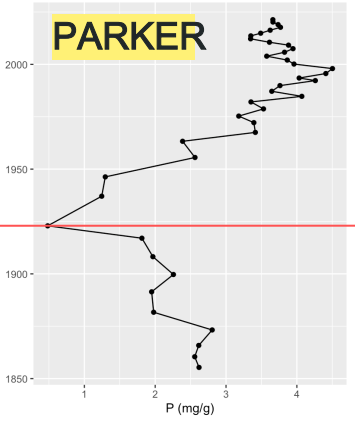
PARKER AND HOWARD PROFILES

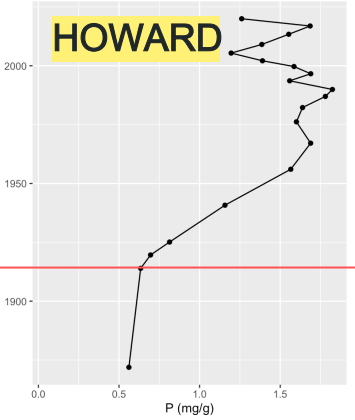




NUTRIENTS

PARKER AND HOWARD PROFILES





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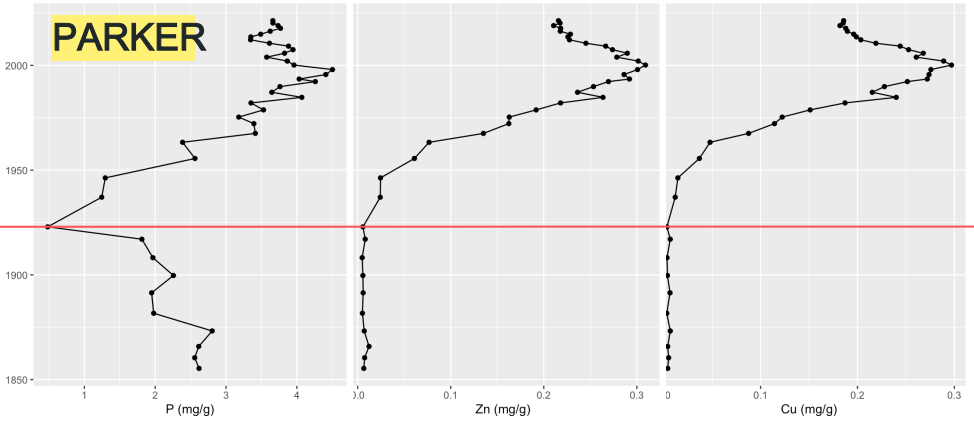

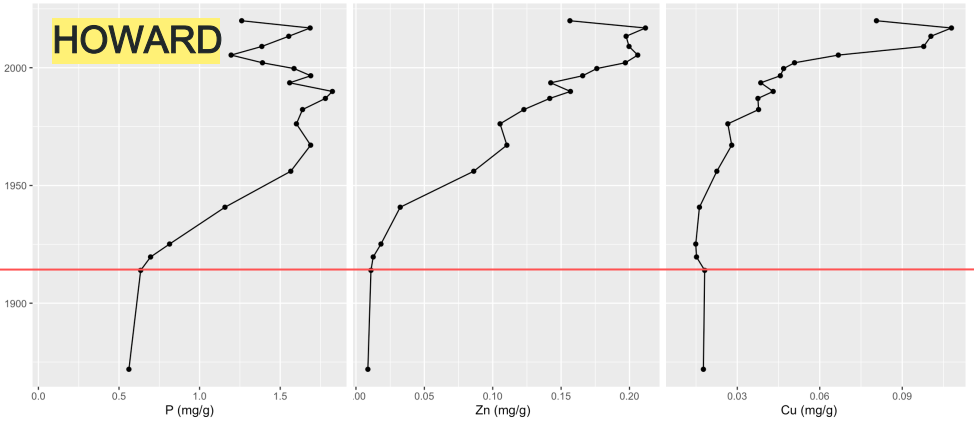

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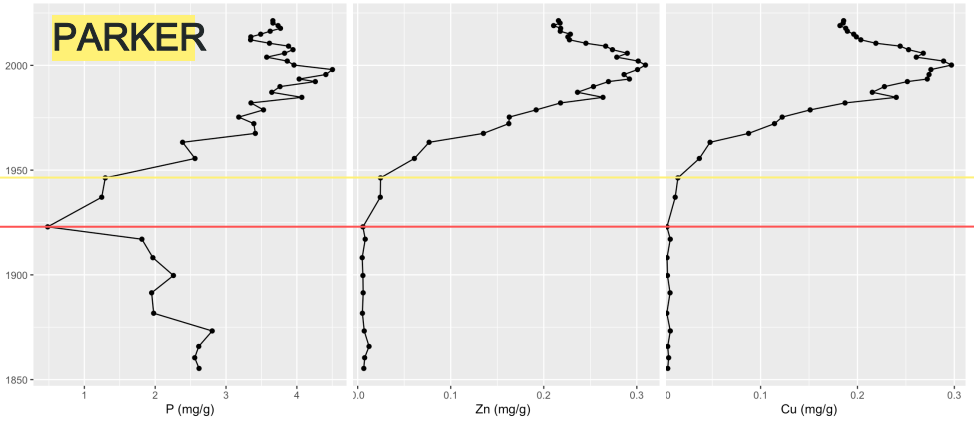
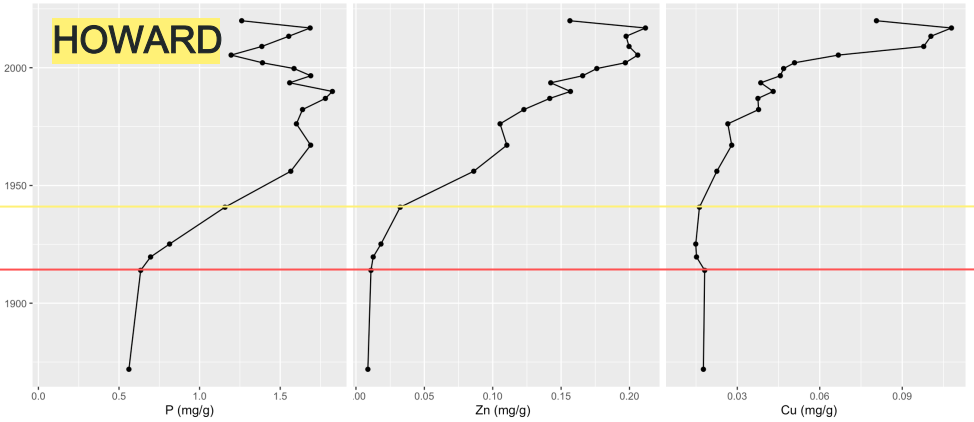
HEAVY METALS

PARKER AND HOWARD PROFILES





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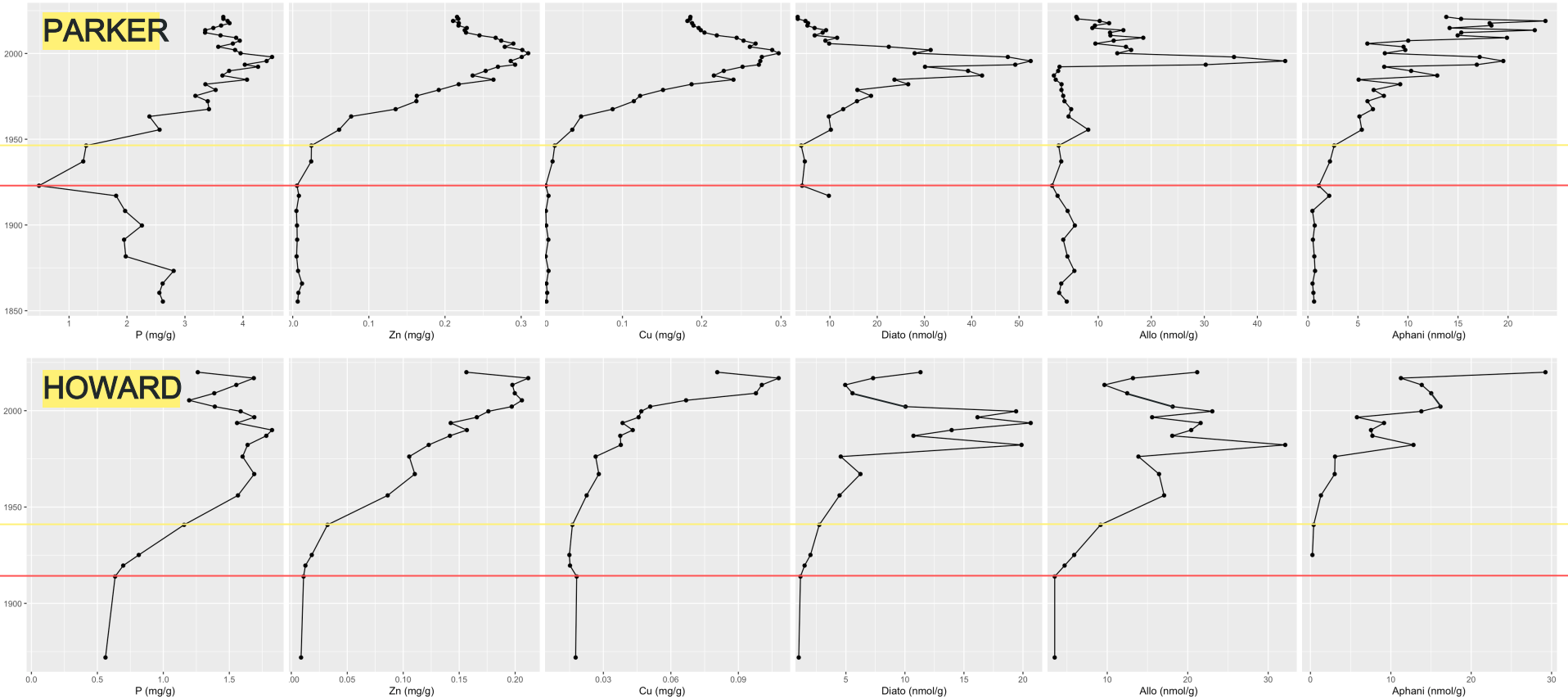

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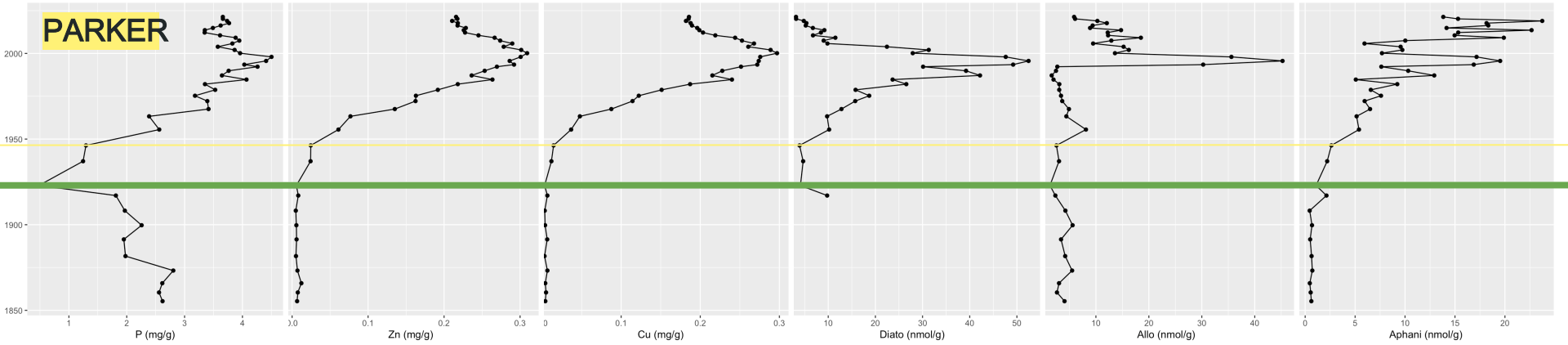
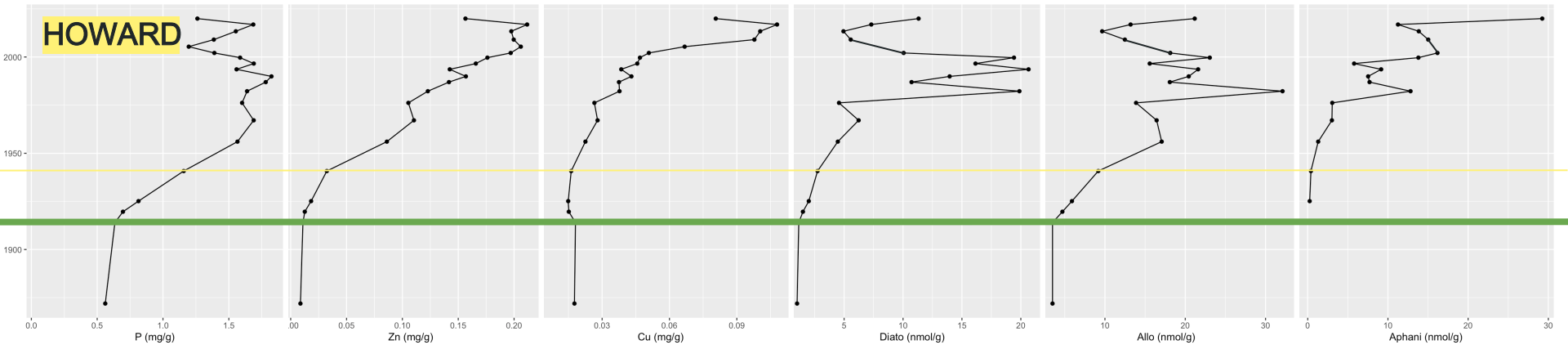
HEAVY METALS

ALGAE/CYANOS

PARKER AND HOWARD PROFILES





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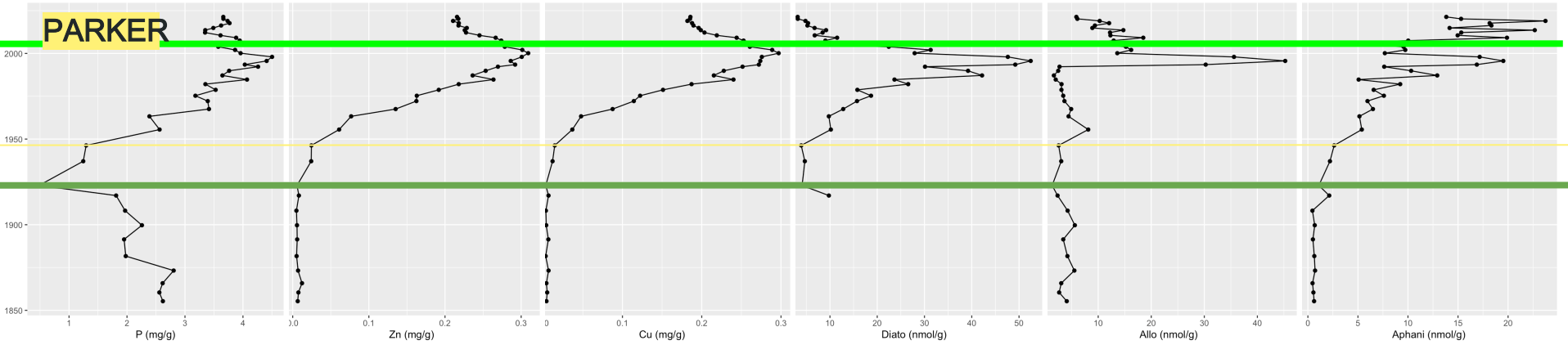
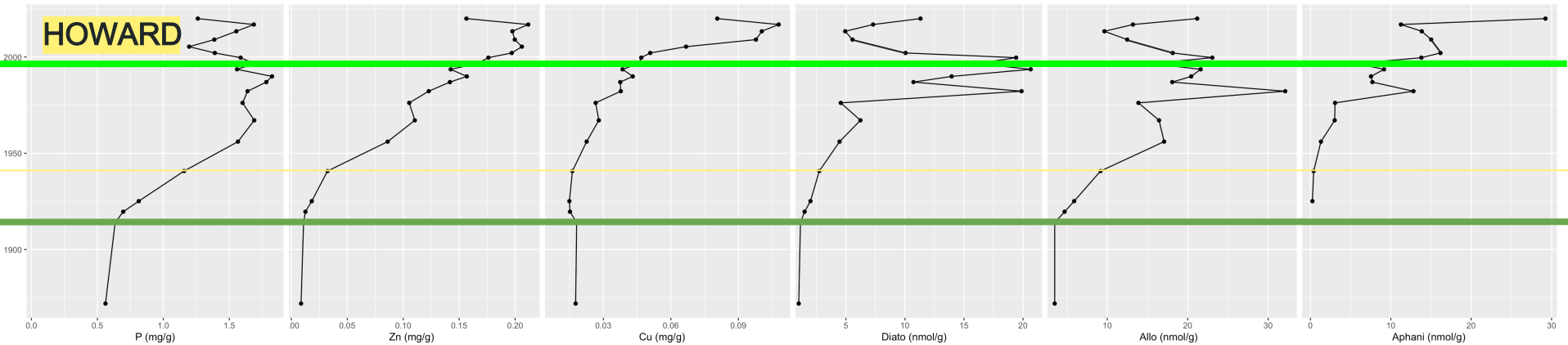




NUTRIENTS

HEAVY METALS

ALGAE/CYANOS

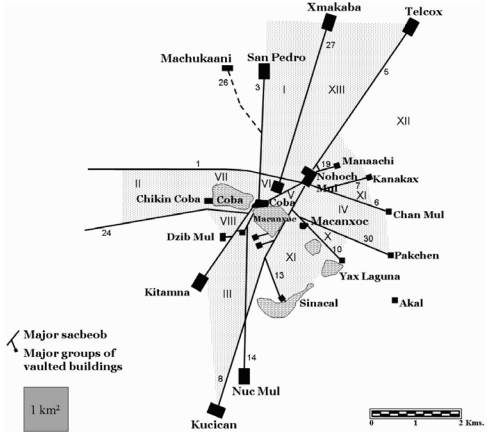
TAKEAWAYS

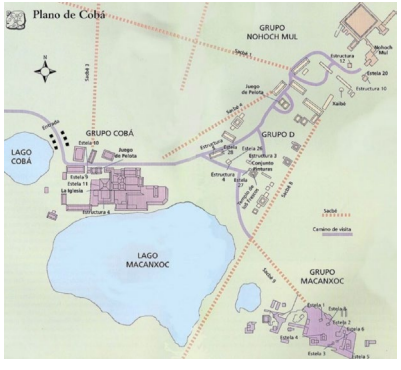
- Canals serve as the primary driver of material input
- Population growth relates to heavy metal inputs

- Cyanobacteria continue to dominate despite management efforts

- What does recovery look like?

COBA, QUINTANA ROO, MEXICO





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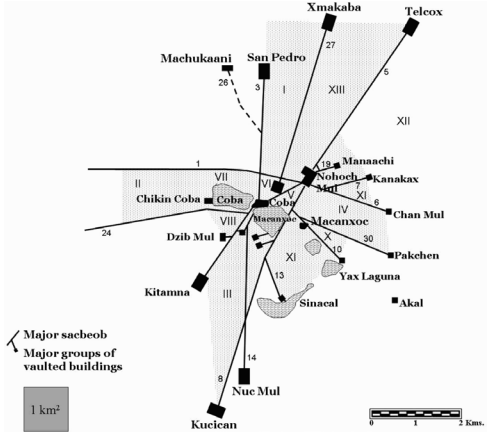
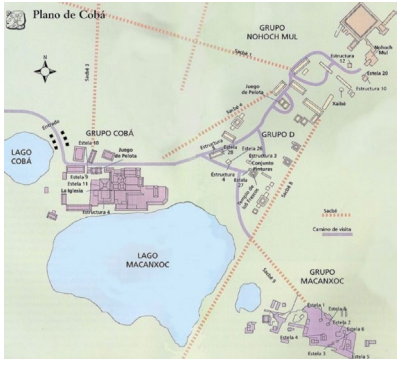
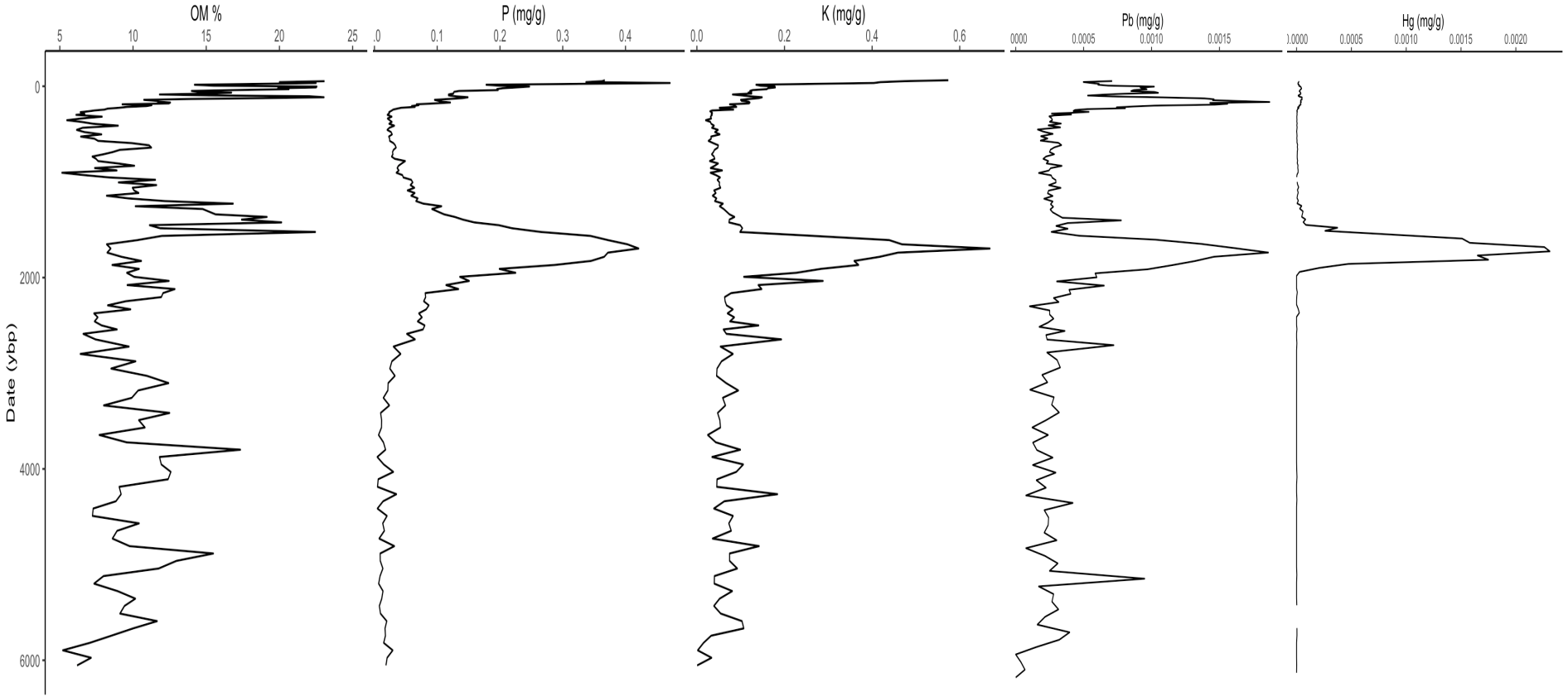




LAKE COBA PROFILES



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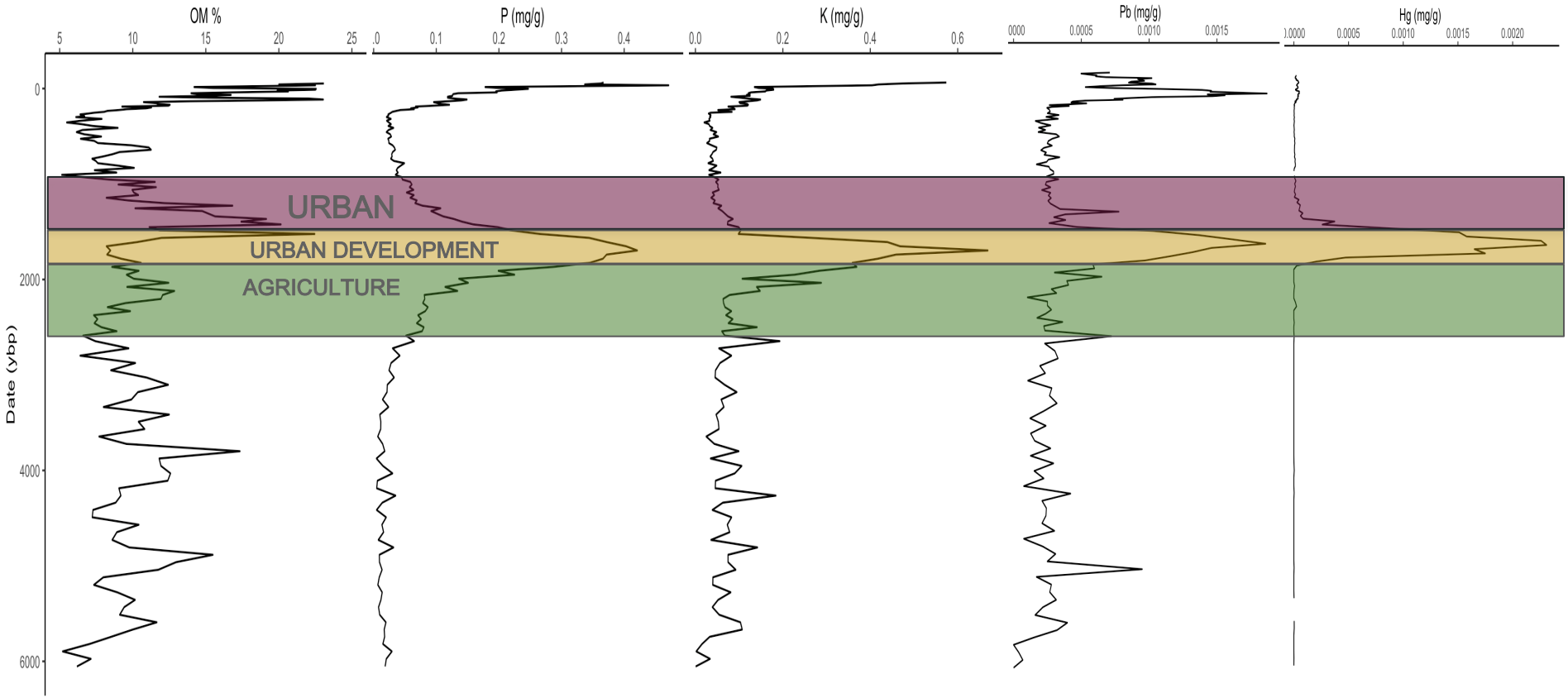


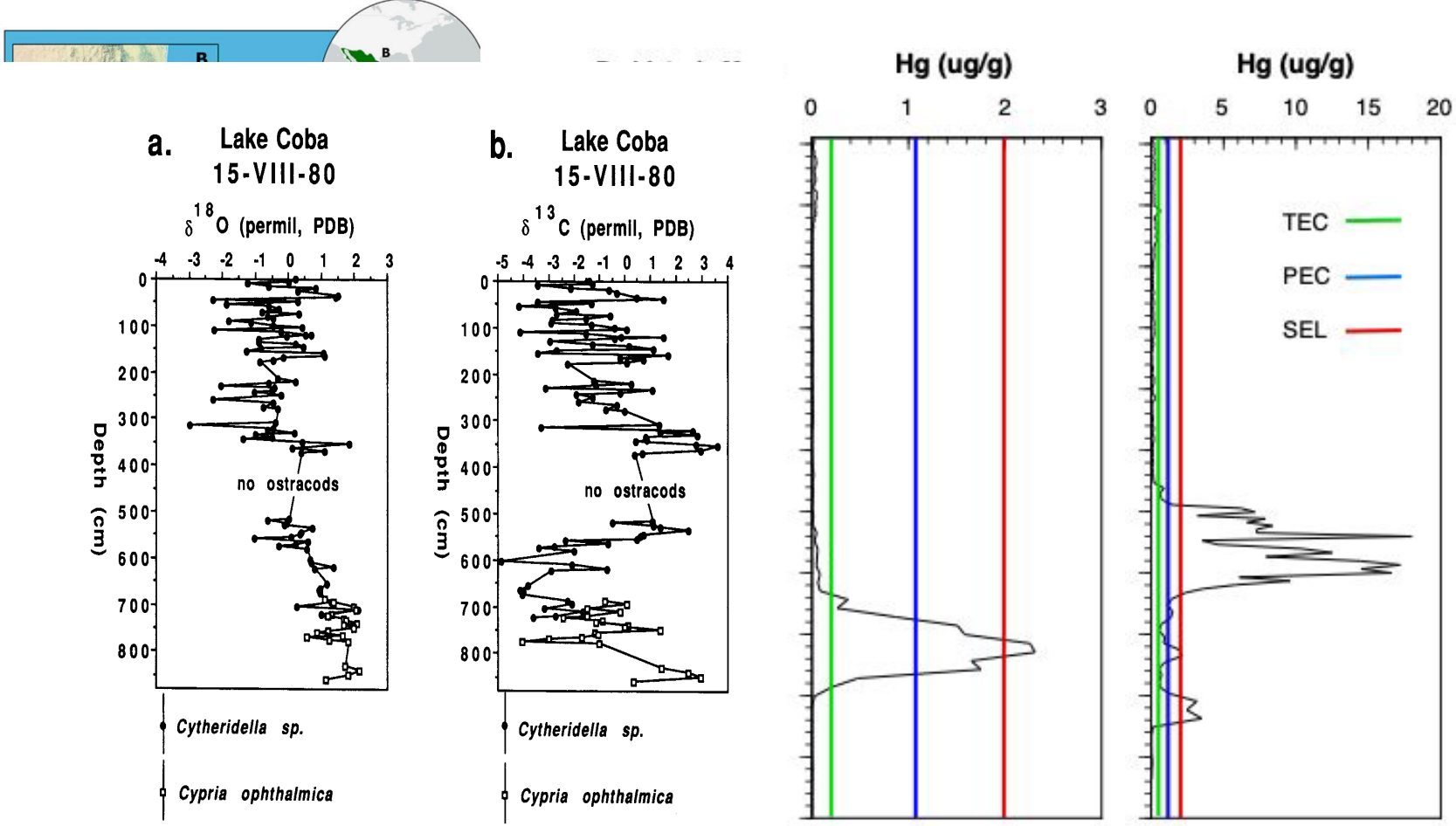
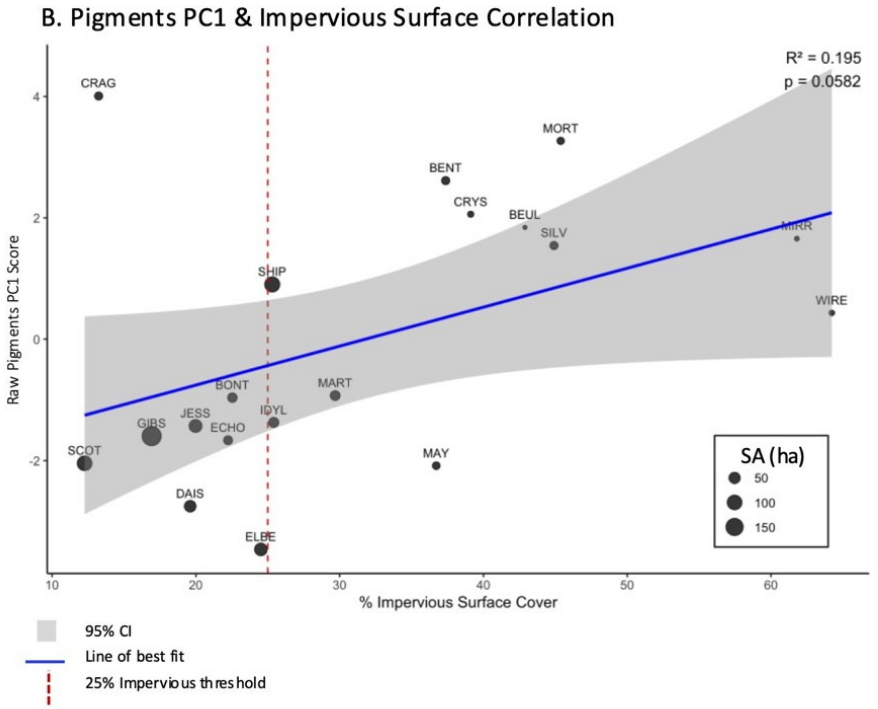


Figure 5 $\delta^{18}O$ (a) and $\delta^{13}C$ (b) ratios in ostracod valves from Coba core 15-VIII-80.

Whitmore et al. 1996

Summary and Next Steps

- Sediments are a needed addition to urban material movement (storage, accumulation, addition to monitoring)
- Paleolimnology provides knowledge of time, drivers, management impacts
- Knowledge is needed on quantifying accumulation and BGC transformation of urban materials post deposition
- Next Steps: Surface Sediments



Thanks?

The Joseph W. Jones Ecological Research Center at Ichauway

USGS

Matt Waters email:
mwaters@auburn.edu