Utah Lake Paleolimnology: Update December, 2019

Brahney et. al.
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Task 1 : **Sampling and Analysis Plan – Completed**
Task 2a : **Collect Cores – Completed**
: Initial Cores Description (2020)
Task 3 : Analyze Cores – Ongoing
Task 4 : Inferred historical conditions – **1 core complete**
Task 4 : Report (2020)

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<u>Initial Cores</u>

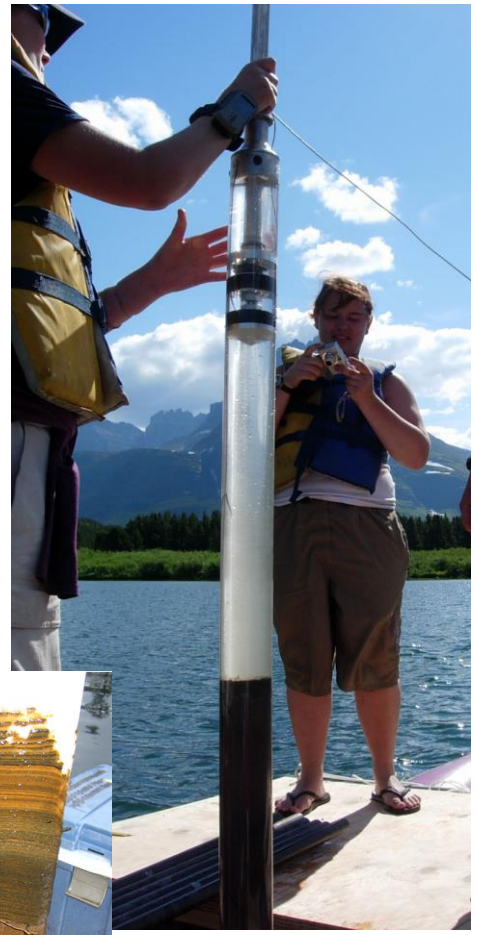
- Bird Island (A, B) ✓
- Goshen Bay ✓
- Provo Bay X

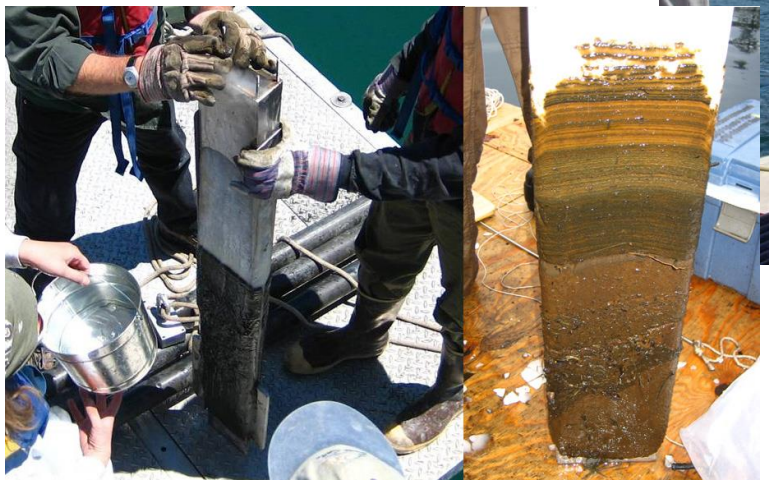
<u>2019 Cores</u>

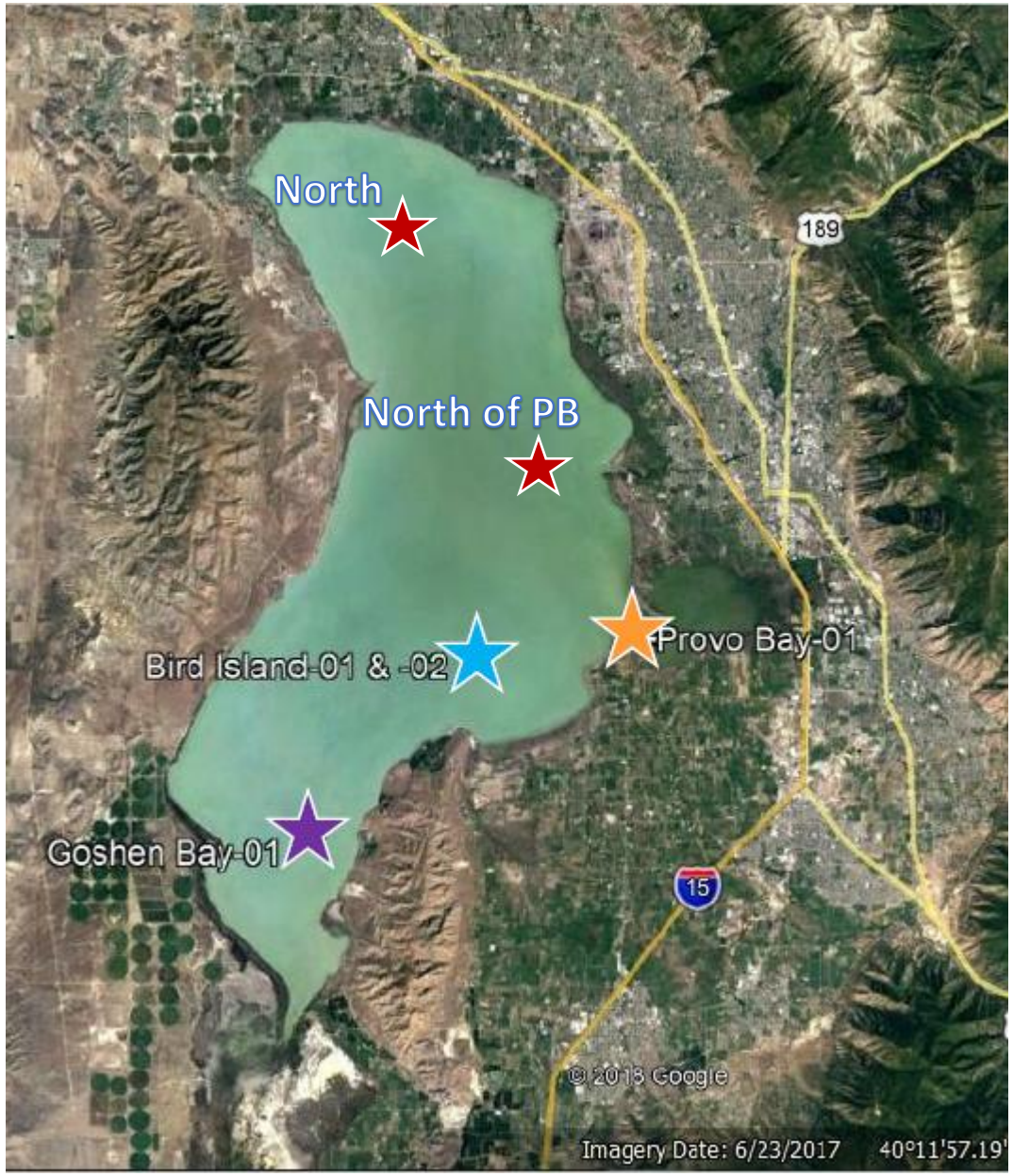
- North
- North of Provo Bay

<u>2020</u>

- Provo Bay







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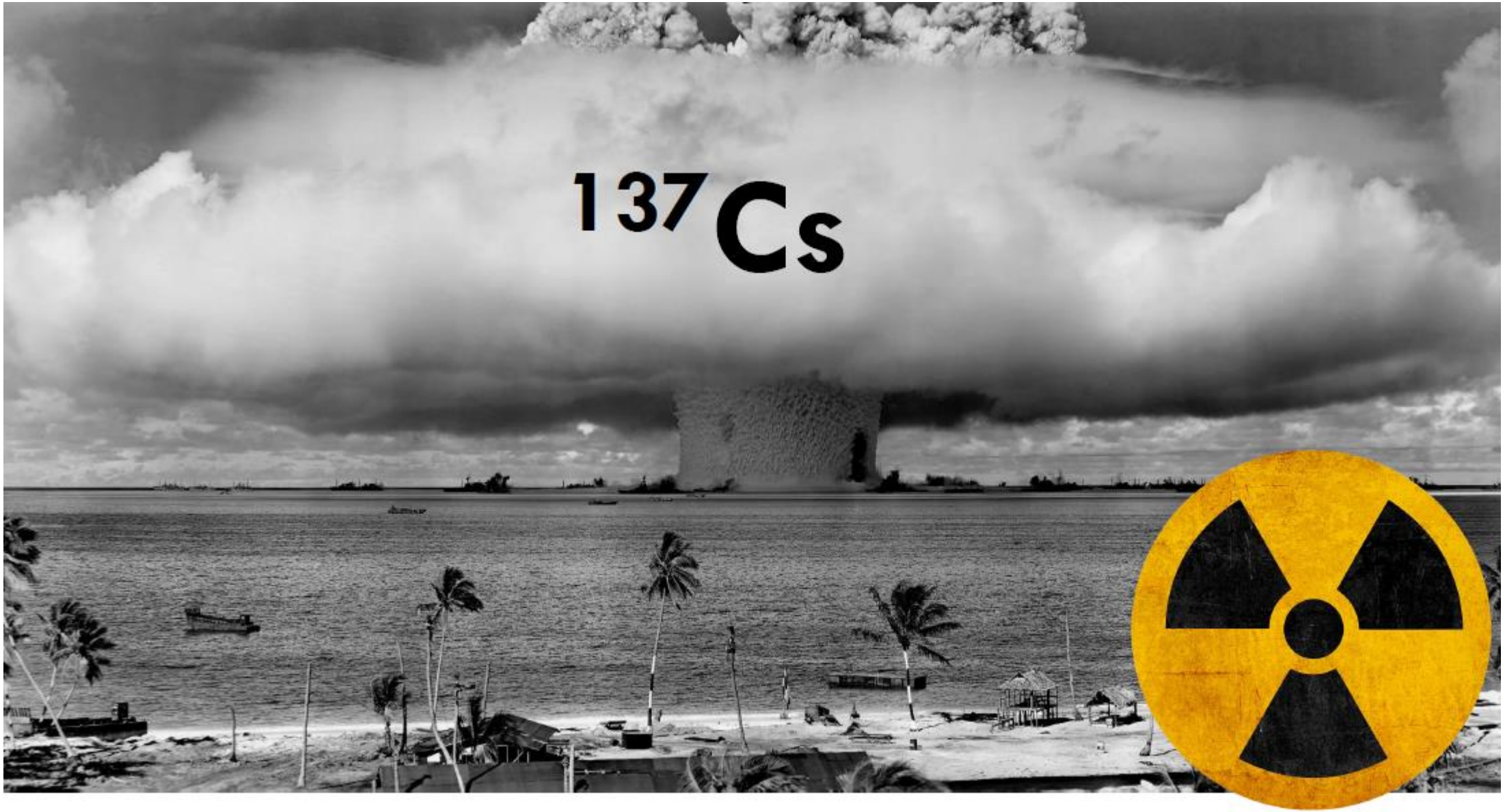
Dating



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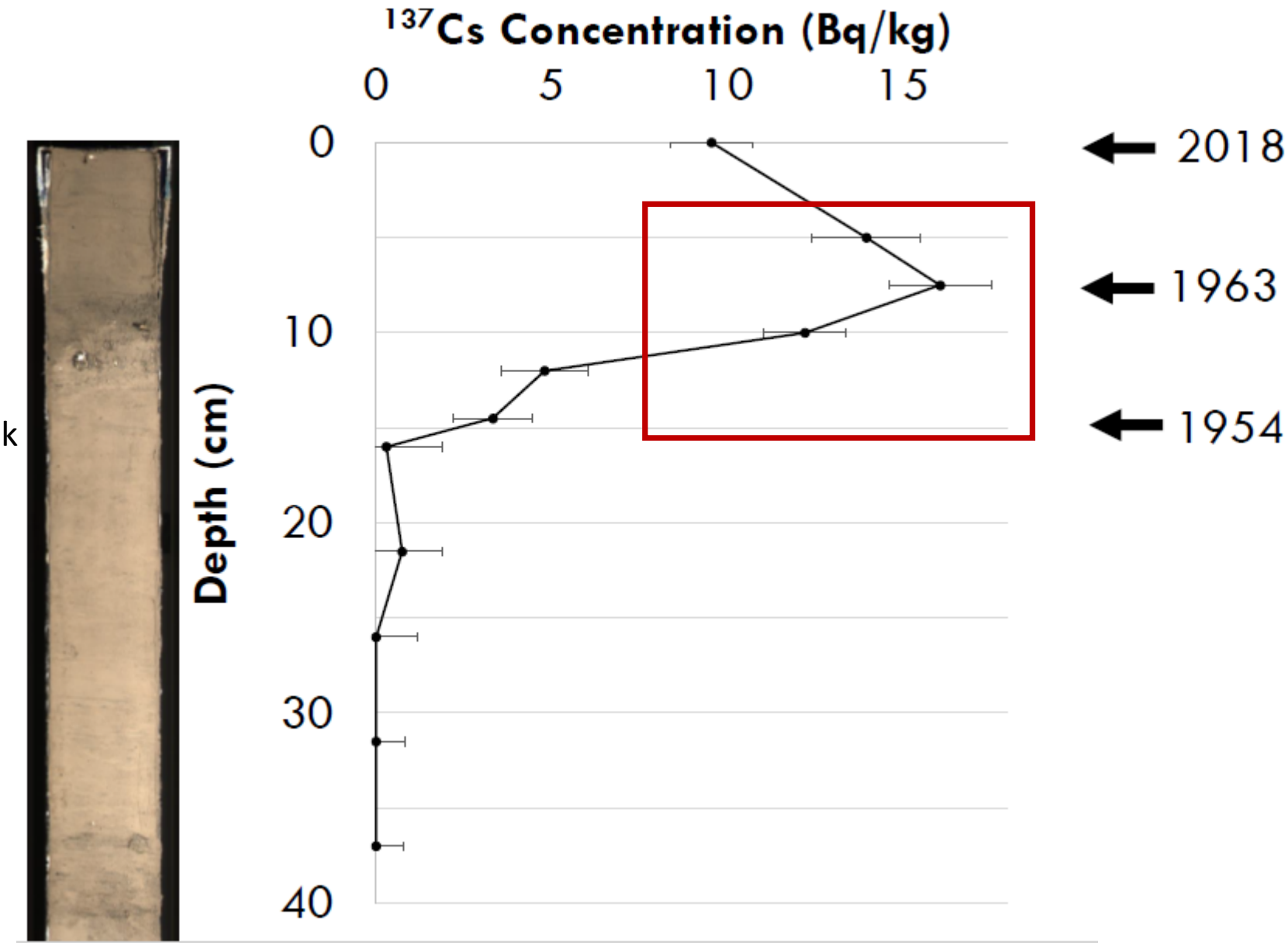
Dating

Goshen Bay - complete

- ^{210}Pb not usable (Low production in desert environments)
- ^{137}Cs - clean record
- ^{14}C for older sediments

Submitted

- ^{137}Cs for BI and PB
- Sample at higher density around peak



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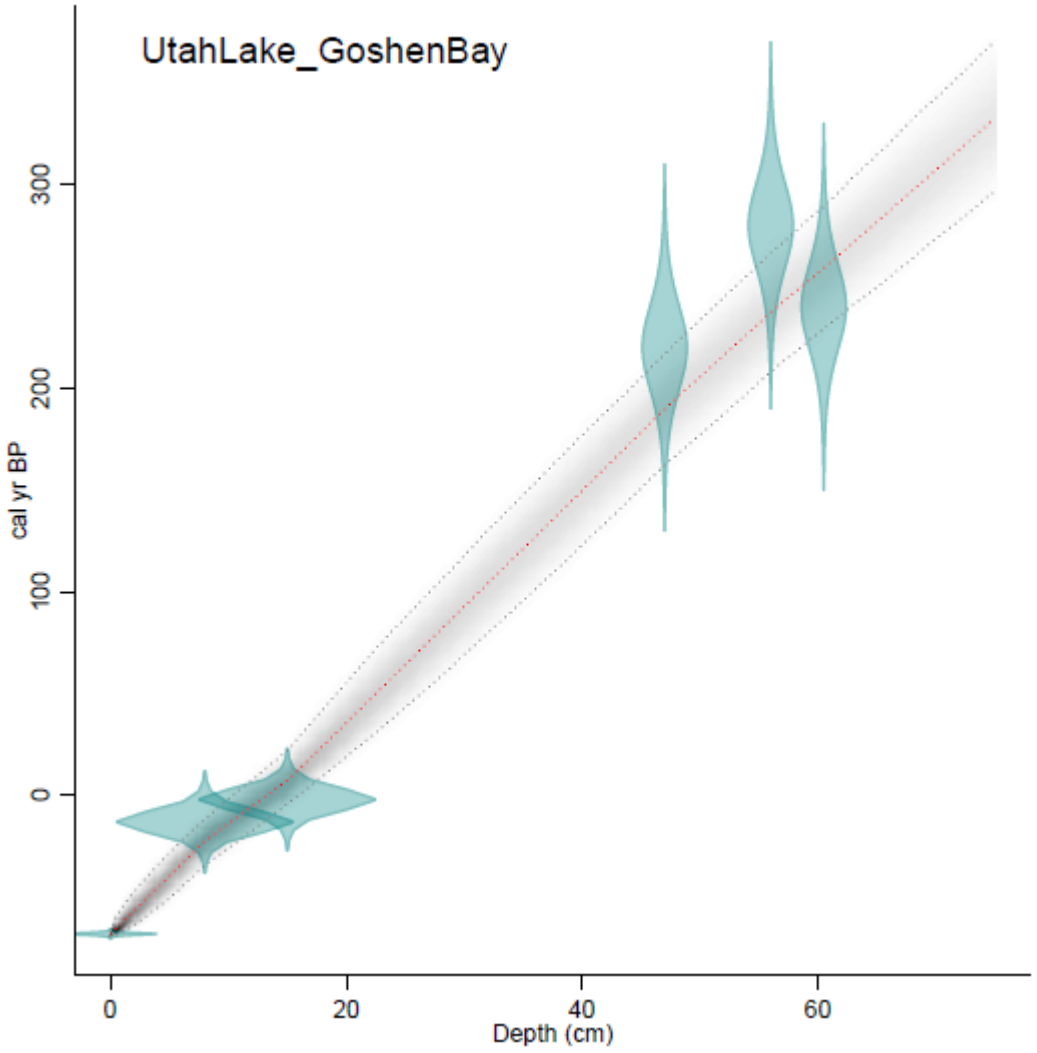
Dating

Bayesian Age-Depth Modeling

- Prediction intervals
- Intensity of shading reflects certainty



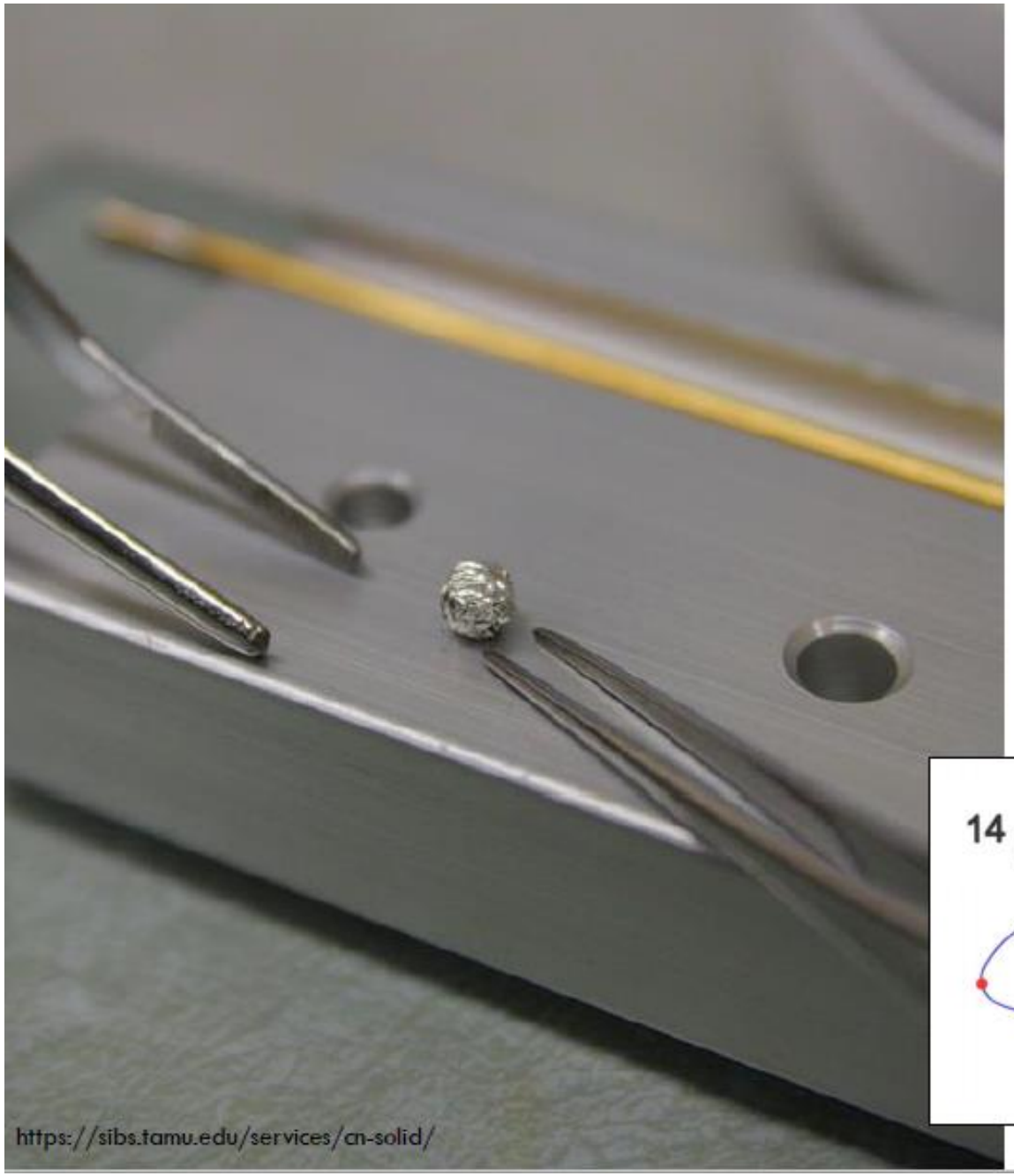
GEOCHEMICAL PROXIES

$\delta^{15}N$

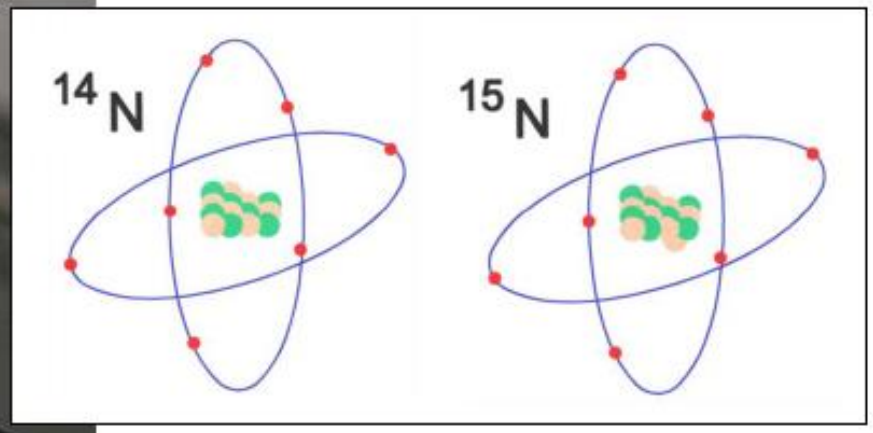
$\delta^{13}C$

C:N ratios (TOC & TON)

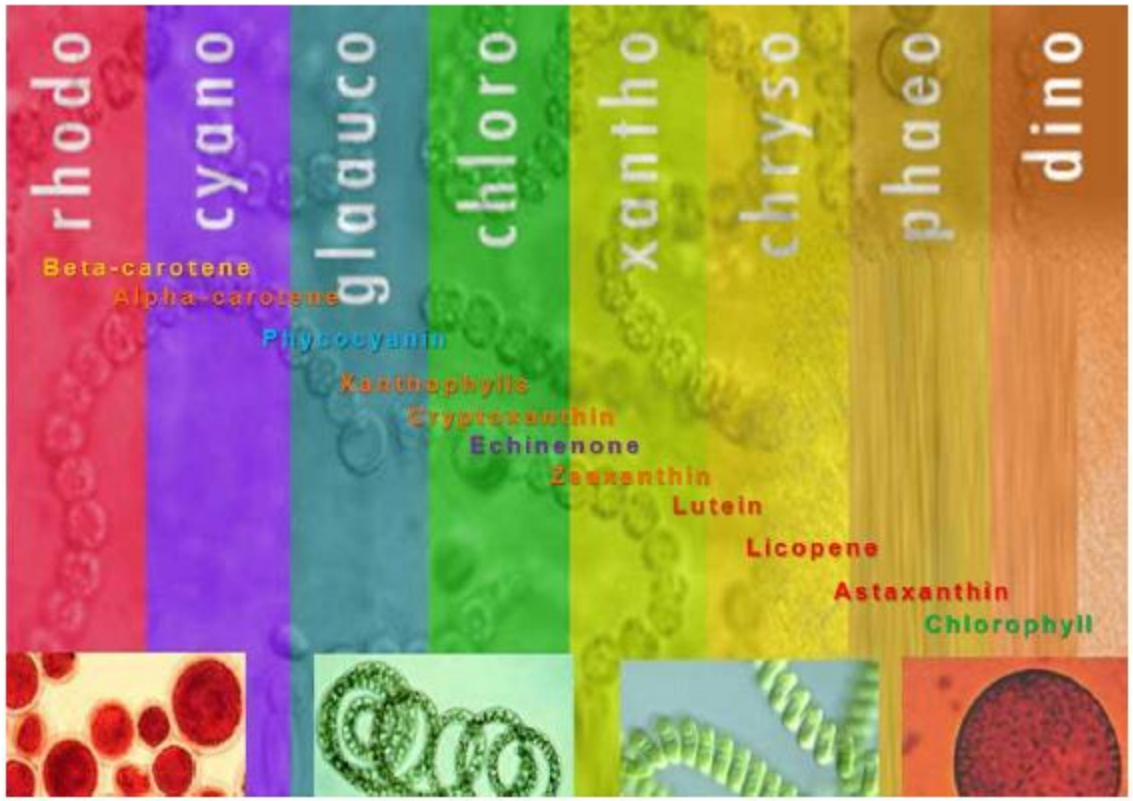
Rock Eval



https://sibs.tamu.edu/services/cn-solid/



BIOLOGICAL PROXIES



Algal pigments

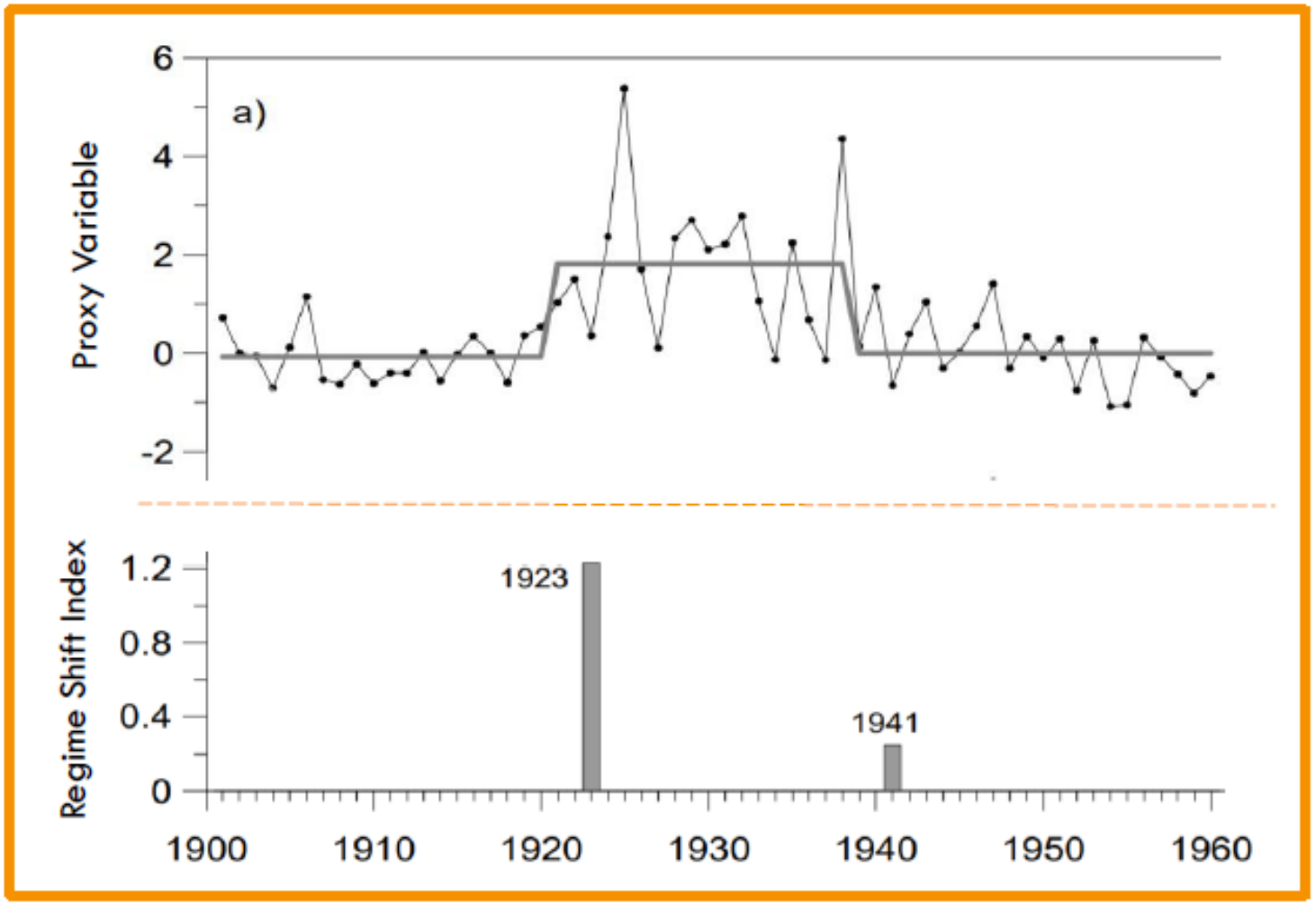
eDNA

(phytoplankton & macrophytes)

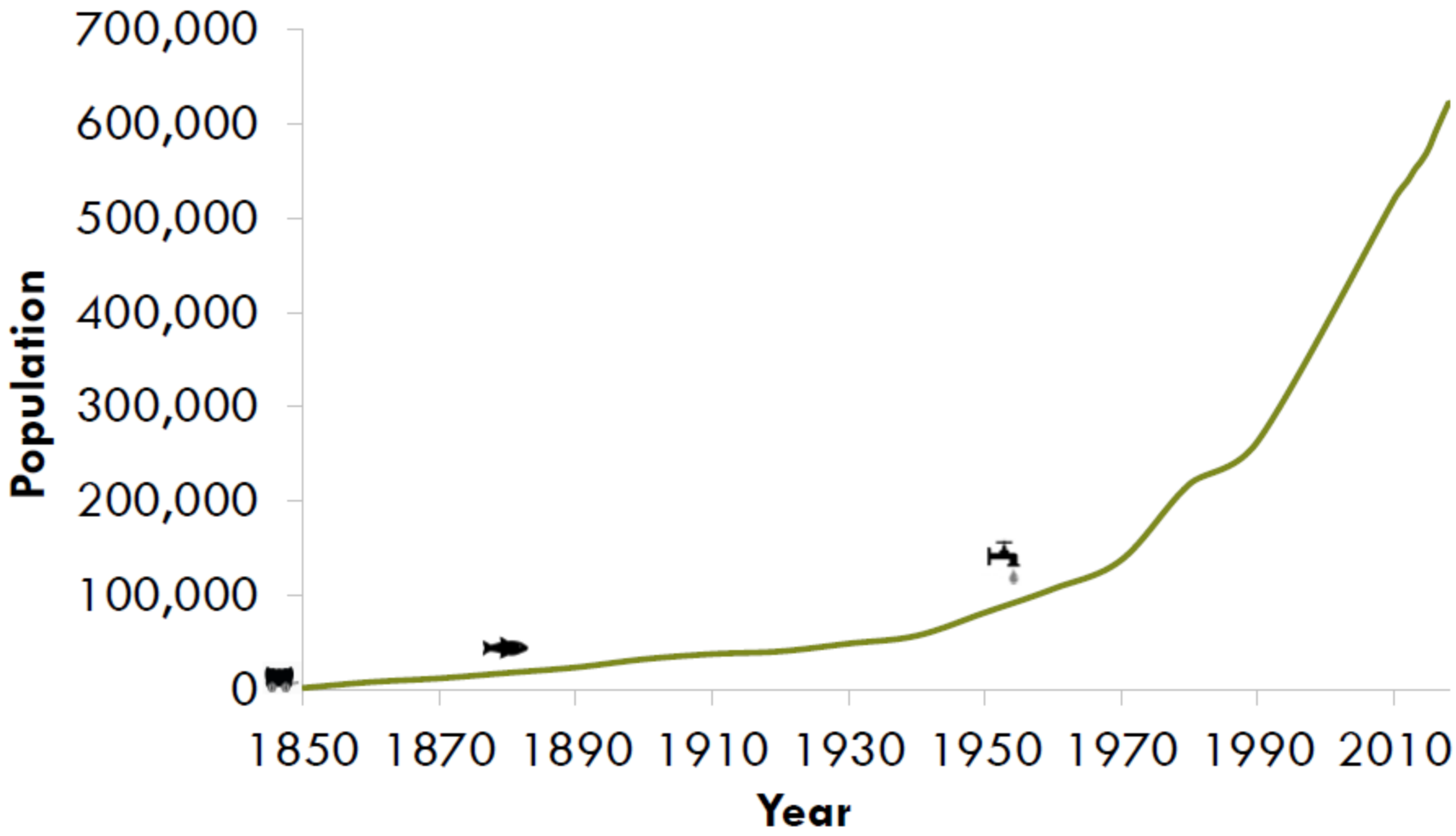
SEQUENTIAL REGIME SHIFT DETECTION

Sequential t-test analysis

(Rodionov, 2004)

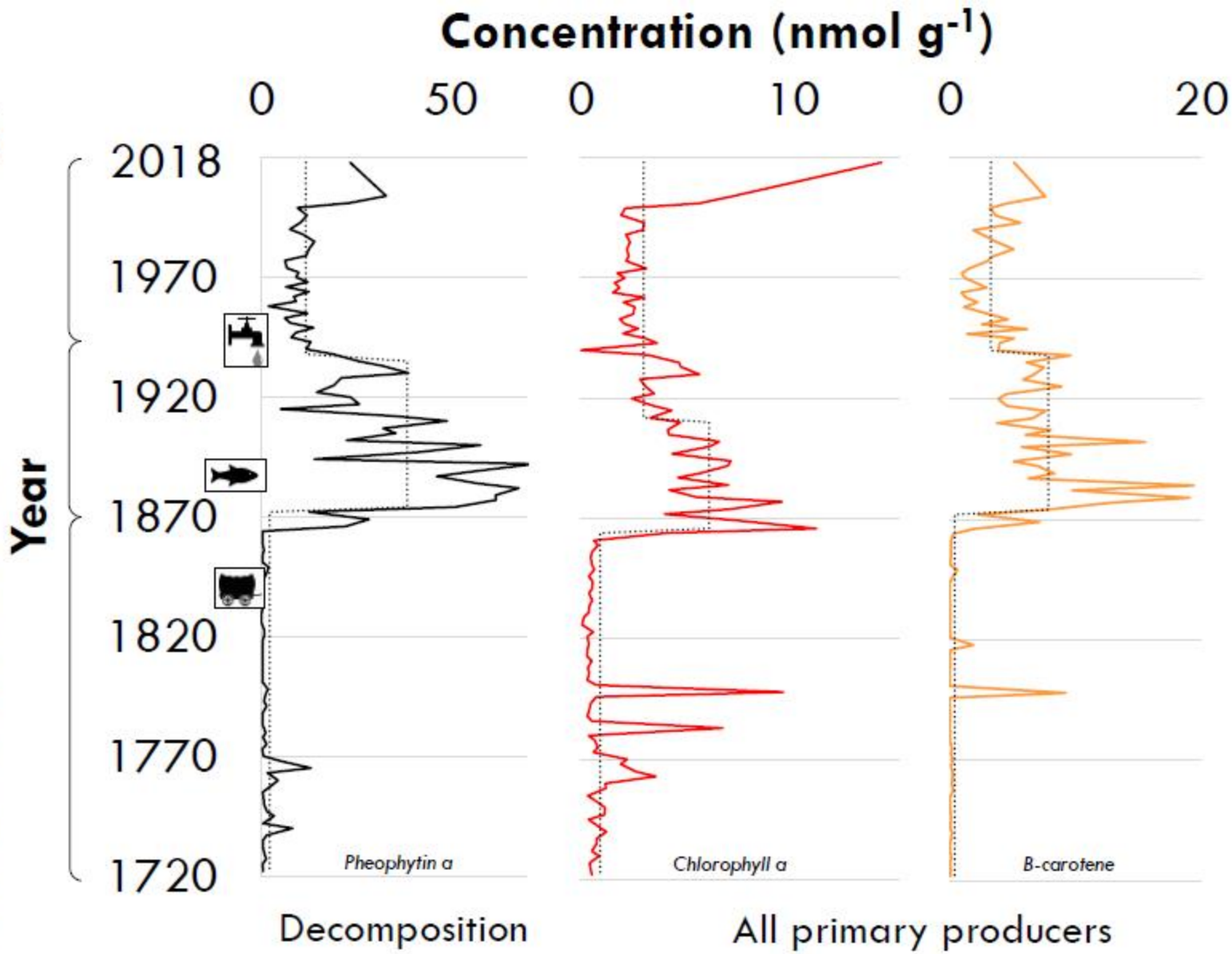


Adapted from (Rodionov, 2005)



worldpopulationreview.com

RESULTS:
ALGAL PIGMENTS



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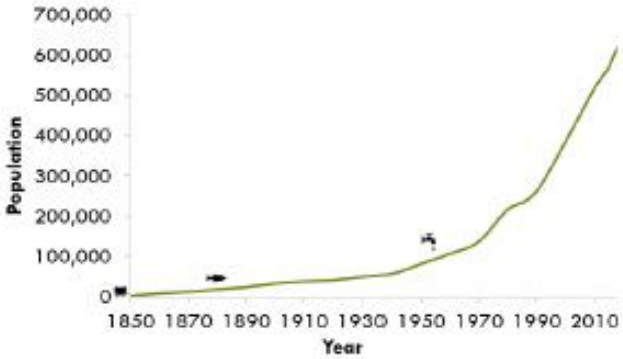
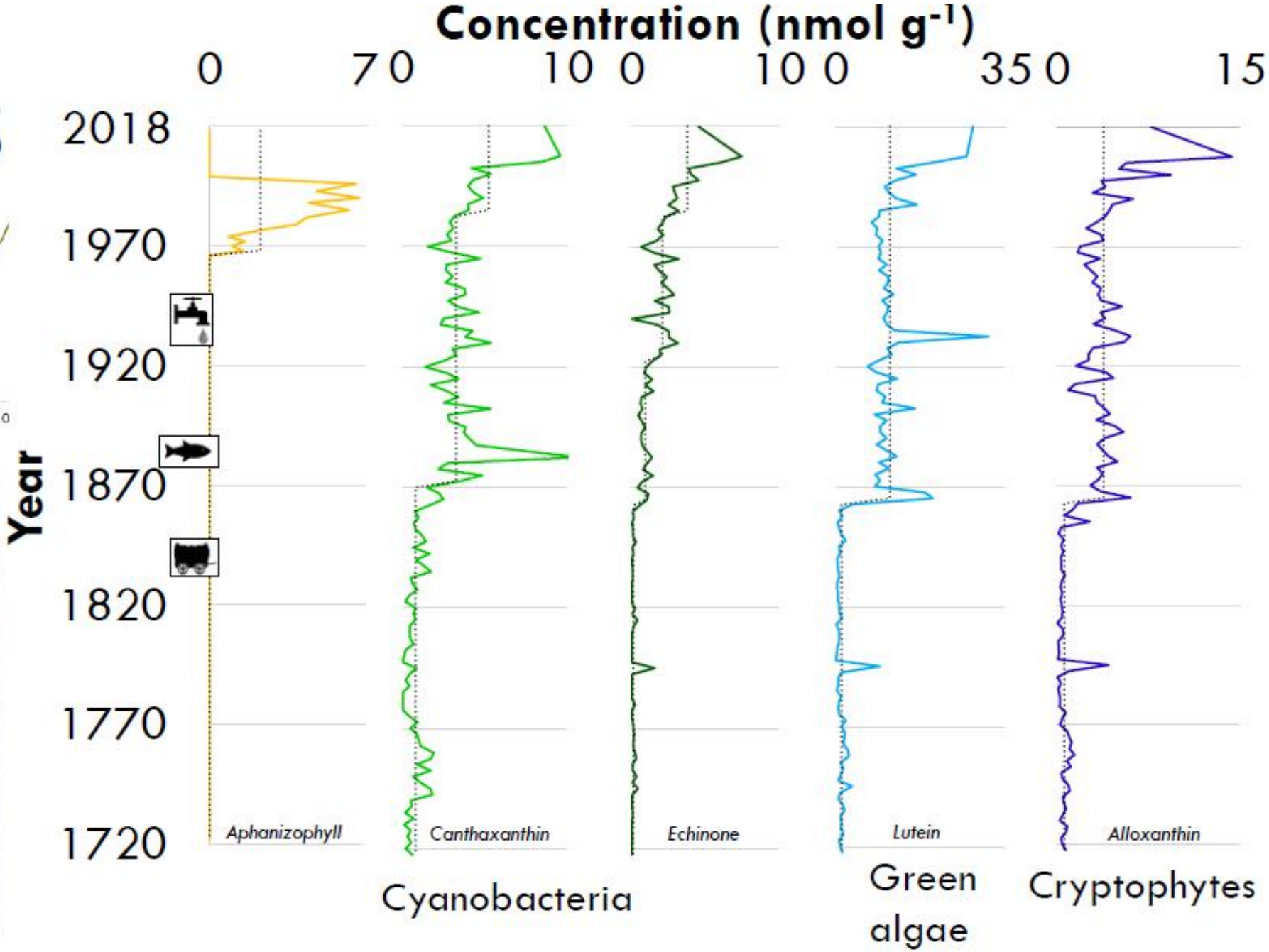
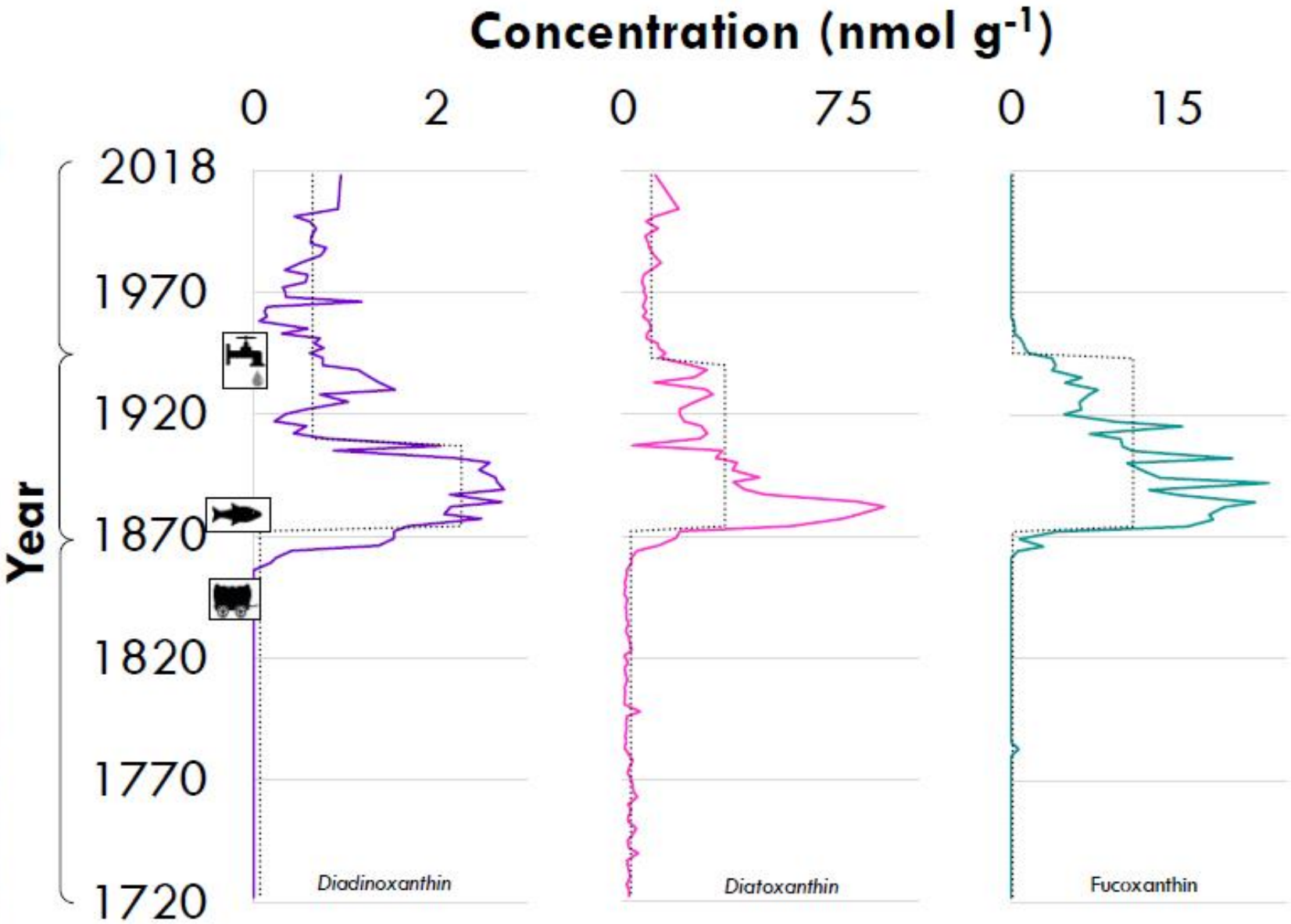
ALGAL PIGMENTS





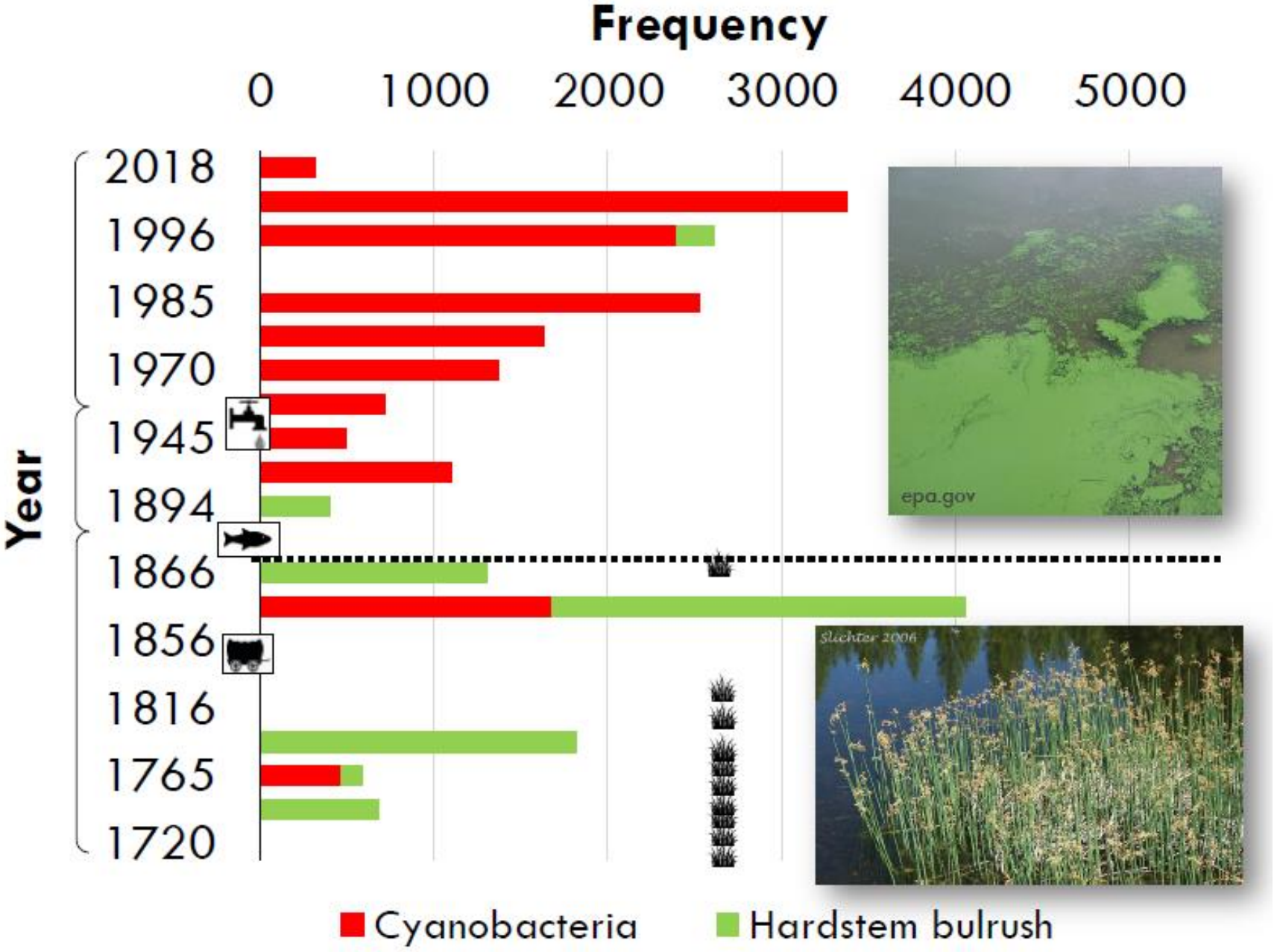
RESULTS:
ALGAL PIGMENTS



Diatoms and dinoflagellates

RESULTS:
E-DNA
CYANOBACTERIA
AQUATIC PLANTS

= Plant remains



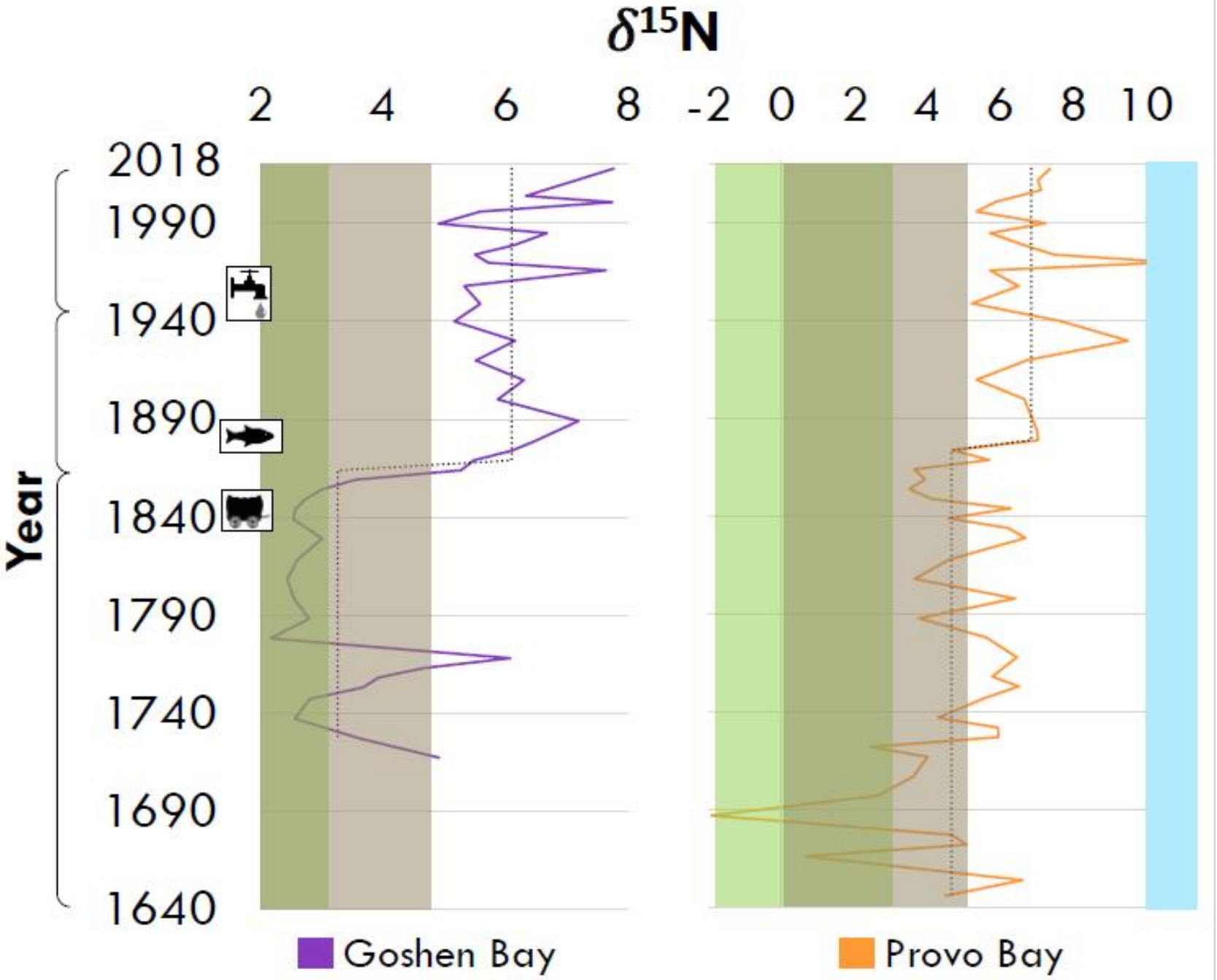
RESULTS:

$\delta^{15}N$

= Natural

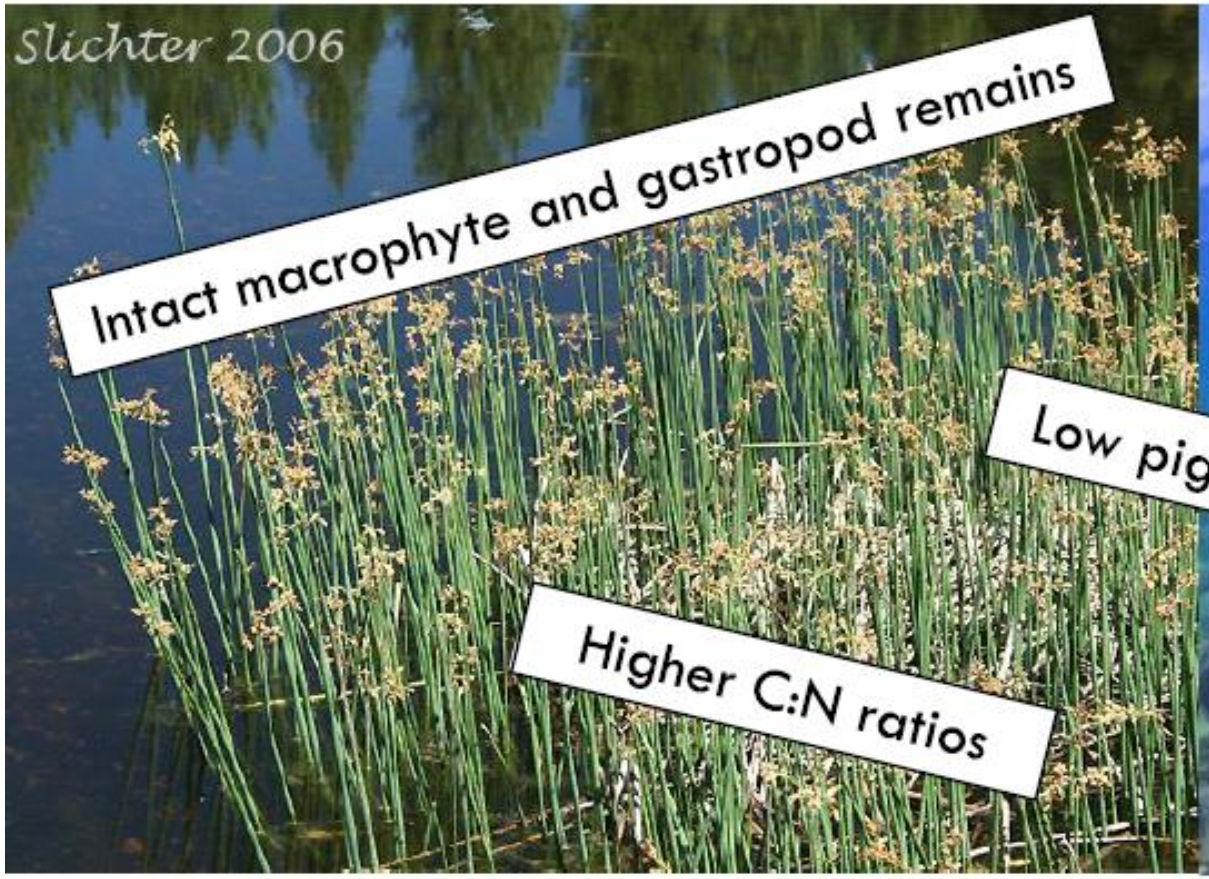
= Untreated raw sewage

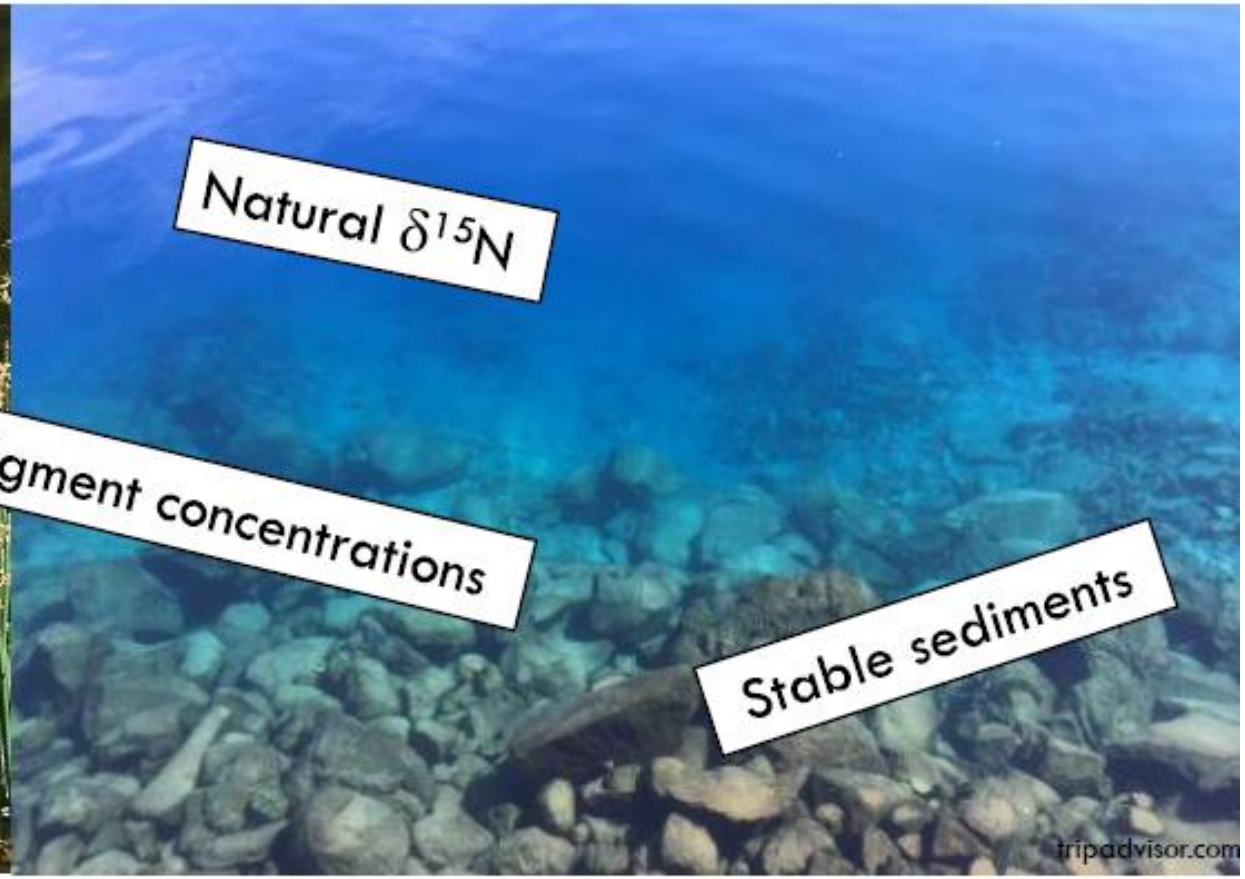
= WWTP effluent



TIME PERIODS IDENTIFIED

1. Pre-regime shift (~1640-1869)



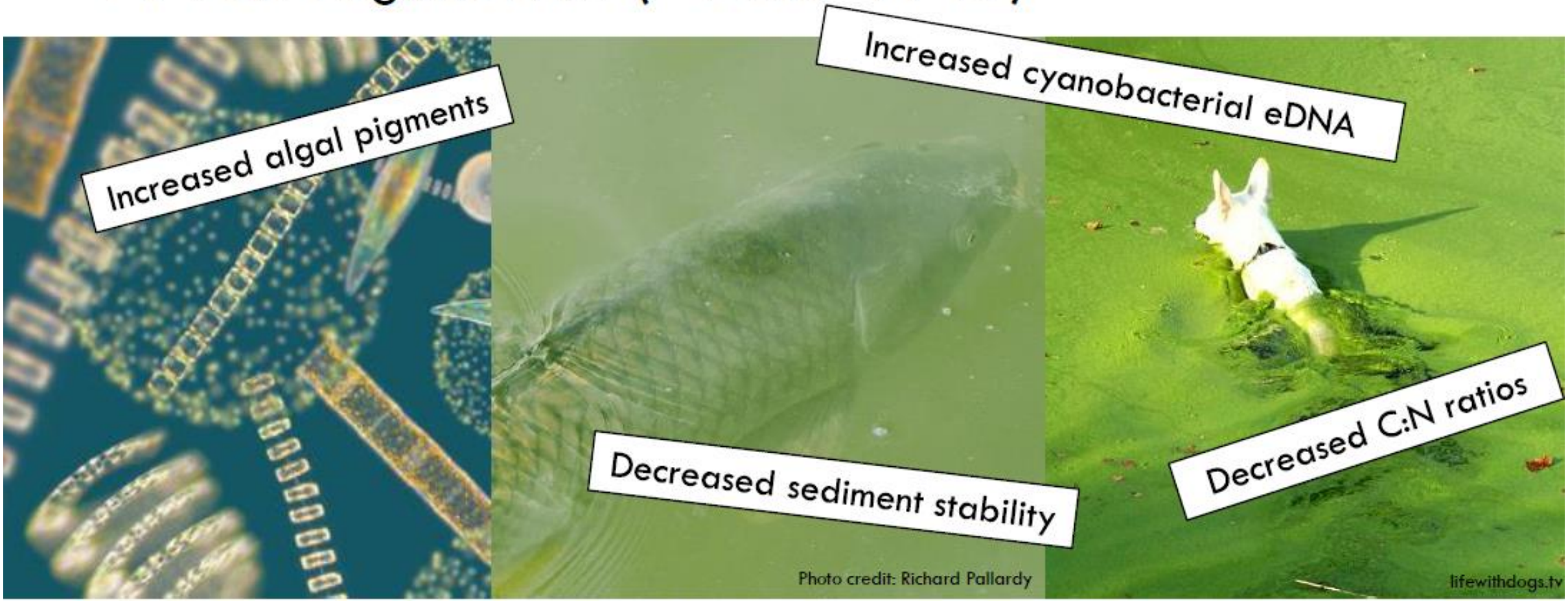


Macrophyte presence

Clearer water

TIME PERIODS IDENTIFIED

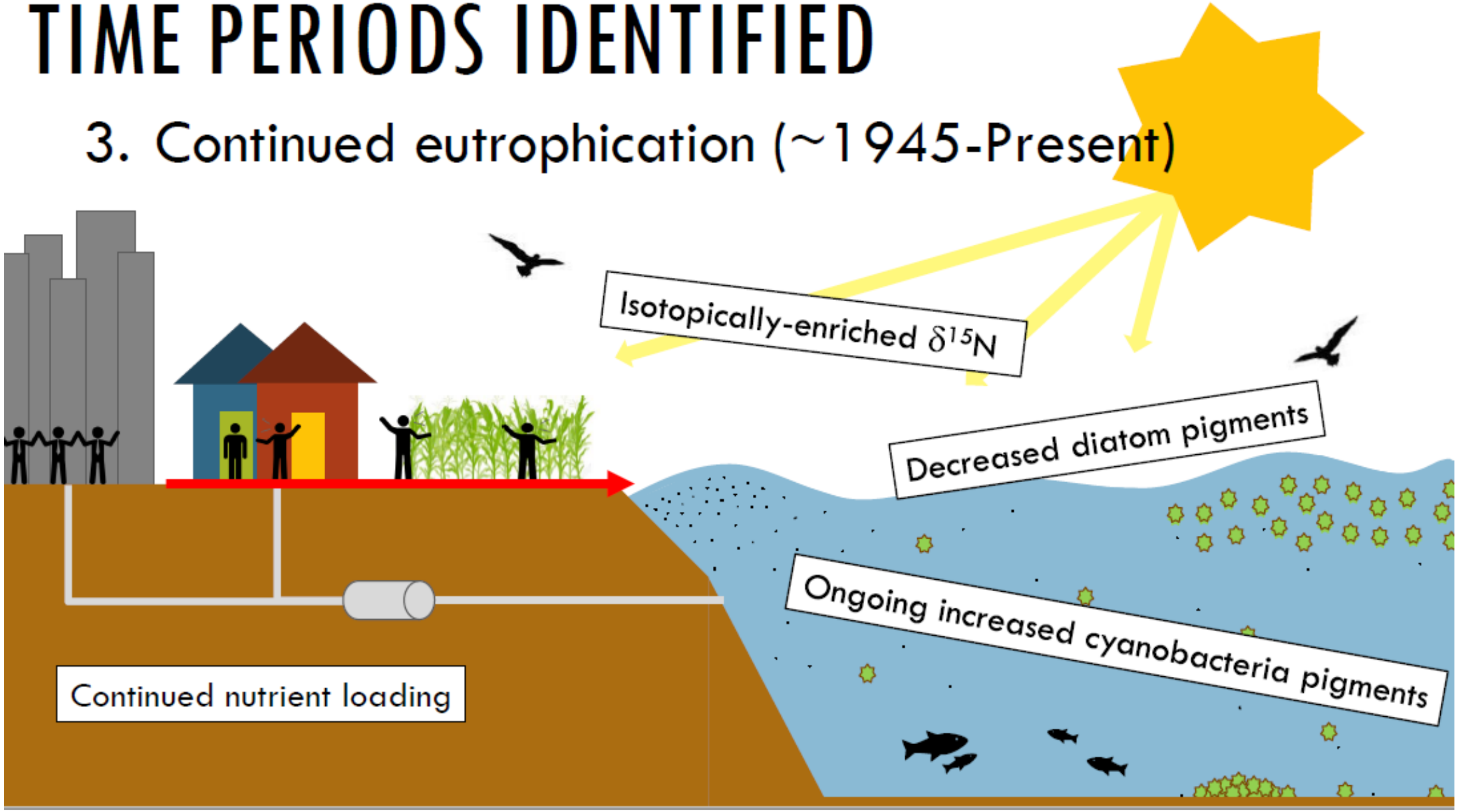
2. Post-regime shift (~1869-1945)



Eutrophic, turbid conditions featuring harmful algal blooms

TIME PERIODS IDENTIFIED

3. Continued eutrophication (~1945-Present)



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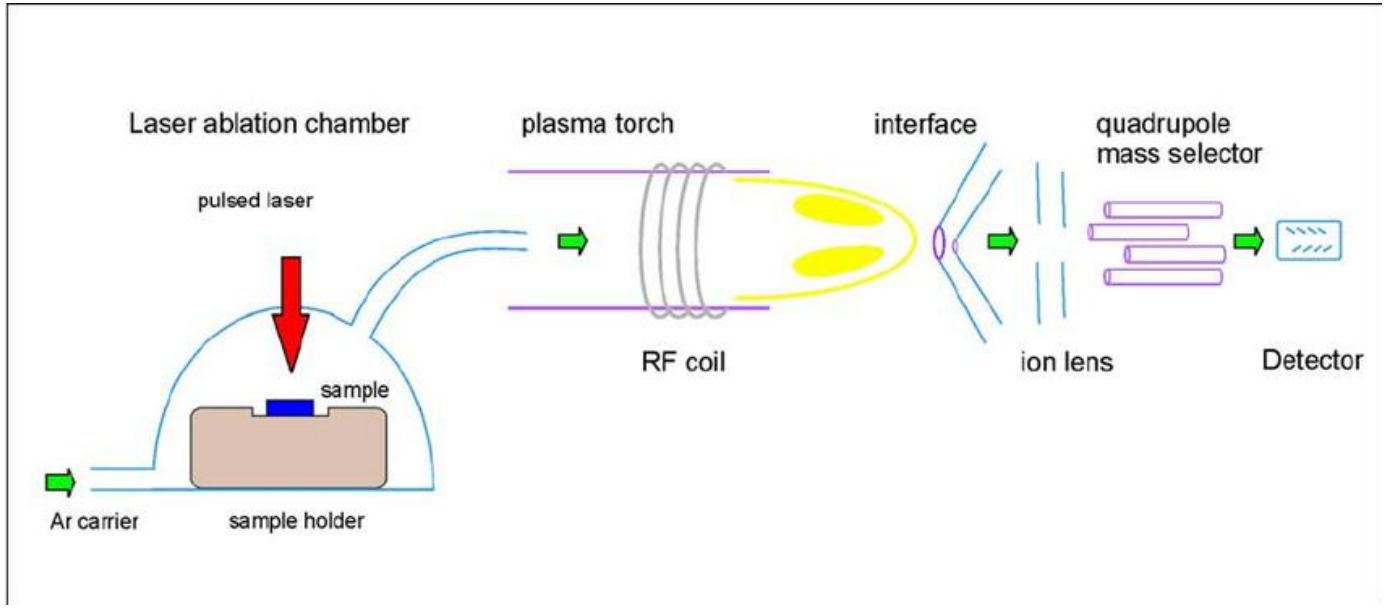
Current and Next Steps

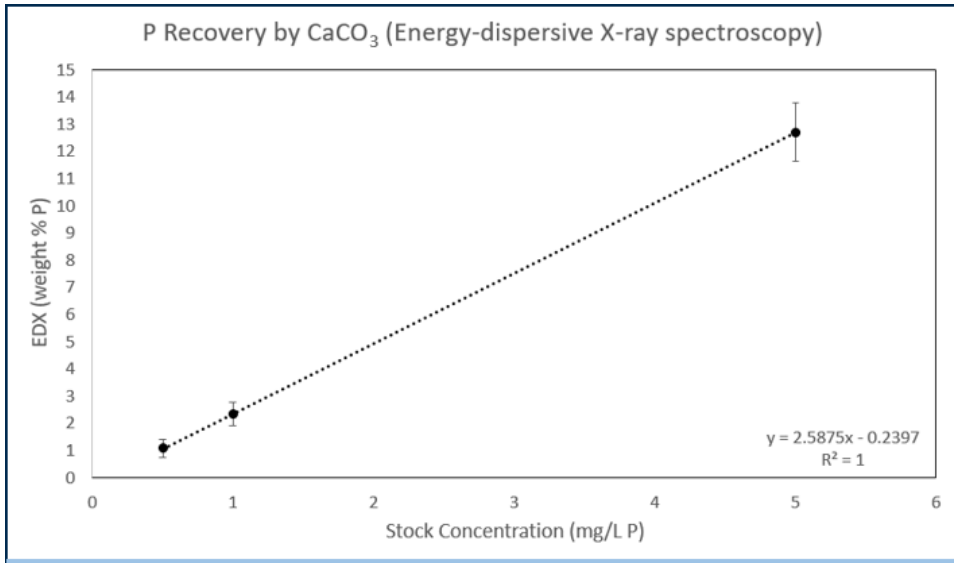
Historical Phosphorus Concentrations

- Sequential extraction (established technique) - ongoing
- Phosphate inclusion in calcite.



SEM-EDX

- 100% recovery in mineral
- Detection limit too high



LA-ICP-MS

- Lower detection limit
- Testing resins to embed sediments

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Current and Next Steps

Samples submitted

- **Carbon and Nitrogen isotopes - completed**
- **Diatoms community composition (BSA - attempt absolution counts)**
  - **Can use amorphous silica as an additional proxy**
- **Algal pigments (Leavitt Lab)**
- **Zooplankton (Brahney Lab)**
- **Charcoal and pollen (Power Lab)**
- **Macrophyte oospores (Brothers Lab)**
- **Rock-Eval pyrolysis (Nelson Lab)**