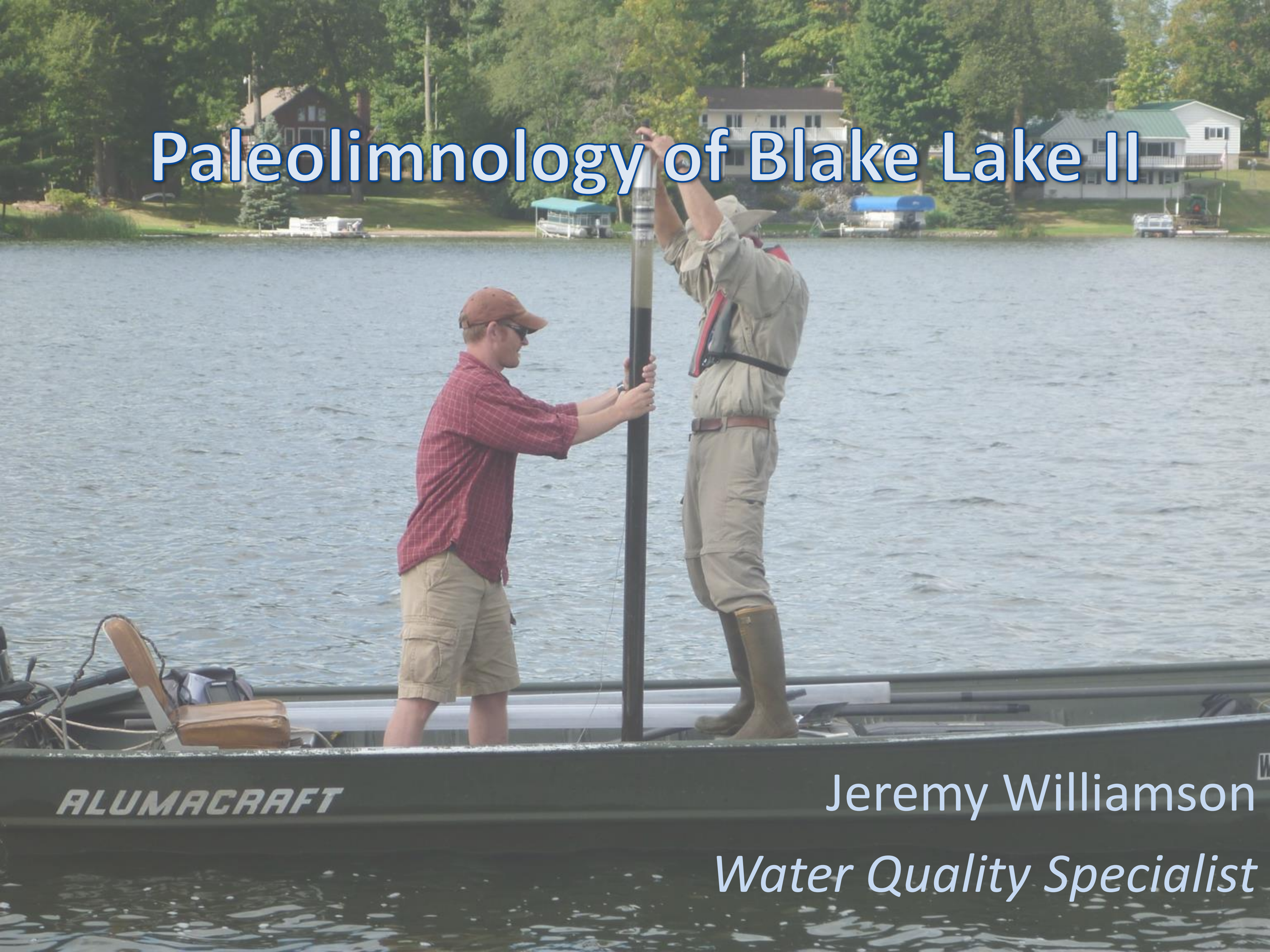
Paleolimnology of Blake Lake II



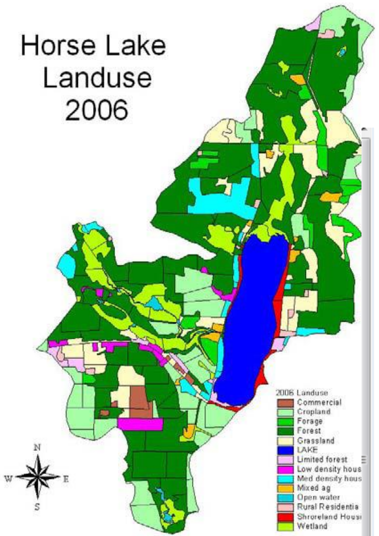
Jeremy Williamson

Water Quality Specialist

Historical Land Use

Watershed Modeling

Horse Lake Landuse 2006



Date: 4/5/2006 Scenario: 4
Lake Id: Lotus Lake
Watershed Id: 2

<u>Hydrologic and Morphometric Data</u>
Tributary Drainage Area: 2569.9 acre
Total Unit Runoff: 8.00 in.
Annual Runoff Volume: 1713.3 acre-ft
Lake Surface Area <As>: 248.0 acre
Lake Volume <V>: 1116.0 acre-ft
Lake Mean Depth <z>: 4.5 ft
Precipitation - Evaporation: 3.3 in.
Hydraulic Loading: 1781.5 acre-ft/year
Areal Water Load <qs>: 7.2 ft/year
Lake Flushing Rate <p>: 1.60 1/year
Water Residence Time: 0.63 year
Observed spring overturn total phosphorus (SPO): 109.0 mg/m^3
Observed growing season mean phosphorus (GSM): 131.0 mg/m^3
% NPS Change: 0%
% PS Change: 0%

NON-POINT SOURCE DATA

Land Use	Acre (ac)	Low	Most Likely	High	Loading %	Low	Most Likely	High
		|---- Loading (kg/ha-year) ----|				|----- Loading (kg/year) ----|		
Row Crop AG	480.5	0.50	1.00	3.00	52.4	97	194	583
Mixed AG	23.2	0.30	0.80	1.40	2.0	3	8	13
Pasture/Grass	297.6	0.10	0.30	0.50	9.7	12	36	60
HD Urban (1/8 Ac)	0.0	1.00	1.50	2.00	0.0	0	0	0
MD Urban (1/4 Ac)	58.1	0.30	0.50	0.80	3.2	7	12	19
Rural Res (>1 Ac)	403.1	0.05	0.10	0.25	4.4	8	16	41
Wetlands	248.3	0.10	0.10	0.10	2.7	10	10	10
Forest	954.2	0.05	0.09	0.18	9.4	19	35	70
Lake Surface	248.0	0.10	0.30	1.00	8.1	10	30	100

POINT SOURCE DATA

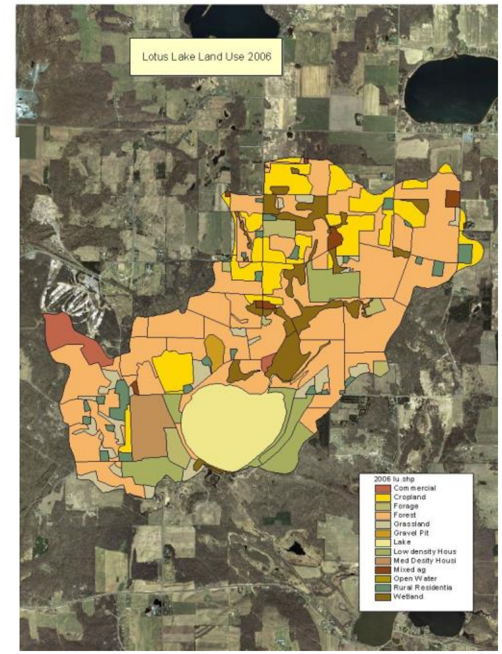
Point Sources	Water Load (m^3/year)	Low (kg/year)	Most Likely (kg/year)	High (kg/year)	Loading %

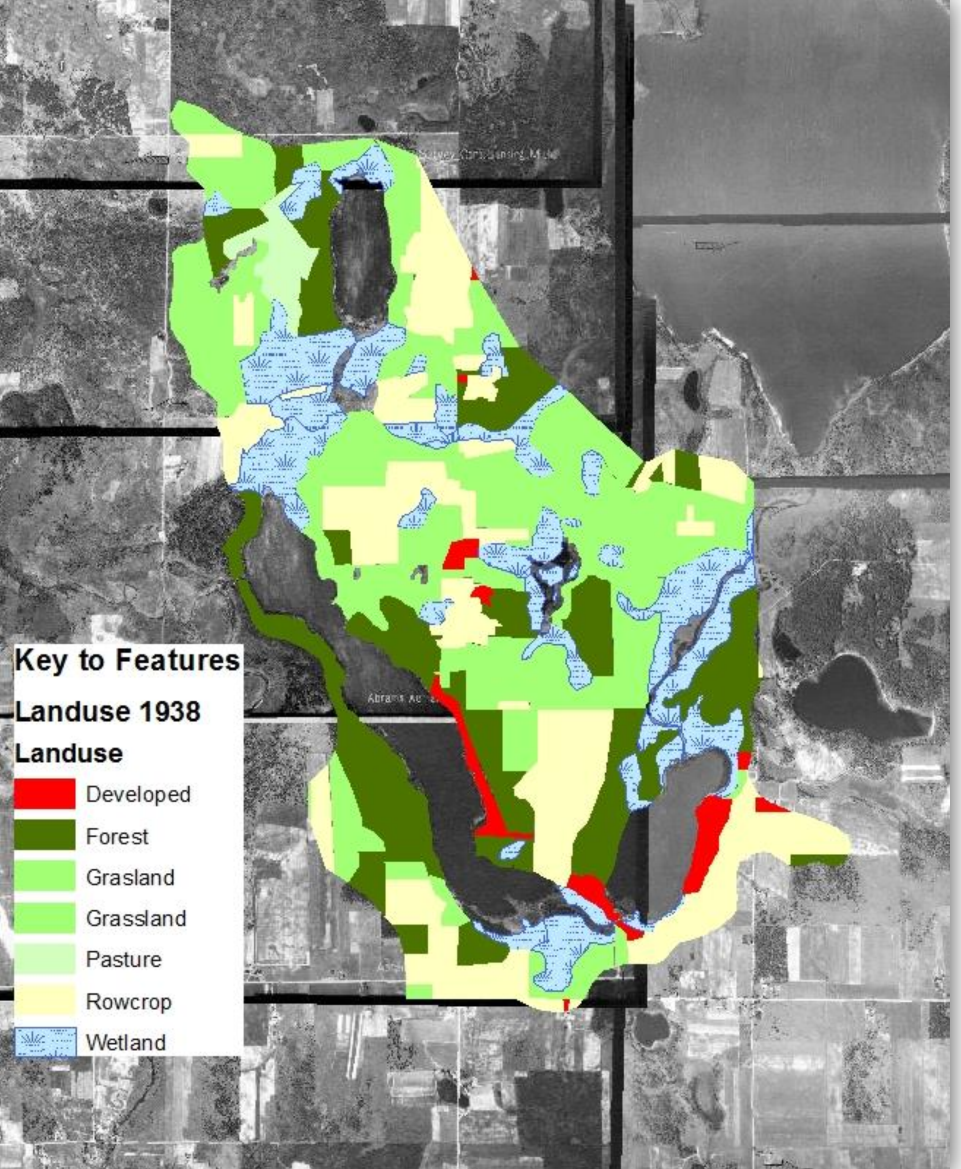
SEPTIC TANK DATA

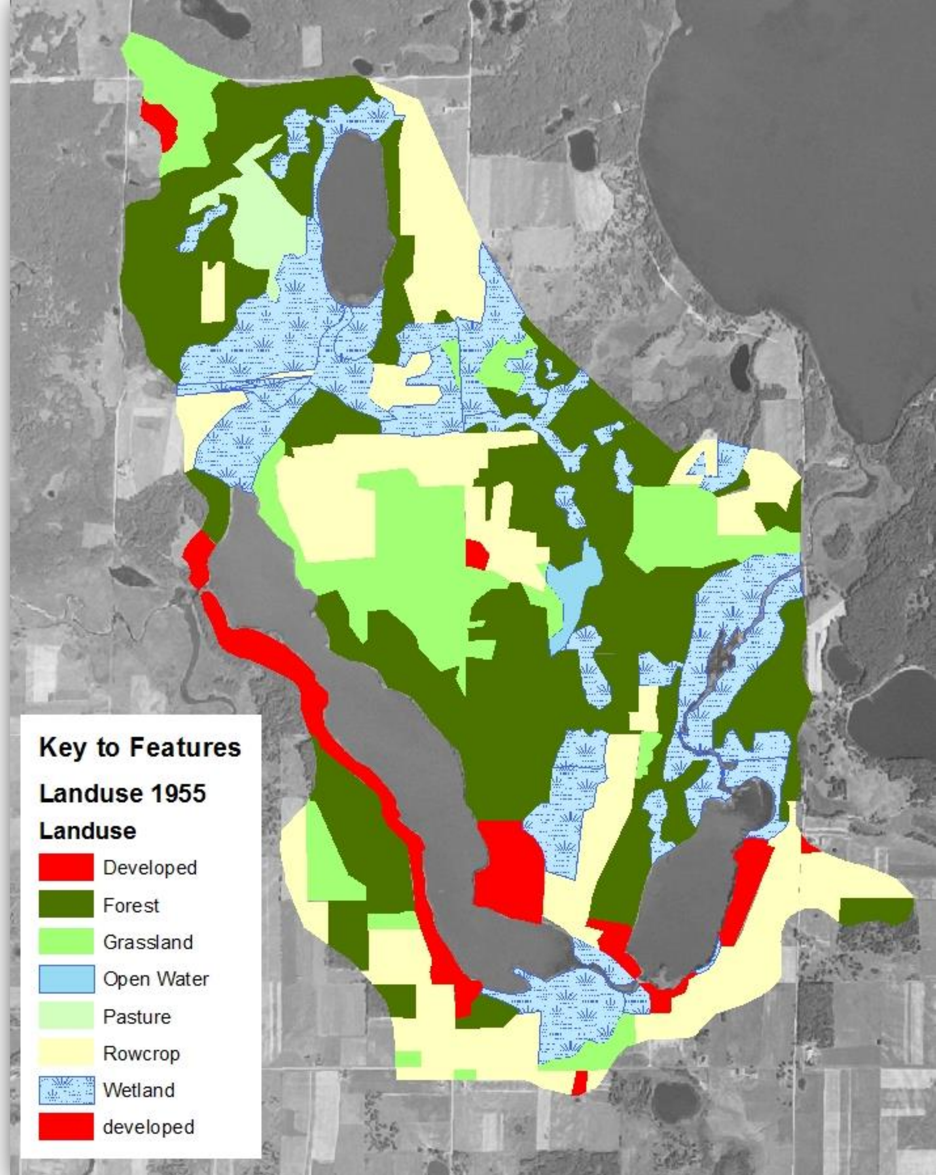
Description		Low	Most Likely	High	Loading %
Septic Tank Output (kg/capita-year)		0.30	0.50	0.80	
# capita-years	172.8				
% Phosphorus Retained by Soil		98.0	90.0	80.0	
Septic Tank Loading (kg/year)		1.04	8.64	27.65	2.3

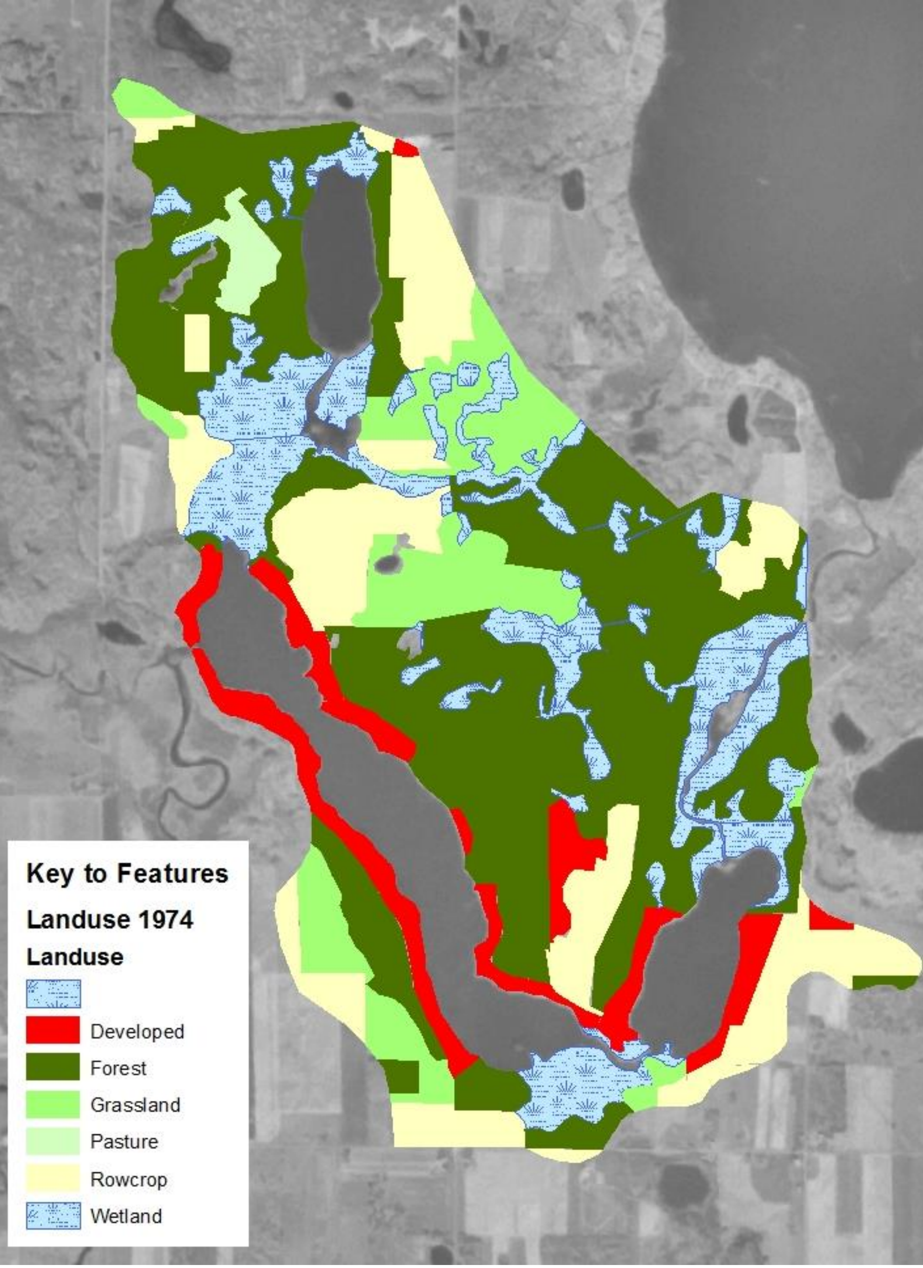
TOTALS DATA

Description	Low	Most Likely	High	Loading %
Total Loading (lb)	397.9	817.8	2111.8	100.0
Total Loading (kg)	180.5	371.0	957.9	100.0
Areal Loading (lb/ac-year)	1.60	3.30	8.52	
Areal Loading (mg/m^2-year)	179.82	369.63	954.43	
Total PS Loading (lb)	0.0	0.0	0.0	0.0
Total PS Loading (kg)	0.0	0.0	0.0	0.0
Total NPS Loading (lb)	373.5	732.4	1829.5	97.7
Total NPS Loading (kg)	169.4	332.2	829.9	97.7




Key to Features
Landuse 1938
Landuse
Developed
Forest
Grasland
Grassland
Pasture
Rowcrop
Wetland


Key to Features
Landuse 1955
Landuse
Developed
Forest
Grassland
Open Water
Pasture
Rowcrop
Wetland
developed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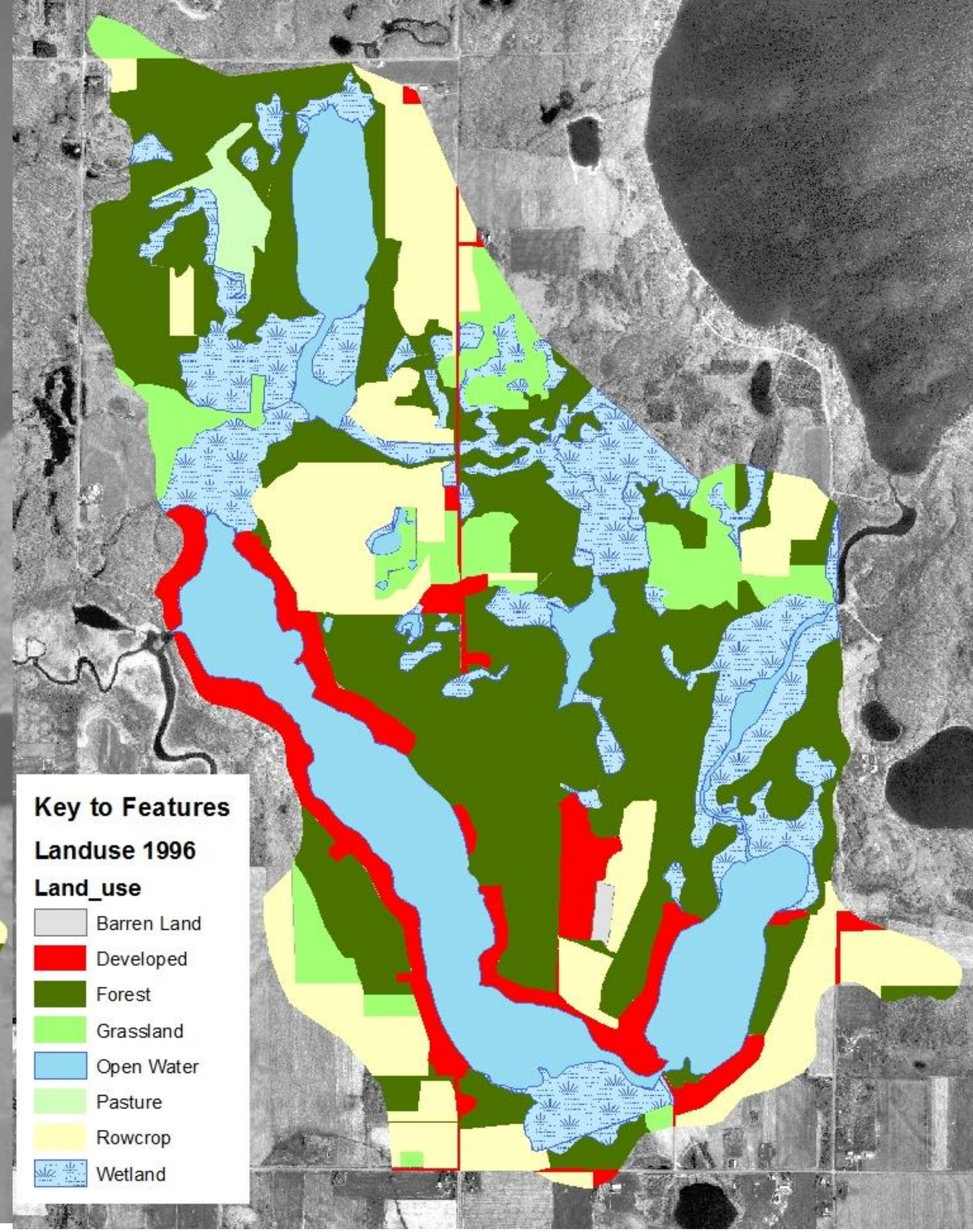
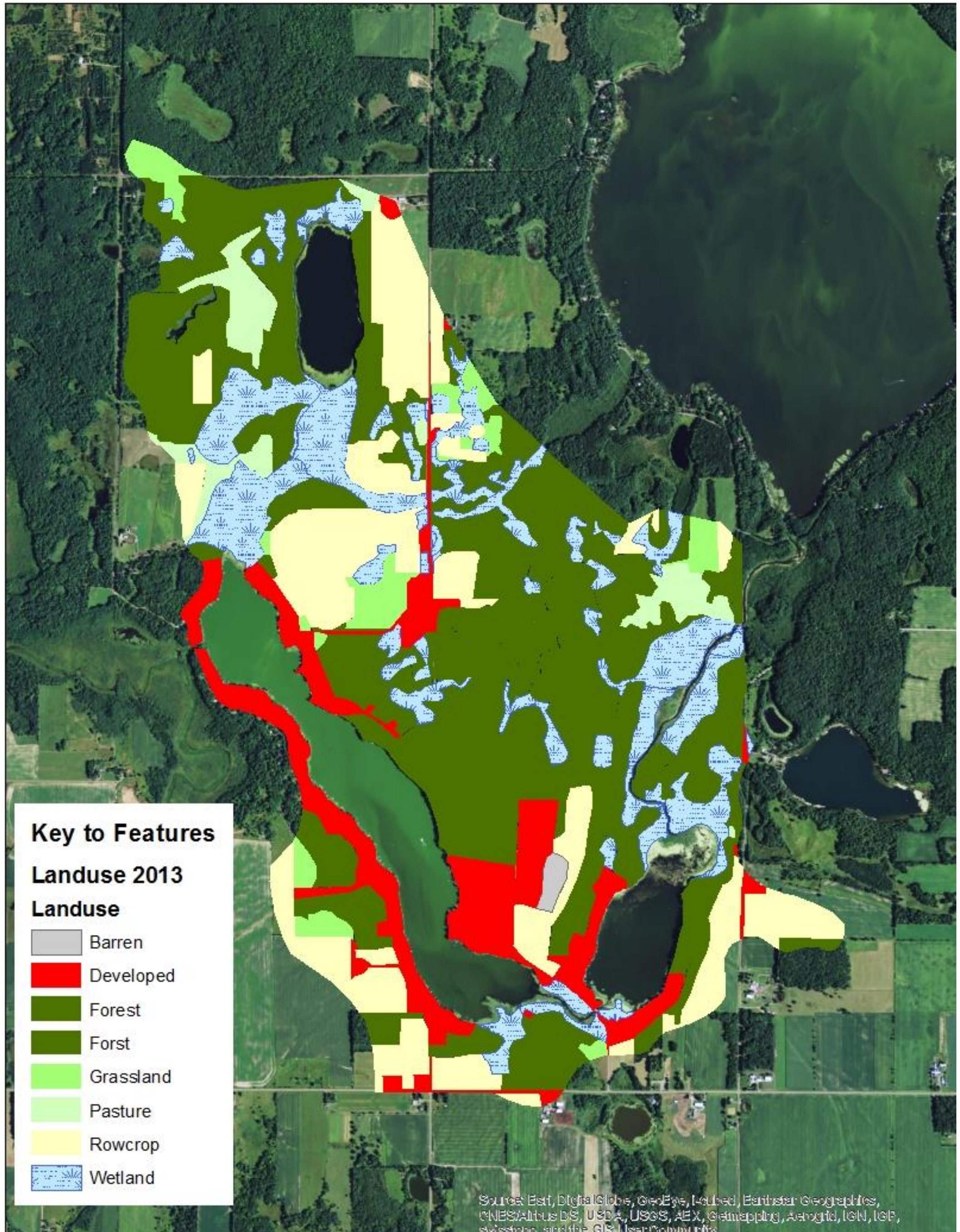
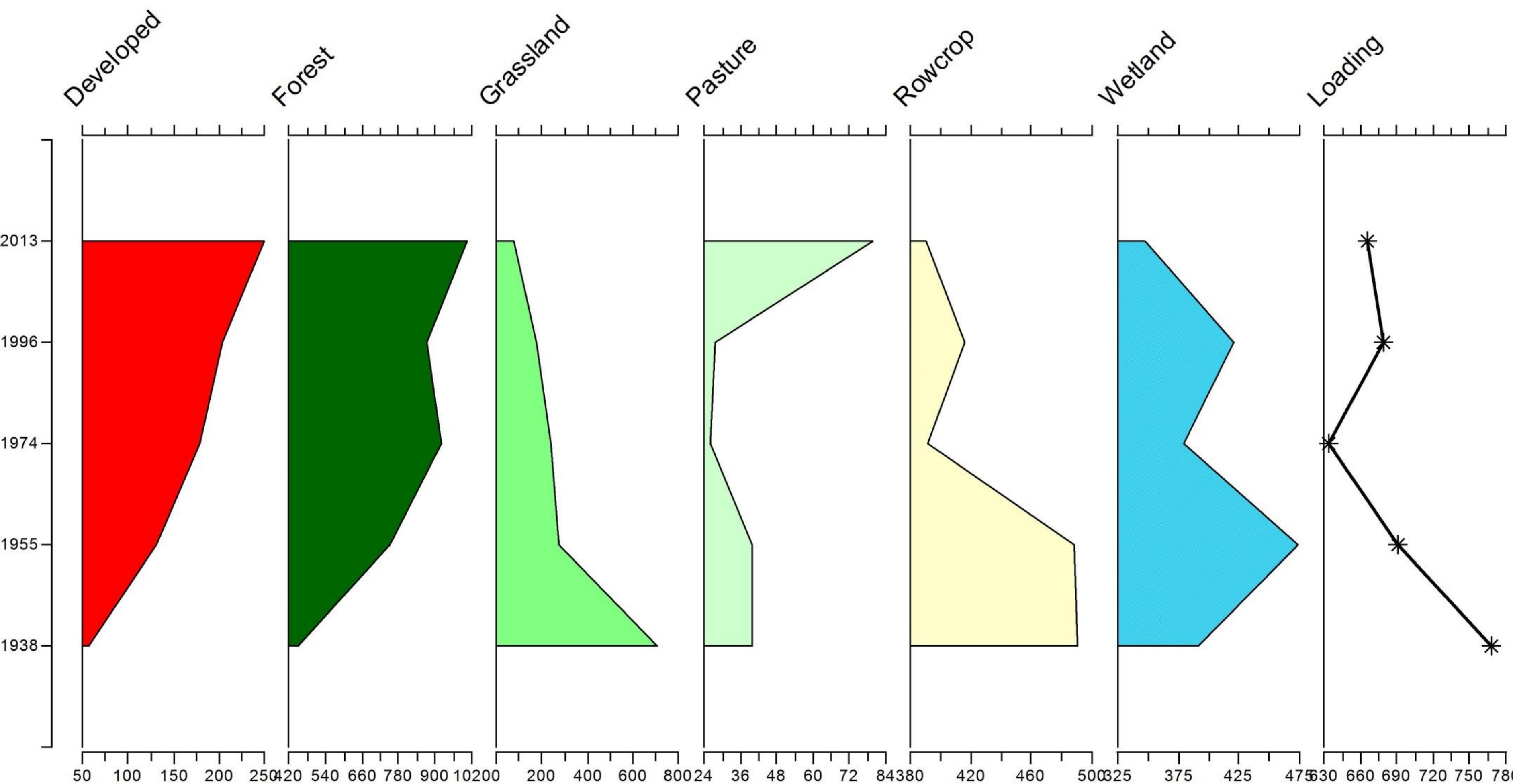
Landuse 1974
Landuse
Developed
Forest
Grassland
Pasture
Rowcrop
Wetland


Key to Features
Landuse 1996
Land_use
Barren Land
Developed
Forest
Grassland
Open Water
Pasture
Rowcrop
Wetland


Key to Features
Landuse 2013
Landuse
Barren
Developed
Forest
Forst
Grassland
Pasture
Rowcrop
Wetland
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community


Developed
Forest
Grassland
Pasture
Rowcrop
Wetland
Loading
2013
1996
1974
1955
1938
50 100 150 200 250
420 540 660 780 900 1020
0 200 400 600 800
24 36 48 60 72 84
380 420 460 500
325 375 425 475
630 660 690 720 750 780


STOP AQUATIC HITCHHIKERS!

Paleolimnology

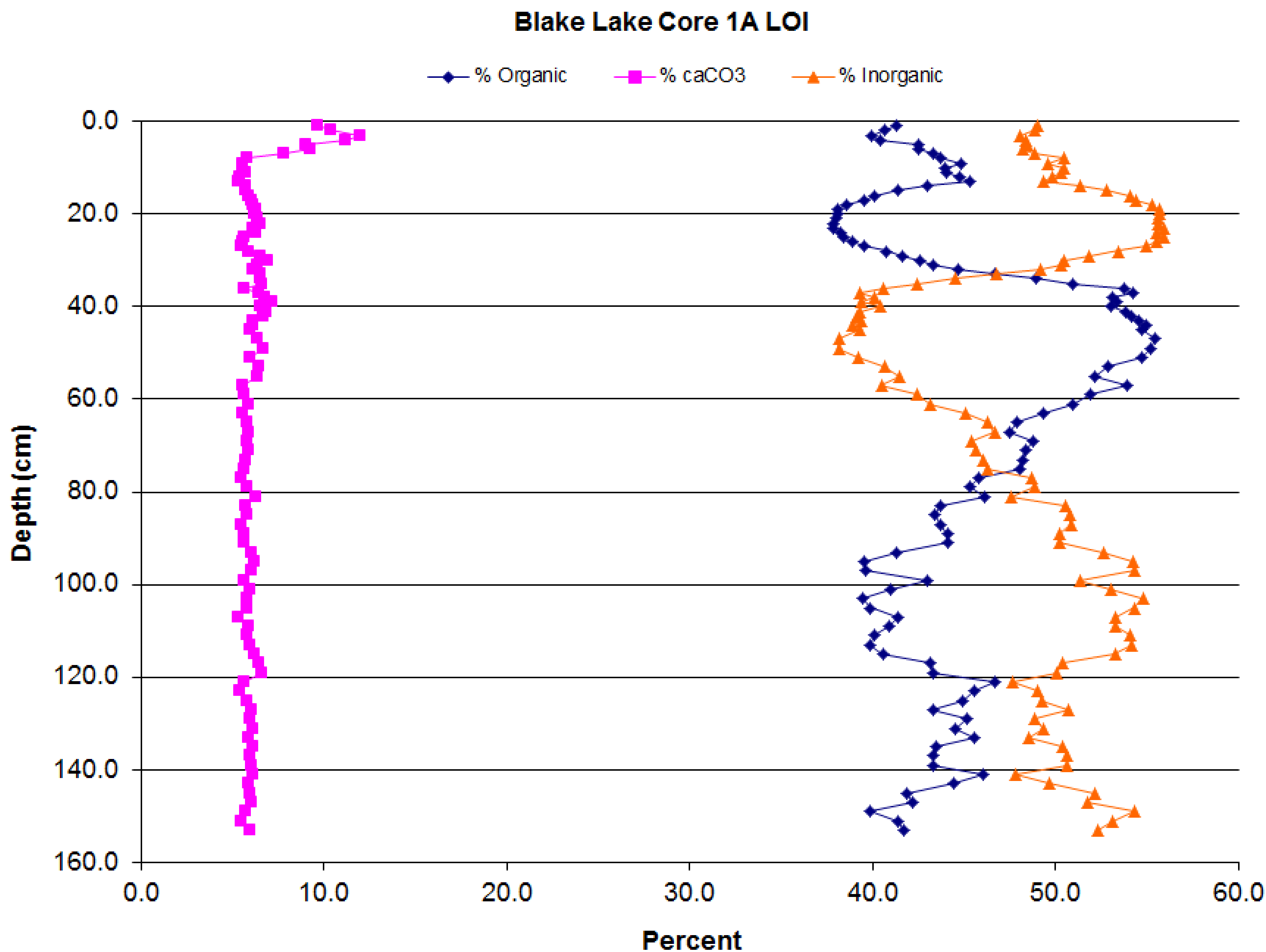
Using sediment cores

Core Dating

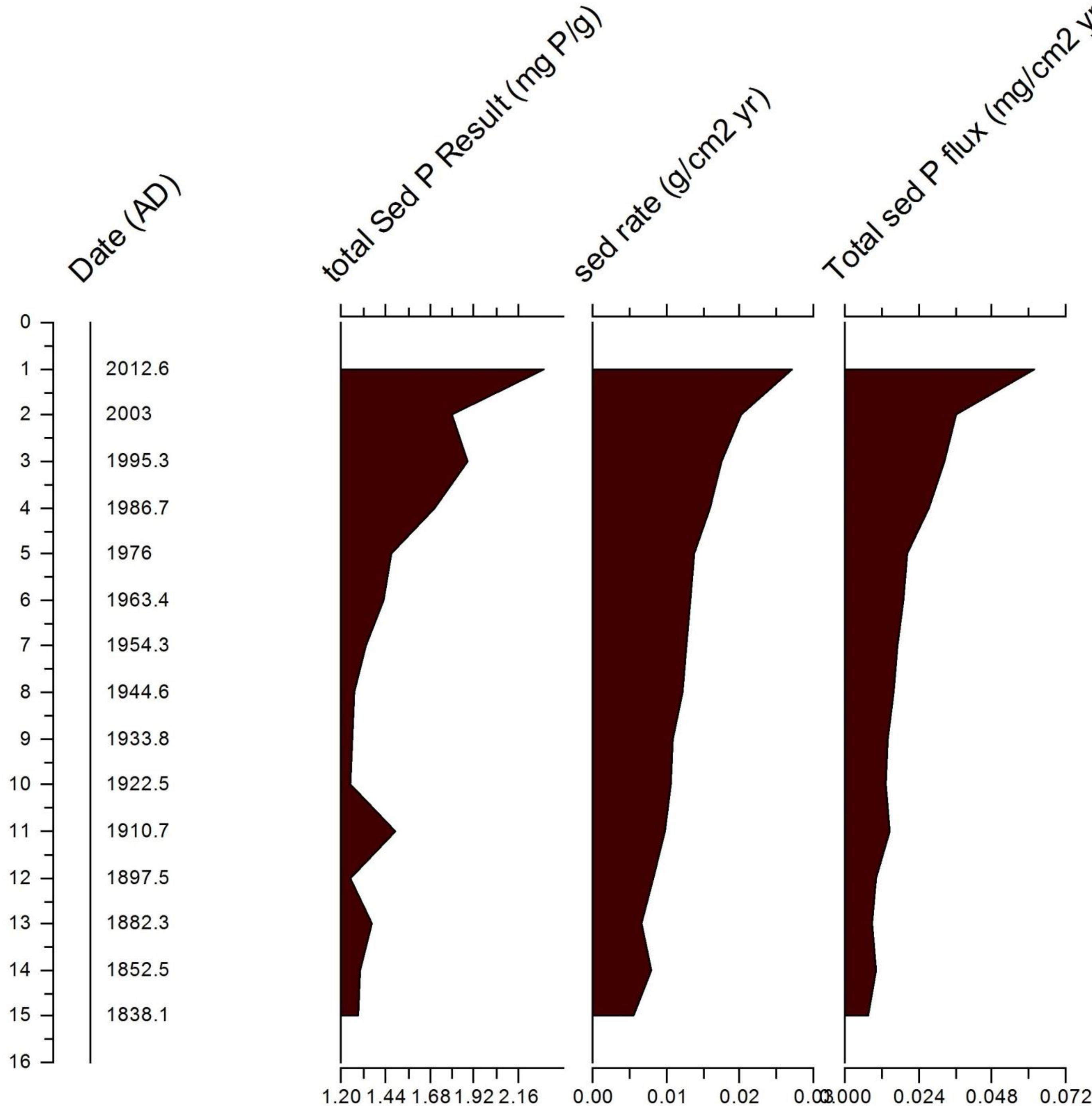
Element	Source	Analysis location
210Pb	From natural radium minerals	SCWRS
137Cs	Atmospheric tests of nuclear bombs	SCWRS
14C	Cosmic rays hitting earth's atmosphere	Arizona

Core Analysis
- -biogeochemical
- -biological, algae, chironomidae
- -sediment character
- -etc.

Core interpretation
- -record of ecological change
- -timing and magnitude
- -quantitative reconstruction of feeding groups



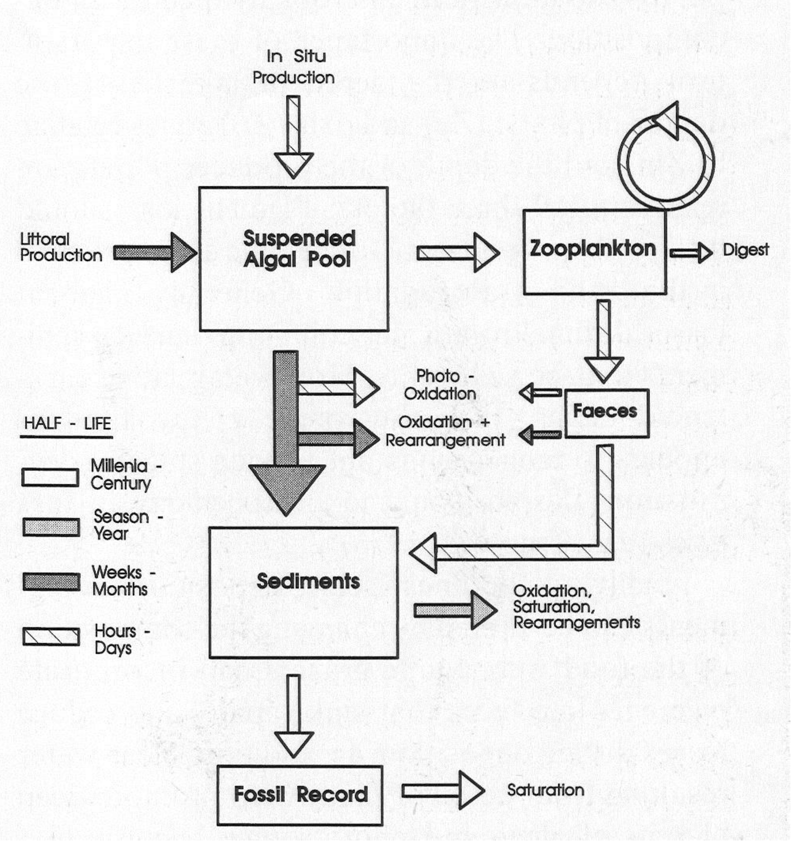
Blake Lake Core 1A LOI
% Organic
% caCO3
% Inorganic
Depth (cm)
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
Percent



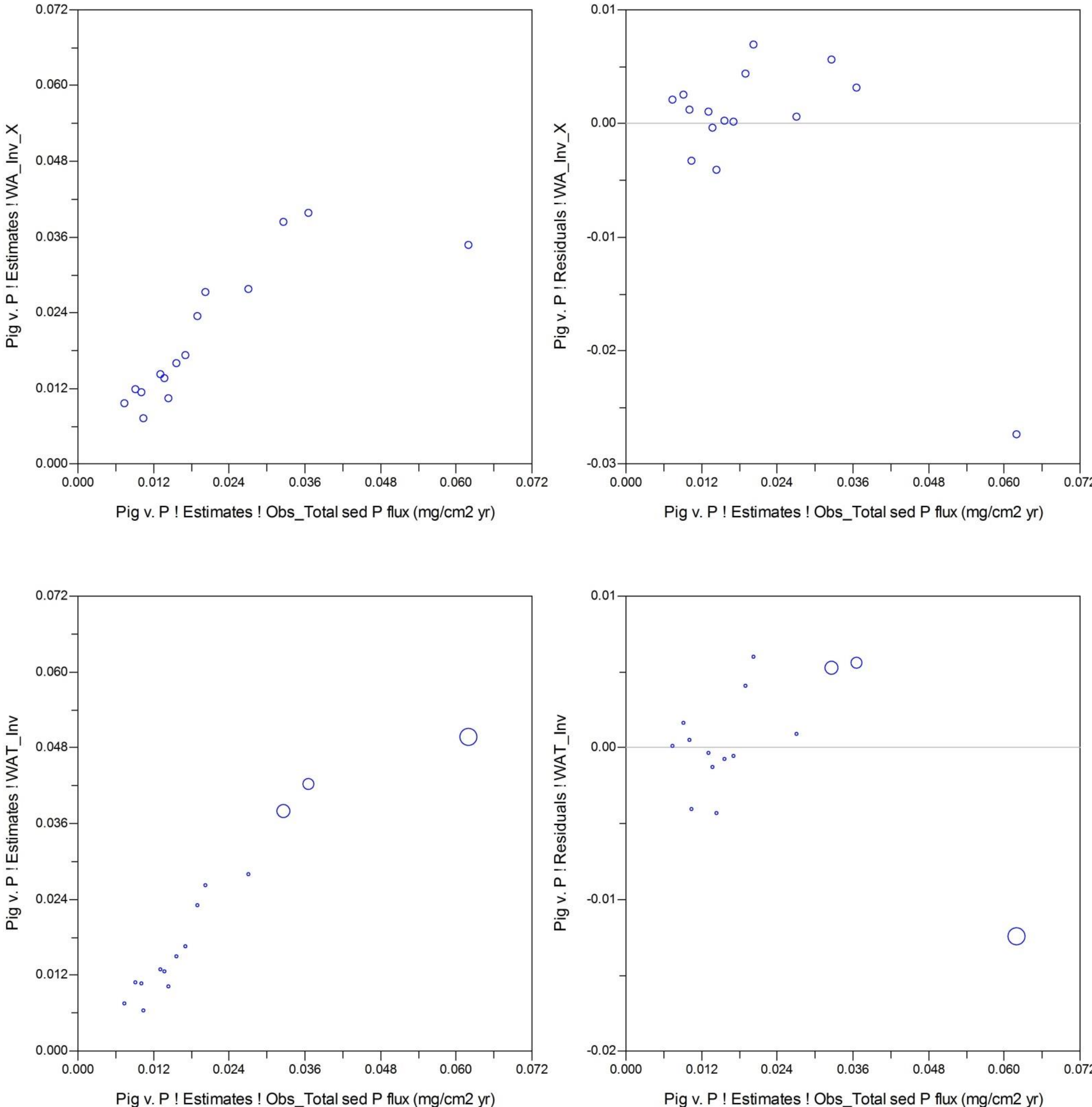
Date (AD)
total Sed P Result (mg P/g)
sed rate (g/cm2 yr)
Total sed P flux (mg/cm2 yr)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
2012.6
2003
1995.3
1986.7
1976
1963.4
1954.3
1944.6
1933.8
1922.5
1910.7
1897.5
1882.3
1852.5
1838.1
1.20
1.44
1.68
1.92
2.16
0.00
0.01
0.02
0.03
0.000
0.024
0.048
0.072

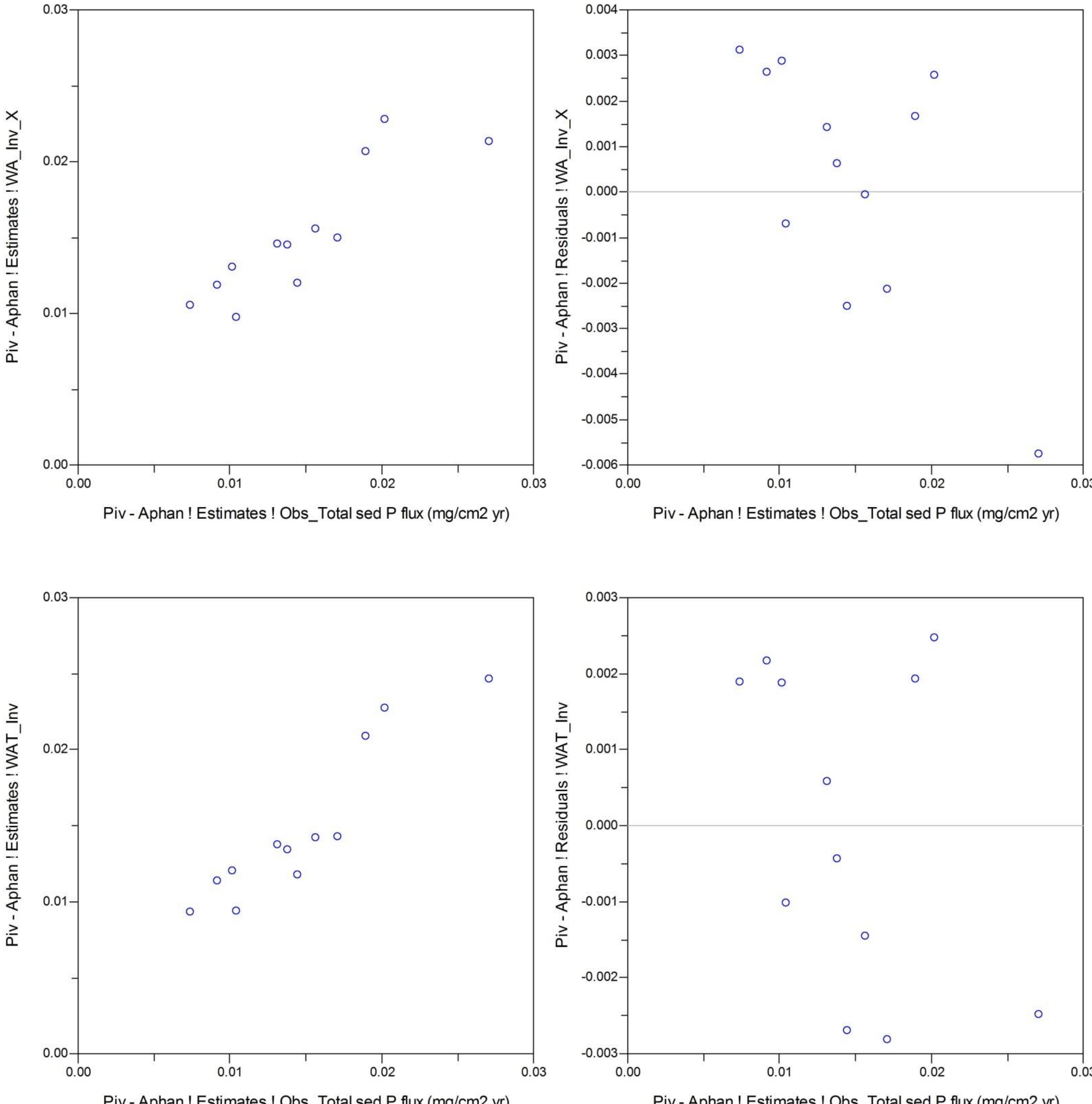
Pigment sedimentation

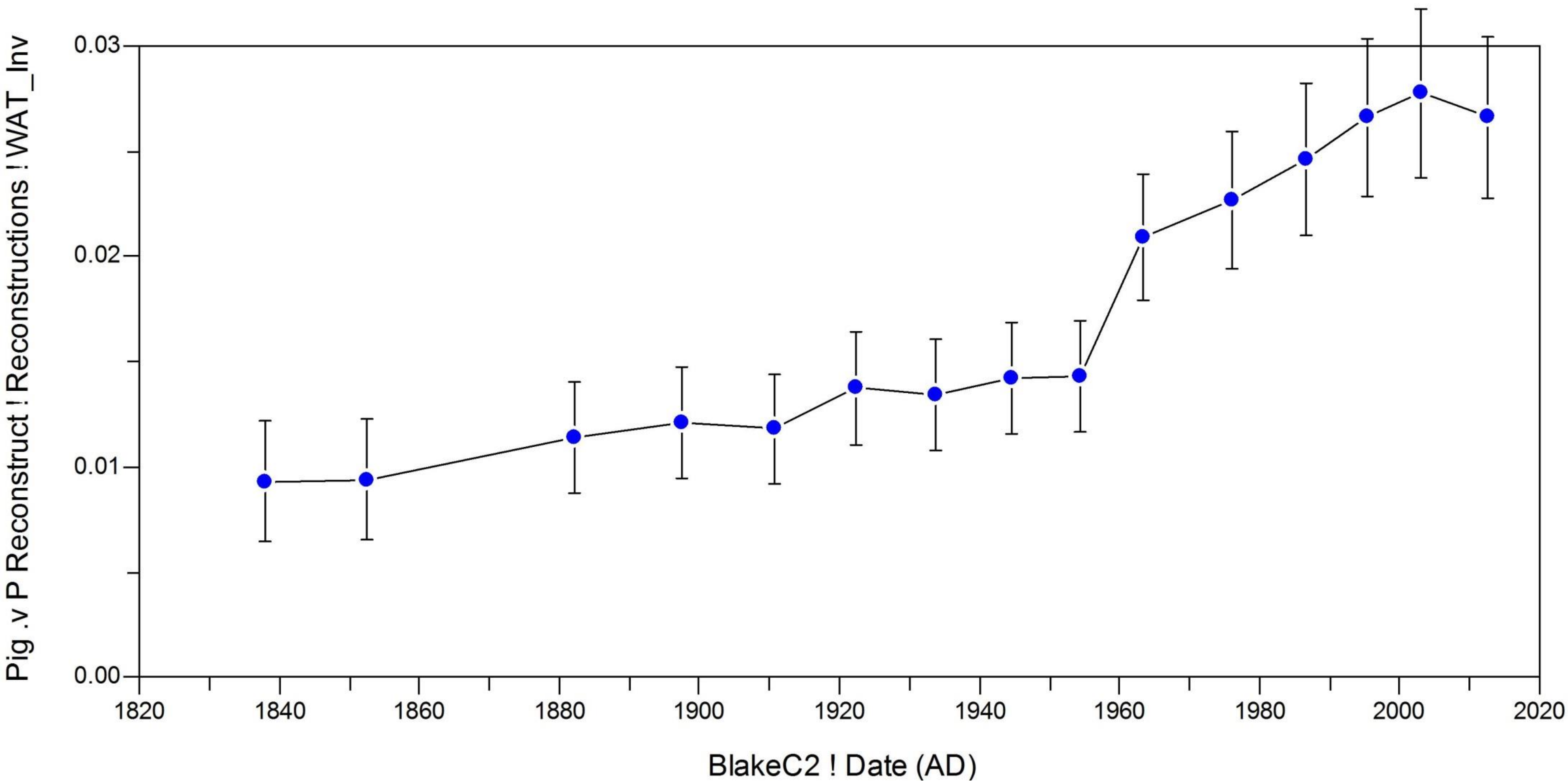
- Pigments are an important record of non-siliceous algae
- Pigment losses are well studied
- Zooplankton can increase transfer rate



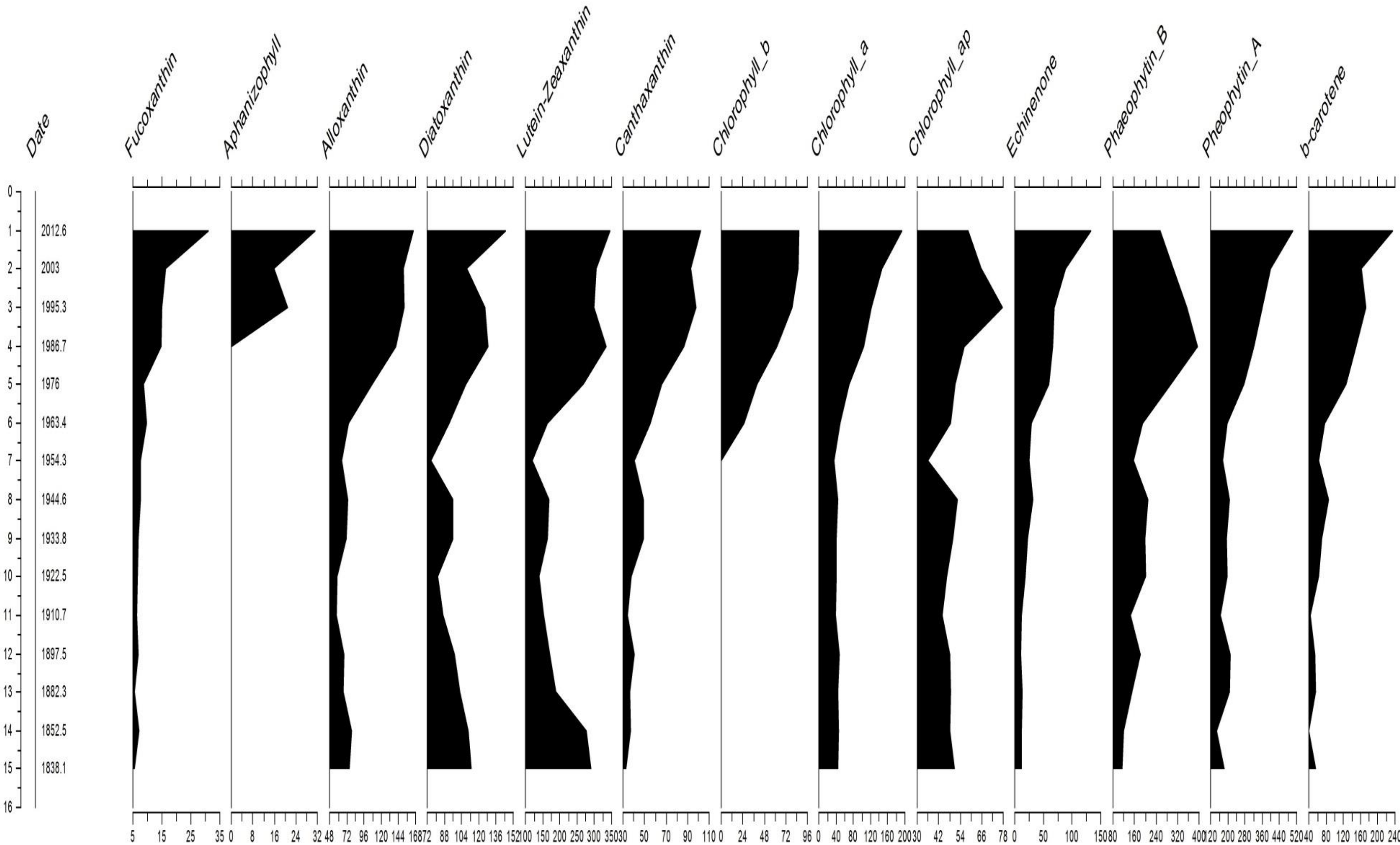
Slide courtesy of N. John Anderson


Pig v. P ! Estimates ! WA_Inv_X
Pig v. P ! Residuals ! WA_Inv_X
Pig v. P ! Estimates ! WAT_Inv
Pig v. P ! Residuals ! WAT_Inv
Pig v. P ! Estimates ! Obs_Total sed P flux (mg/cm2 yr)
0.000
0.012
0.024
0.036
0.048
0.060
0.072
0.01
0.00
-0.01
-0.02
-0.03

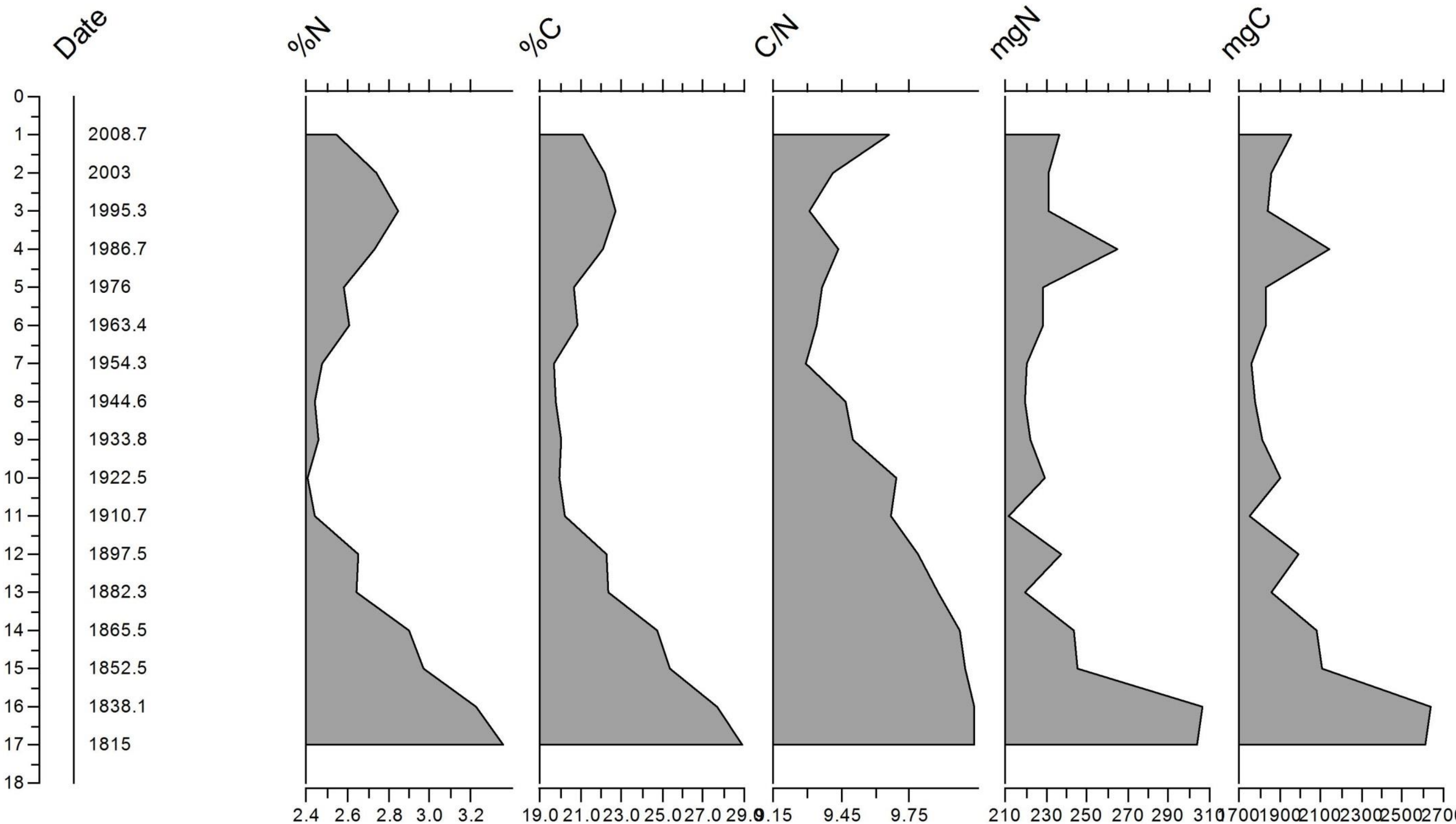

Piv - Aphan ! Estimates ! WA_Inv_X
Piv - Aphan ! Residuals ! WA_Inv_X
Piv - Aphan ! Estimates ! WAT_Inv
Piv - Aphan ! Residuals ! WAT_Inv
Piv - Aphan ! Estimates ! Obs_Total sed P flux (mg/cm2 yr)
Piv - Aphan ! Estimates ! Obs_Total sed P flux (mg/cm2 yr)
Piv - Aphan ! Estimates ! Obs_Total sed P flux (mg/cm2 yr)
Piv - Aphan ! Estimates ! Obs_Total sed P flux (mg/cm2 yr)
0.00
0.01
0.02
0.03
0.004
0.003
0.002
0.001
0.000
-0.001
-0.002
-0.003
-0.004
-0.005
-0.006



Pig.v P Reconstruct ! Reconstructions ! WAT_Inv
0.03
0.02
0.01
0.00
1820
1840
1860
1880
1900
1920
1940
1960
1980
2000
2020
BlakeC2 ! Date (AD)



Date
Fucoxanthin
Aphanizophyll
Alloxanthin
Diatoxanthin
Lutein-Zeaxanthin
Canthaxanthin
Chlorophyll_b
Chlorophyll_a
Chlorophyll_ap
Echinenone
Phaeophytin_B
Pheophytin_A
b-carotene
2012.6
2003
1995.3
1986.7
1976
1963.4
1954.3
1944.6
1933.8
1922.5
1910.7
1897.5
1882.3
1852.5
1838.1


Date
%N
%C
C/N
mgN
mgC
2008.7
2003
1995.3
1986.7
1976
1963.4
1954.3
1944.6
1933.8
1922.5
1910.7
1897.5
1882.3
1865.5
1852.5
1838.1
1815
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
2.4 2.6 2.8 3.0 3.2
19.0 21.0 23.0 25.0 27.0 29.0
9.15 9.45 9.75
210 230 250 270 290 310
1700 1900 2100 2300 2500 2700


10 µm

Blake Lake 1852

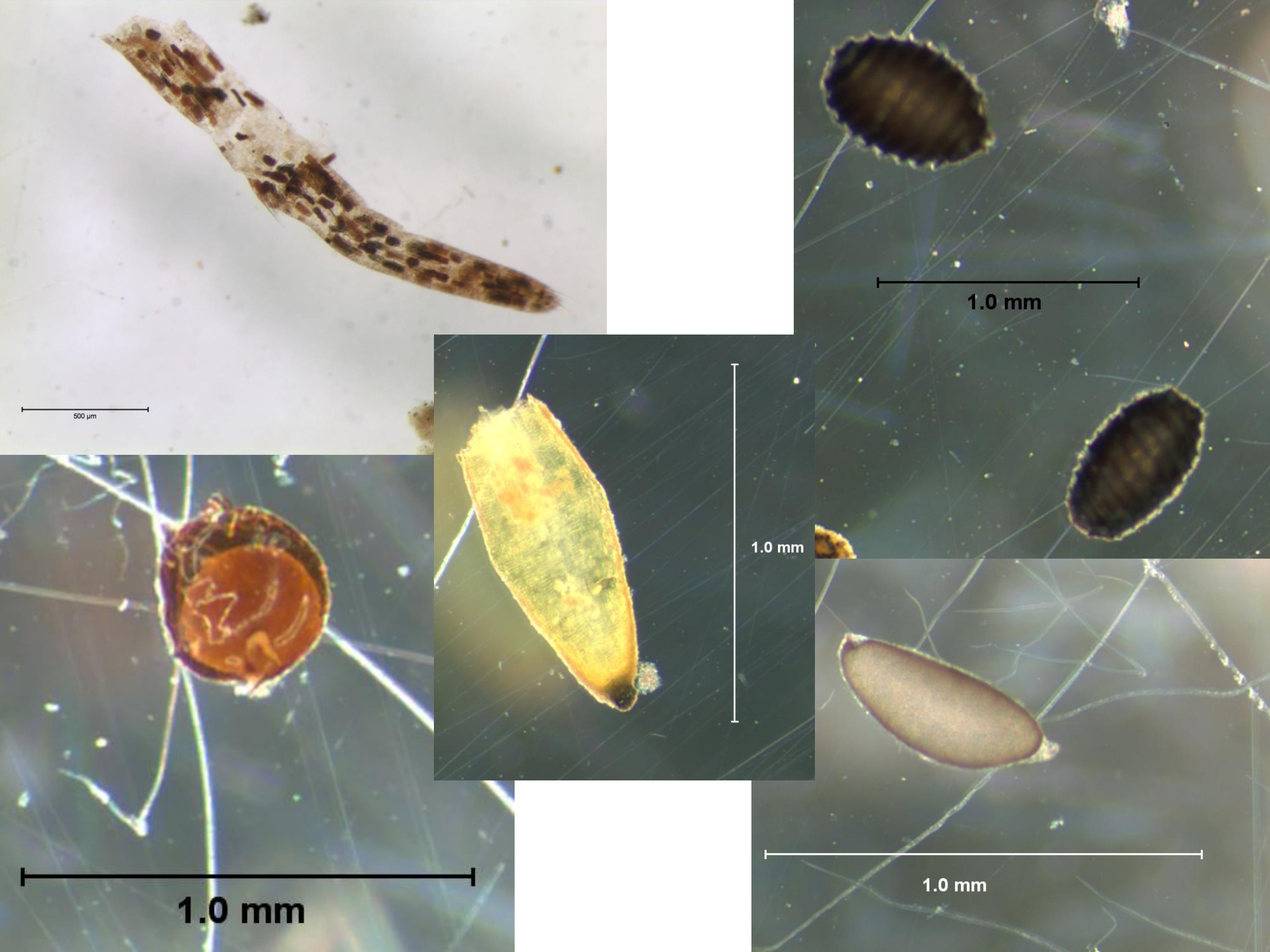
Blake Lake 2012

Altered biological structure and the reconstruction of fish

- How do we get to fish from the sediment record?
  - **directly: fish scales**
  - **indirectly - through zooplankton assemblage structure**
  - **Pigments – grazing indicators**

Slide courtesy of N. John Anderson


500 µm


500 µm
1.0 mm
1.0 mm
1.0 mm
1.0 mm

Questions?

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Aquatic Invasive Species Biologist
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