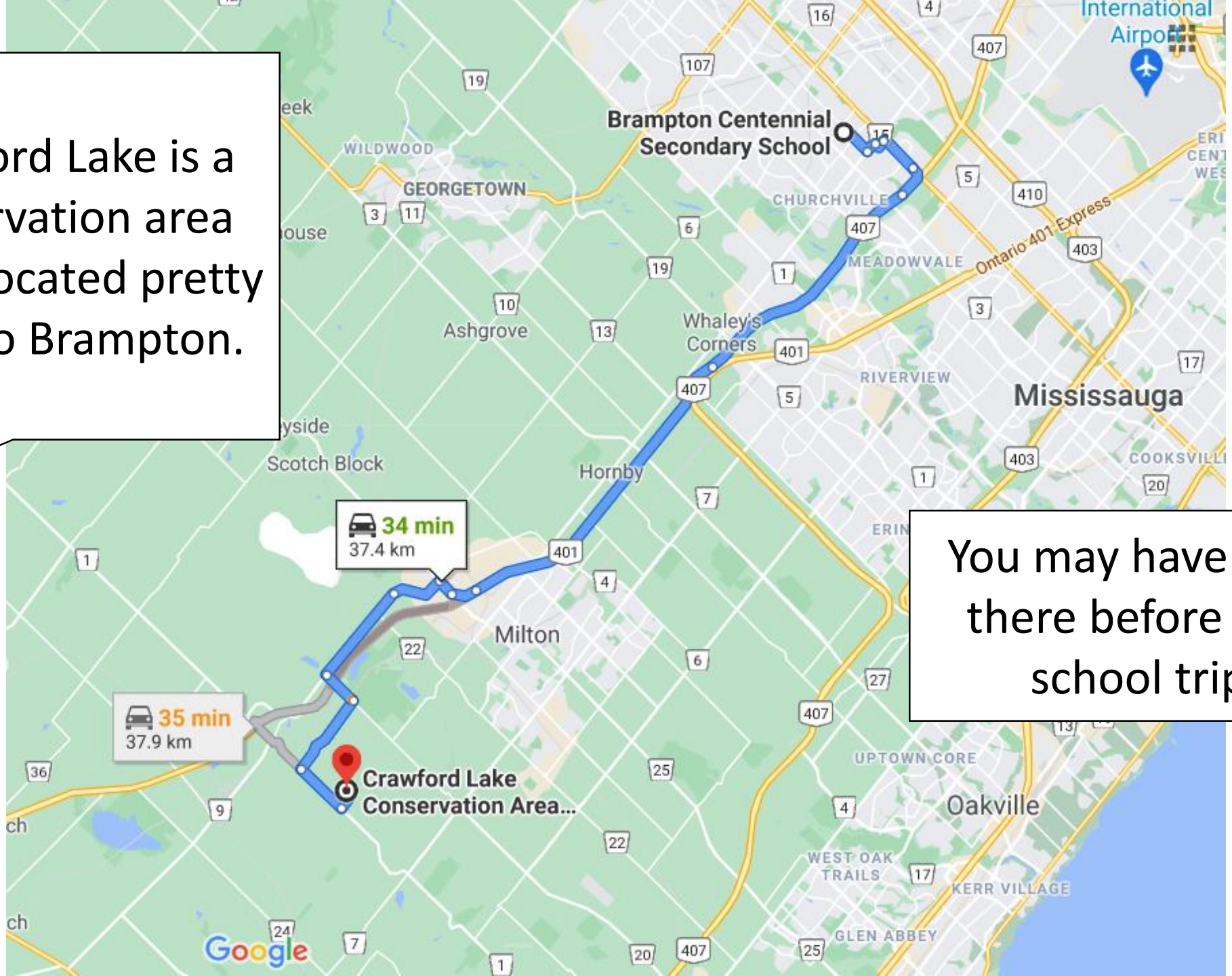
Crawford Lake Core Samples

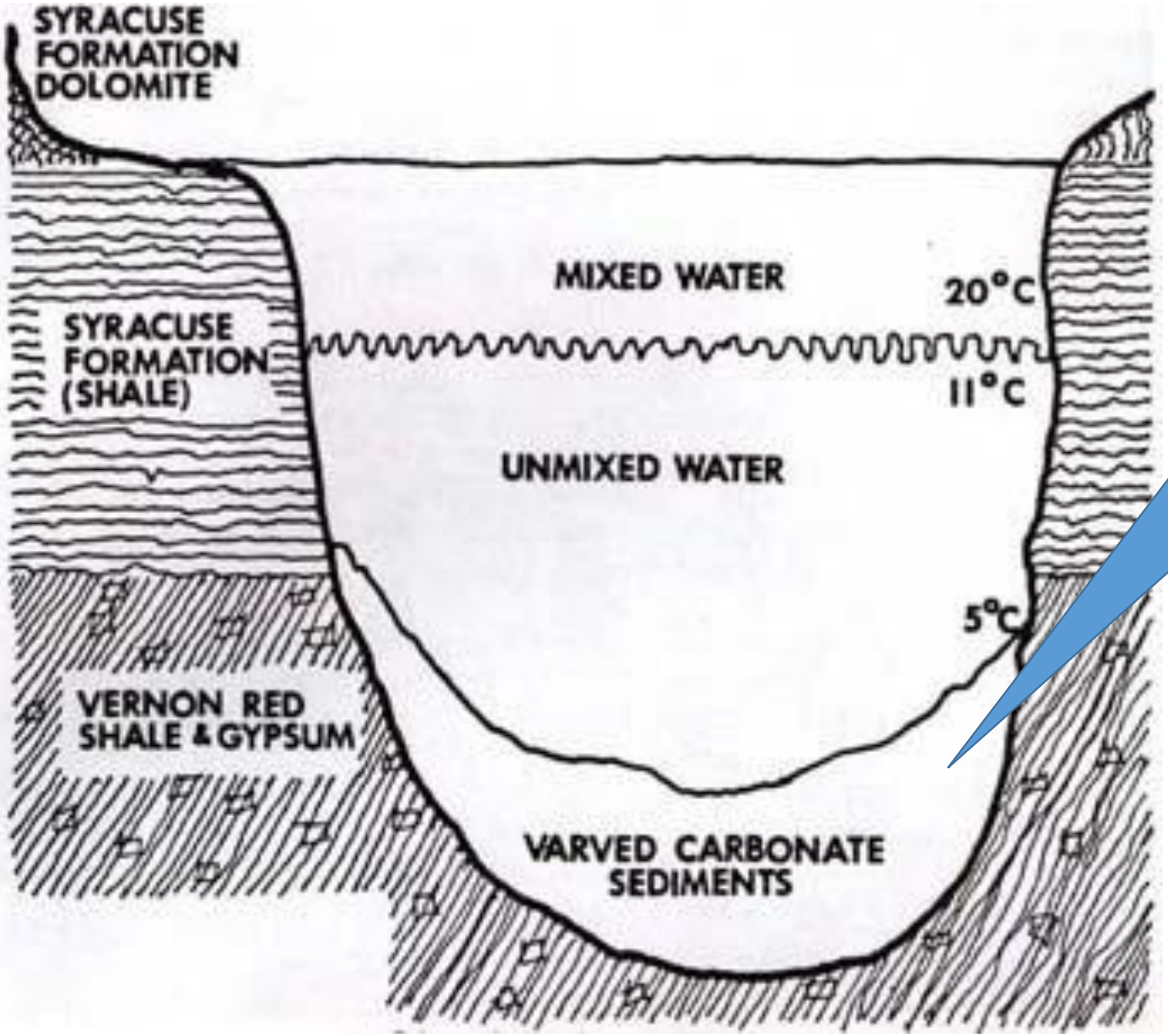
Source Graphs

Crawford Lake is a conservation area that is located pretty close to Brampton.



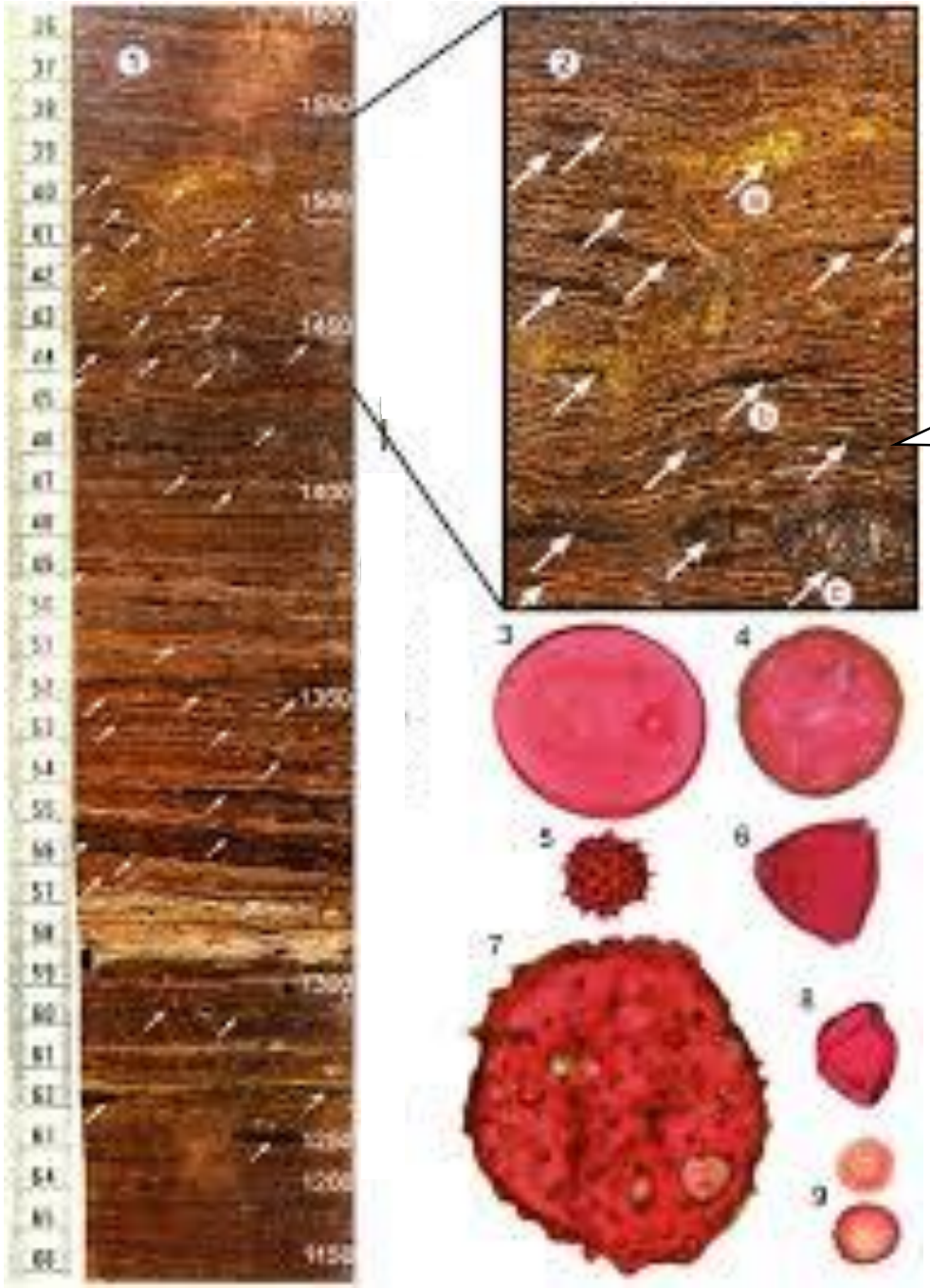
You may have been there before on a school trip.


The lake is EXTREMELY important to researchers because it is meromictic.
EXTREMELY is actually an understatement. Researchers all over the world use it and incredibly important findings have resulted.



Essentially, the water at the bottom doesn't move, so layers (VARVES) build up at the bottom.

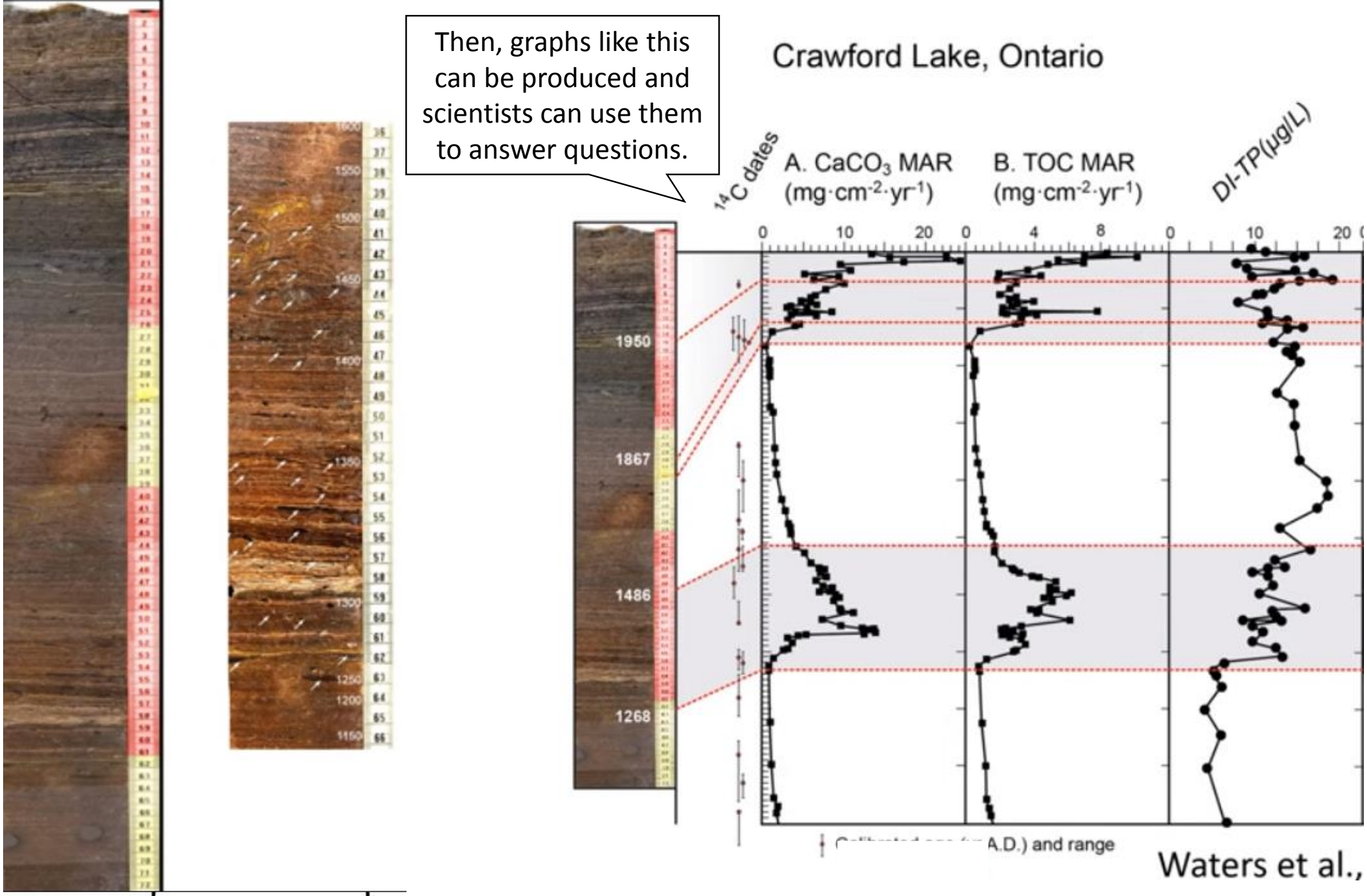
Lake Crawford's Varves.



Each level has a series of microfossil, pollen and other organic matter that shows what was in the area that year.

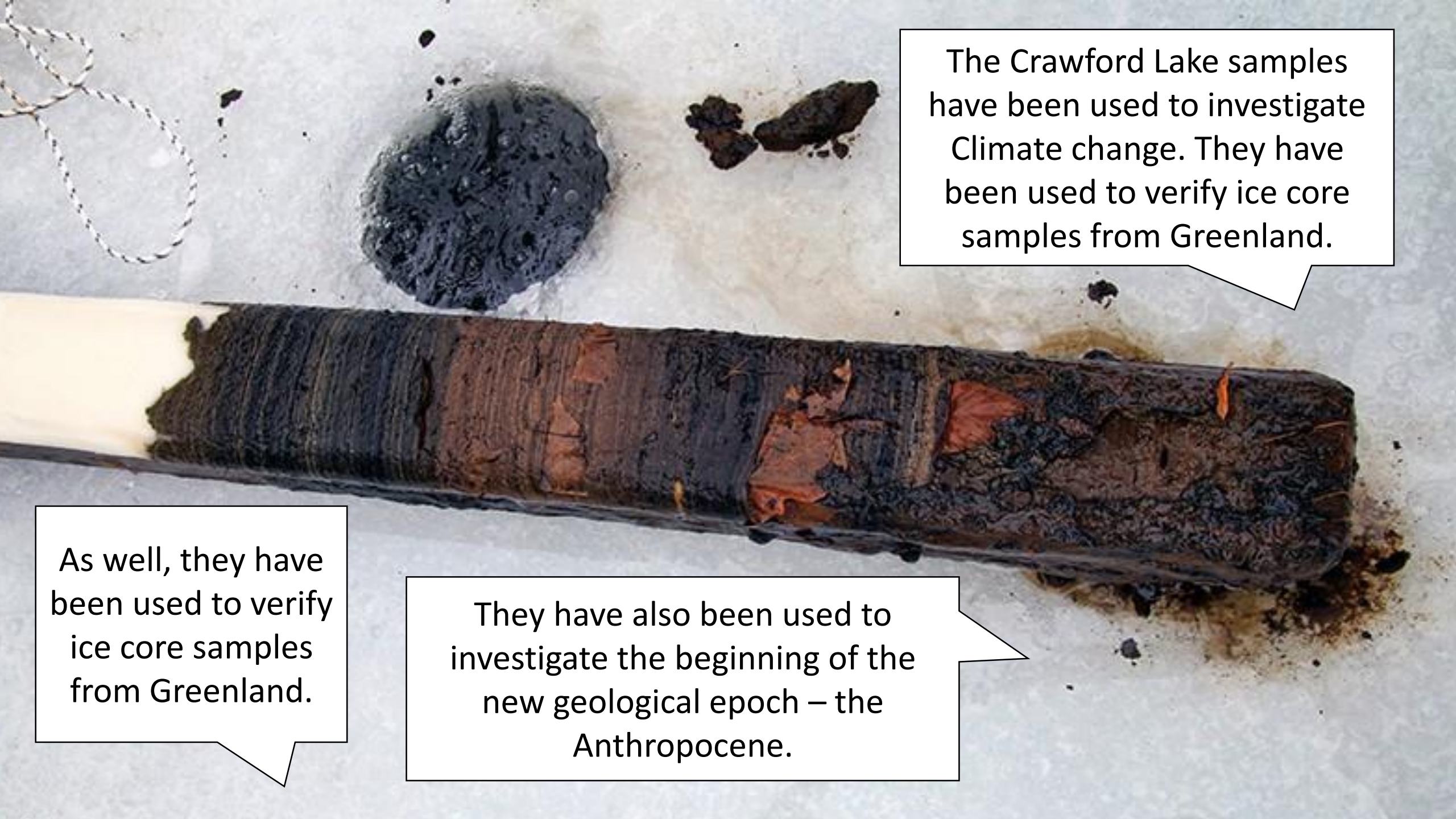
Scientists look at each layer, identify and count what they find under the microscope.

Then, graphs like this can be produced and scientists can use them to answer questions.

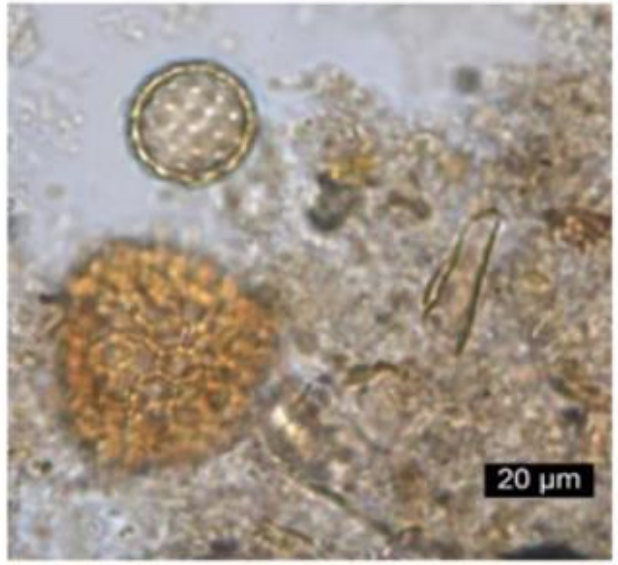


The samples can be taken in winter (it’s easier to stand on the water then).


Alternatively, the samples can be taken in the summer via a boat.


The Crawford Lake samples have been used to investigate Climate change. They have been used to verify ice core samples from Greenland.
As well, they have been used to verify ice core samples from Greenland.
They have also been used to investigate the beginning of the new geological epoch – the Anthropocene.

Problem Phase



In the earliest studies, researchers found crop pollen. Since that doesn't travel far, they knew a village had existed nearby.

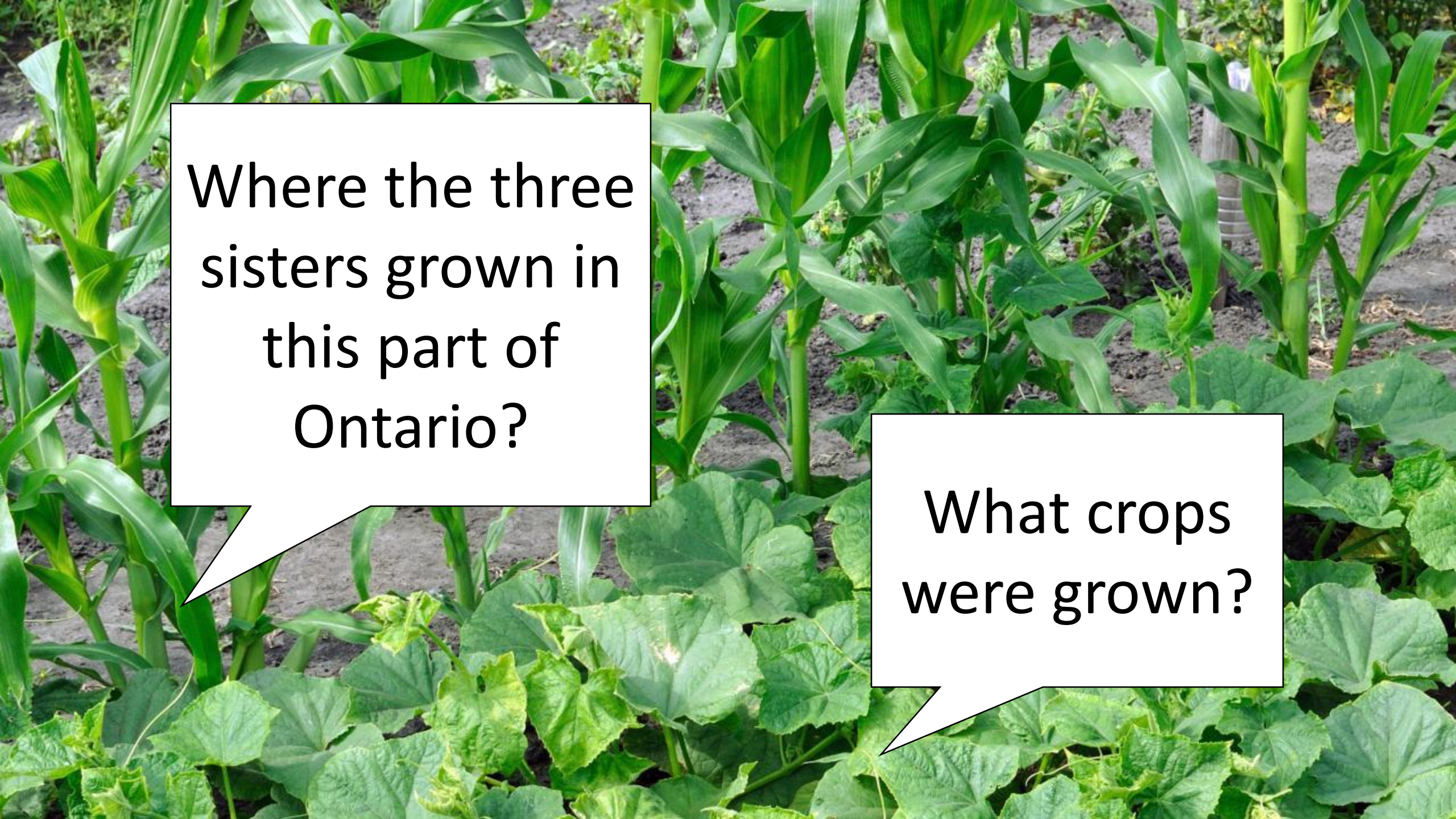
Who grew the crops?

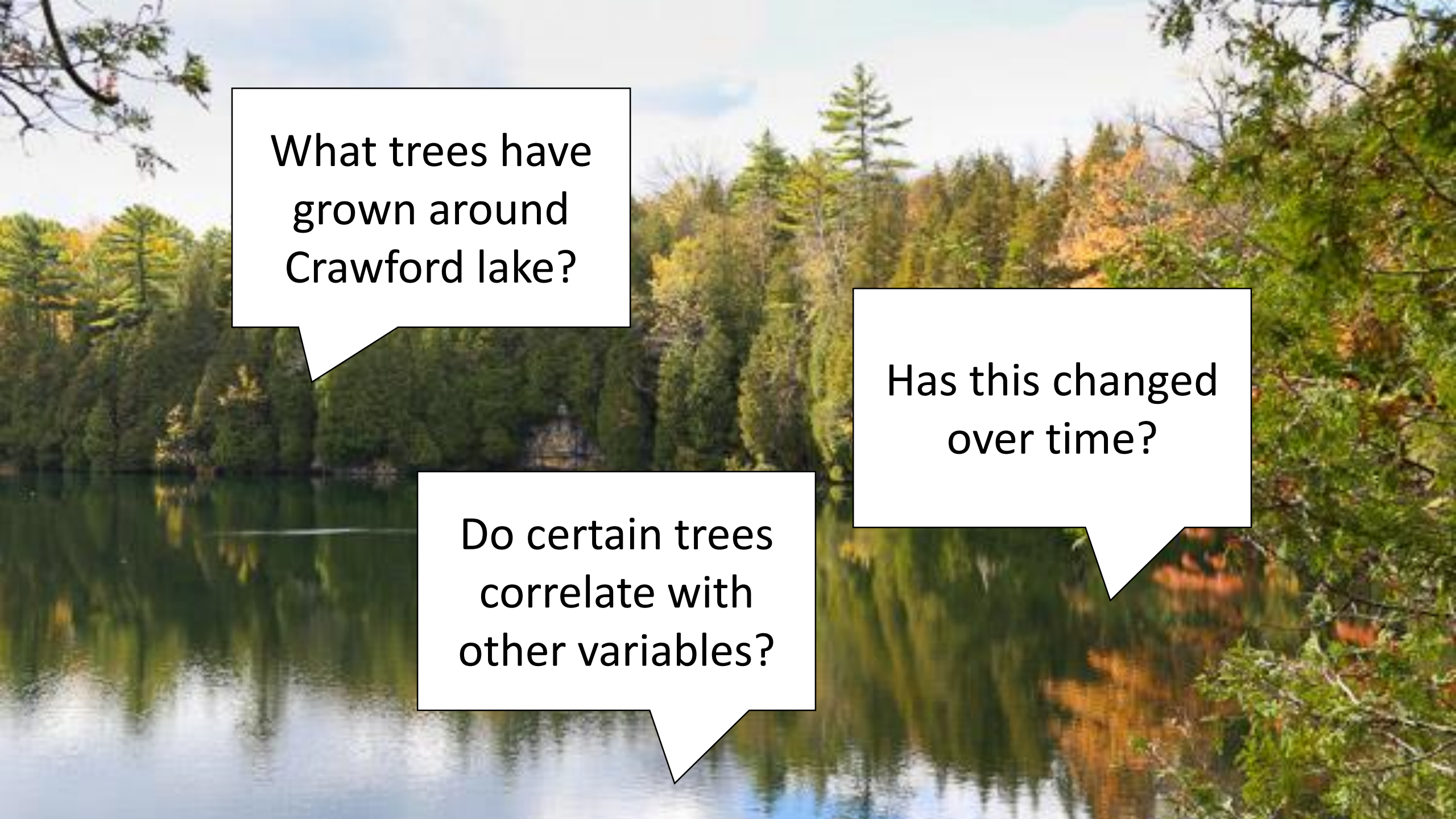
When? What where their lifeways like?

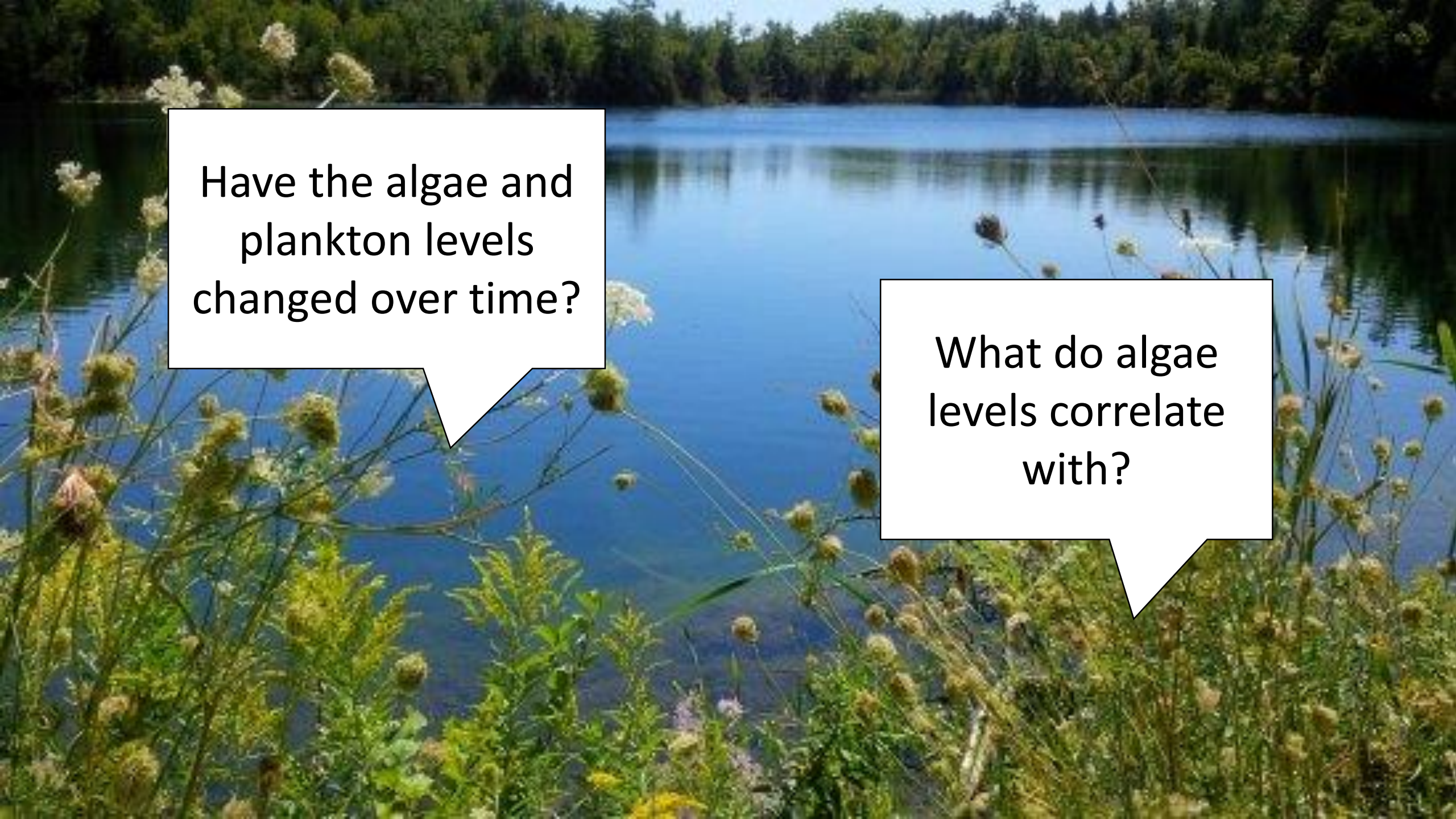
Was the village used repeatedly or continuously?

Period	Archaeological Culture	Date Range	Attributes
PALEO-INDIAN			
Early	Gainey, Barnes, Crowfield	9000-8500 BC	Big game hunters. Fluted projectile points
Late	Holcombe, Hi-Lo, Lanceolate	8500-7500 BC	Small nomadic hunter-gatherer bands. Lanceolate projectile points
ARCHAIC			
Early	Side-notched, corner notched, bifurcate-base	7800-6000 BC	Small nomadic hunter-gatherer bands; first notched and stemmed points, and ground stone celts.
Middle	Otter Creek , Brewerton	6000-2000 BC	Transition to territorial settlements
Late	Narrow, Broad and Small Points Normanskill, Lamoka, Genesee, Adder Orchard etc.	2500-500 BC	More numerous territorial hunter-gatherer bands; increasing use of exotic materials and artistic items for grave offerings; regional trade networks
WOODLAND			
Early	Meadowood, Middlesex	800-400 BC	Introduction of pottery, burial ceremonialism; panregional trade networks
Middle	Point Peninsula, Saugeen, Jack's Reef Corner Notched	400 BC-AD 800	Cultural and ideological influences from Ohio Valley complex societies; ~~incipient horticulture~~
Late	Algonquian, Iroquoian	AD 800-1300	Transition to village life and agriculture
	Algonquian, Iroquoian	AD 1300-1400	Establishment of large palisaded villages
	Algonquian, Iroquoian	AD 1400-1600	Tribal differentiation and warfare
HISTORIC			
Early	Huron, Neutral, Petun, Odawa, Ojibwa	AD 1600 – 1650	Tribal displacements
Late	Six Nations Iroquois, Ojibwa, Mississauga	AD 1650 – 1800s	Migrations and resettlement
	Euro-Canadian	AD 1780 - present	European immigrant settlements


Based on the time period, should the reconstructed village have a palisade or not?


Where the three sisters grown in this part of Ontario?
What crops were grown?

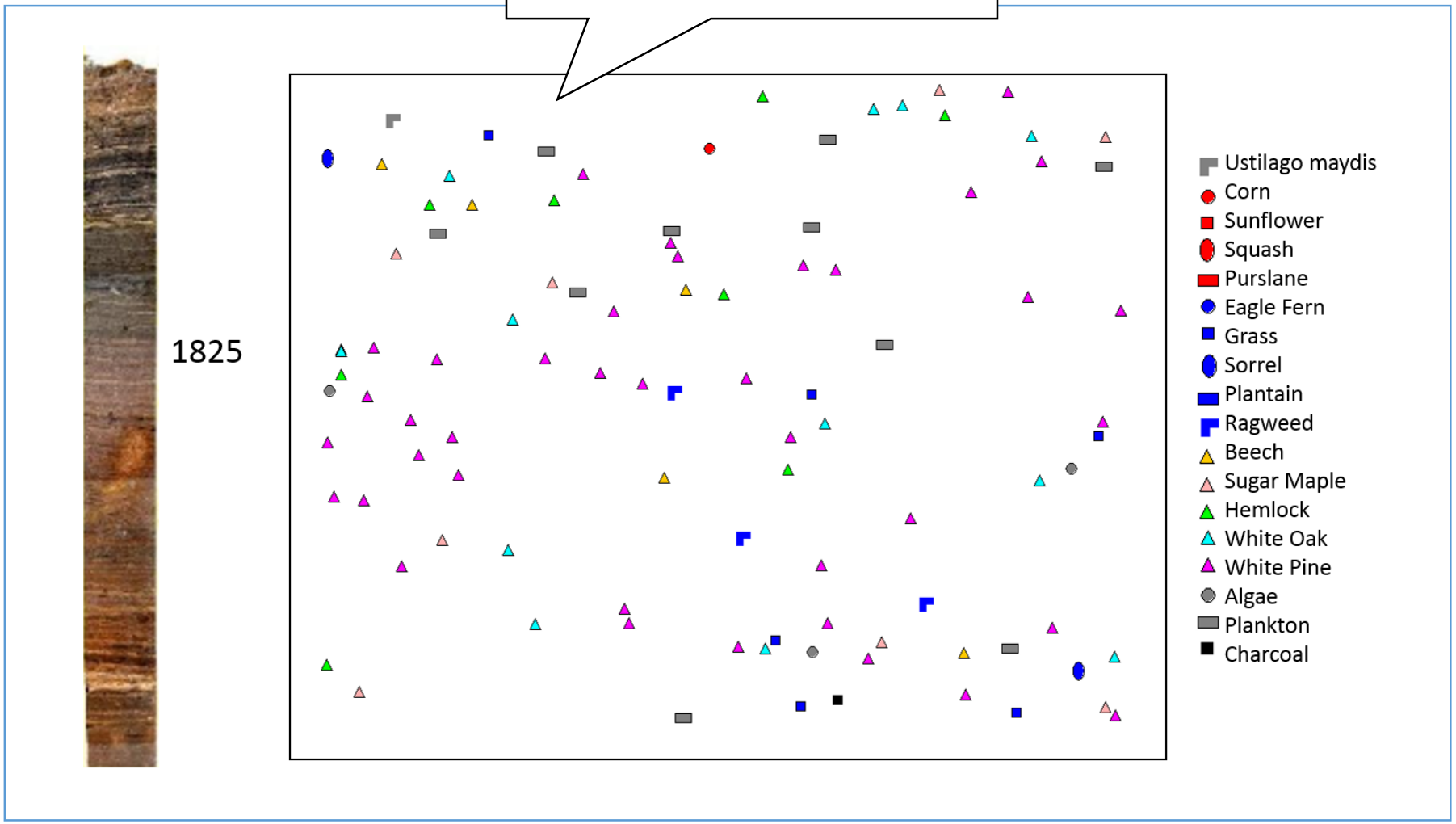

What trees have grown around Crawford lake?
Has this changed over time?
Do certain trees correlate with other variables?


Have the algae and plankton levels changed over time?
What do algae levels correlate with?


What changed when the Crawfords moved in?
How were the soil samples different and the same as the earlier villages?
When did they move in? How do you know?

Plan Phase

You will be given a simulation of a slice of the lake bottom sample.

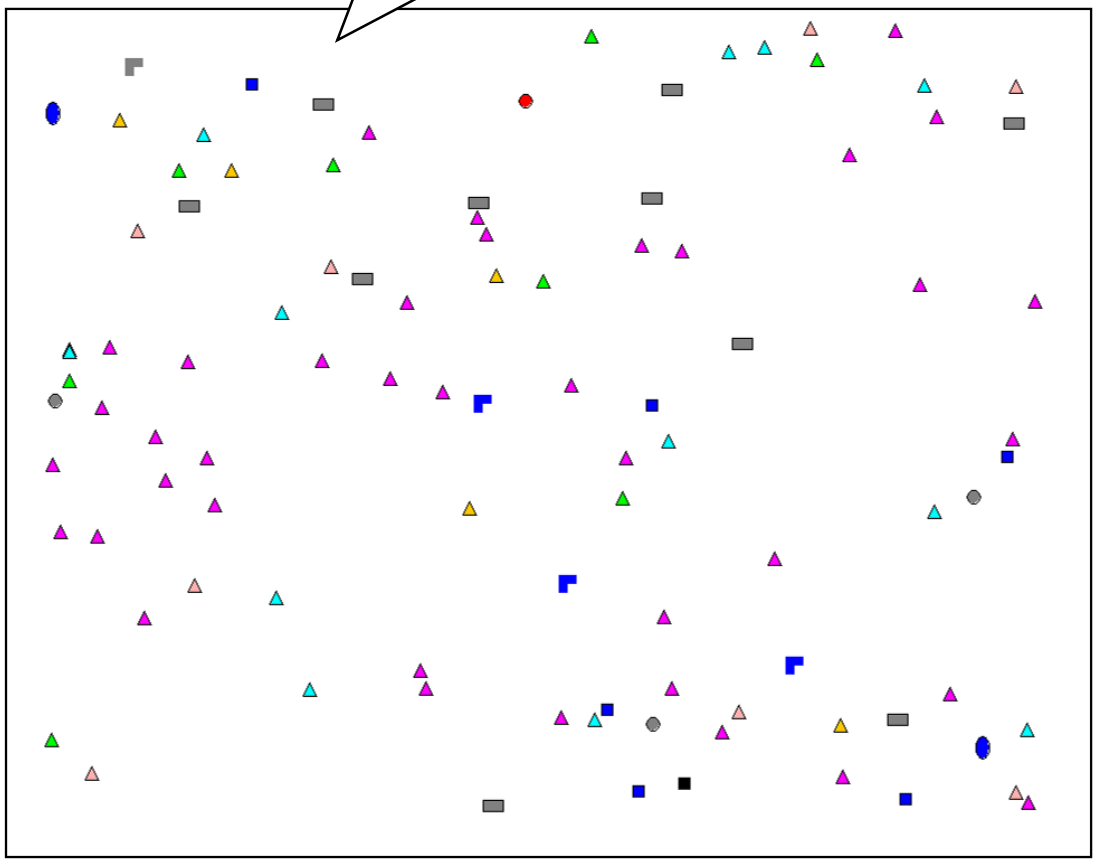


Plan Phase

You will be given a simulation of a slice of the lake bottom sample.

The simulation represents the particles this way.

1825



- Ustilago maydis
- Corn
- Sunflower
- Squash
- Purslane
- Eagle Fern
- Grass
- Sorrel
- Plantain
- Ragweed
- Beech
- Sugar Maple
- Hemlock
- White Oak
- White Pine
- Algae
- Plankton
- Charcoal

Plan Phase

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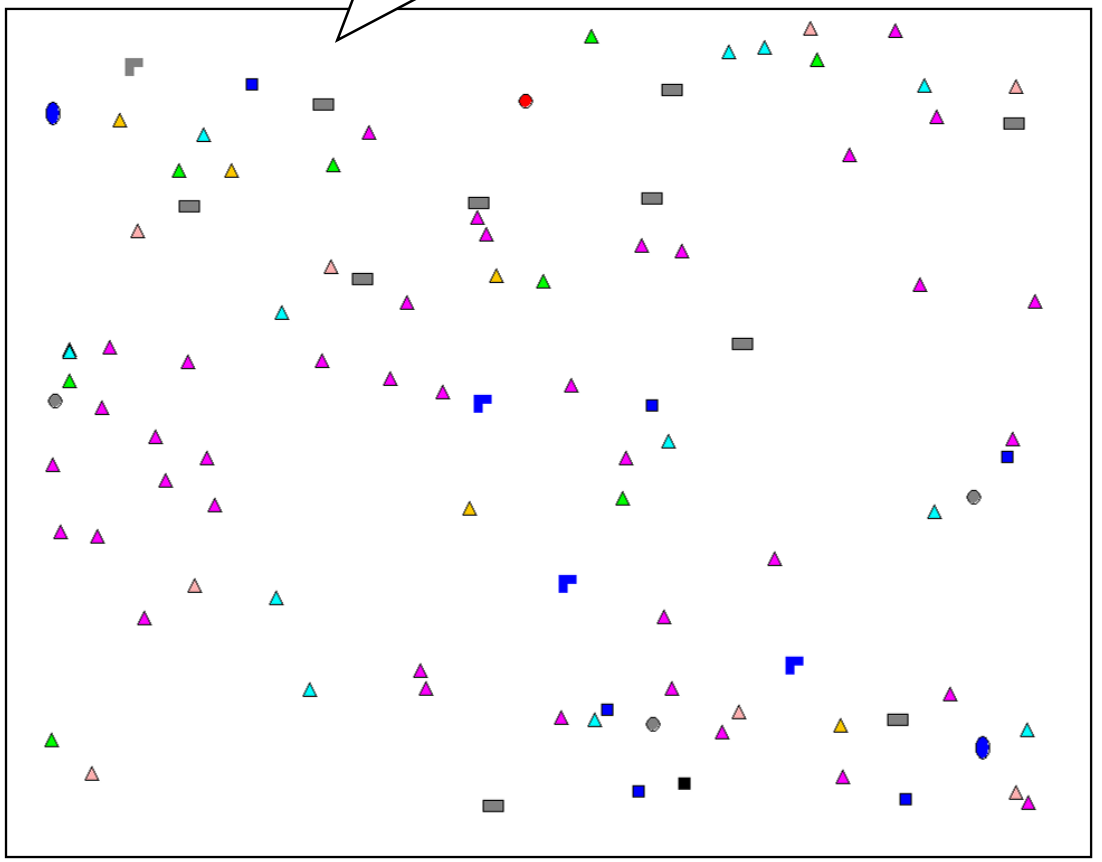
1825



- Ustilago maydis
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- Sunflower
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- Sugar Maple
- Hemlock
- White Oak
- White Pine
- Algae
- Plankton
- Charcoal

And yes, it is true that you can't see all of these things at the same time. This is a simulation.

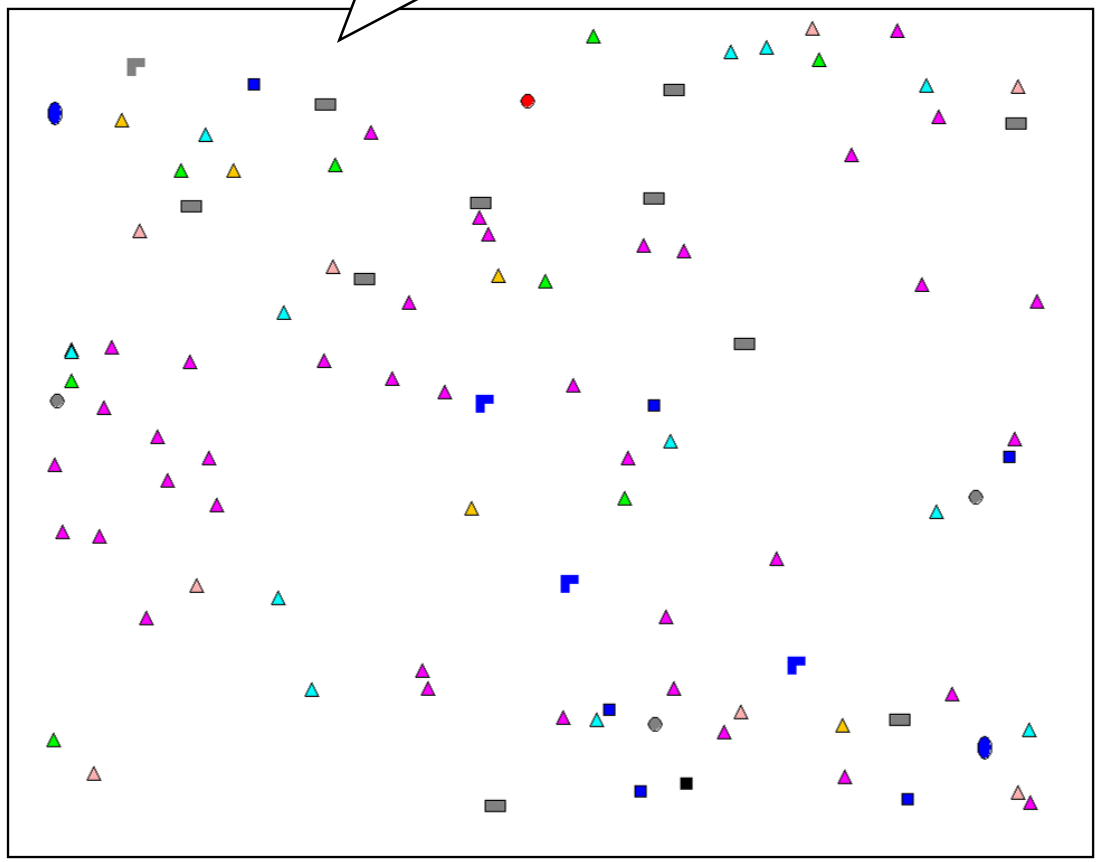
Plan Phase

You will be given a simulation of a slice of the lake bottom sample.

The simulation represents the particles this way.

The rough position of the year in the Crawford lake sample.

The year of the sample. The years were taken in 25 year increments.



- Ustilago maydis
- Corn
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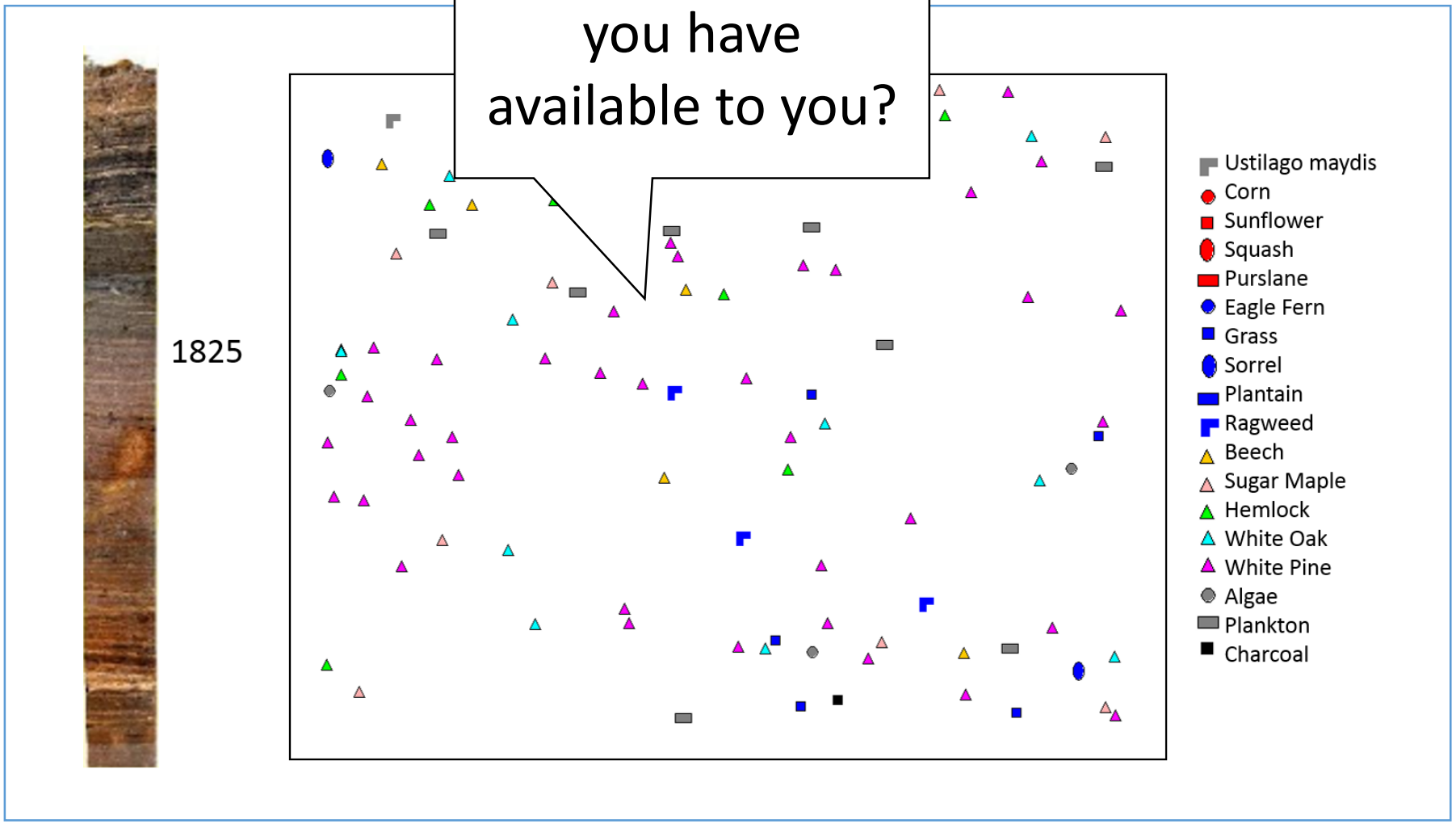
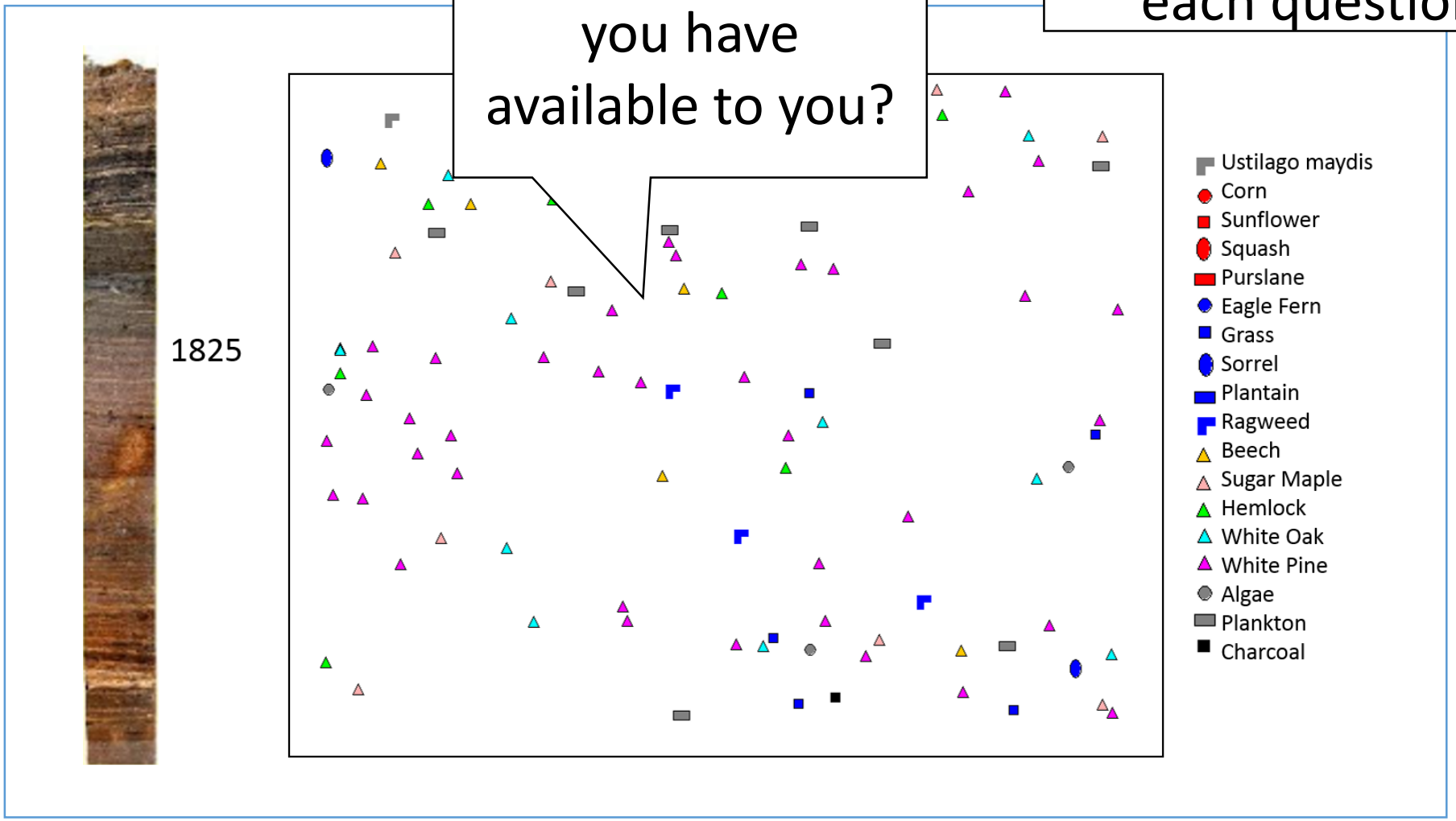
Plan Phase


What variables do you have available to you?
1825
Ustilago maydis
Corn
Sunflower
Squash
Purslane
Eagle Fern
Grass
Sorrel
Plantain
Ragweed
Beech
Sugar Maple
Hemlock
White Oak
White Pine
Algae
Plankton
Charcoal

Plan Phase

What variables do you have available to you?

Which variables can be used to answer each question?



Plan Phase

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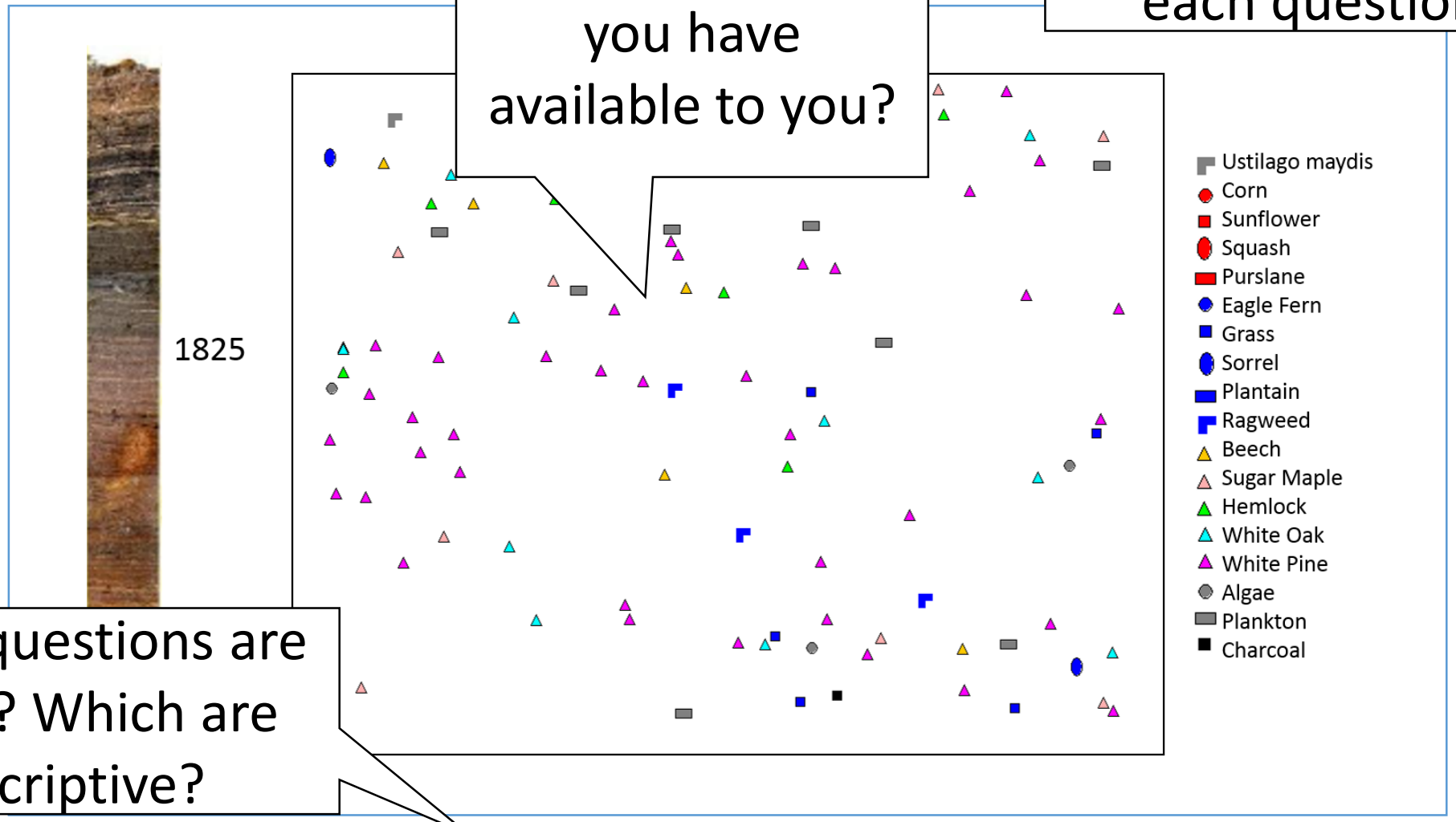
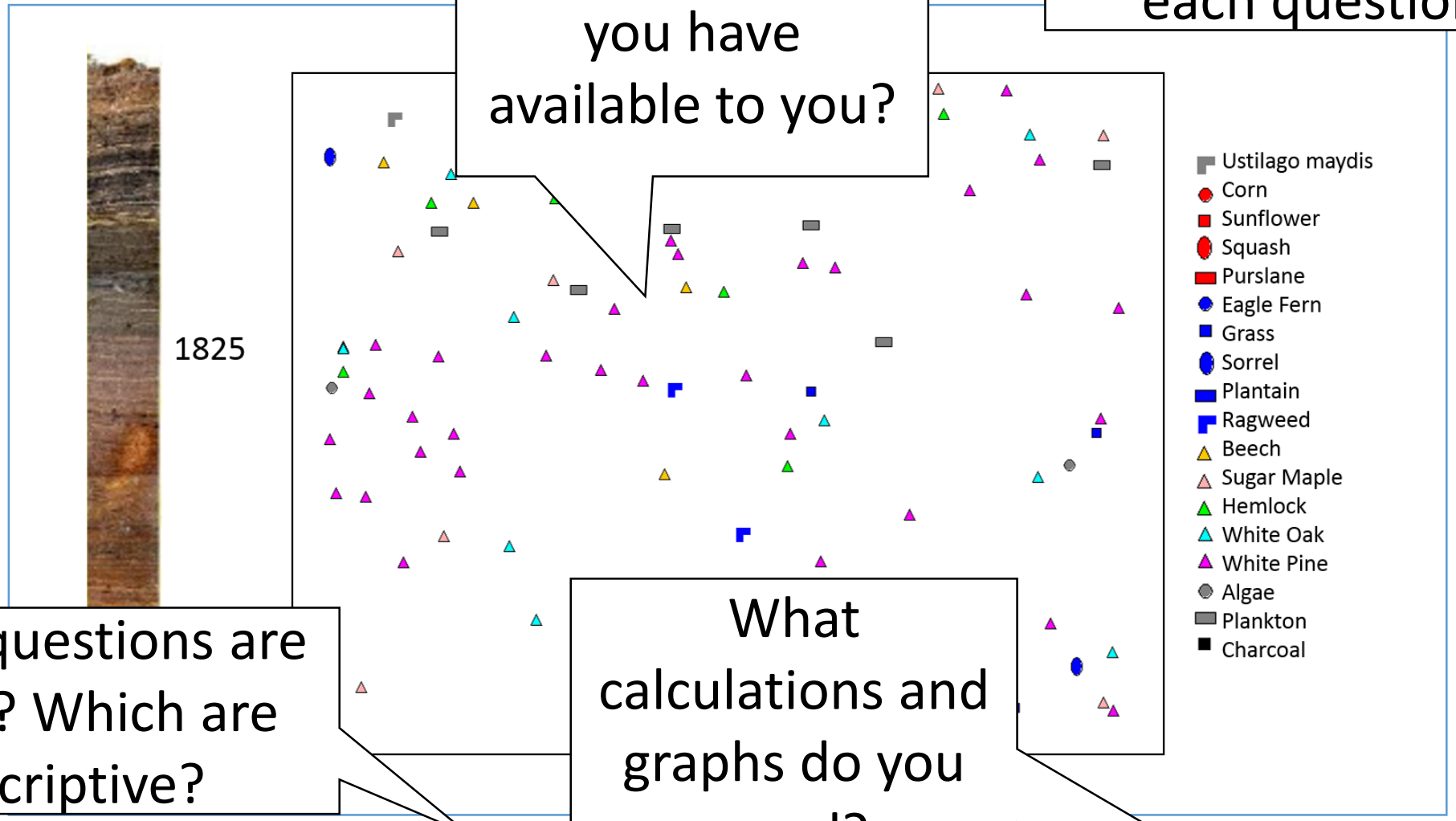


Which questions are causal? Which are descriptive?

Plan Phase

What variables do you have available to you?

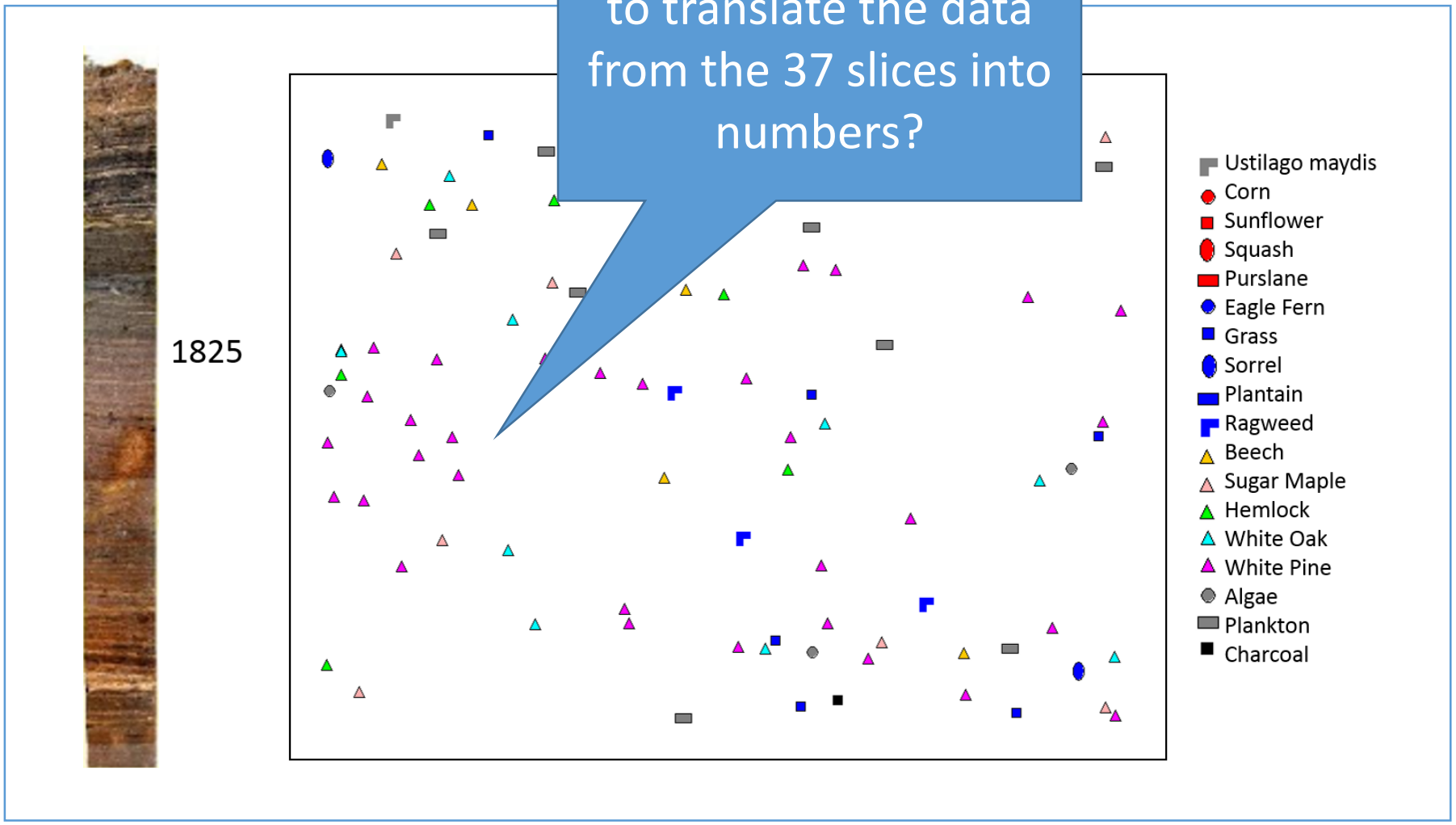
Which variables can be used to answer each question?



Which questions are causal? Which are descriptive?

What calculations and graphs do you need?

Data Phase


Is there any way that we can work together to translate the data from the 37 slices into numbers?
1825
Ustilago maydis
Corn
Sunflower
Squash
Purslane
Eagle Fern
Grass
Sorrel
Plantain
Ragweed
Beech
Sugar Maple
Hemlock
White Oak
White Pine
Algae
Plankton
Charcoal

Work on finding out some pieces of information about the area surrounding Crawford Lake now!

Analysis Phase

How does this data from the Conservation Halton website compare with your data?

15th Century Reconstructed Iroquoian Village

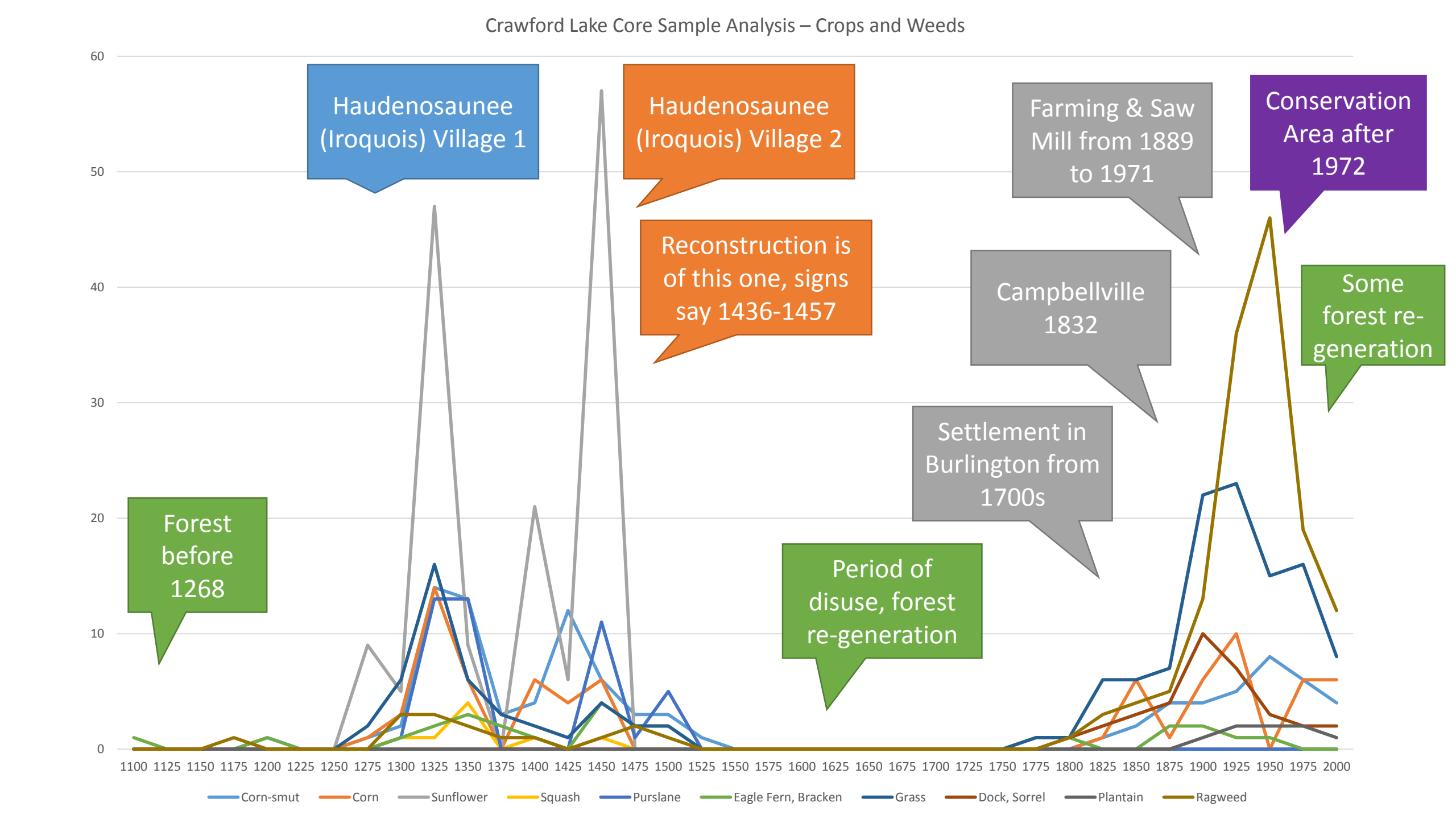
The University of Western Ontario and the Museum of Ontario Archaeology first excavated the Crawford Lake site between 1972 and 1987 under the supervision of Dr. William Finlayson. During that time, the remains of 11 longhouses and a number of features and artifacts were uncovered. Between 2013 and 2017, AMEC Foster-Wheeler has continued the excavations and revealed the remains of another longhouse and several more artifacts. It has been concluded that the site has seen 2 periods of occupation over a span of approximately 200-300 years. The modern reconstruction of the village represents the second occupation period dated between 1436 and 1457 and home to people who were possibly ancestors of the Wendat. The village likely had 5 longhouses and an estimated population of about 250 people.

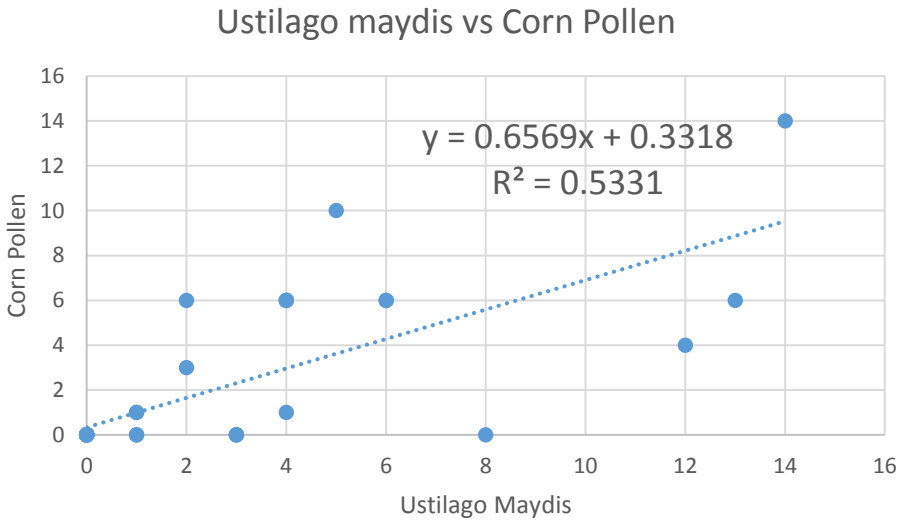
Crawford Family Cottage Remains

George Crawford moved to the Campbellville area with his 8 sisters and mother from Scotland in 1818. The following year, George's father, Andrew, joined the family and received a Crown grant of 100 acres next to his son's 200 acres. George and his wife Esther had 11 children. In 1889, George's son Murray established a saw mill in Campbellville (the buildings can still be seen south of the intersection of Guelph Line and Campbell Ave. in the town of Campbellville). Murray was on the lookout for a commercial logging area and he eventually bought the 200 acres, including the lake. At this location, the Crawford's built a large summer cottage in 1899, which served the family for many years. By 1963, Murray's grandson had taken over the mill/business and he (Murray Mahon) decided to sell the land to Conservation Halton in the 1969. The remains of the cottage front porch can still be seen beside Crawford Lake.

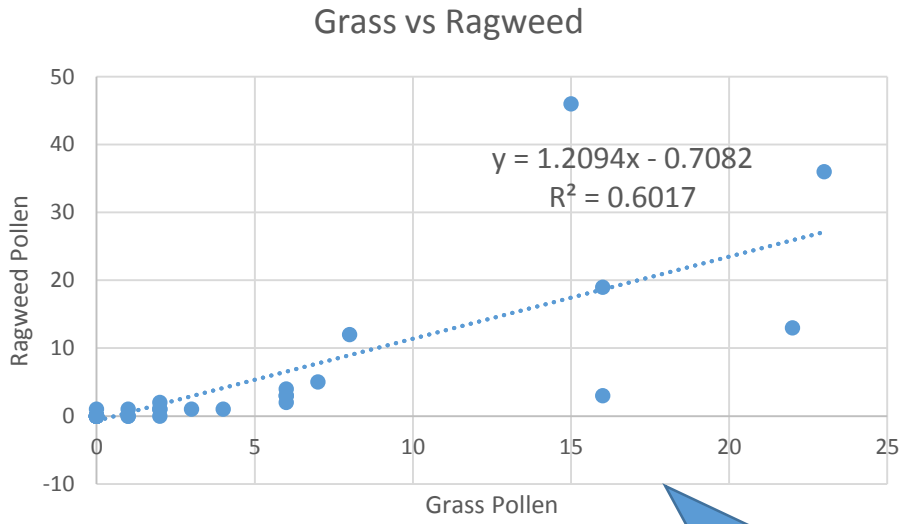
The Howard Farm

In 1903, William Howard purchased 50 acres of land near what is now known as the Nassagaweya Canyon. In 1906, Howard purchased a further 100 acres from Henry Stingle. Stingle had owned the land since 1845 and – as a carpenter – built wooden furniture, including coffins, for the locals in the area. (The remains of the Stingle bank barn and outbuildings can still be viewed along the bypass trail between the Snowshoe and Nassagaweya Canyon trails). This land was split in 1913, when William sold 100 acres to his son Nelson and 50 acres to his son Jack. In 1918, Nelson ended up taking over his brother's 50 acres. Nelson's son, Tom, took over the farm in 1945. In 1971, Tom sold the property to Conservation Halton. Not much remains of the Howard family farm. The Crawford Lake Visitor Centre is built on the location of the Howard farm house and the Wolf Clan Longhouse is now located where the Howard barn once stood. You can still find evidence of the family farm in the field boundaries that extend through the Iroquoian Village.

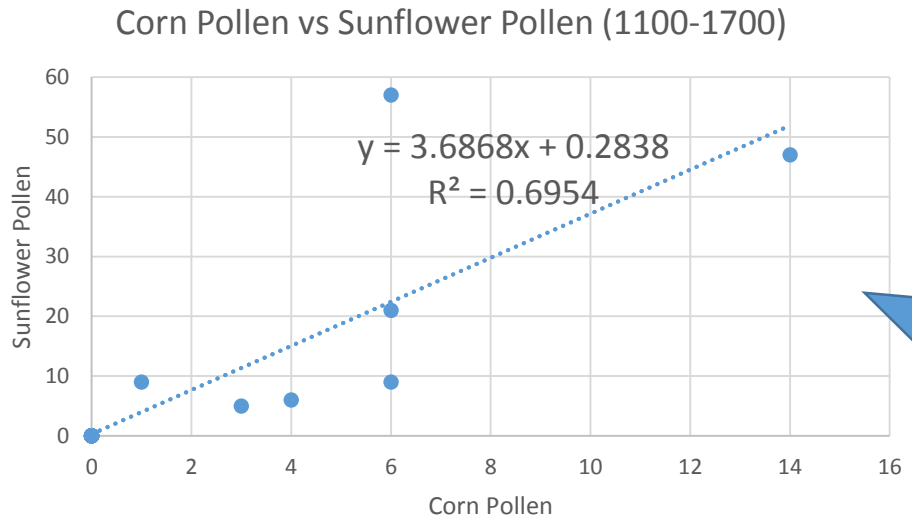

Crawford Lake Core Sample Analysis – Crops and Weeds
Haudenosaunee (Iroquois) Village 1
Haudenosaunee (Iroquois) Village 2
Reconstruction is of this one, signs say 1436-1457
Farming & Saw Mill from 1889 to 1971
Conservation Area after 1972
Campbellville 1832
Some forest re-generation
Settlement in Burlington from 1700s
Forest before 1268
Period of disuse, forest re-generation
60
50
40
30
20
10
0
1100 1125 1150 1175 1200 1225 1250 1275 1300 1325 1350 1375 1400 1425 1450 1475 1500 1525 1550 1575 1600 1625 1650 1675 1700 1725 1750 1775 1800 1825 1850 1875 1900 1925 1950 1975 2000
Corn-smut
Corn
Sunflower
Squash
Purslane
Eagle Fern, Bracken
Grass
Dock, Sorrel
Plantain
Ragweed



Since the Ustilago maydis is disease of corn, this correlation is not surprizing.

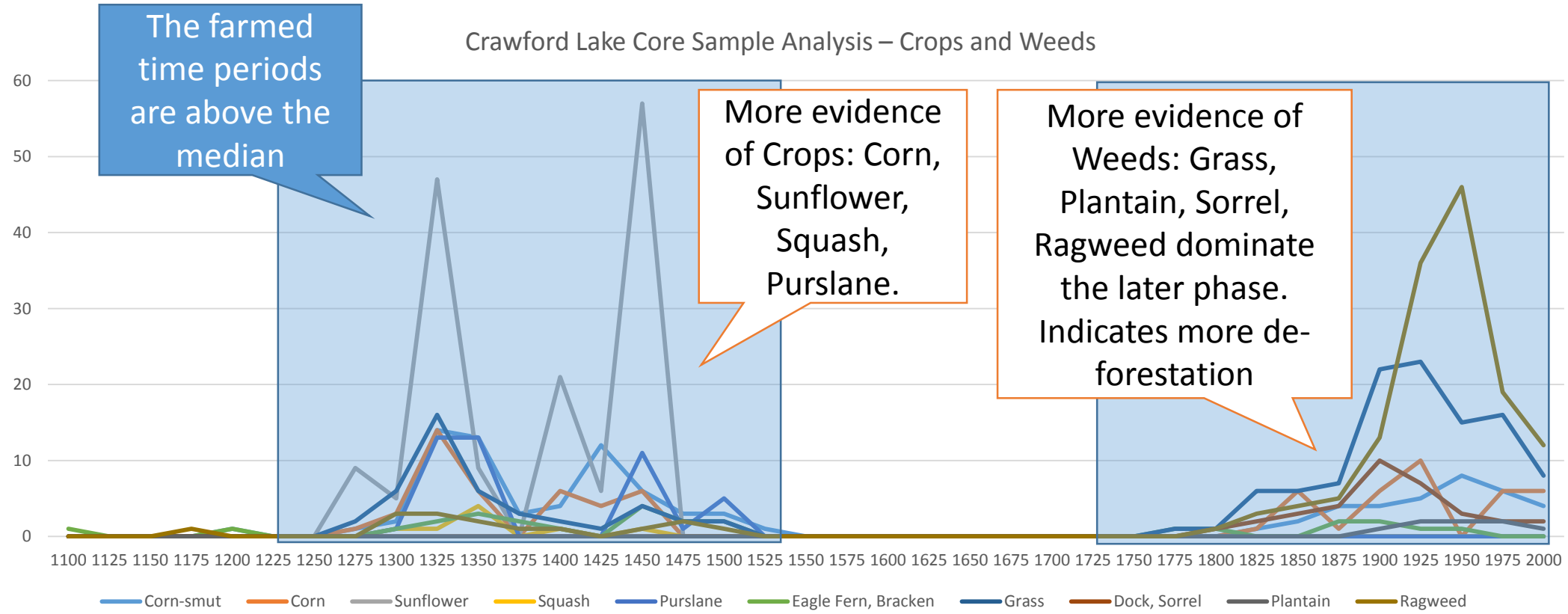


The weeds and grass increase together.



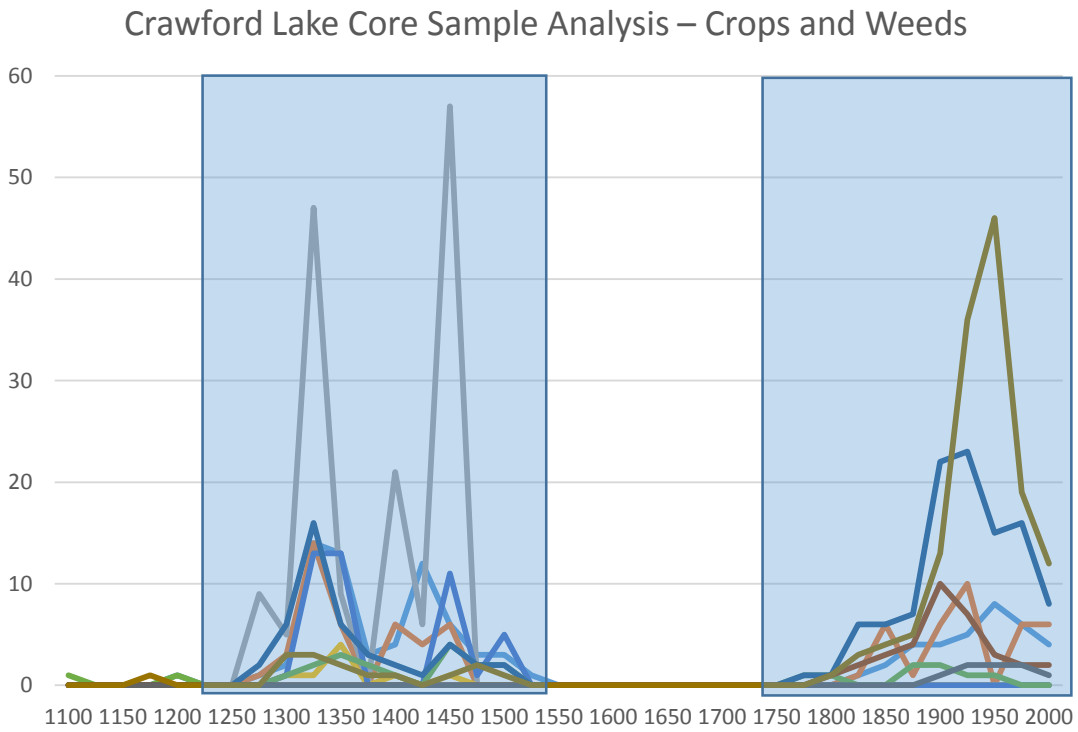
Two crops clearly grown together. We don't normally list sunflowers as a local crop; we should!

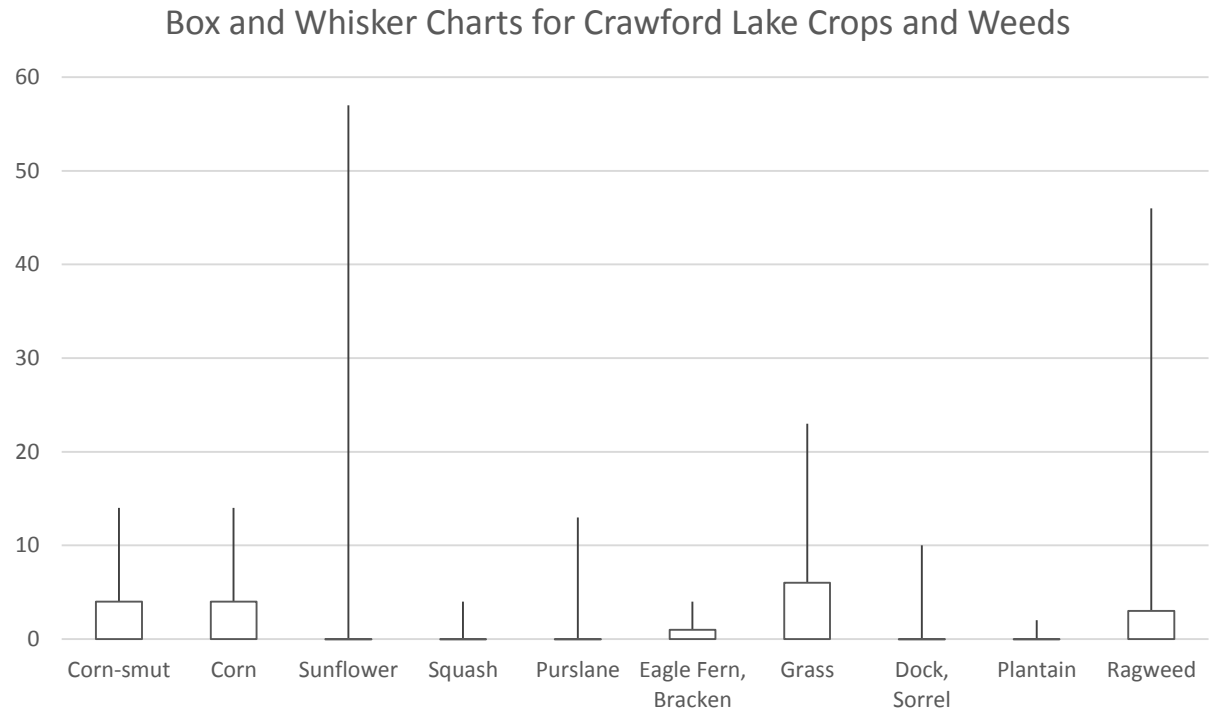
Year	Corn-smut	Corn	Sunflower	Squash	Purslane	Eagle Fern, Bracken	Grass	Dock, Sorrel	Plantain	Ragweed
Min	0	0	0	0	0	0	0	0	0	0
Q1	0	0	0	0	0	0	0	0	0	0
Median	1	0	0	0	0	0	1	0	0	0
Q3	4	4	0	0	0	1	6	0	0	3
Max	14	14	57	4	13	4	23	10	2	46

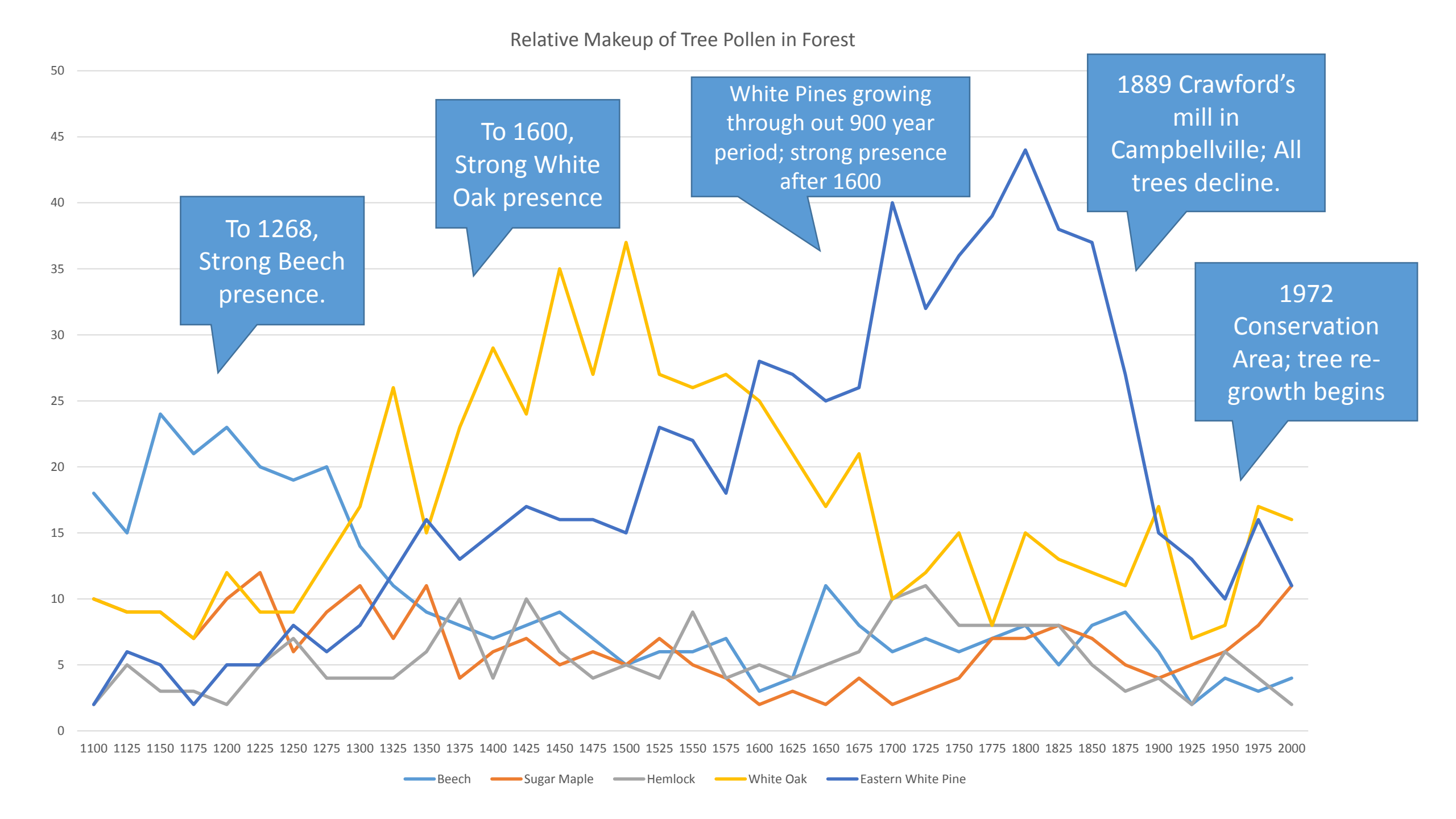


Year	Corn-smut	Corn	Sunflower	Squash	Purslane	Eagle Fern, Bracken	Grass	Dock, Sorrel	Plantain	Ragweed
Min	0	0	0	0	0	0	0	0	0	0
Q1	0	0	0	0	0	0	0	0	0	0
Median	1	0	0	0	0	0	1	0	0	0
Q3	4	4	0	0	0	1	6	0	0	3
Max	14	14	57	4	13	4	23	10	2	46

These extreme periods produce and odd box and whisker graphs.





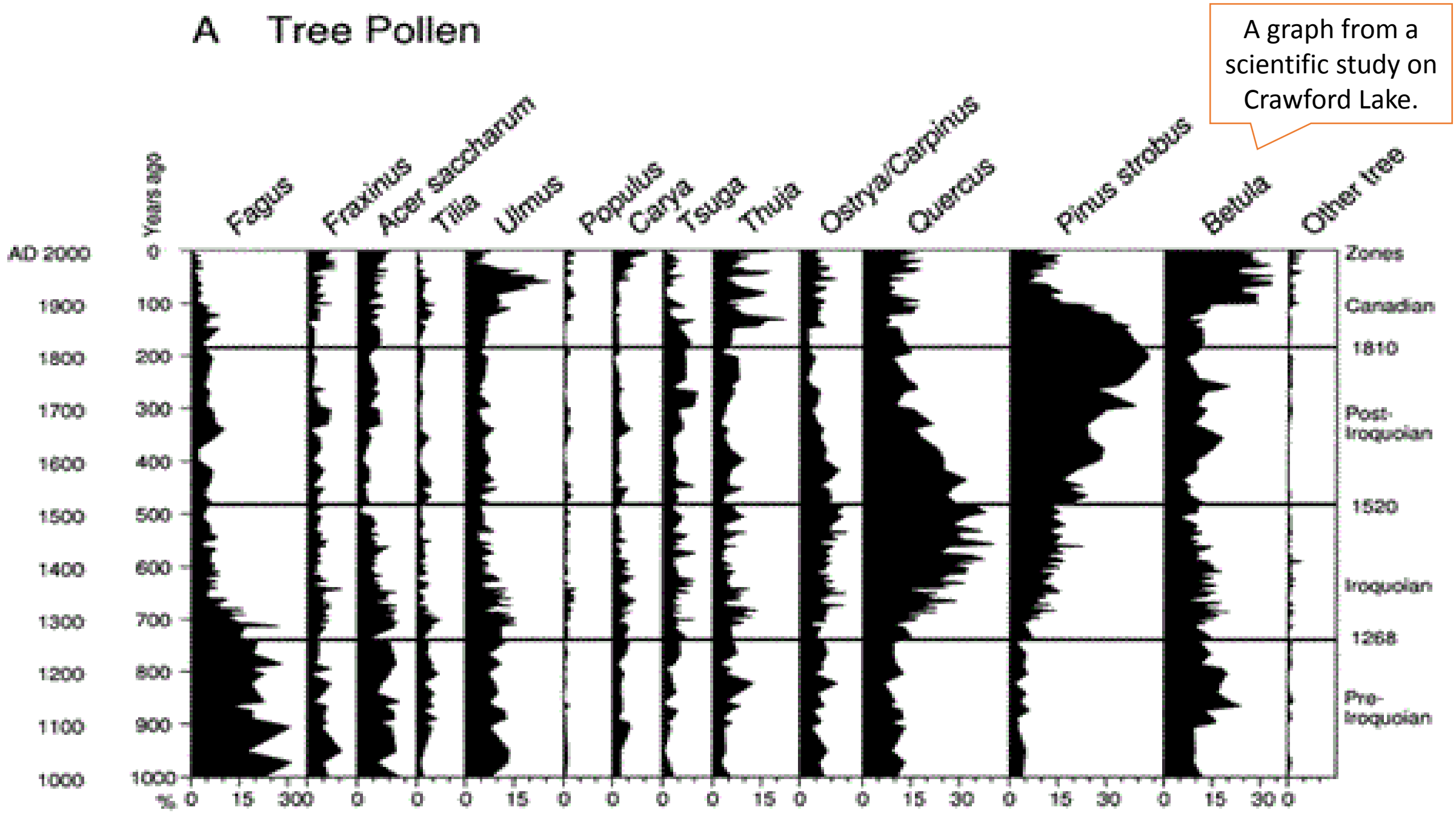

Relative Makeup of Tree Pollen in Forest
50
45
40
35
30
25
20
15
10
5
0
1100 1125 1150 1175 1200 1225 1250 1275 1300 1325 1350 1375 1400 1425 1450 1475 1500 1525 1550 1575 1600 1625 1650 1675 1700 1725 1750 1775 1800 1825 1850 1875 1900 1925 1950 1975 2000
To 1268, Strong Beech presence.
To 1600, Strong White Oak presence
White Pines growing through out 900 year period; strong presence after 1600
1889 Crawford's mill in Campbellville; All trees decline.
1972 Conservation Area; tree re-growth begins
Beech
Sugar Maple
Hemlock
White Oak
Eastern White Pine

Conclusions Phase

To what extent does our simulated data match some of the results of professional studies?

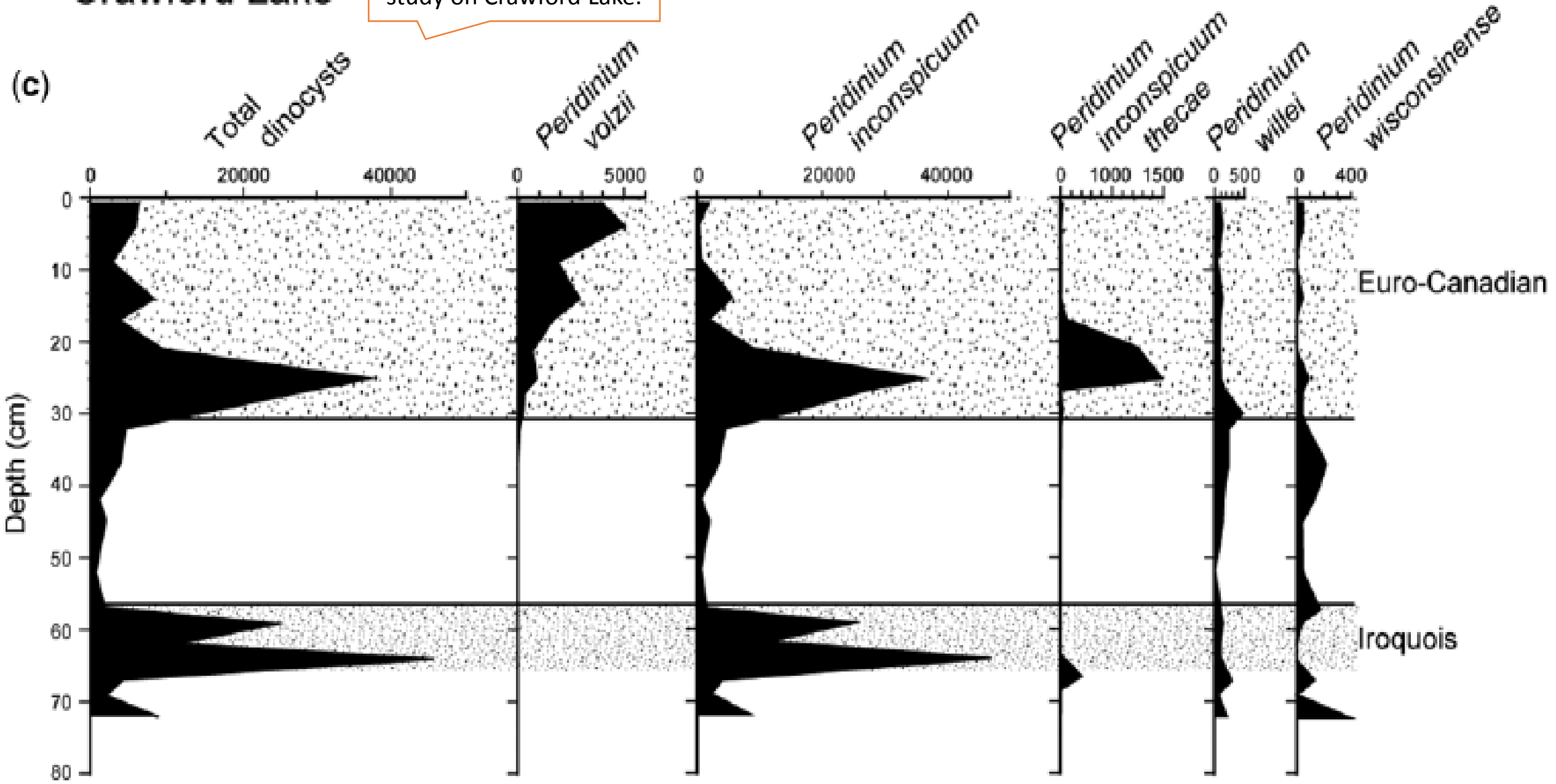
Can you answer any of the questions we had in the Problem phase?

Any areas for further study?


A Tree Pollen
A graph from a scientific study on Crawford Lake.
Years BP
AD 2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
0
100
200
300
400
500
600
700
800
900
1000
Fagus
Fraxinus
Acer saccharum
Tilia
Ulmus
Populus
Carya
Tsuga
Thuja
Ostrya/Carpinus
Quercus
Pinus strobus
Betula
Other tree
%
0 15 300 0 0 0 15 0 0 0 0 15 0 0 15 30 0 15 30 0 15 30 0
Zones
Canadian
1810
Post-Iroquoian
1520
Iroquoian
1268
Pre-Iroquoian

Crawford Lake

A graph from a scientific study on Crawford Lake.



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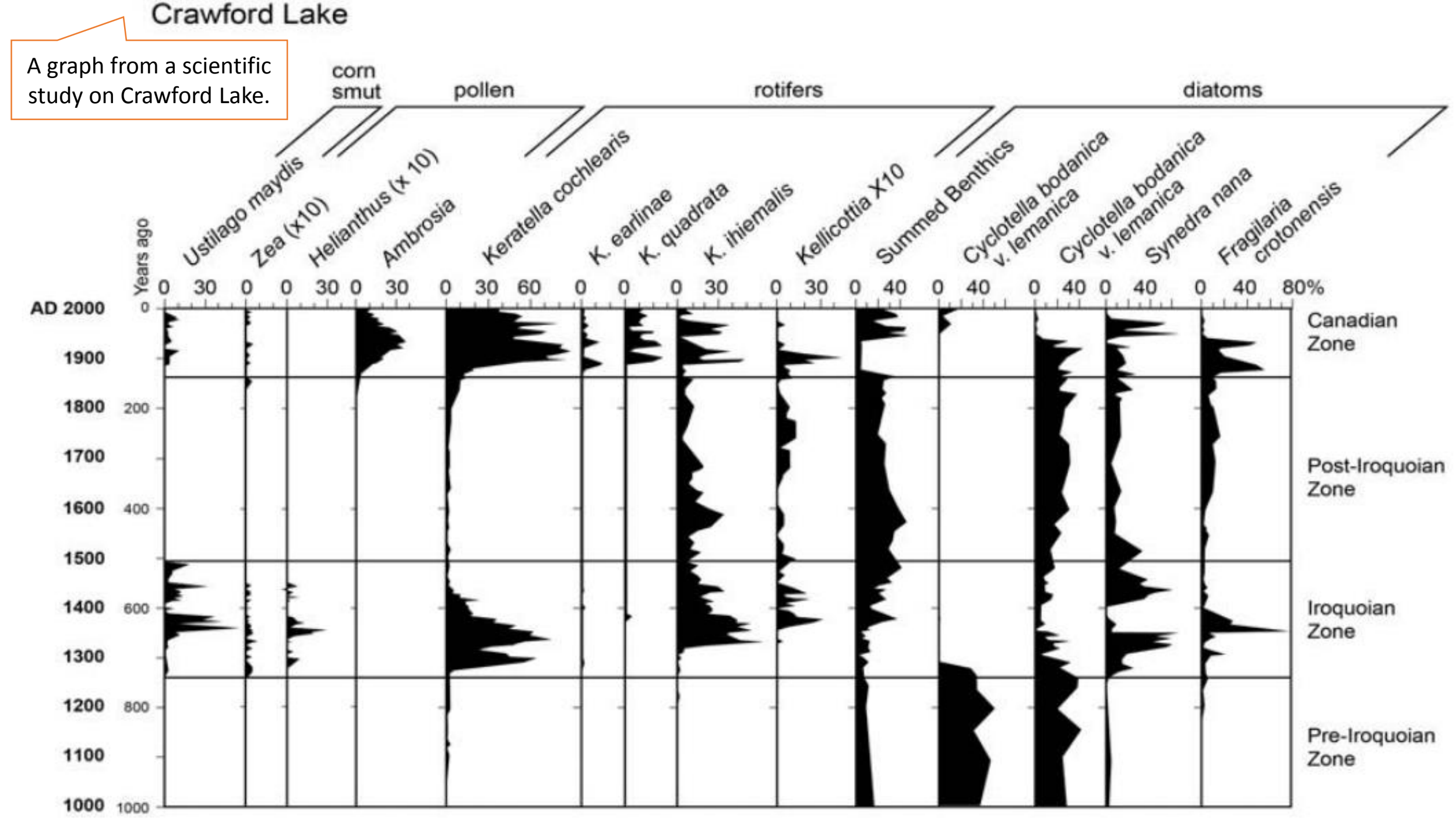
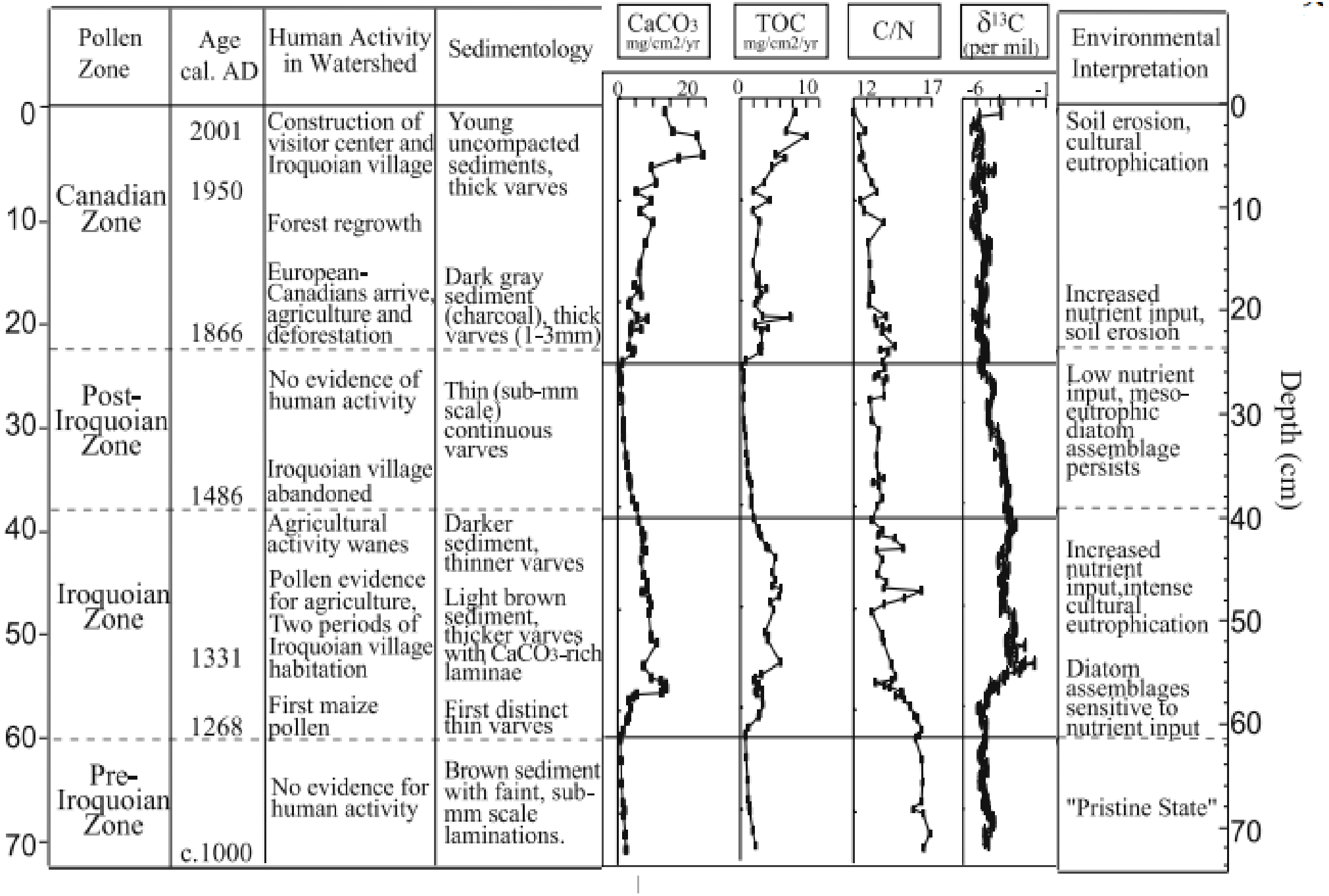


A graph from a scientific study on Crawford Lake.



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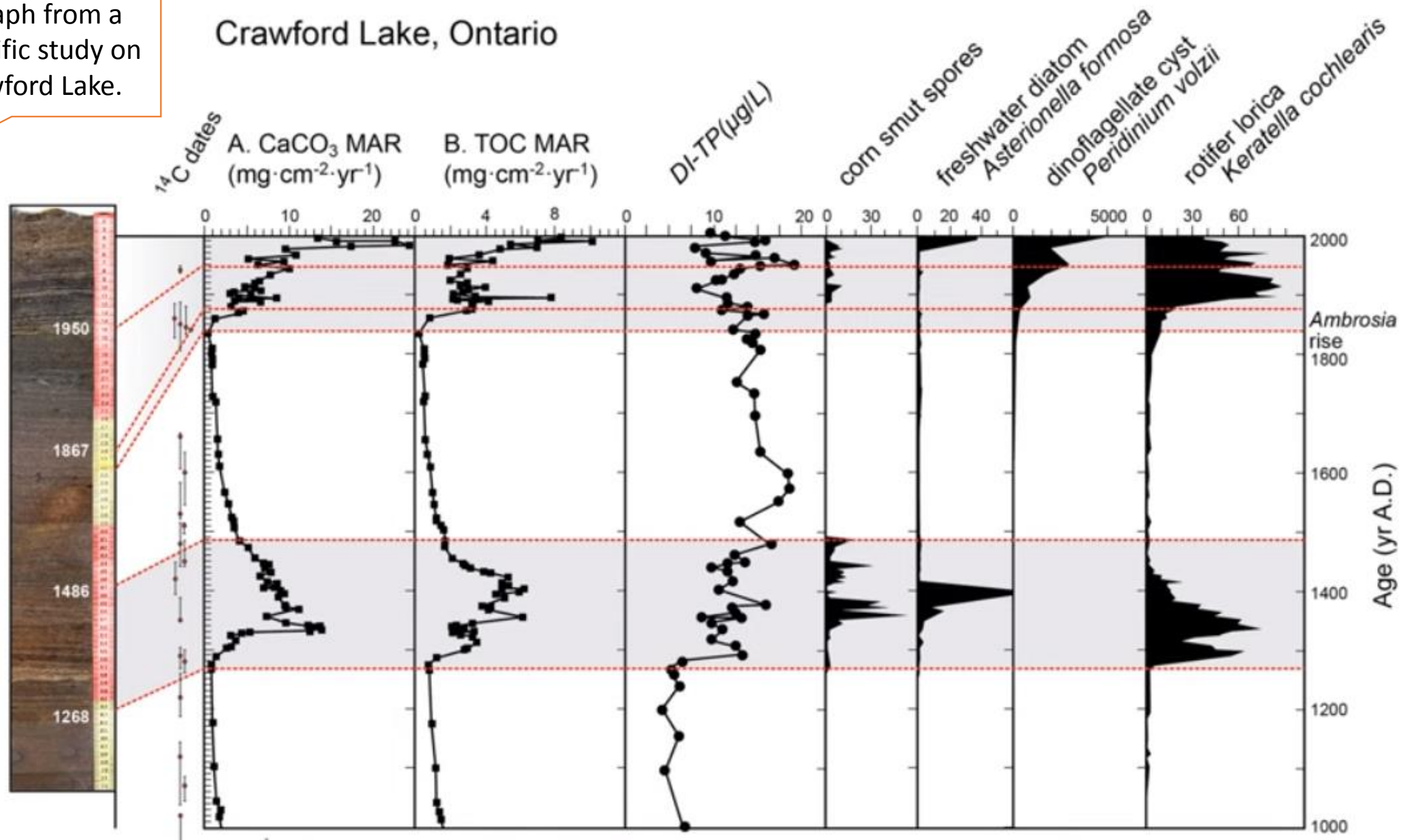
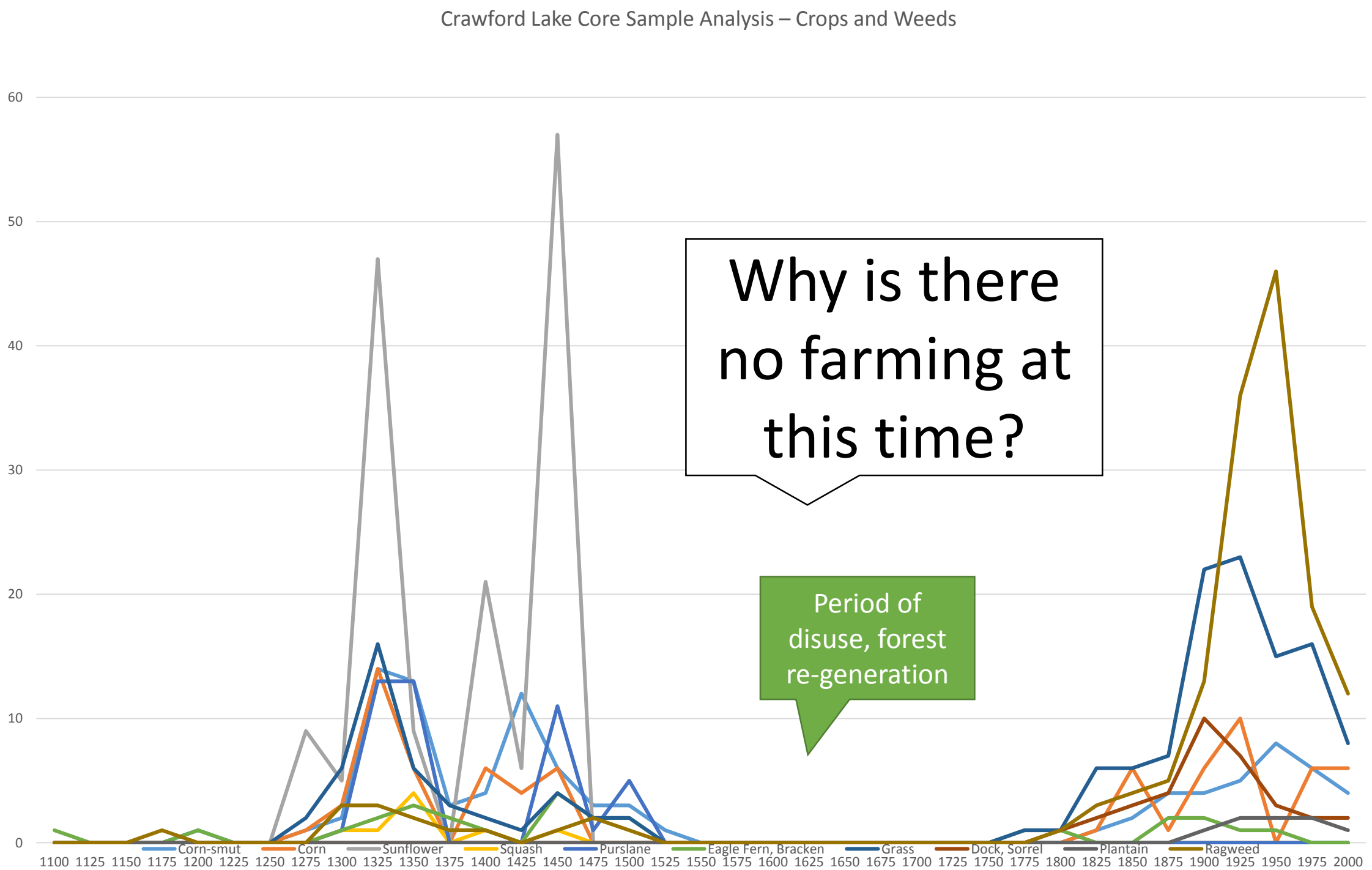
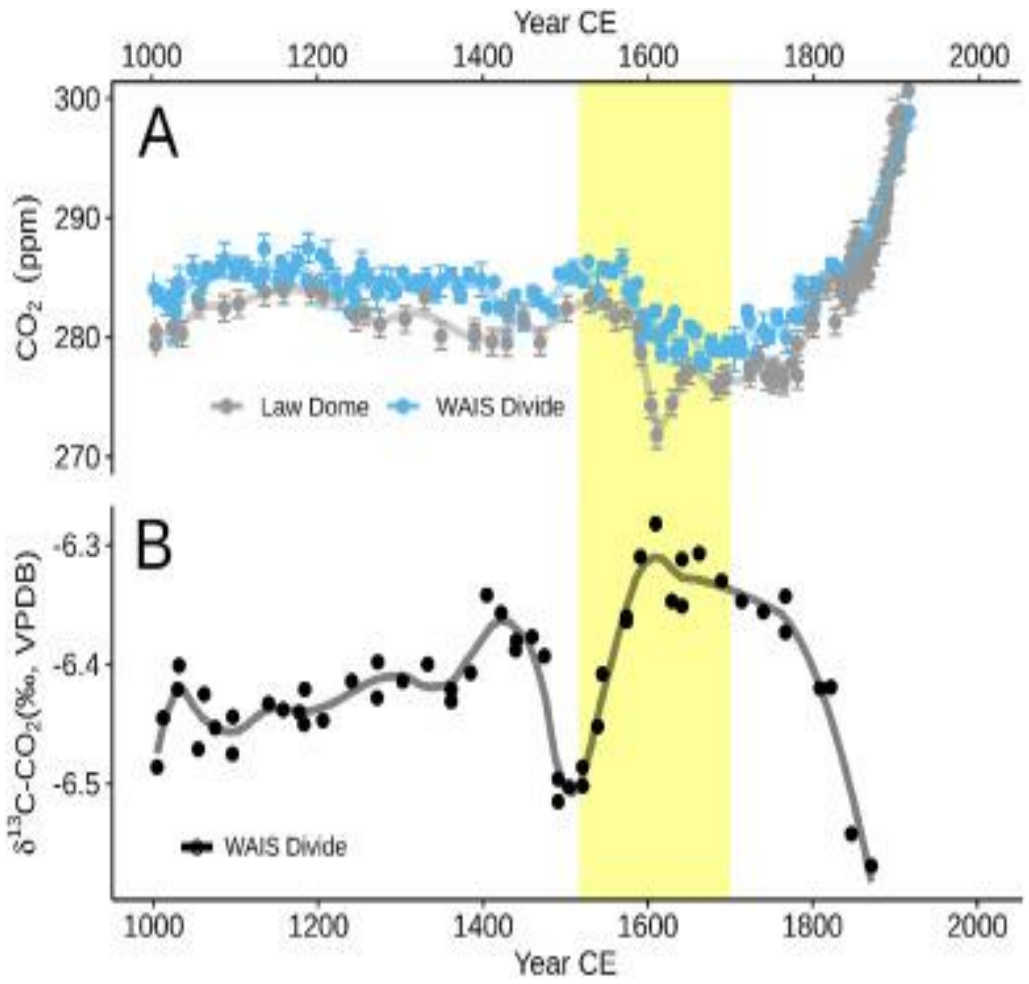



Crawford Lake Core Sample Analysis – Crops and Weeds
60
50
40
30
20
10
0
Why is there no farming at this time?
Period of disuse, forest re-generation
Corn-smut
Corn
Sunflower
Squash
Purslane
Eagle Fern, Bracken
Grass
Dock, Sorrel
Plantain
Ragweed
1100 1125 1150 1175 1200 1225 1250 1275 1300 1325 1350 1375 1400 1425 1450 1475 1500 1525 1550 1575 1600 1625 1650 1675 1700 1725 1750 1775 1800 1825 1850 1875 1900 1925 1950 1975 2000



Earth system impacts of the European arrival and Great Dying in the Americas after 1492

Our new study clarifies the size of pre-Columbian populations and their impact on their environment. By combining all published estimates from populations throughout the Americas, we find a probable indigenous population of 60 million in 1492. For comparison, Europe's population at the time was 70 to 88 million spread over less than half the area.

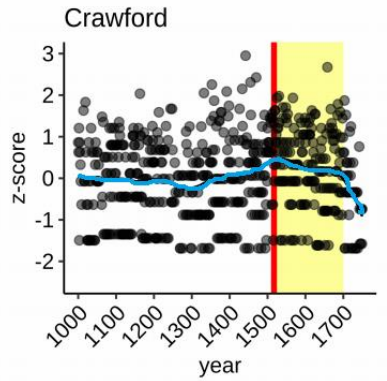
By knowing how much agricultural land is required to sustain one person, population numbers can be translated from the area known to be under human land use. We found that 62 million hectares of land, or about 10 percent of the landmass of the Americas, had been farmed or under another human use when Columbus arrived. For comparison, in Europe 23 percent and in China 20 percent of land had been used by humans at the time.

This changed in the decades after Europeans first set foot on the island of Hispaniola in 1497—now Haiti and the Dominican Republic—and the mainland in 1517. Europeans brought measles, smallpox, influenza and the bubonic plague across the Atlantic, with devastating consequences for the indigenous populations.

Our new data-driven best estimate is a death toll of 56 million by the beginning of the 1600s—90 percent of the pre-Columbian indigenous population and around 10 percent of the global population at the time. This makes the "Great Dying" the largest human mortality event in proportion to the global population, putting it second in absolute terms only to World War II, in which 80 million people died—three percent of the world's population at the time.

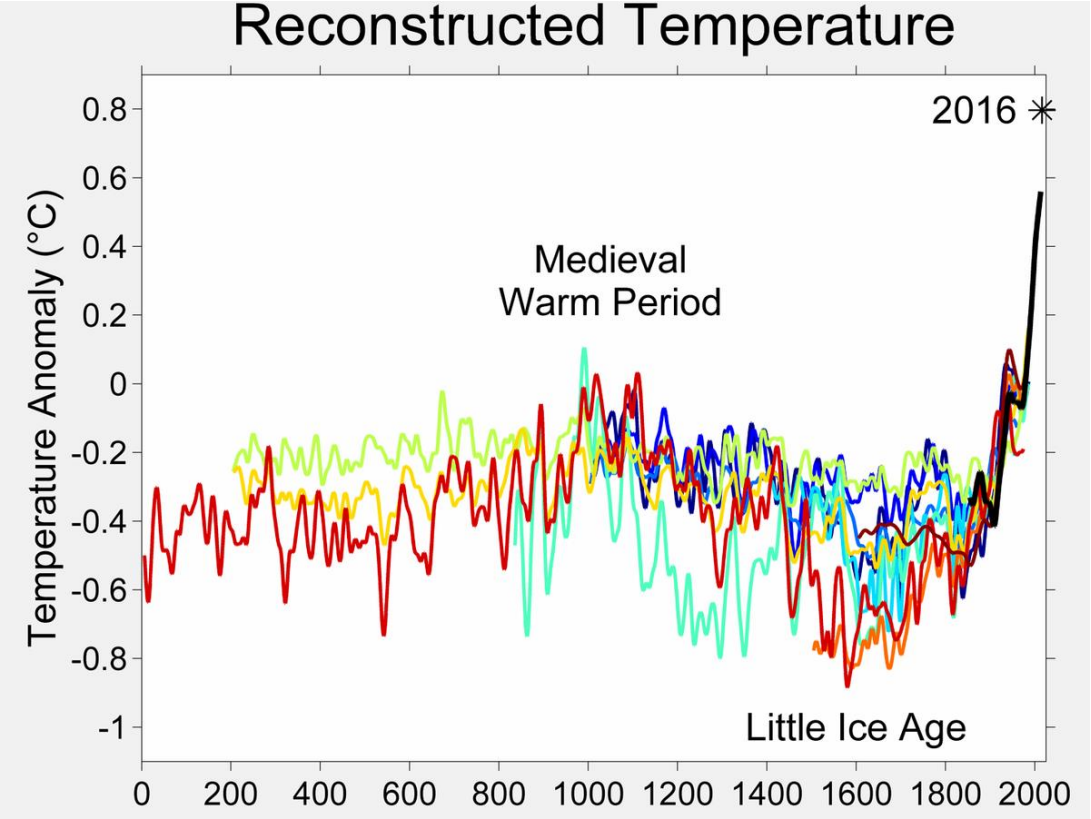
A figure of 90 percent mortality in post-contact America is extraordinary and exceeds similar epidemics, including the Black Death in Europe—which resulted in a 30 percent population loss in Europe. One explanation is that multiple waves of epidemics hit indigenous immune systems that had evolved in isolation from Eurasian and African populations for 13,000 years.

This new death toll was calculated using core samples of the Greenland ice shield ice AND meromictic lakes.



Indeed, it was this graph in the report that made me wonder, hey, is that the Crawford Lake near me?

Global Consequences of the “Great Dying”



This human tragedy meant that there was simply not enough workers left to manage the fields and forests. Without human intervention, previously managed landscapes returned to their natural states, thereby absorbing carbon from the atmosphere. The extent of this regrowth of the natural habitat was so vast that it removed enough CO_2 to cool the planet.

The lower temperatures prompted feedbacks in the carbon cycle which eliminated even more CO_2 from the atmosphere—such as less CO_2 being released from the soil. This explains the drop in CO_2 at 1610 seen in Antarctic ice cores, solving an enigma of why the whole planet cooled briefly in the 1600s. During this period, severe winters and cold summers caused famines and rebellions from Europe to Japan.