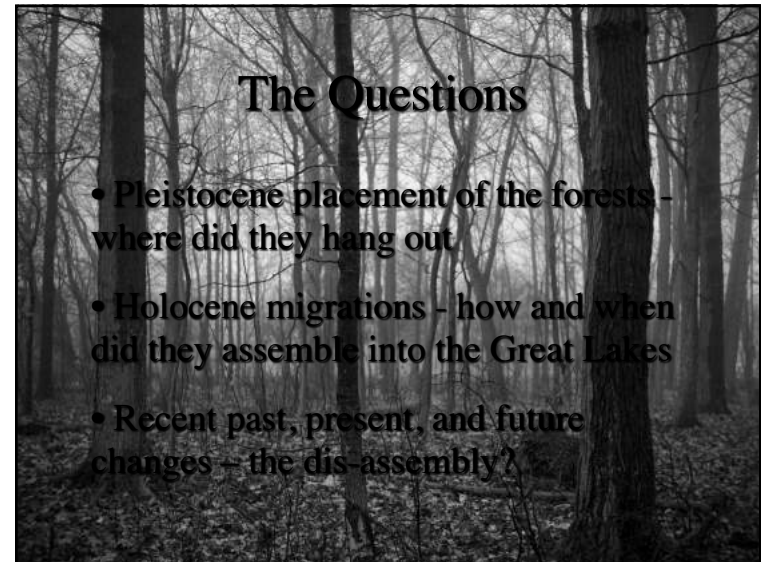


1



2

Vegetation vs. Flora

- Vegetation refers to the physical appearance (physiognomy) of the forest type - ecology driven
- Flora refers to the species (genus, family) composition of any given forest - history driven

American beech

sugar maple

Northern hardwood forests in WI and MI have sugar maple, but beech co-dominates mainly in MI

3

Pleistocene - the Ice Ages

Maximum extent of glaciation in the most recent or Wisconsin stage (Pleistocene epoch).

- The vegetation and flora as we see it now (Holocene) was dramatically affected by Pleistocene events

Monthly Temperature (°C) in St. Louis

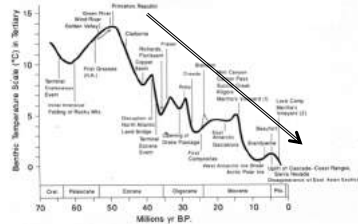
Millions yr BP

4

Pleistocene - the Ice Ages



- In the Tertiary, earth experienced intensification towards climatic cooling
- Culminated with a series of glacial-interglacial cycles in Pleistocene
- North American flora and vegetation profoundly influenced by these "ice-age" events



5

Pleistocene - the Ice Ages

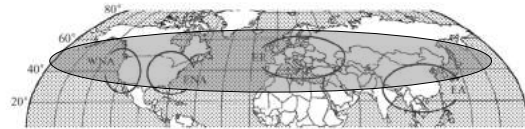


Figure 1. Map of the Northern Hemisphere showing the four major areas of temperate forest endemism that are the focus of the present analysis; EA: eastern Asia; ER: Europe (including southwestern Asia); ENA: eastern North America; WNA: western North America.

Break-up of the great Northern Hemisphere Arcto-Tertiary forests

6

Pleistocene - the Ice Ages



- Wisconsin glaciation (last epoch) most important - maximum at 18,000 ya
- Assembly of flora and vegetation of most Great Lakes was during the late Pleistocene and Holocene - (14,000 ya to present)

7

Pleistocene - the Ice Ages

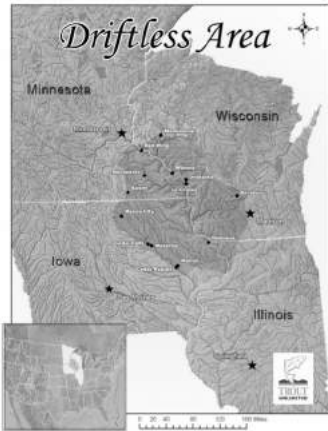


Ice-free Areas

- Southern North America of glaciers
- Beringia, much of Alaska, Siberia
- Coastal plains, steep coastlines of Pacific northwest
- Wisconsin Driftless Area - never completely surrounded by ice

8

Pleistocene - the Ice Ages



Ice-free Areas

- North America south of glaciers
- Beringia, much of Alaska, Siberia
- Coastal plains, steep coastlines of Pacific northwest
- Wisconsin Driftless Area - never completely surrounded by ice

9

Pleistocene - the Ice Ages

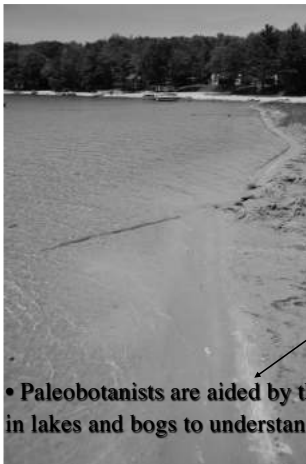


What was happening south of the glacial maxima?

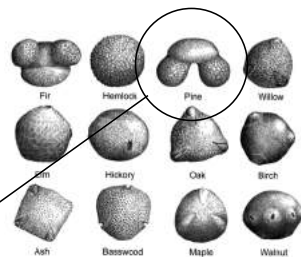
Maximum extent of glaciation in the most recent or Wisconsin stage (Pleistocene epoch).

10

Pleistocene - the Ice Ages



Yearly deposits accumulate in lake bottoms to be covered by silt layers, or in bog peat strata

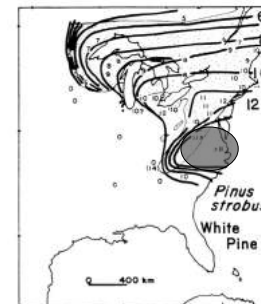


• Paleobotanists are aided by the pollen record (especially trees) in lakes and bogs to understand Pleistocene vegetation and flora

11

Assembly of Flora & Vegetation

Importantly, the different species of trees (and herbs) entering the Great Lakes region after the glaciers retreated entered via different routes - that is, they came from different refugia or survivia

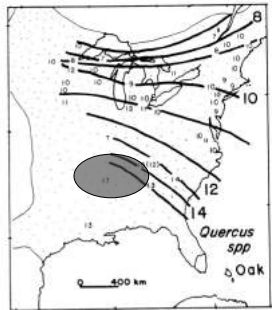


White pine from the Alleghenian refugium and present distribution

12

Assembly of Flora & Vegetation

Importantly, the different species of trees (and herbs) entering the Great Lakes region after the glaciers retreated entered via different routes - that is, they came from different refugia or survivia



Bur oak from the Ozarkian refugium and present distribution



13

Pleistocene - the Ice Ages

- Much of eastern North America outside these refugia would have looked like this boreal scene



White spruce - *Picea glauca*

Most widespread tree in North America

Illinois 16K years ago



14

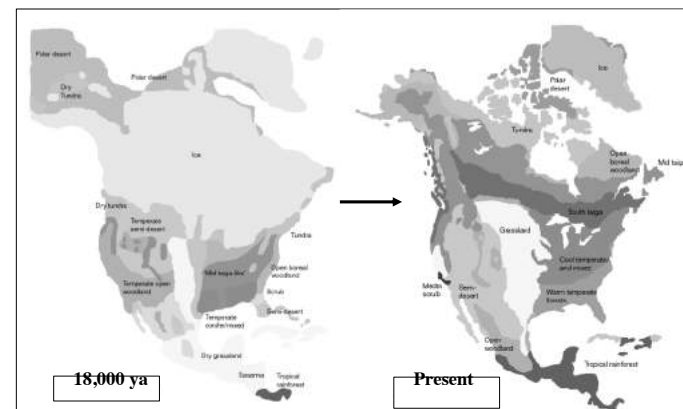
The Questions

- Pleistocene placement of the forests - where did they hang out
- Holocene migrations - how and when did they assemble into the Great Lakes
- Recent past, present, and future changes - the dis-assembly?

15

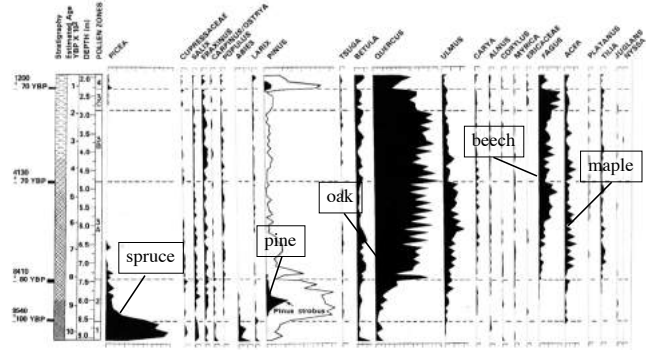
Assembly of Flora & Vegetation

How and when did this assembly in the Great Lakes happen?



16

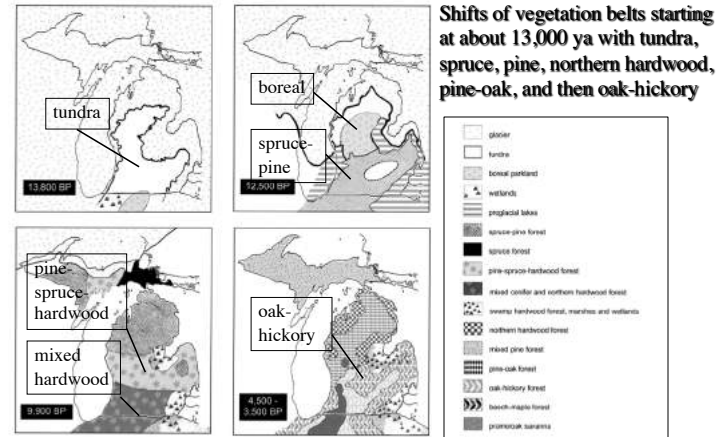
Assembly of Flora & Vegetation



- Pollen record shows waves of species over time
- Boreal elements (spruce) early in the Holocene, followed by pines, and then oaks, maples and lastly beech

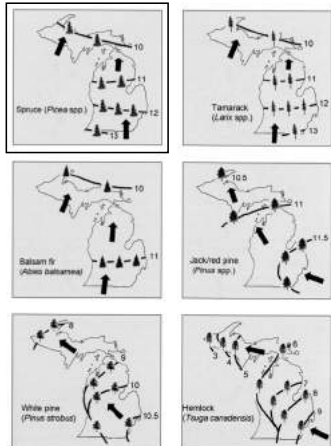
17

Assembly of Flora & Vegetation



18

Assembly of Flora & Vegetation



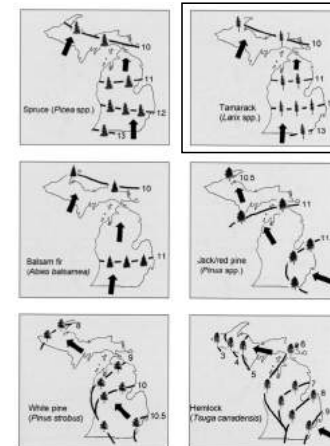
Coniferous species migrated into the Great Lakes region in waves (flora):

Boreal species like spruce & tamarack arrived first



19

Assembly of Flora & Vegetation



Coniferous species migrated into the Great Lakes region in waves (flora):

Boreal species like spruce & tamarack arrived first

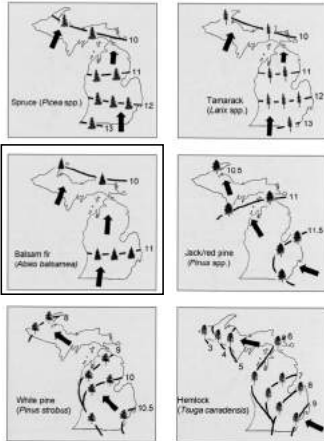


20

Assembly of Flora & Vegetation

Coniferous species migrated into the Great Lakes region in waves (flora):

Boreal species like spruce & tamarack arrived first, and later balsam fir

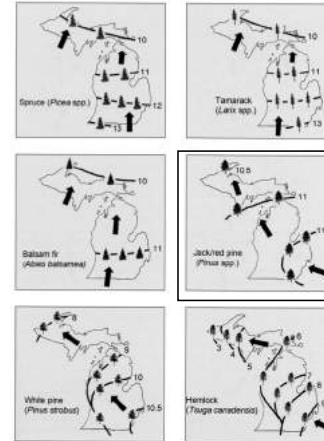


21

Assembly of Flora & Vegetation

Coniferous species migrated into the Great Lakes region in waves (flora):

Of pine species, xeric jack pine and red pine arrived first

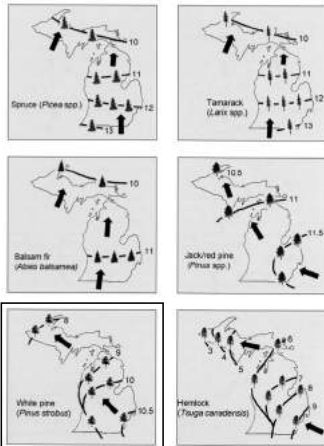


22

Assembly of Flora & Vegetation

Coniferous species migrated into the Great Lakes region in waves (flora):

... followed by more mesic loving white pine

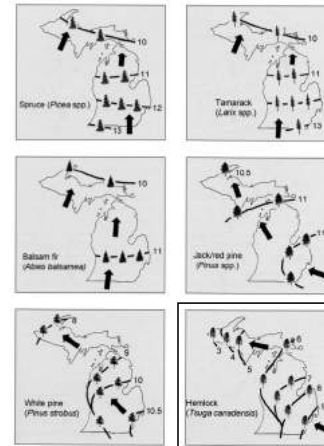


23

Assembly of Flora & Vegetation

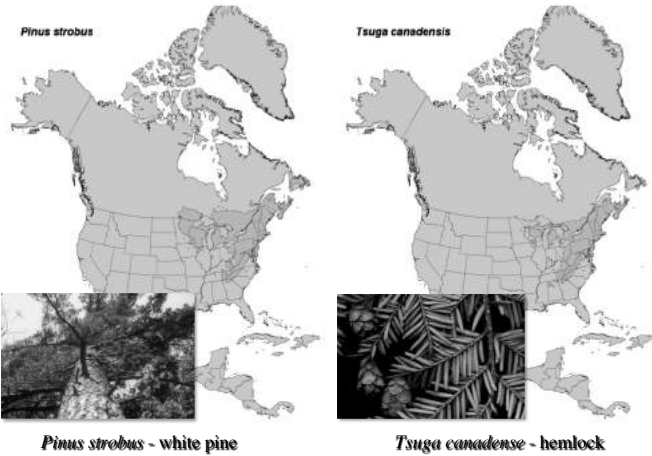
Coniferous species migrated into the Great Lakes region in waves (flora):

Hemlock, characteristic of mesic Northern Hardwood forests, arrived last



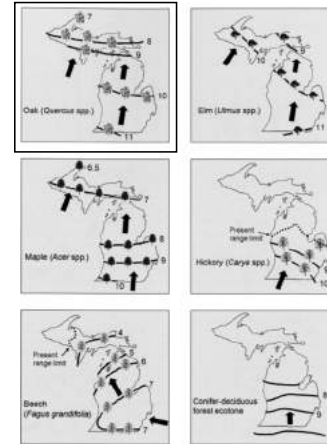
24

Dis-assembly of the forests?



25

Assembly of Flora & Vegetation

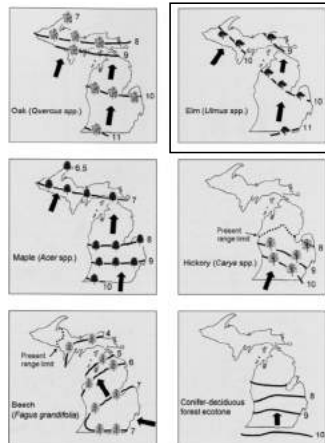


Angiosperm hardwoods migrated into the Great Lakes region in waves towards the end of conifer migration:
Oaks arrived first from the south - 11,000 ya



26

Assembly of Flora & Vegetation

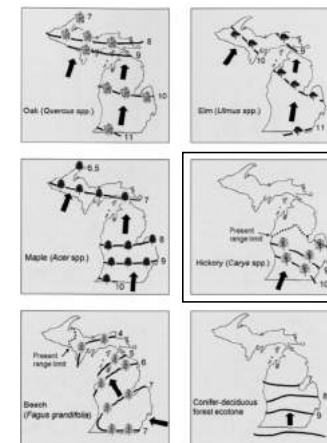


Angiosperm hardwoods migrated into the Great Lakes region in waves towards the end of conifer migration:
Elms arrived at about the same time from the southeast - 11,000 ya



27

Assembly of Flora & Vegetation



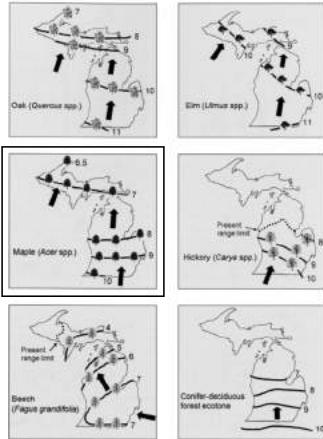
Angiosperm hardwoods migrated into the Great Lakes region in waves towards the end of conifer migration:
Hickories arrived shortly thereafter from the southwest - 10,500 ya



28

Assembly of Flora & Vegetation

Angiosperm hardwoods migrated into the Great Lakes region in waves towards the end of conifer migration:
Followed by mesic-loving maples . . .

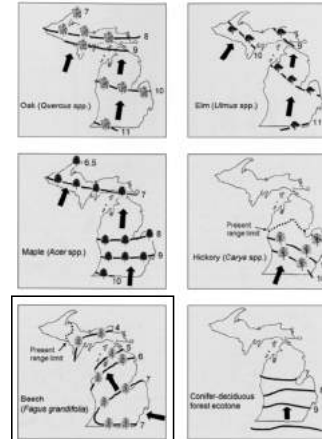


Acer saccharum

29

Assembly of Flora & Vegetation

Angiosperm hardwoods migrated into the Great Lakes region in waves towards the end of conifer migration:
. . . and finally American beech last



30

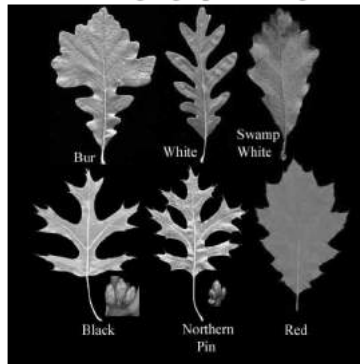
Assembly of Flora & Vegetation

The flora of the Great Lakes can be divided into a number of elements, each of which shares a common geographical origin (refugia).

Closely related species (such as oaks) can often be part of different floristic elements.

This is due to both different ecological preferences (such as hydric vs. mesic vs. xeric) and to geographical origin.

Quercus - the oaks



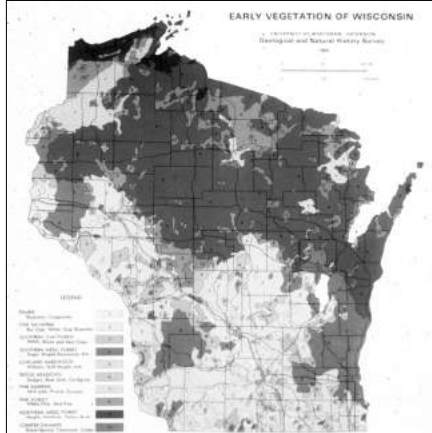
31

The Questions

- Pleistocene placement of the forests - where did they hang out
- Holocene migrations - how and when did they assemble into the Great Lakes
- Recent past, present, and future changes - the dis-assembly?

32

Dis-assembly of the forests?

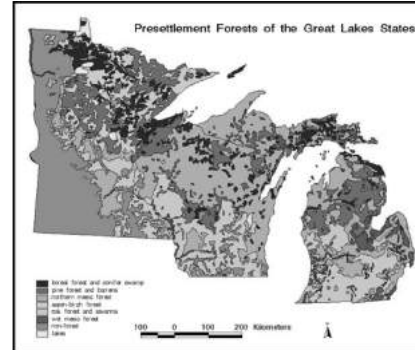


Substantial changes in forest and prairie communities since presettlement times due to urbanization, farming, and forestry

How do we know what presettlement forests or community types were actually present mid-1800s?

33

Dis-assembly of the forests?

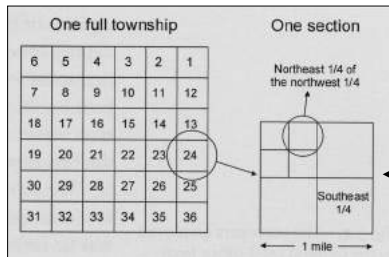


Substantial changes in forest and prairie communities since presettlement times due to urbanization, farming, and forestry

How do we know what presettlement forests or community types were actually present mid-1800s?

34

Dis-assembly of the forests?



How do we know what presettlement forests or community types were actually present?

640 acres

The General Land Office surveys of the 1800s required that a rectangular system of land survey be done. Trees nearest each quarter section corner were bark-slashed, identified, and dbh recorded.

Fig. 5.1. The basic units of land division in the rectangular system of land survey. A normal township contains 36 sections of one square mile each. Each section contains 640 acres and can be divided into four quarter sections of 160 acres each or 16 quarter-quarter sections of 40 acres each.

35

Dis-assembly of the forests?



Shown here is such a "Witness Tree" from the NE corner of section 18 in Hamlin Township (R18W, T19N) north of Ludington, Michigan.

WITNESS TREE
As the afternoon was well nigh spent, I hunted up the section corner where we had left the tent.
 John Langsner
Landowner in the Upper Peninsula of Michigan
 The timber cruiser had to be good at finding his way in the woods. Most of the time, his only reference points were witness trees established by government surveyors as they ran section lines through the forest. The surveyors inscribed the Township, Range and section number in the bark of a witness tree at a section corner. This witness tree, marked R18W, T19N, 18, stood at the northeast corner of Section 18, Hamlin Township, about five miles north of Ludington, Michigan.

Hartwick Pines State Park, MI – logging museum

36

Dis-assembly of the forests?



"Witness Tree" from the NE corner of section 18 in Hamlin Township (R18W, T19N) north of Ludington, Michigan.

A close up of the slashed tree shows the original surveyor's marks:

R 18 W

T 19 N 18

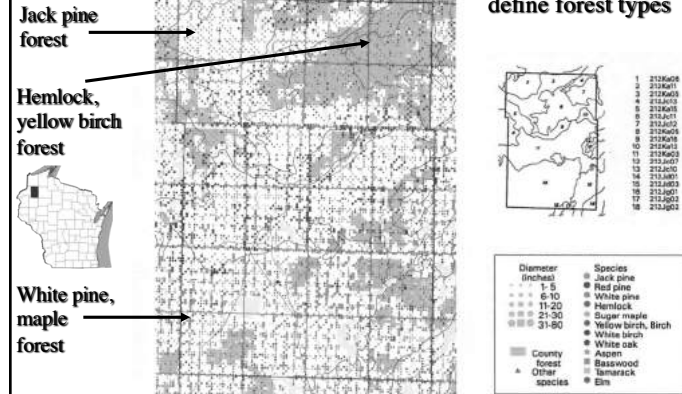
Hartwick Pines State Park, MI – logging museum

37

Dis-assembly of the forests?

Presettlement Vegetation - Species of All Witness Trees
Washburn County, Wisconsin - DRAFT

Witness trees used to define forest types

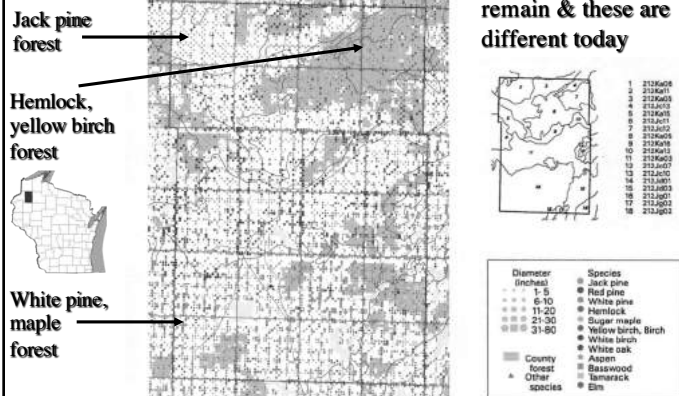


38

Dis-assembly of the forests?

Presettlement Vegetation - Species of All Witness Trees
Washburn County, Wisconsin - DRAFT

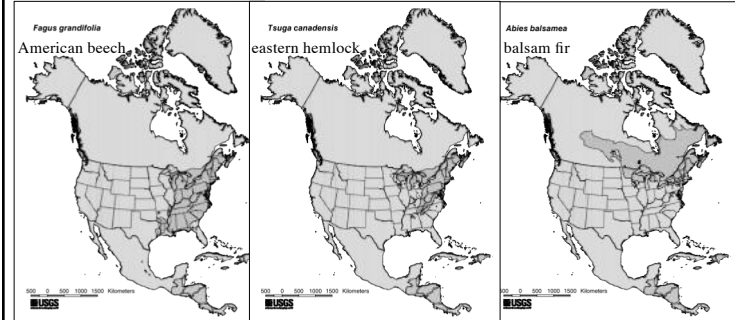
Small forest regions remain & these are different today



39

Dis-assembly of the forests?

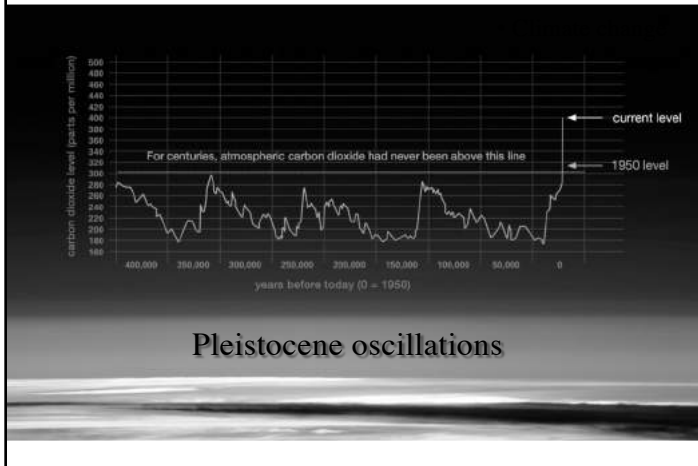
Historical distribution of 3 important tree species – already impacted by humans



Future distribution of 3 important tree species? – climate change, disease, invasives

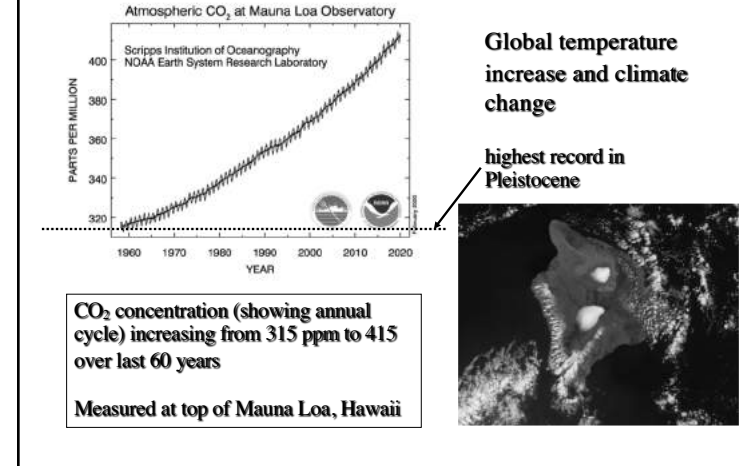
40

Dis-assembly of the forests?



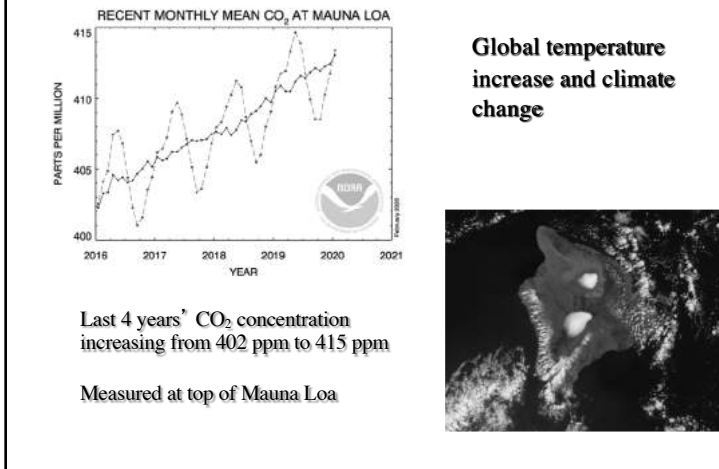
41

Dis-assembly of the forests?



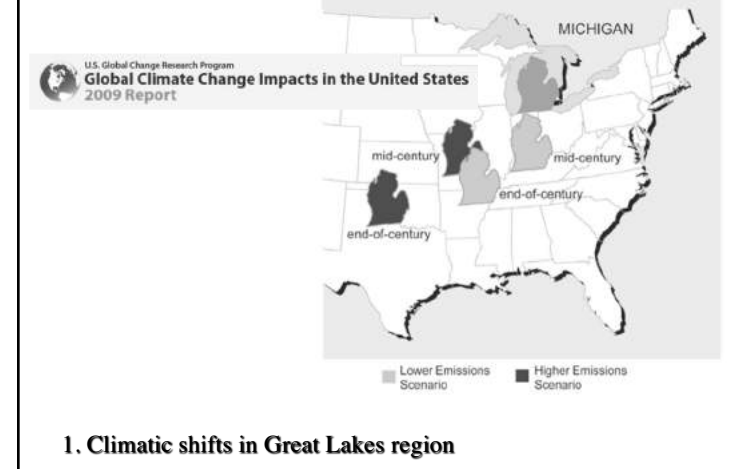
42

Dis-assembly of the forests?



43

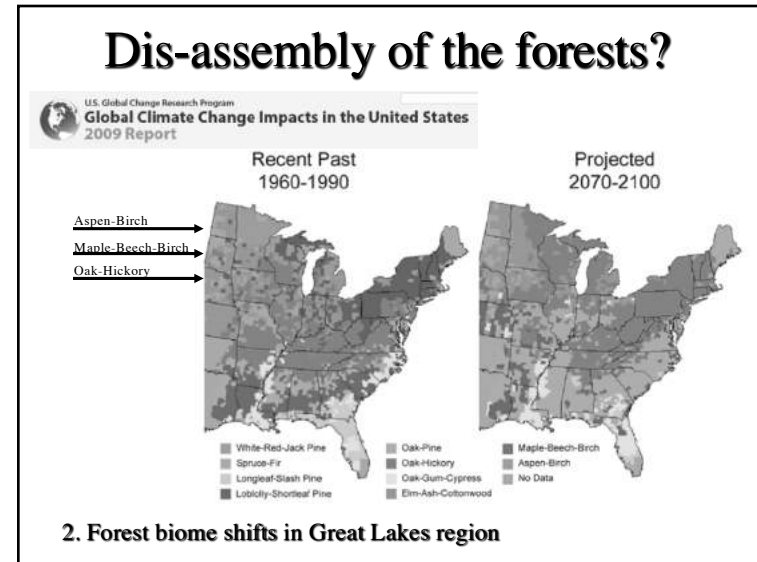
Dis-assembly of the forests?



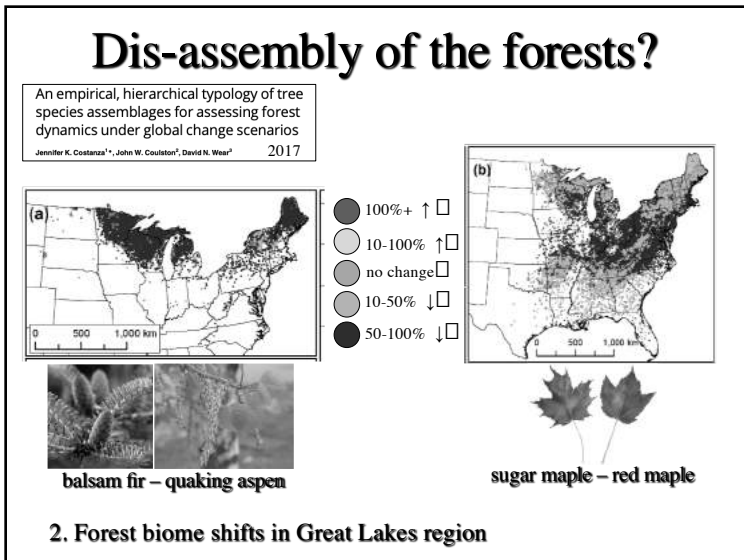
44



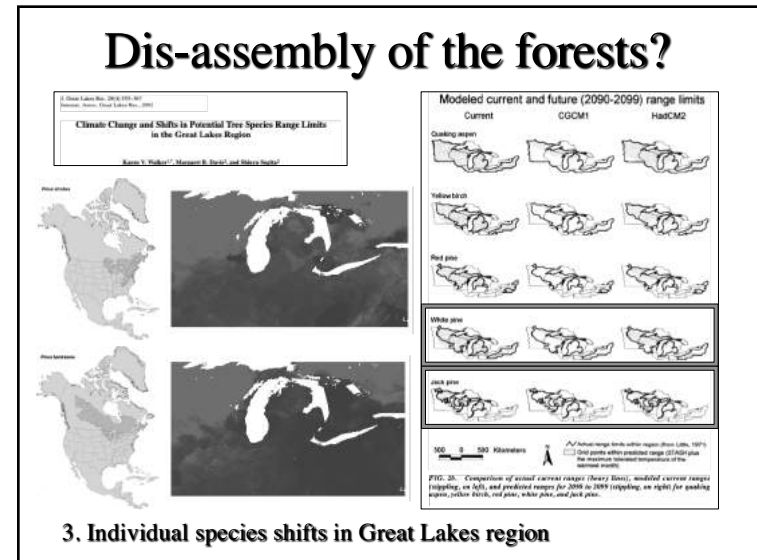
45



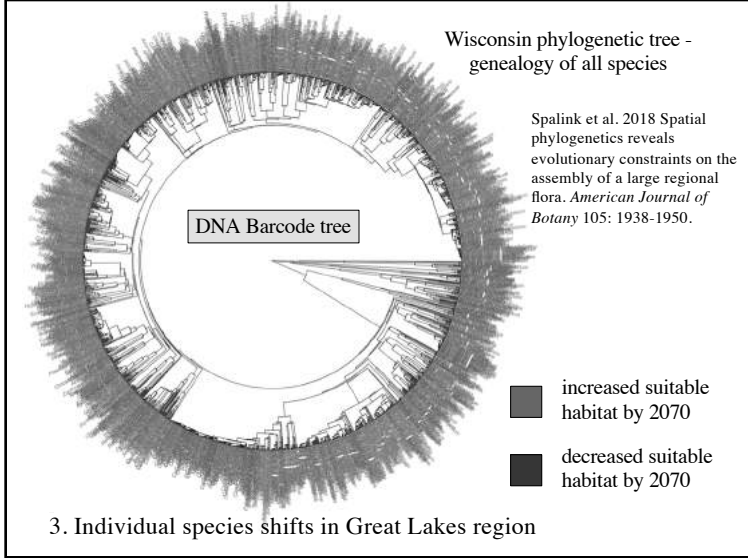
46



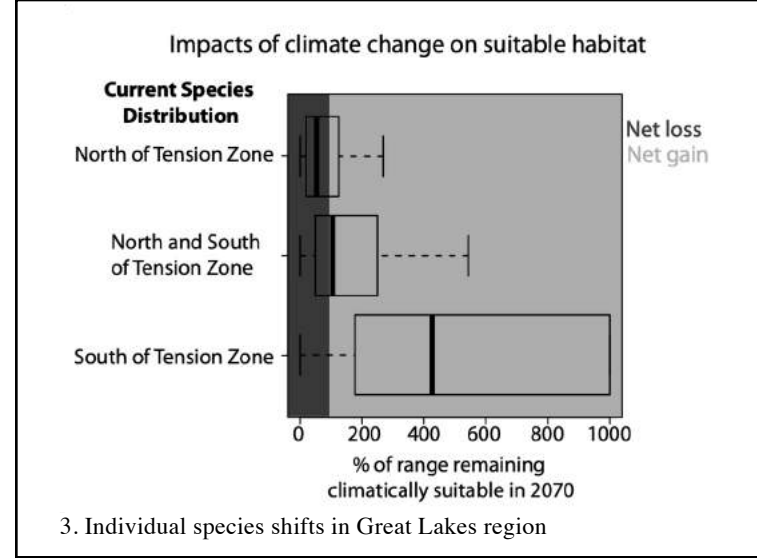
47



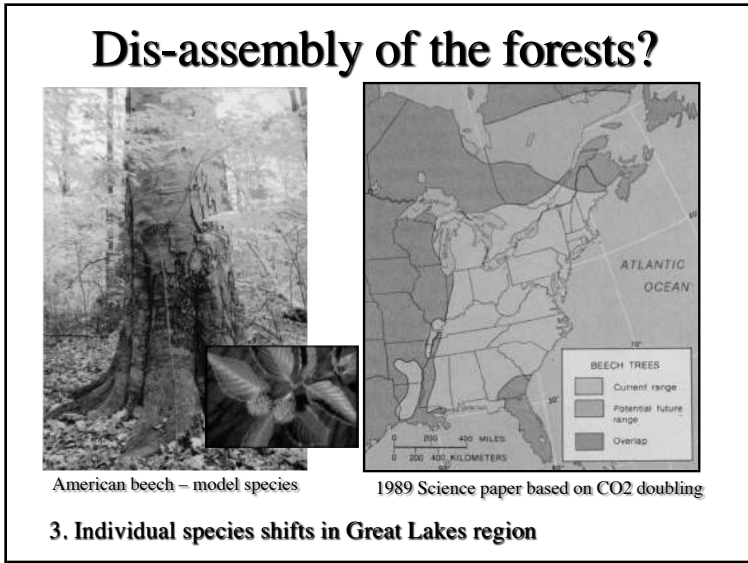
48



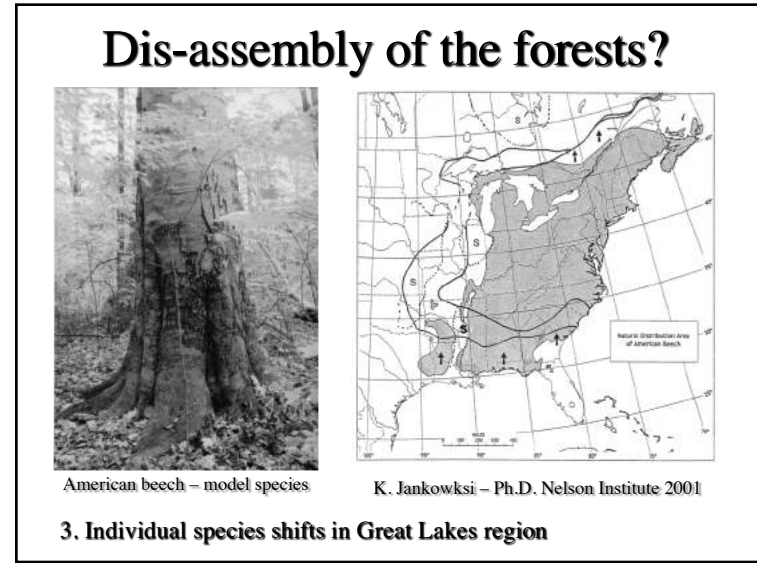
49



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51



52

Dis-assembly of the forests?



American beech – model species

RESEARCH PAPER
Assessing the environmental and dispersal controls on *Fagus grandifolia* distributions in the Great Lakes region
 Megan Sealey¹ | Simon Goring¹ | John W. Williams^{1,2}

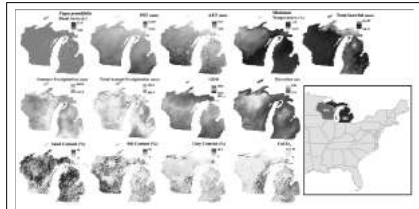


FIGURE 3 Maps of *Fagus grandifolia* local area at the time of Caspian/Scandinavian settlement, environmental variables for Wisconsin and Michigan from PRISM climatology (1979–2021) and SURGO soil variables, and location of study area within the eastern continental United States (1: Lake Michigan, 4th: Michigan, 6th: Wisconsin)

3. Individual species shifts in Great Lakes region

53

Dis-assembly of the forests?



American beech – model species

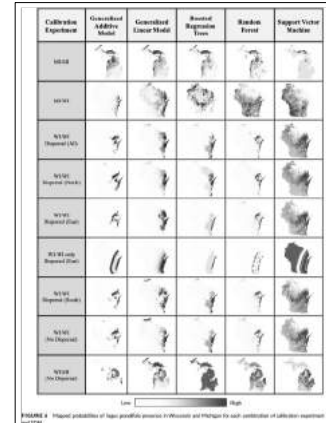


FIGURE 4 Projected probabilities of *Fagus grandifolia* presence in Wisconsin and Michigan for each combination of calibration experiment and model

3. Individual species shifts in Great Lakes region

54

Dis-assembly of the forests?



American beech – model species



Epifagus virginiana
 Beech drops
 (root parasite only on American beech)

No matter what model of global warming is used, whole vegetation units need to migrate
 Beech drops must track beech migration or go extinct.

3. Individual species shifts in Great Lakes region

55