Forest community ecology: Implications for forest conservation

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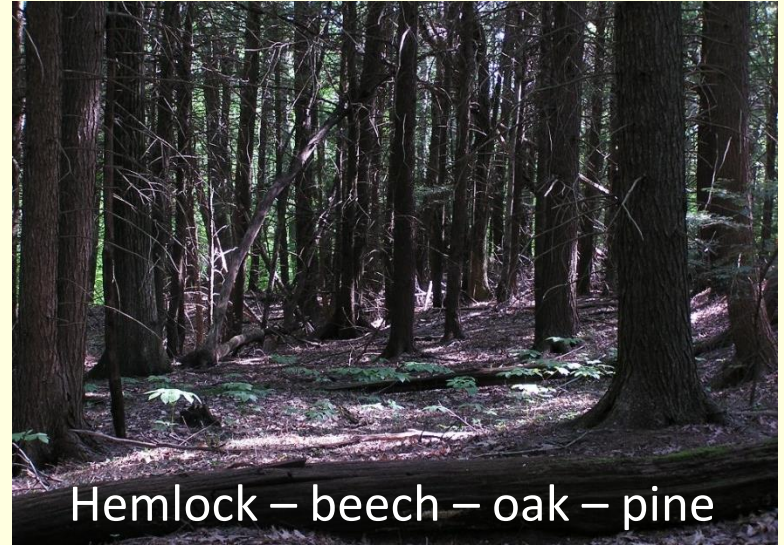tom.lee@unh.edu

Forest Community = "Forest stand"

A group of plants, animals, and microbes – dominated by trees – that occur together

Forest Community Ecology

Study of the factors that influence the properties of forest communities
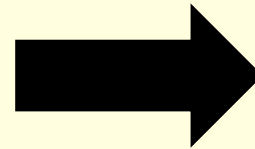
Different kinds of forest communities

Sugar maple – white ash

Hemlock – beech – oak – pine

Paper birch – Aspen

Why different communities?

THE LAND'S PHYSICAL CHARACTERISTICS VARY

Topographic position   Soil moisture

Bedrock type   ➡   Soil fertility

Soil depth, stoniness, and texture   Microclimate

Different species are adapted to different conditions...

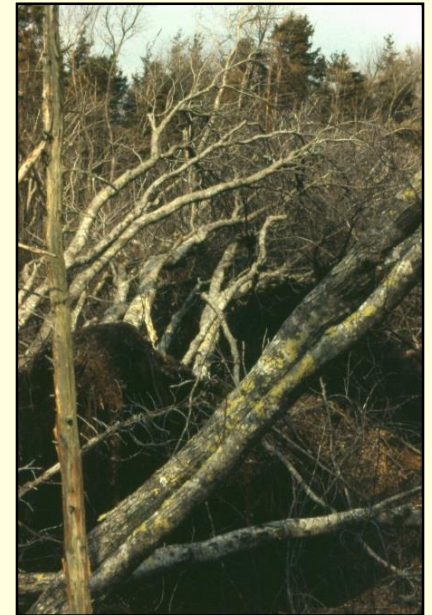**DIFFERENT CONDITIONS = DIFFERENT COMMUNITIES**

Why different communities?

DISTURBANCE HISTORY VARIES

DISTURBANCE: *An event of short duration that causes mortality*

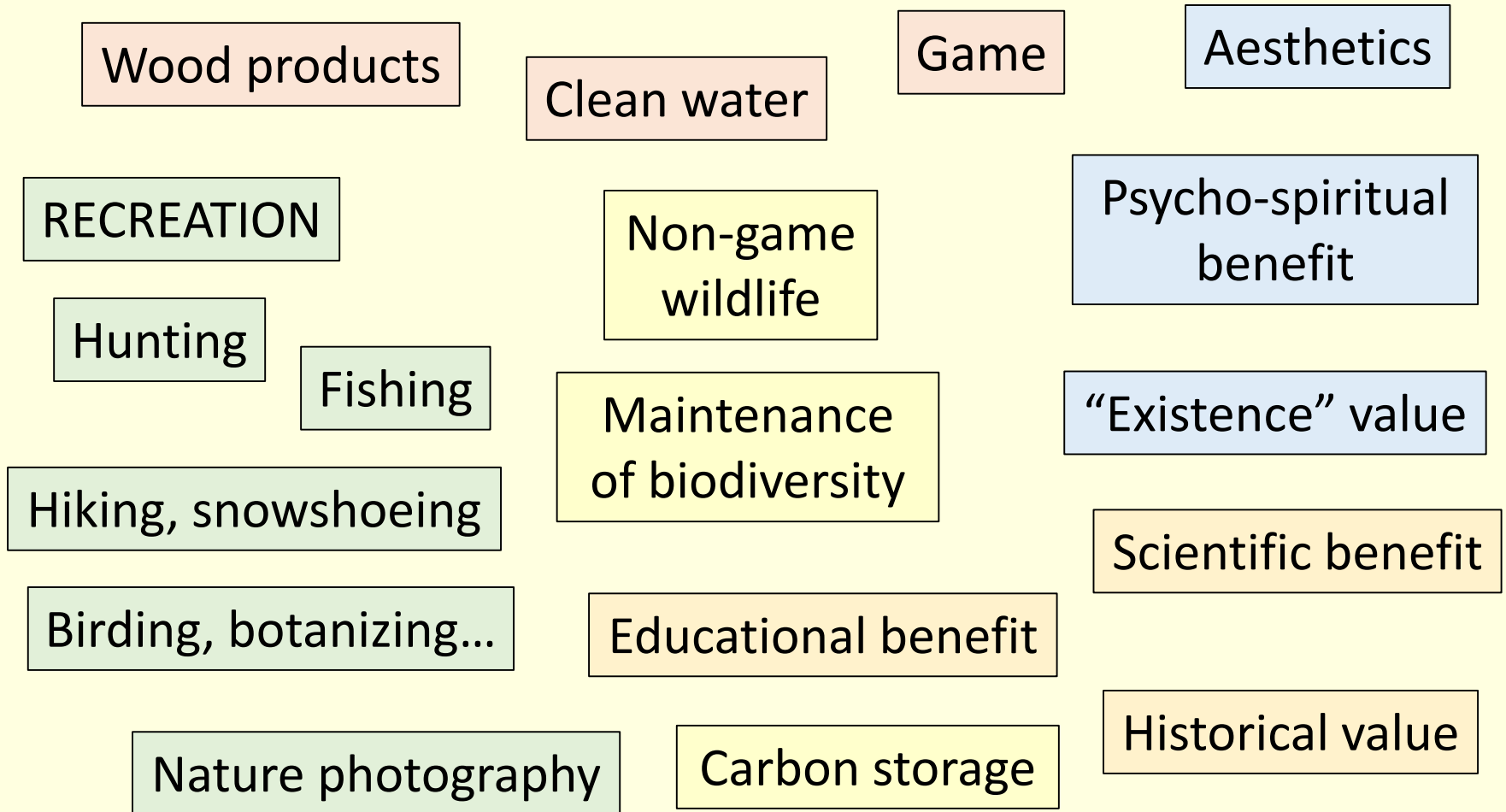Natural disturbance

Human disturbance

Forest conservation

The act of planning, managing, and maintaining forested areas so they provide the same services in the future as they provide today

- *What 'services' are we talking about?*

- *Exactly what services do we want sustained?*

Services provided by forests

Wood products

Clean water

Game

Aesthetics

RECREATION

Non-game wildlife

Psycho-spiritual benefit

Hunting

Fishing

Maintenance of biodiversity

"Existence" value

Hiking, snowshoeing

Scientific benefit

Birding, botanizing…

Educational benefit

Nature photography

Carbon storage

Historical value

Conservation goals

- When we protect a forest, we usually have particular services we want to sustain

- Important to identify these priority services

- Before taking any action: Establish clear, long-term conservation goals

- Once goals set: On to management

Conservation goals - examples

- "Provide habitat for diverse game and non-game wildlife and produce wood products"

- "Restore the 'original' pre-European forest, providing aesthetics, passive recreation, educational and historical value"

Forest conservation: Insight from community ecology

We'll take up three areas:

- Forest history

- Forest stand development

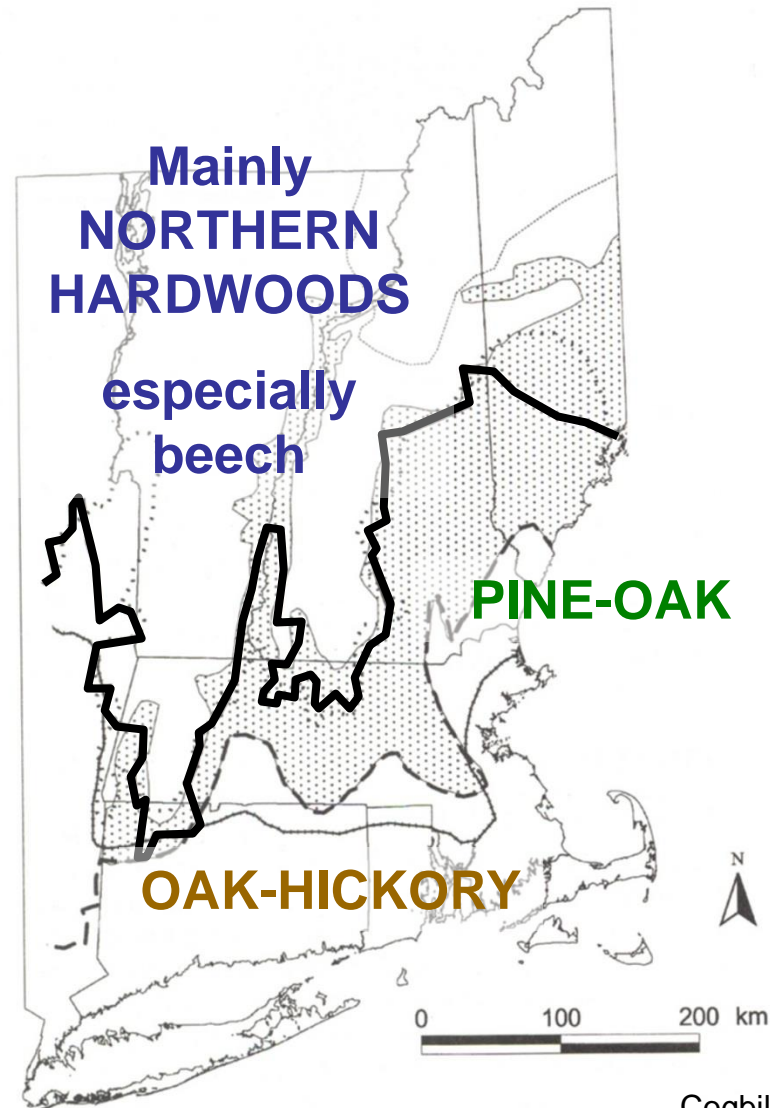- Environmental change

What were pre-European forests like?

Based on "witness trees" listed in early land surveys

(Cogbill et al. 2002)
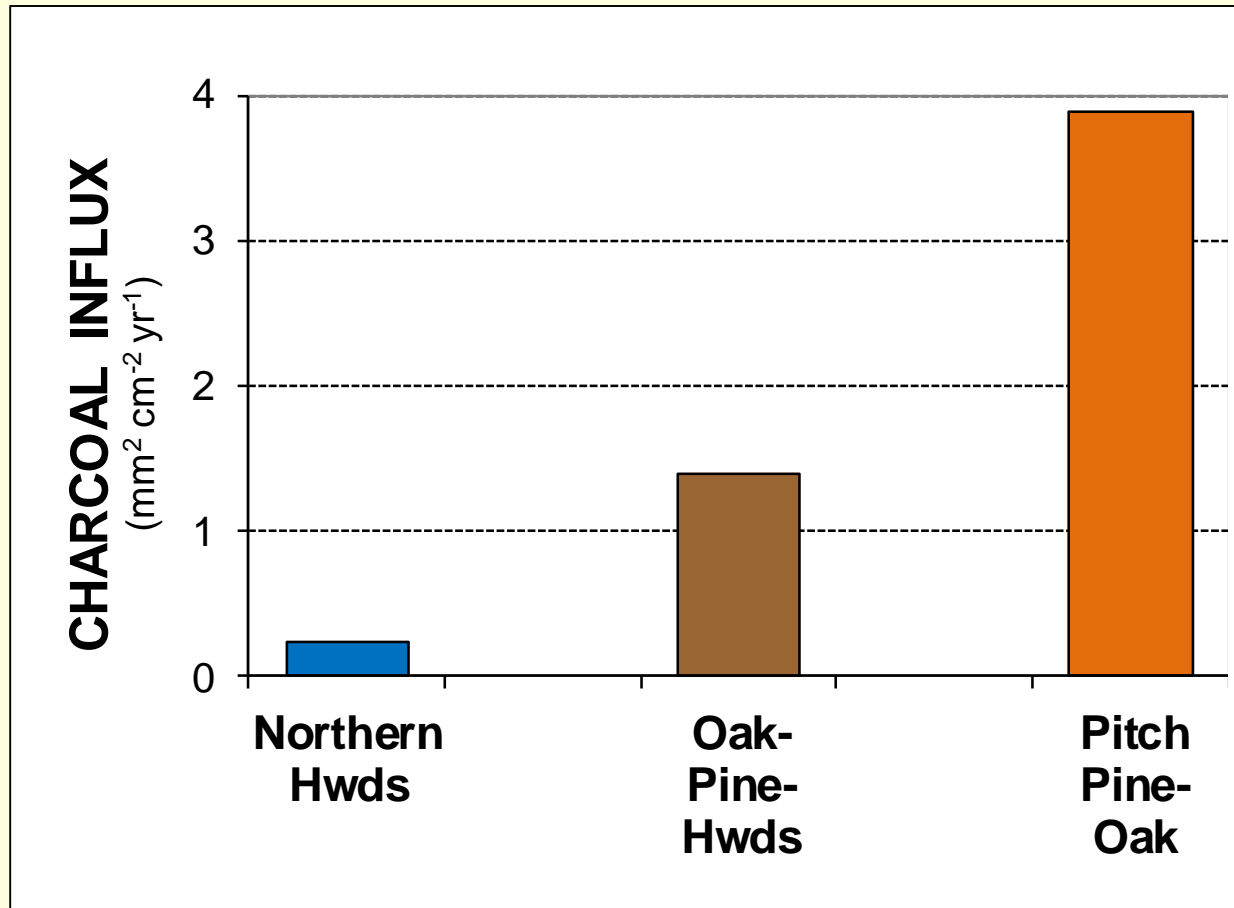
Our area:
Pine: 10-30%,
Oak: 20-50%

Mainly **NORTHERN HARDWOODS**

especially beech

PINE-OAK

OAK-HICKORY

0   100   200 km

Cogbill et al. 2002

Early European era: Pine and oak

- Pine and oak dominance is surprising

- Given climate and soils, "primeval" forests should have been dominated by
  - *American beech*
  - *Eastern hemlock*

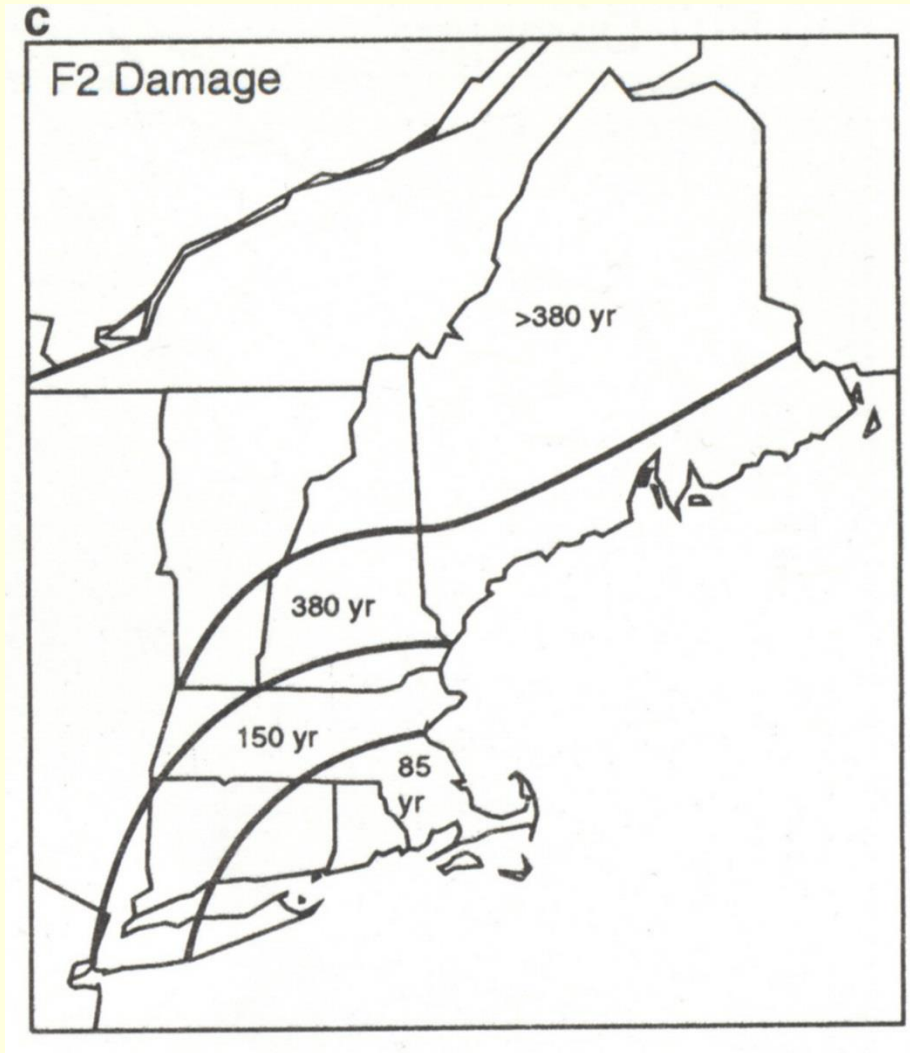- CONCLUSION: Must have been some disturbance!

Fire: Charcoal in lake sediments

Calculated from Parshall and Foster (2002)

Hurricane damage

F2 damage: Large trees snapped or uprooted

Boose et al. (2001)
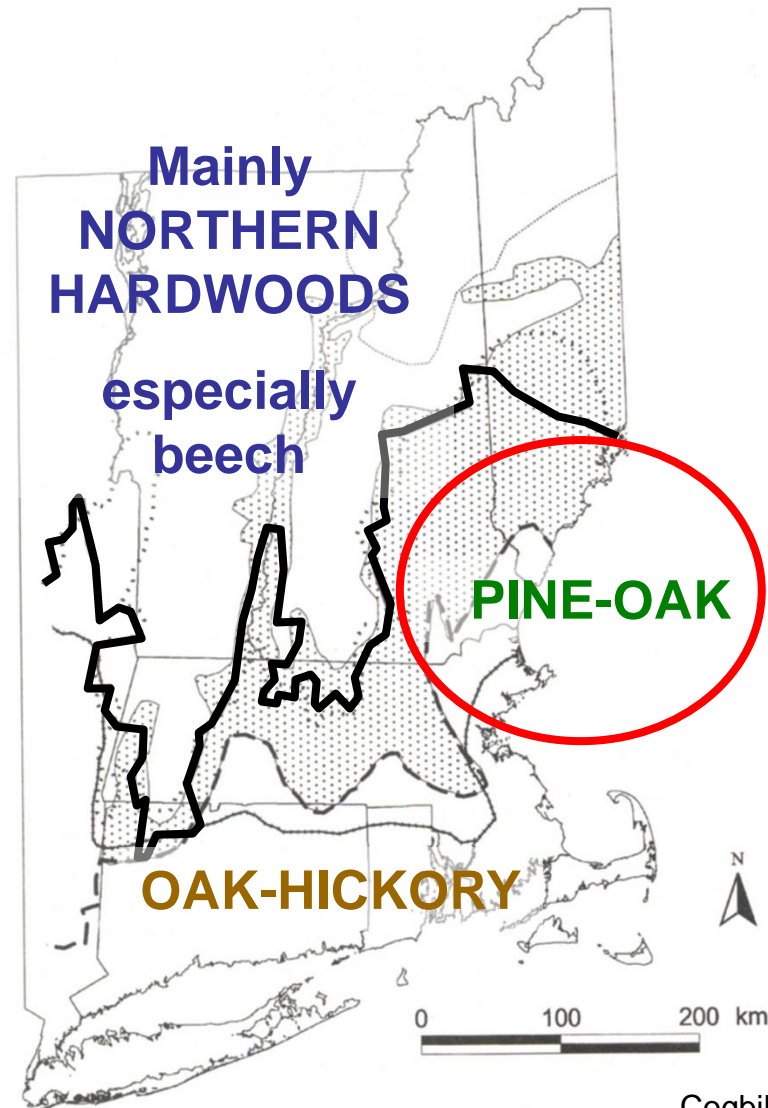
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How did Europeans alter
New England forests?

Pre-European Forest (1600)

Harvard Forest Diorama

Area settled and forest cleared: 1620-1850

Harvard Forest Diorama

Farm Abandonment (after 1850)

Harvard Forest Diorama

"Old-field" white pine on abandoned land

"Old-field" white pine-hardwoods on abandoned land

We've been logging these old-field pine stands since the mid-1900s

Logging "old-field" white pine on abandoned land

Harvard Forest Diorama

Logged white pine succeeded by hardwoods, not pine!

Hardwoods also dominate after natural disturbances…

An aggrading forest of hardwoods

Harvard Forest Diorama

So today, in central New England

- No original forest
- Old-field white pine forest
- Hemlock-beech-oak-white pine
- Post-logging hardwood forest

FORCES THAT MAINTAINED THE ORIGINAL, PRE-EUROPEAN FOREST NO LONGER DOMINATE…

To establish and maintain 'original forest' takes lots of energy and $$

Photo courtesy Parker Schuerman

Prescribed burning, Ossipee pine barrens

Lessons from forest history

- A forest's properties are influenced by the conditions under which the forest established

- After a forest is disturbed, don't expect the same forest to eventually appear

- Difficult to restore "pre-Columbian" forest

Conservation goals: Insight from community ecology

- Forest history

- Forest stand development

- Environmental change

Stand development

- Most forests originate after a disturbance

- Typically, stand development follows predictable steps

- Example: Old-field succession
  "What happens of you leave an old field undisturbed for a few centuries..."

Old field succession

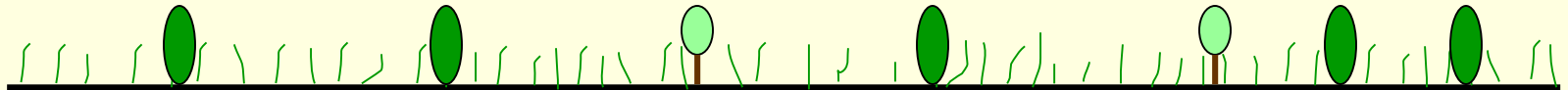

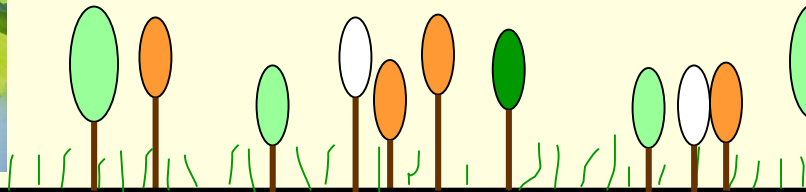eastern redcedar · white pine · oak · maple · white birch · black birch
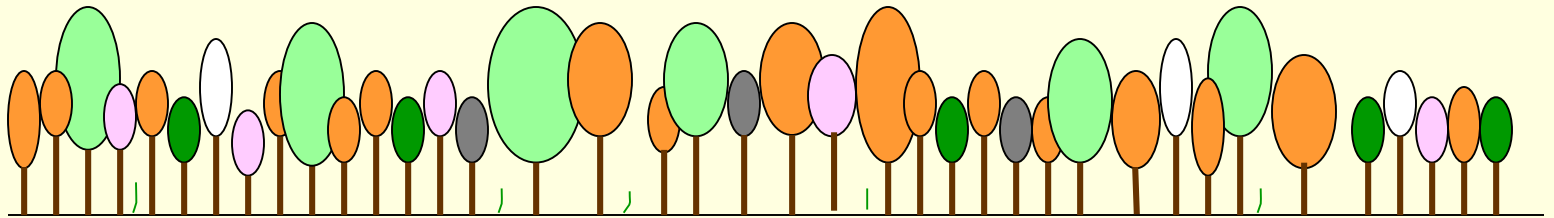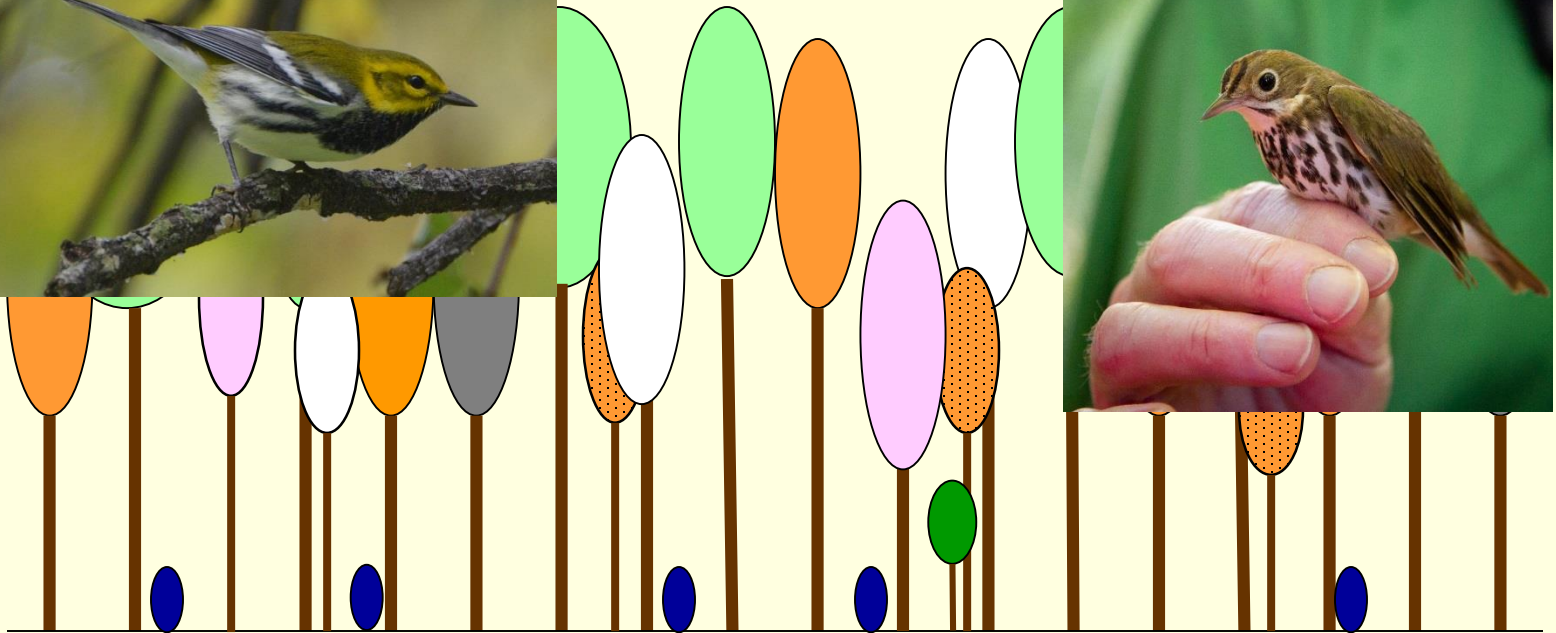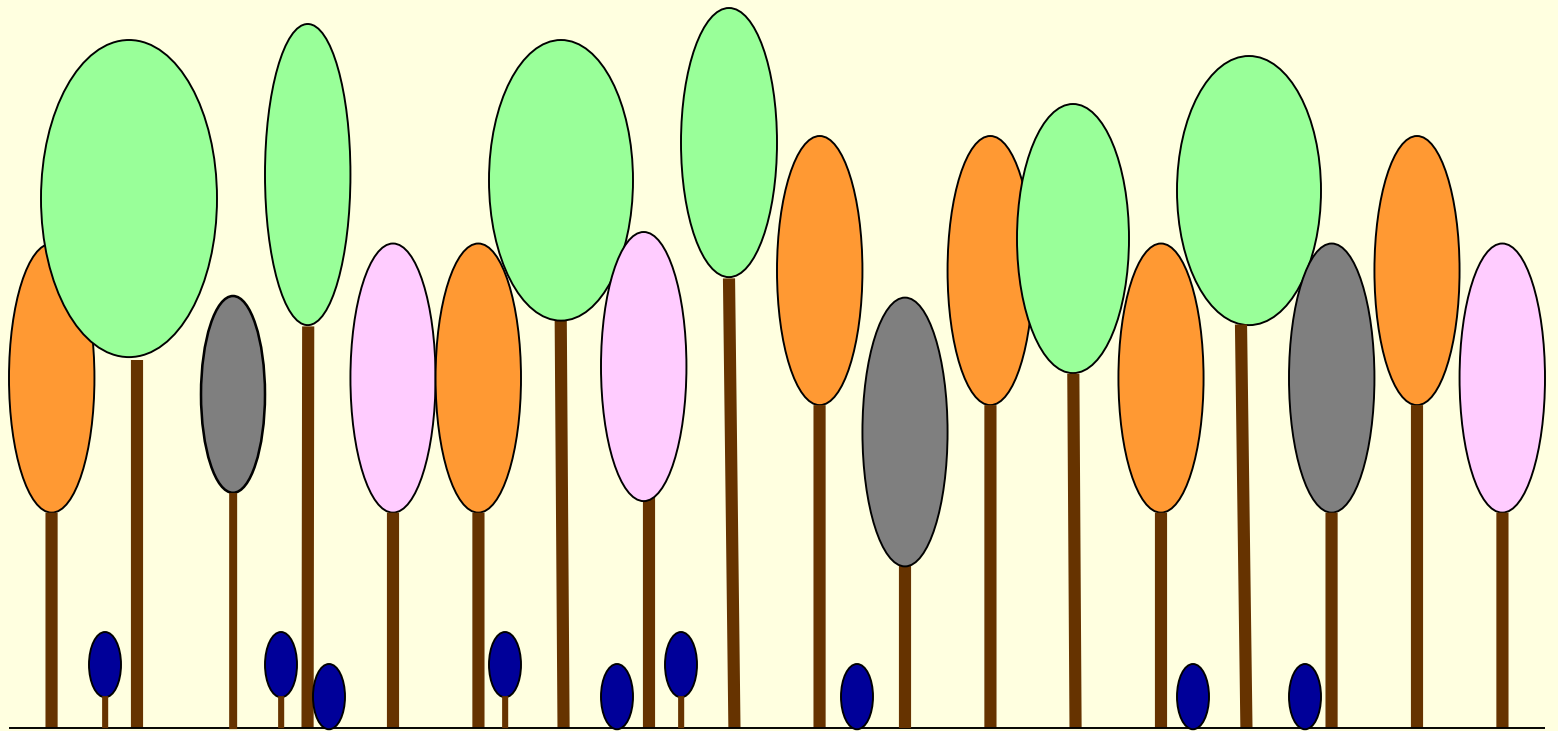
FIELD
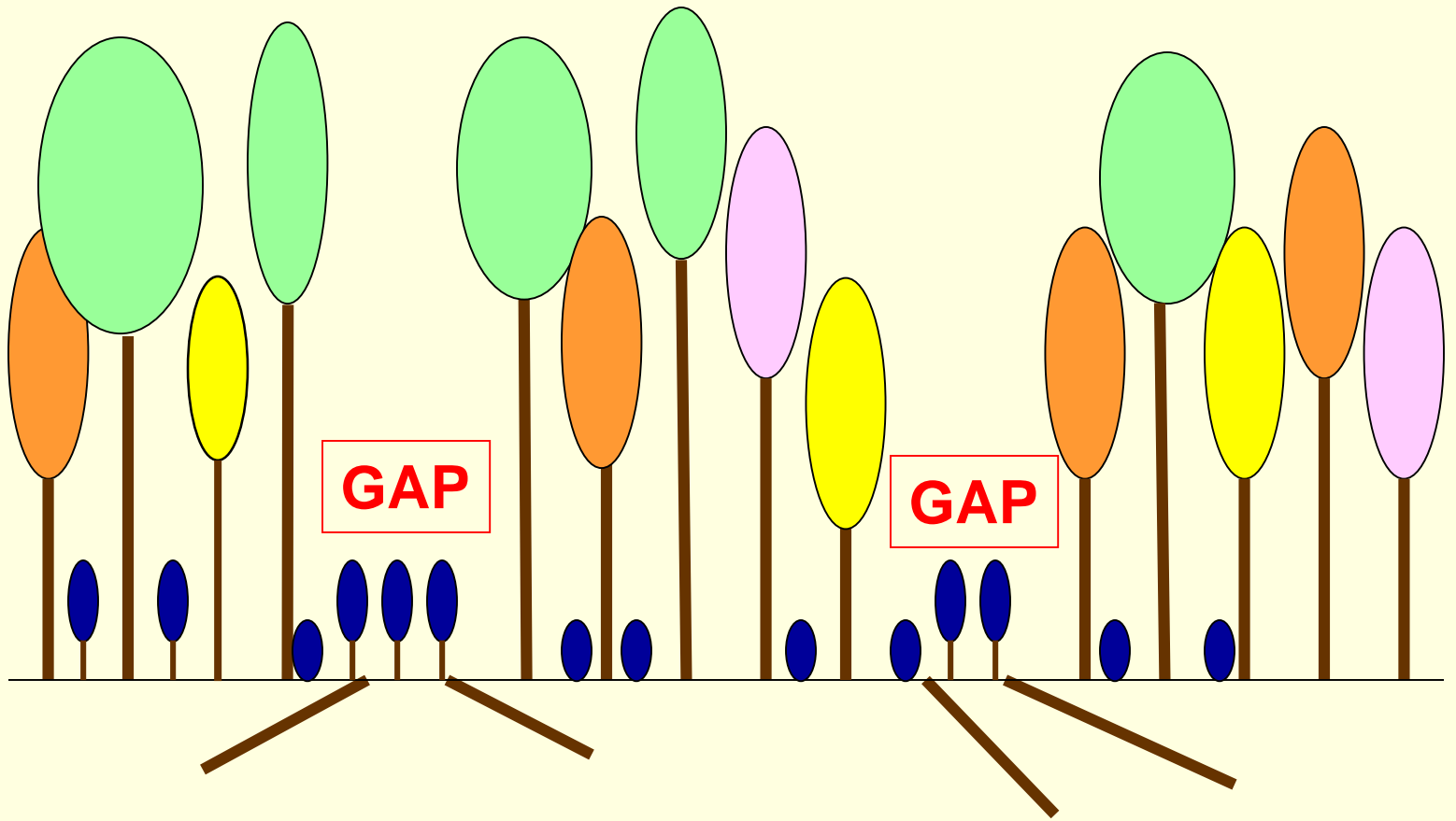
5 YEARS

10 YEARS

50 YEARS

90 YEARS

Hemlock/beech

130 YEARS

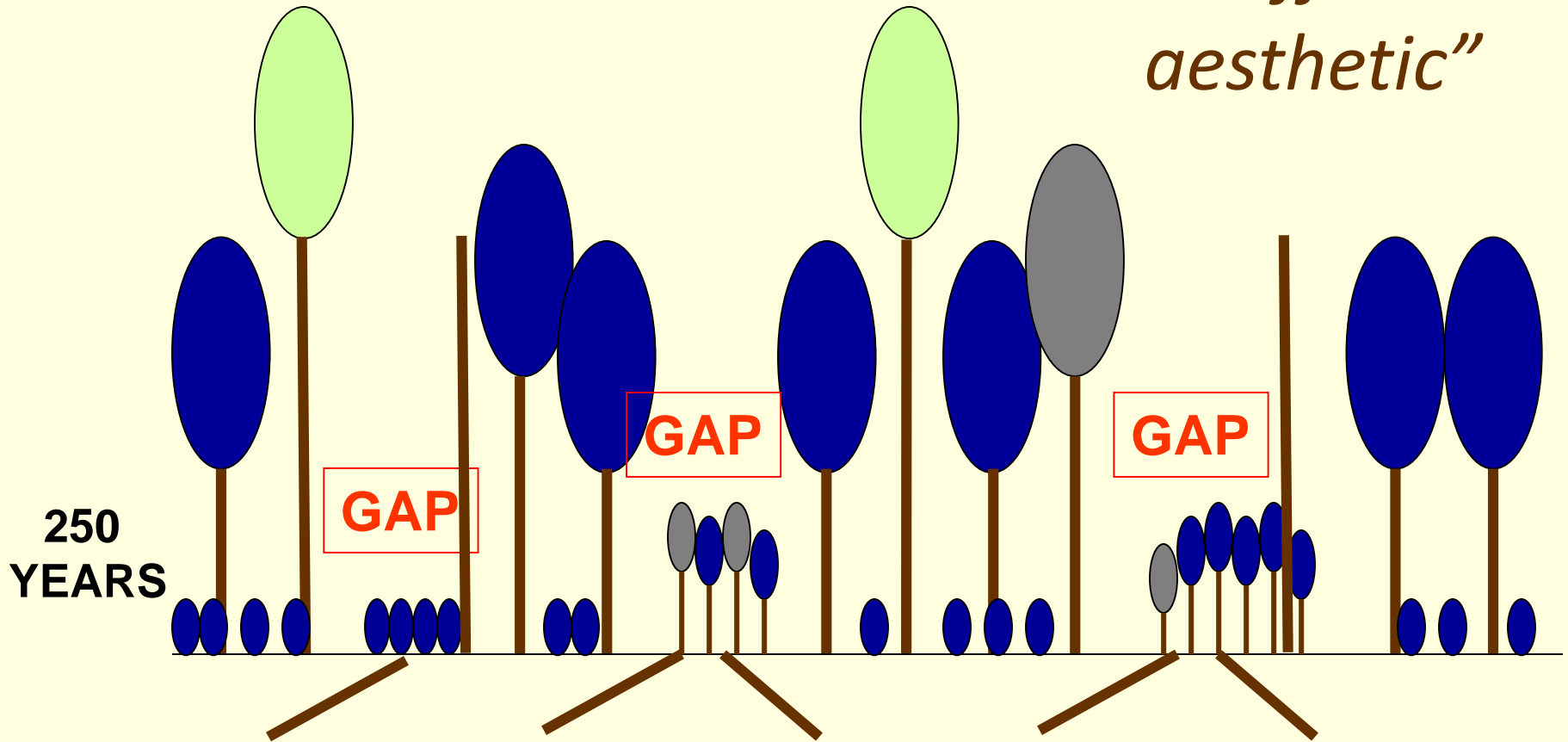Hemlock/beech

170
YEARS

GAP

GAP

"a different aesthetic"

250 YEARS

GAP

GAP

GAP

Some large trees, lots of coarse woody debris and snags

400 YEARS

GAP

GAP

GAP
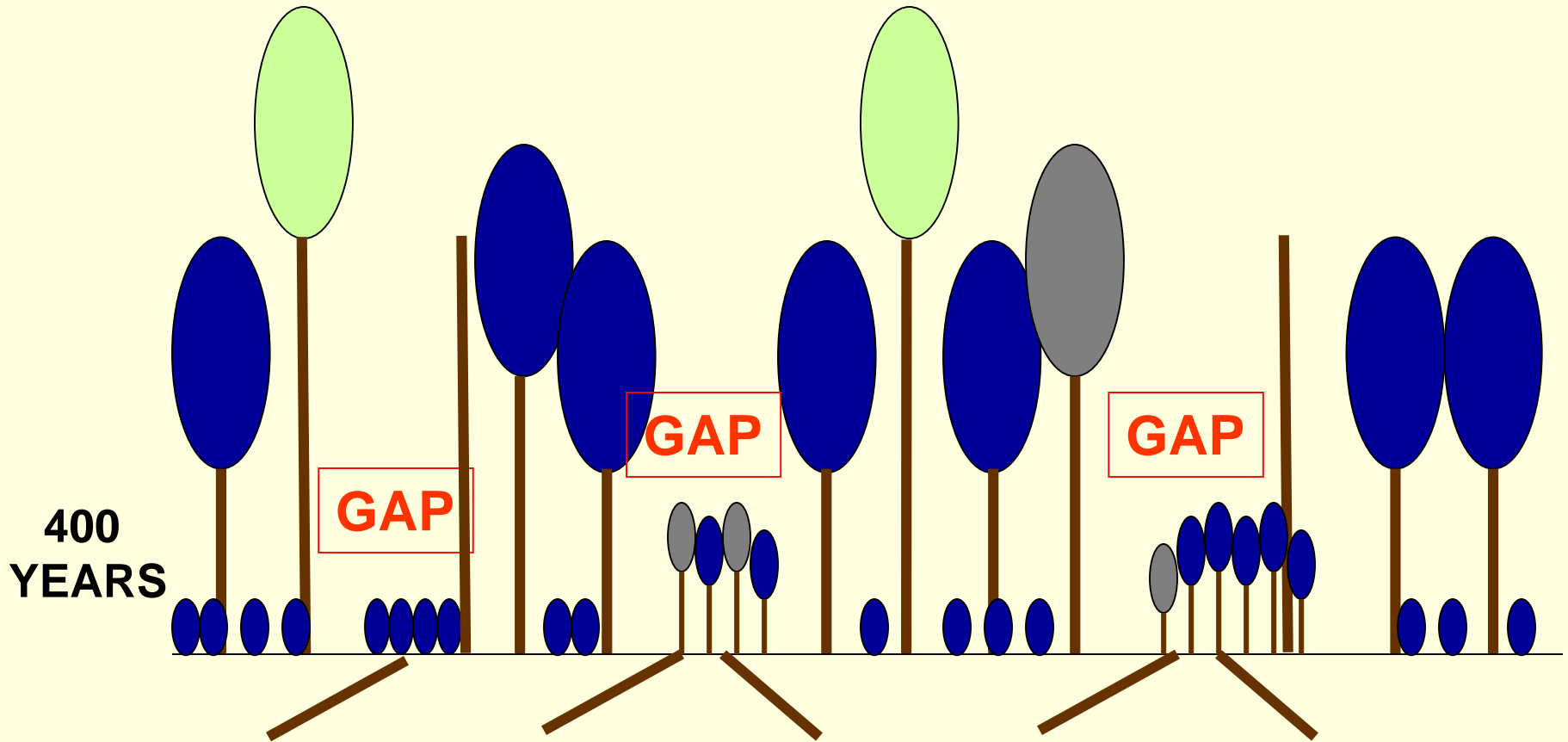
Natural canopy gaps generally too small to regenerate early successional species

Lessons from stand development

- Tree diversity declines in late succession

- As succession proceeds, early successional specialist species are lost

- Small canopy gaps regenerate mainly shade tolerant species

- Need big gaps for persistence of early successional species

Tree response to canopy gap size

	NO GAP	SMALL GAP (<1/5 acre)	LARGE GAP (≥ 1/5 acre)
Tree species			
• BEECH	————————————————————————————		
• HEMLOCK	————————————————————————————		
• SUGAR MAPLE	————————————————————————————		
• BLACK BIRCH		————————————————————————	
• RED MAPLE		————————————————————————	
• RED OAK		————————————————————————	
• PAPER BIRCH			———————————
• ASPEN			———————————
• WHITE PINE			———————————

Logging can be planned to influence:
- **tree species composition**
- **type of wildlife habitat**

"nudge the forest
to an earlier
successional state"

Conservation goals: Insight from community ecology

- Forest history

- Forest stand development

- Environmental change

Non-native species

Prey upon and compete with natives

Tree pests

Emerald ash borer

Beech bark disease

Plants

Many of these are good gap colonizers

If logging, be aware!

Glossy buckthorn
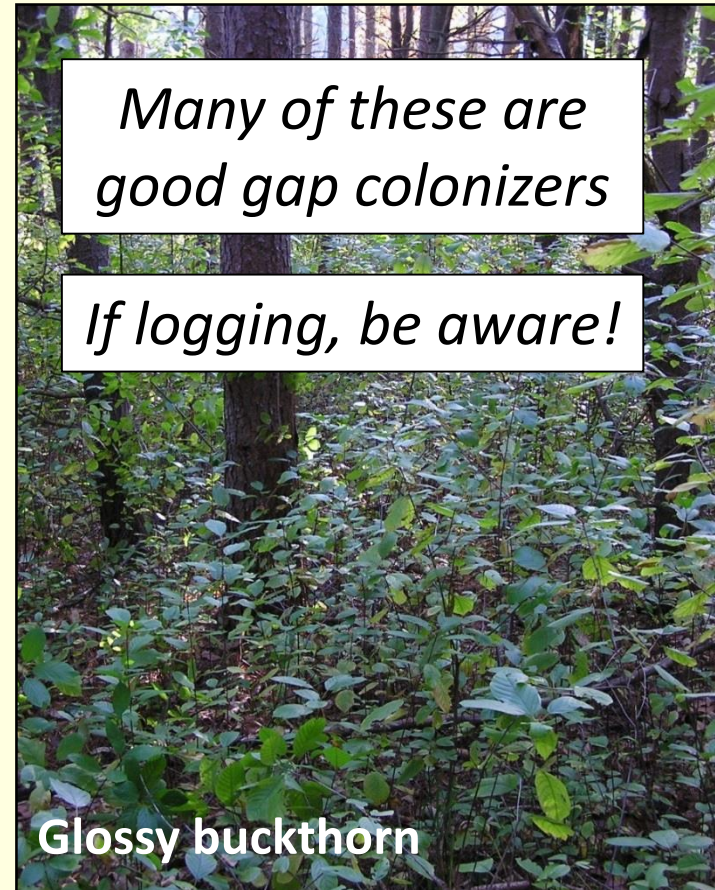
Two of our late successional tree species are under siege

Hemlock woolly adelgid

Beech bark disease

Climate is changing…

Mean annual minimum temperature

- Warmer
- Wetter,
- More intense storms
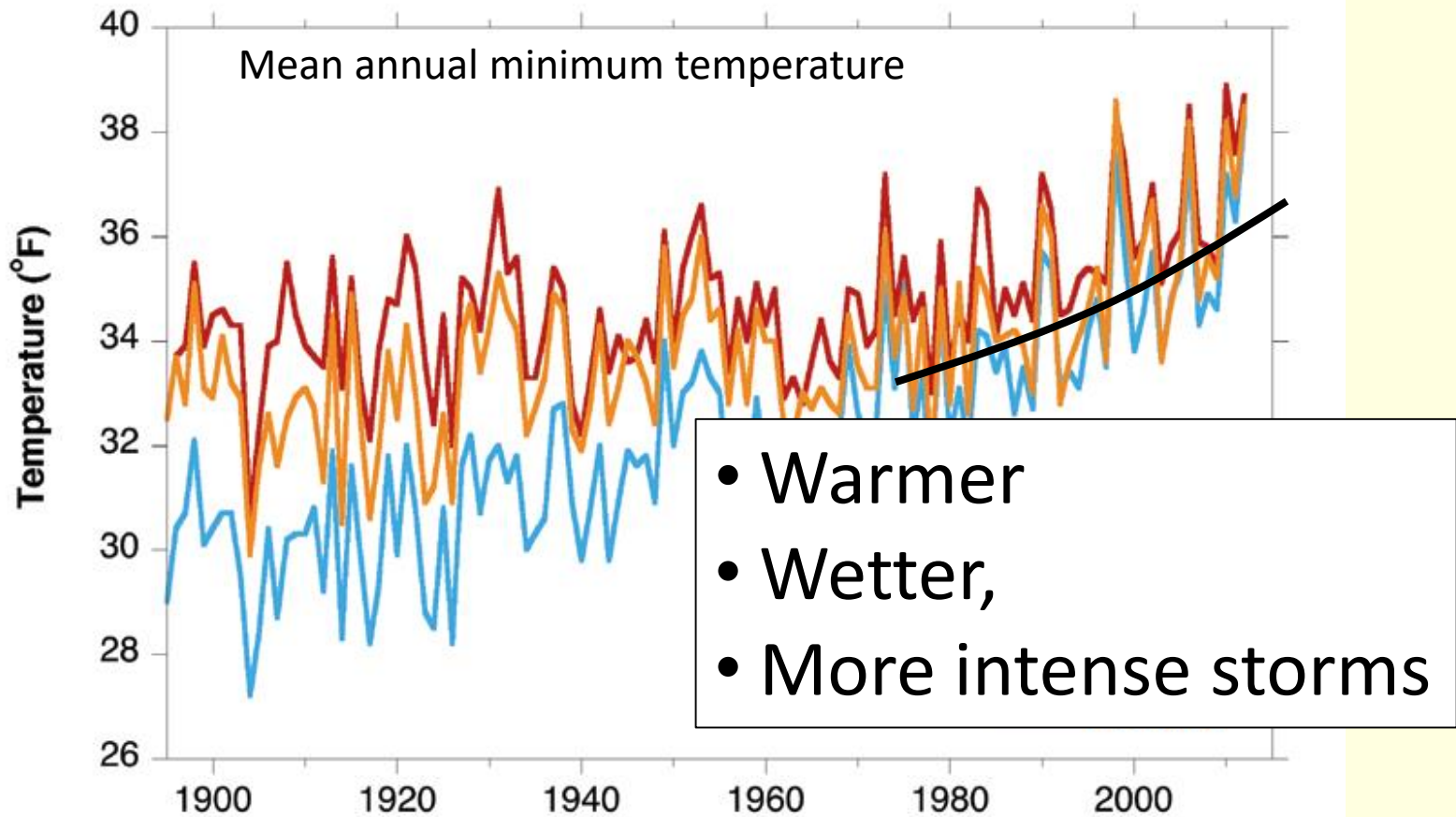
Wake et al. (2014)

Tree ranges will change – slowly

DECREASE		INCREASE	
White pine	Red oak	Black oak	*Scarlet oak
Beech	Hemlock	White oak	*Tuliptree
Sugar maple	Aspen	Shagbark hickory	
Paper birch			

WHY SLOW CHANGE?
- Predicted changes in temperatures not fatal
- Trees long lived, hold space, resist invasion
- Trees migrate slowly

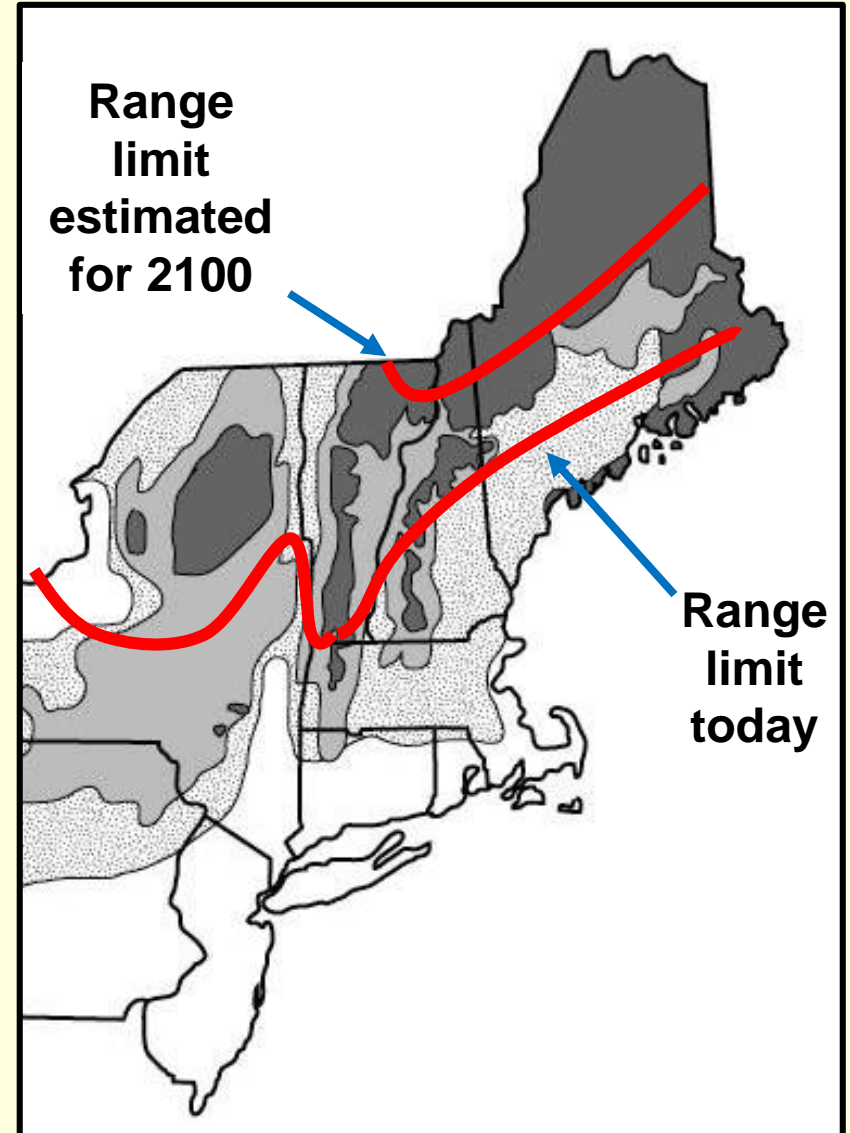# But change could be rapid...

- If storm intensity increases
  - *More disturbance; more canopy openings*
  - *More opportunities for new species*

- If pest species abundance increases

Hemlock woolly adelgid

- Hemlock will decline due to climate warming

- Decline may be reinforced by woolly adelgid, itself liberated by warming

Range limit estimated for 2100

Range limit today

# What kinds of forests will be RESILIENT to climate change?

- Best predictor of RESILIENCE is diversity

- A FOREST is more resilient if it has:
  - *More species*
  - *Greater diversity of age classes*

- A LANDSCAPE is more resilient if it has:
  - *Greater diversity of forest types*
  - *Wide range of stages of succession*
  - *Greater diversity of stand structures*

WHY?

Climate change RESILIENCE

PORTFOLIO EFFECT *(from finance)*

- A greater DIVERSITY of investments makes you more likely to survive change in the economy

- While some investments do *poorly* in periods of change, others will do *well*
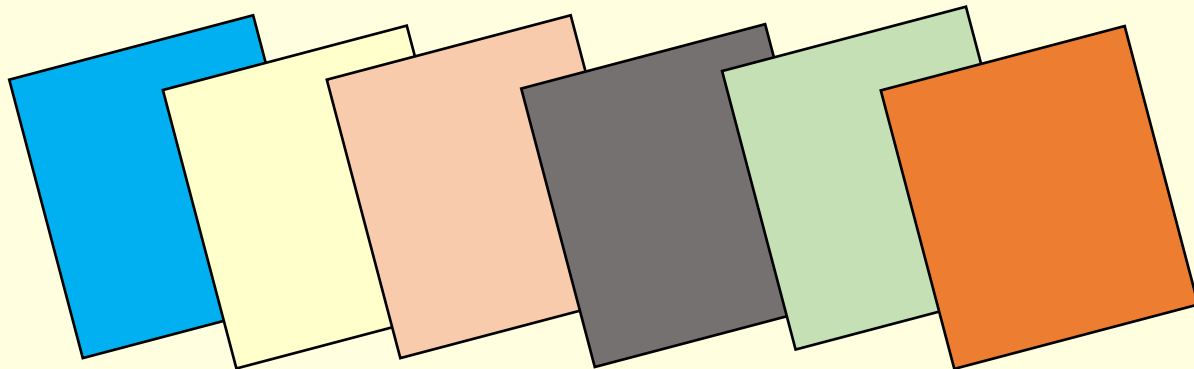
Lessons from environmental change

- Forest composition will be altered by invasive species and climate change

- Some changes predictable (e.g., ash decline), some less so (e.g., tree migration)

- For climate resilience: Diverse forests in landscapes with many different forest types

One last thought:

"Context"

In planning forest conservation consider:
- *Other properties you own*
- *What your neighbors are doing*

Ultimately, how you conserve forest land is determined by your objectives

Wood products

Clean water

Game

Aesthetics

RECREATION

Non-game wildlife

Psycho-spiritual benefit

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"Existence" value

Hiking, snowshoeing

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Historical value

Photography

Carbon storage