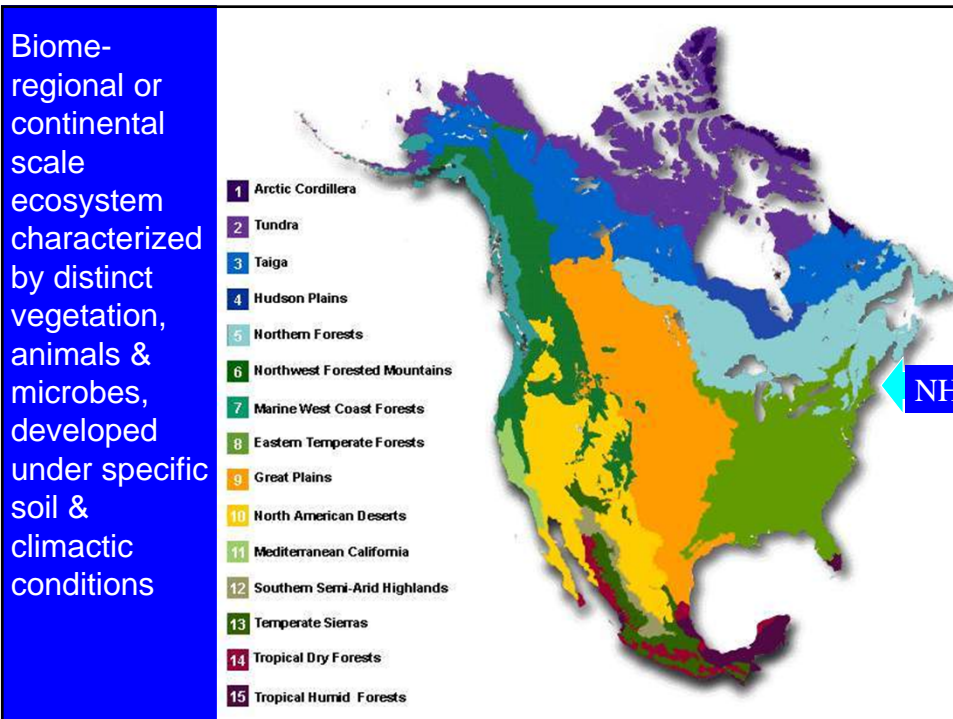


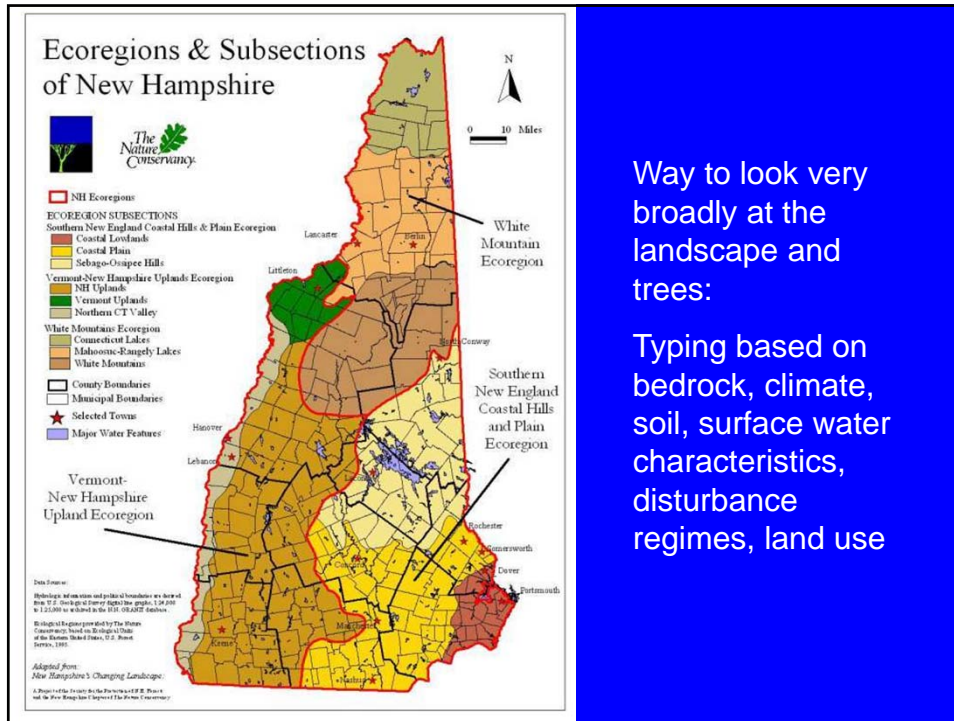
# Why Trees Grow Where They Do?

## The Basics of Forest Ecology



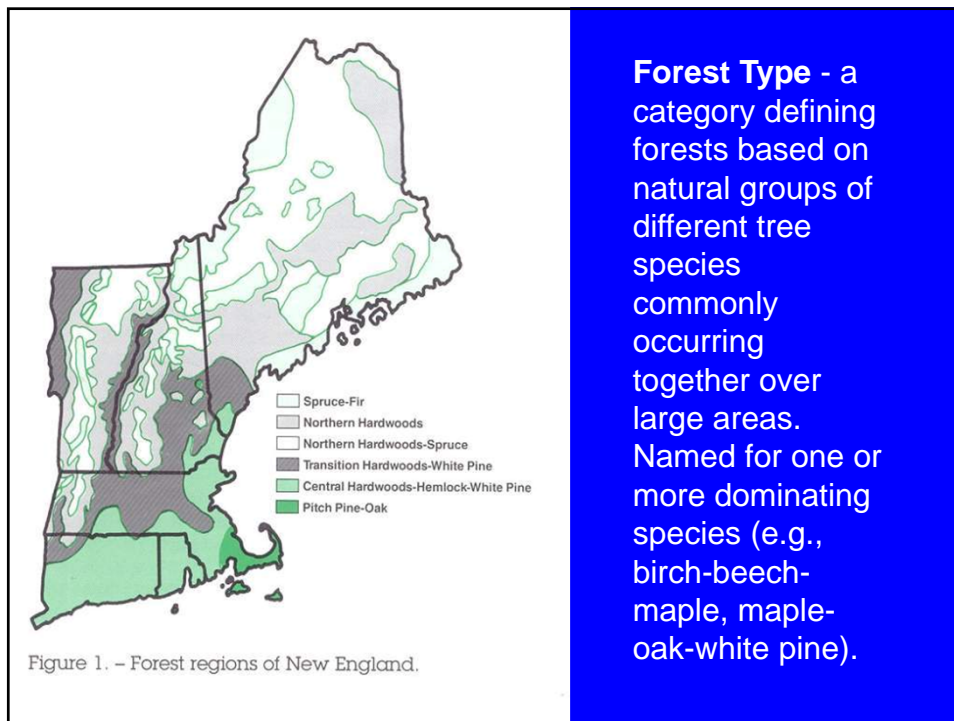
Steve Roberge,  
Cheshire County Extension Forester





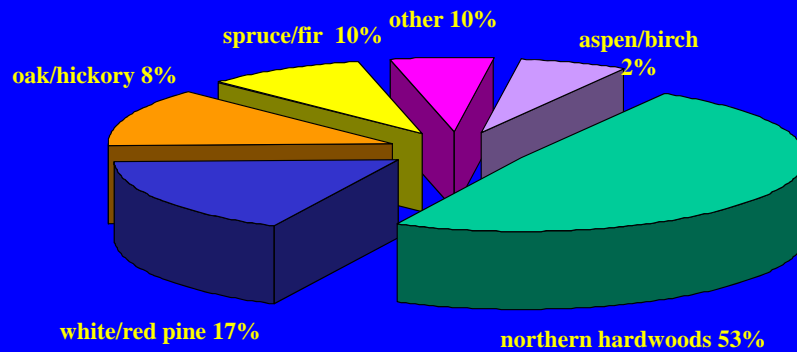
Way to look very broadly at the landscape and trees:

Typing based on bedrock, climate, soil, surface water characteristics, disturbance regimes, land use



**Forest Type** - a category defining forests based on natural groups of different tree species commonly occurring together over large areas. Named for one or more dominating species (e.g., birch-beech-maple, maple-oak-white pine).

## New Hampshire Forest Types, 2002



Source: USDA Forest Service

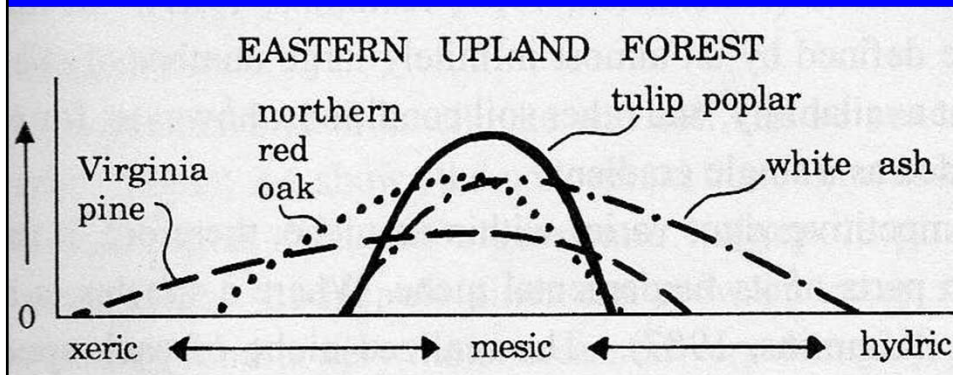
## Why Trees Grow Where They Do?

1. Adaptations over time
2. Climate
  - length of growing season, precipitation
3. Relationship to other trees
  - succession, seed source/absence, tolerance
4. Past site history
  - human disturbance
  - natural disturbance
5. Inherent site capability
  - soil: water & nutrient levels, productivity
  - topography: slope/ aspect/ elevation (effect climate)

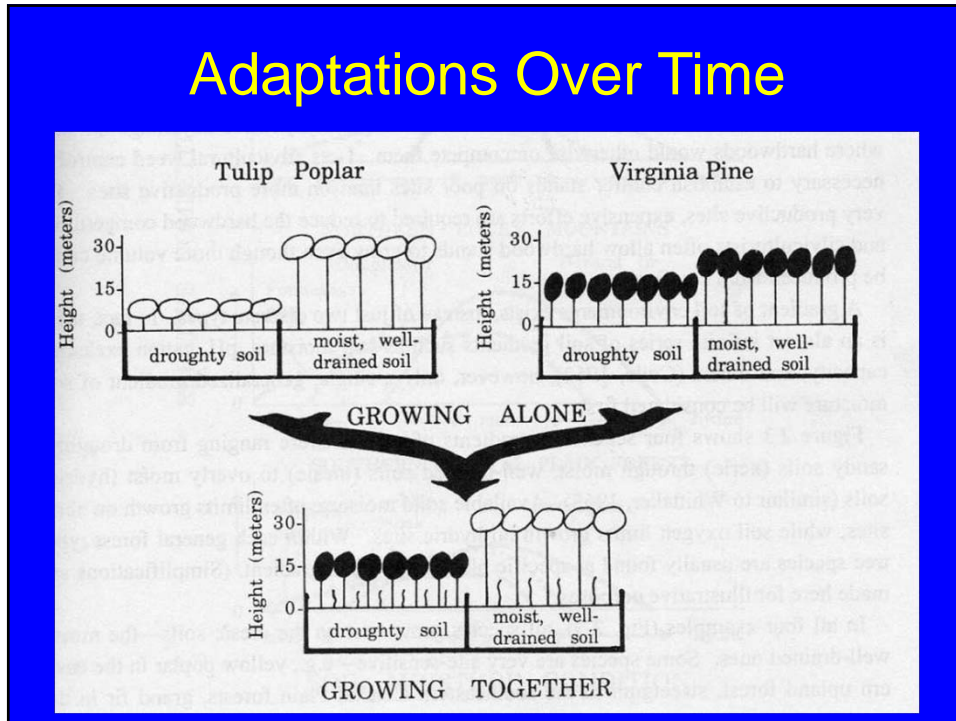
## Adaptations Over Time

- Trees have been adapting to their environment since the beginning. This has set broad, but very definite limits to where they grow.
  - loblolly pine → south
  - red spruce → north
- They adapt to specific sites within their growing region
  - black gum → wet
  - pitch pine → dry

## Adaptations Over Time



## Adaptations Over Time



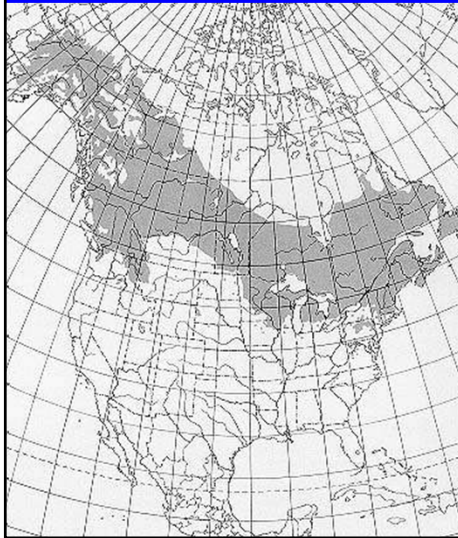
## Climate

- Not weather- long term weather pattern
- Controls amount of solar energy & water
- Temperature, precipitation, wind
  - Average annual rainfall
  - Snow depth and timing
  - Length of growing season
- Affects soil development
- North-south, high-low elevation
- e.g paper birch/ black birch

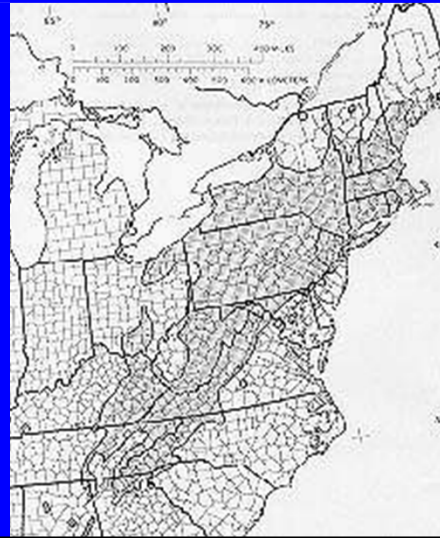


# Climate

Paper Birch

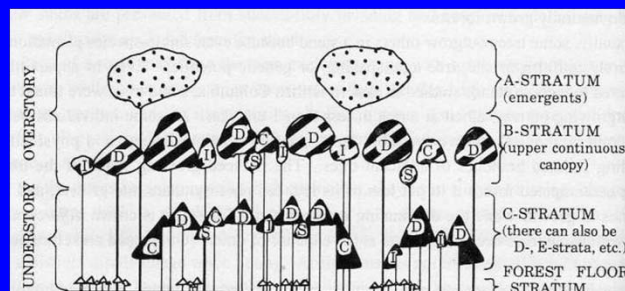


Black Birch



## Relationship to Other Trees

- Amount of light
- Determines whether or not a tree will regenerate-  
shade tolerance
  - aspen, willow need direct sun
  - white pine need partial sun
- How much light a tree has determines how fast it grows



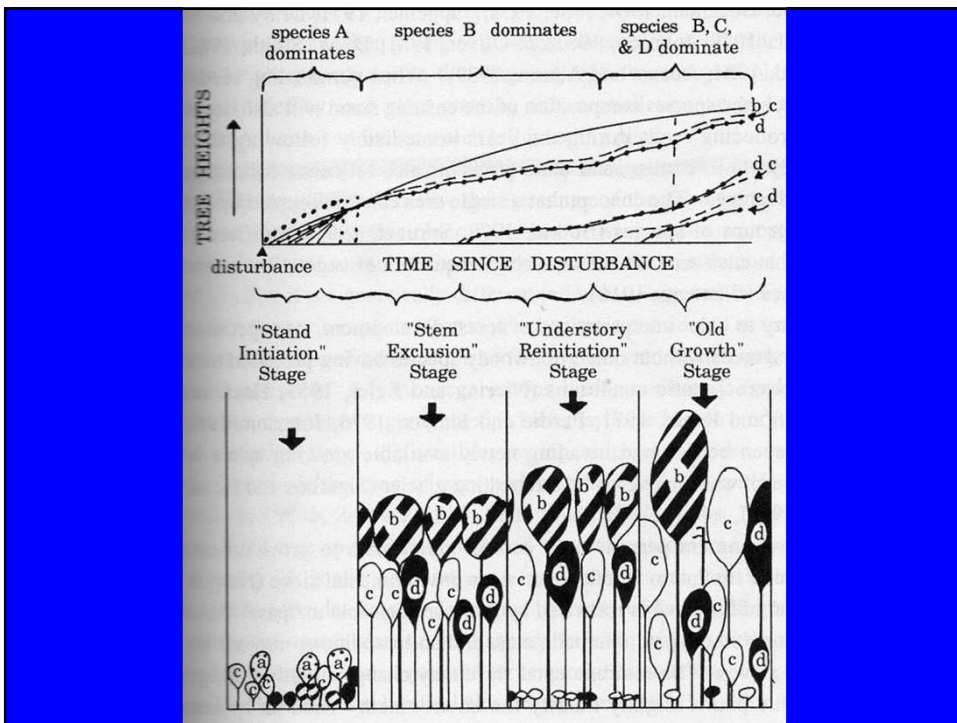
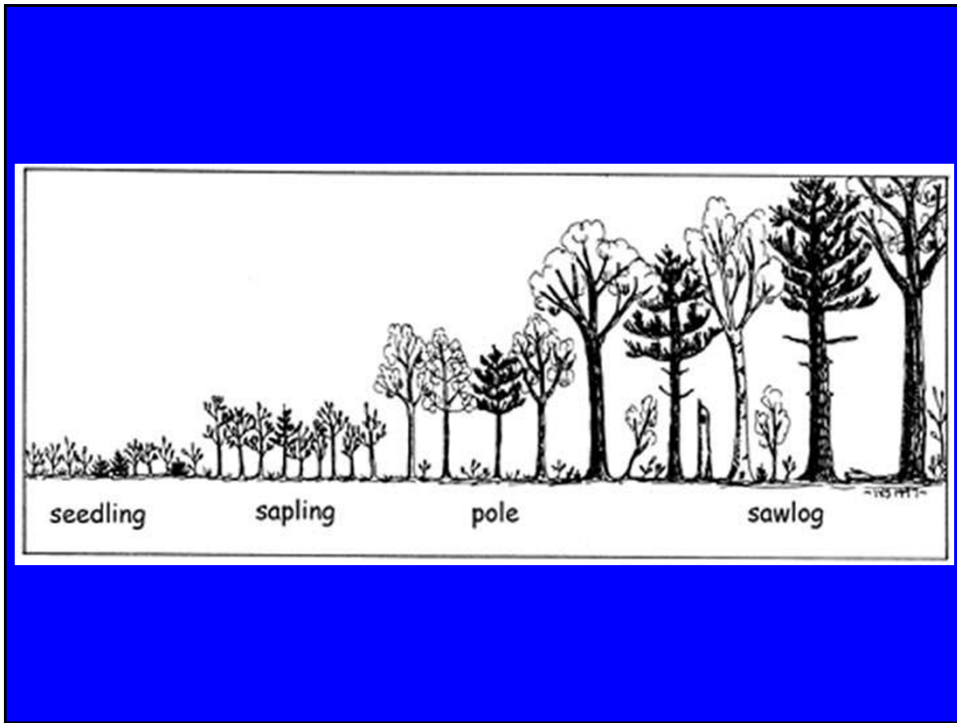
## Seed

- Source or lack of one determines what might grow
- Not every year a good seed year for everything
- Seeds disseminated by
  - wind, gravity, animals, birds
  - most seed falls within 200 feet of the parent tree



## Succession

- The change in plant communities or structure over time
- Changing light conditions
- Soil temperature, nutrient moisture regimes
- Not a neat path of succession
  - differs by site
  - humans and natural disturbance





## Succession

- The change in plant communities or structure over time
- Changing light conditions
- Soil temperature, nutrient moisture regimes
- Not a neat path of succession
  - differs by site
  - humans and natural disturbance
- As forest change food & shelter change and animal populations change

## Succession



## Shade Tolerance

Tolerance is the ability of a tree to grow satisfactorily in the shade of another tree.



## Tolerant vs. Intolerant

- Intolerant to shade
  - tends not to reproduce under self
  - “sun-loving”
  - tend to be light seeded, wind-dispersed
  - early successional species
- Tolerant to shade
  - reproduce under self
  - Tend to be heavier seeded moved by gravity, animals
- Intermediate

### **Intolerants**

- can't reproduce in shade
- usually short lived
- wind dispersed, light seeded
- early successional or pioneer species



**White Birch**

### **Tolerants**

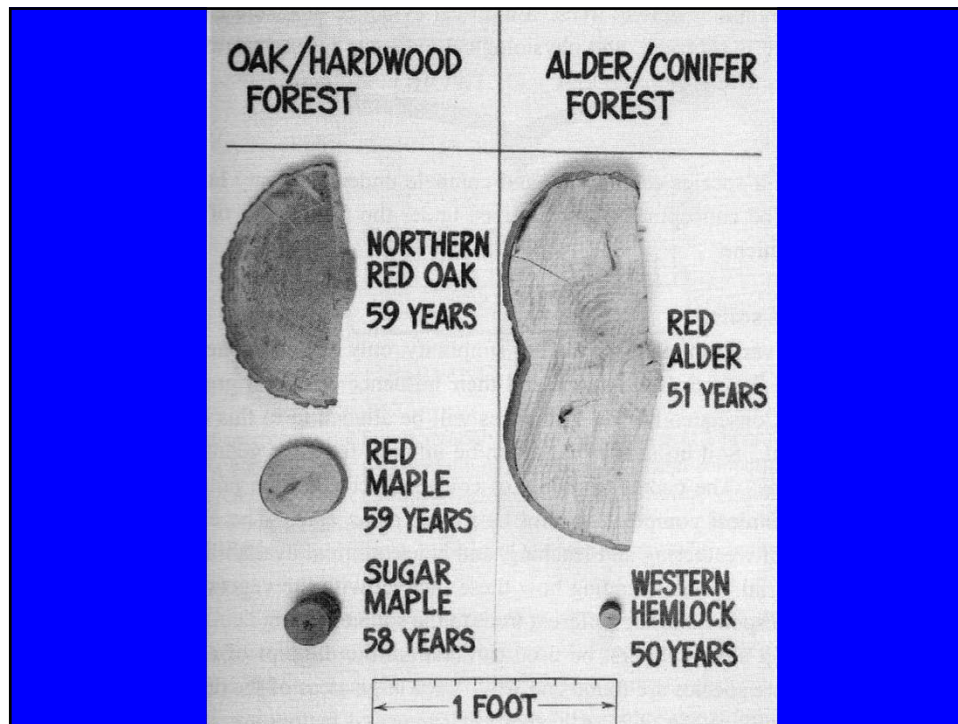
- reproduce and survive in shade for long periods
- usually long lived
- late successional or climax species



**Eastern Hemlock**



Softwoods		Hardwoods	
<b>Extremely Tolerant</b>			
balsam fir		American beech	
eastern hemlock		sugar maple	
<b>Tolerant</b>			
red spruce	white spruce		red maple
	northern white cedar		
<b>Intermediate</b>			
eastern white pine		white ash	red oak
		yellow birch	
<b>Intolerant</b>			
red pine			paper birch
<b>Extremely Intolerant</b>			
			aspen



## Why Trees Grow Where They Do?

1. Adaptations over time
2. Climate: length of growing season, precipitation
3. Relationship to other trees
  - Succession, seed source/ absence, tolerance
4. Past site history
  - human disturbance
  - natural disturbance
5. Inherent site capability (aka thank the glacier)
  - Soil: water & nutrient levels, productivity
  - topography: slope/ aspect/ elevation (effect climate)

## Disturbance



## Disturbance



## Human Disturbance

- Native Americans burned forests for hunting, girdled and cleared forests for agriculture.
  - Coastal and riverine
- From 1700 to the present humans are the number one disturbance factor affecting the structure and composition of our forests.

## Non-native Insects, Diseases, Plants, Animals



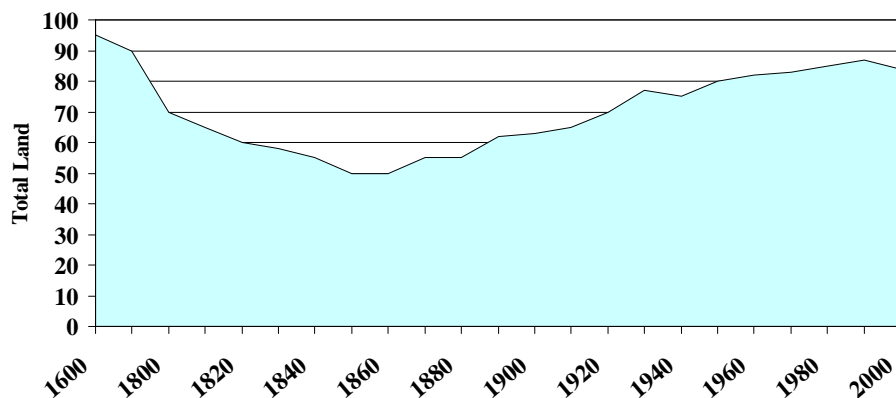
- 1869 gypsy moth to Medford MA
- 1890 beech bark disease in NH
- 1910 white pine blister rust in southern NH
- 1916-1920 chestnut blight does first damage
- 1930 Dutch elm disease outbreak in NH
- 1960's butternut canker first appears
- 2000's hemlock woolly adelgid & ALB



## Past Land Use

- Ag & Human activity may have altered the ability of soils to hold minerals
- Eroded & loss of organic matter
- Encouraged regeneration of atypical species
  - by altering the seedbed, encouraged white pine
  - the white pine story

**Trend of Forest Land Cover in New Hampshire  
1600-2000**



Source: UNH Cooperative Extension

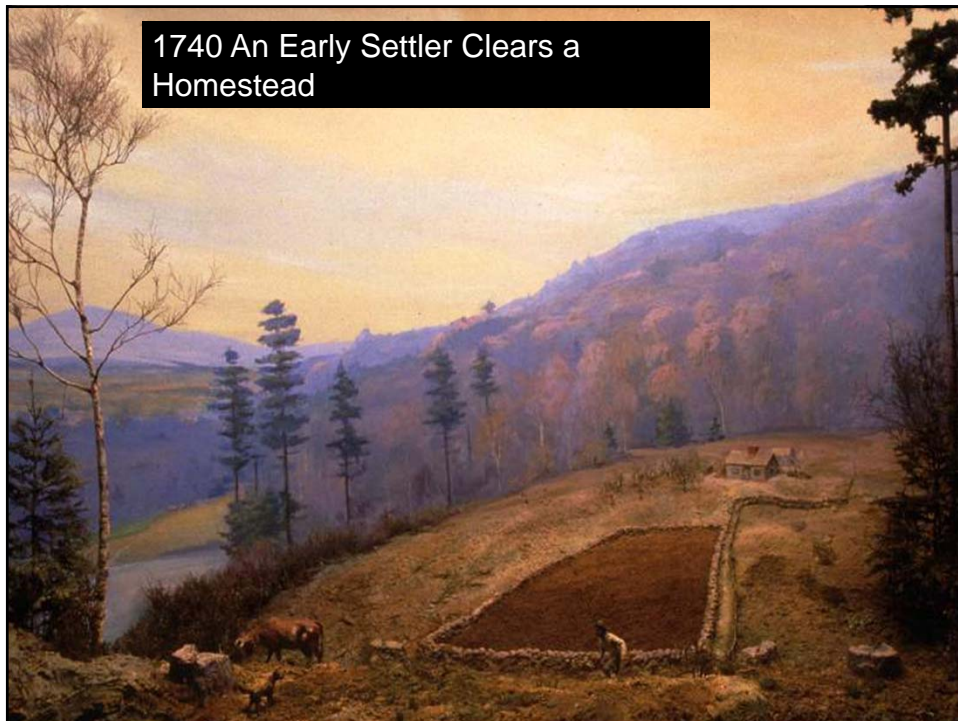


## 1700 Presettlement Mixed Forest



Prior to European Settlement- Forests were a patch-like mosaic shaped by: natural and human disturbance history, site conditions, and individual species characteristics.

## 1740 An Early Settler Clears a Homestead



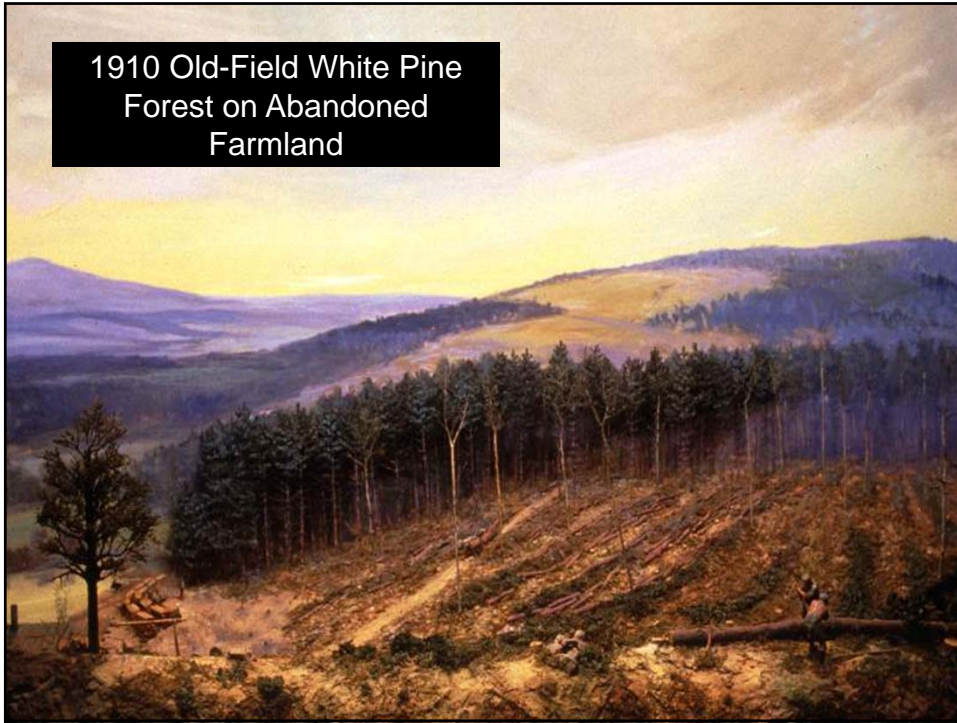
1830-1850 Height of  
Forest Clearance and  
Agriculture



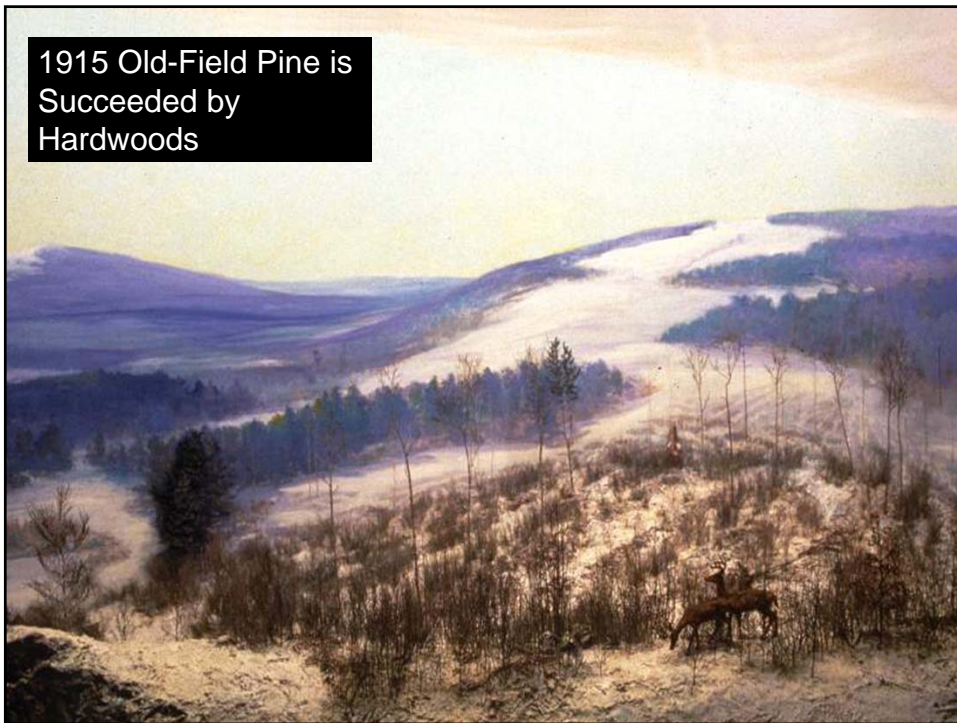
1850 Farm  
Abandonment



1910 Old-Field White Pine  
Forest on Abandoned  
Farmland



1915 Old-Field Pine is  
Succeeded by  
Hardwoods



## Natural Disturbance

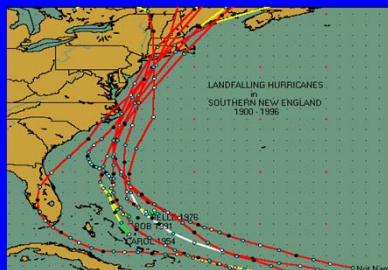
- Hurricanes- 1938, 1954, 1955
- Tornado- 2008
- Wind events
- Ice storms- 1998, 2008
- Fire
  - more control today
  - fire dependant/beneficiaries
    - pitch pine type, ridge top oaks, “scrub” oak, birches, aspens
  - pre-European, some Native American burn river bottomlands for ag and game
- Individual, small group death

## Disturbances and Forest Dynamics

1938 Hurricane



Harvard Forest Archives



NOAA

-Greatly influence species composition, age and structure.

-Kill individual trees, patches of trees or stands.

-Hurricanes, ice storms, insects, pathogens, fire, thunderstorms, wildlife, logging, conversion to agriculture.

## Prevailing Wind Patterns



## Natural Disturbances Create a Diverse Forest



## Gaps from individual trees



widespread and scattered throughout the landscape

## Large scale disturbances less frequent but larger areas disturbed



## Beavers important form of forest disturbance



## Inherent Site Capability-Soil

### Soil Profile

The topsoil layer is O-layer and is composed mainly of leaf and twigs.

Below is humus, a dark organic matter formed from decomposing O-layers.

Below the humus there often lies a white sandstone layer designated A<sub>1</sub>.

Over layer down, the B horizon begins. The B<sub>1</sub> and B<sub>2</sub> are red, brown, and yellowish layers of soil transported by tree roots.

All rock below are the C horizon, gray and yellowish layers and are permeated by tree roots.



NH has hundreds of soil types that can be grouped into 9 broad habitat types

Water & nutrient source for the tree

Geology helps determine soil fertility

20,000 years ago...



...New England was buried under ice a mile thick.

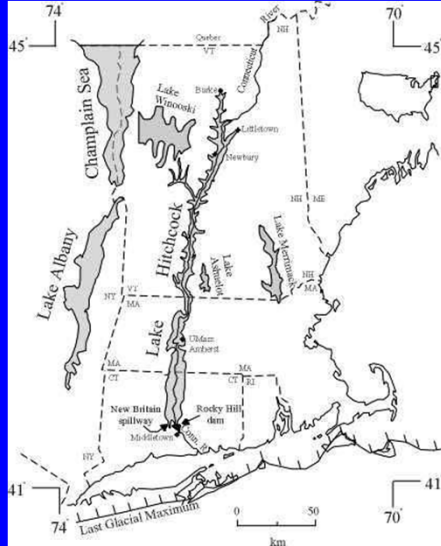
By 12,000 years ago...



... the glacier had melted.



## Glacial Lake Hitchcock



-Formed 15,000 years ago in Ct.

-Lasted for more than 4,000 years.

-At its largest it spanned over 200 miles down the valley.

-Large deposits of clay, sand and gravel.

## Tundra: NE's First Natural Community



# 11,000 years ago Spruce woodlands were the dominant forest.



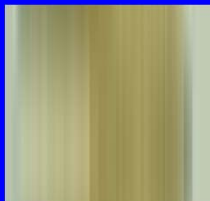
-Patches of trees interspersed with tundra vegetation.

-Coincided with the arrival of the first Native Americans.

## How do we know what tree species arrived when?

Answer: Tree Pollen!

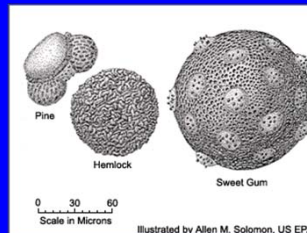
White Pine



Oak



Pollen Core



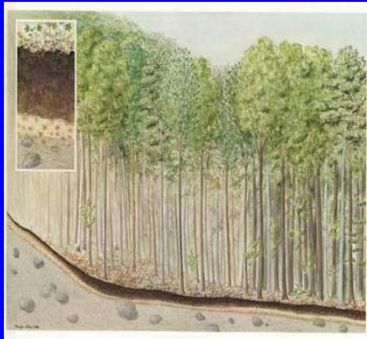
## Soils



- Soils have four main ingredients
  - mineral particles
  - organic matter
  - water, and
  - air
- The type of soil in a given area will help determine what types of trees can grow & how well.

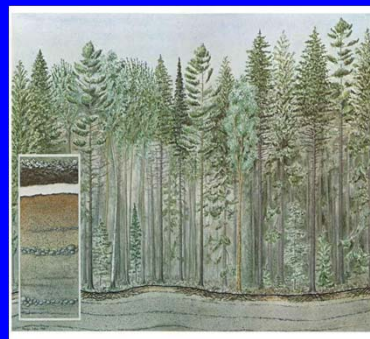
## Soil

### Enriched Soils



- Lots of organic matter and fine particles.
- Very productive for hardwoods: sugar maple, white ash

### Outwash Soils



- Mostly sand and gravel, left by glacial meltwater.
- Very productive for white pine

## Certain Soils "Favor" Certain Species

- white ash, sugar maple → • moderate well drain & enriched fine texture
- beech → • sandy tills
- red oak → • sandy tills & outwash
- white pine → • outwash & sandy tills
- red spruce, hemlock, balsam fir → • shallow pan, poorly drained, outwash, shallow to bedrock

## Site Influences What Will Grow

### Tolerate Wet Soils



yellow birch  
black gum      red maple  
hemlock

### Well-drained soils



red oak  
beech      sugar maple  
ash

## Northern Hardwoods

sugar maple



white ash



rich soils

## Northern Hardwoods

beech



poor soils

yellow birch &  
red maple



wet soils

aspen &  
white birch



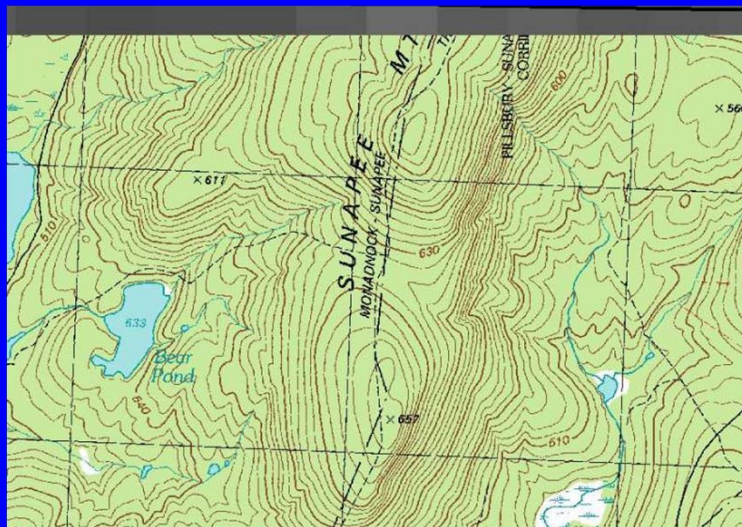
disturbed sites

## Topography: Slope/ Aspect/ Elevation

- Soil habitat types related to topography
- Water regime related
  - More water on north facing slopes and at base of slopes than on south facing slopes and on top
- Elevation
  - temperature, soil habitat types, moisture all related

*Inherent site capability*

## Elevation & Topography Influence Species Composition



## Elevation & Topography Influence Species Composition



Spruce and Fir at High Elevations and Hill Tops

