Forest community ecology: Implications for forest conservation

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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
Bedrock type
Soil depth, stoniness, and texture

Soil moisture
Soil fertility
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
- Psycho-spiritual benefit
- "Existence" value
- Scientific benefit
- Historical value

**RECREATION**
- Hunting
- Fishing
- Hiking, snowshoeing
- Birding, botanizing...

- Non-game wildlife
- Maintenance of biodiversity
- Educational benefit

- Nature photography
- Carbon storage

- "Existence" 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%

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)
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%
How did Europeans alter New England forests?

Pre-European Forest (1600)
Area settled and forest cleared: 1620-1850
Farm Abandonment (after 1850)
“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.
Logged white pine succeeded by hardwoods, not pine!

Hardwoods also dominate after natural disturbances…
An aggrading forest of hardwoods
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 $$

Prescribed burning, Ossipee pine barrens

Photo courtesy Parker Schuerman
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
130 YEARS

Hemlock/beech
170 YEARS GAP GAP
Some large trees, lots of coarse woody debris and snags

“a different aesthetic”
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

<table>
<thead>
<tr>
<th>Tree species</th>
<th>NO GAP</th>
<th>SMALL GAP (&lt;1/5 acre)</th>
<th>LARGE GAP (≥ 1/5 acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEECH</td>
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<td>HEMLOCK</td>
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<td>SUGAR MAPLE</td>
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<td>BLACK BIRCH</td>
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<td>RED MAPLE</td>
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<td>RED OAK</td>
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<td>PAPER BIRCH</td>
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<td>ASPEN</td>
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<tr>
<td>WHITE PINE</td>
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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

Tree pests

Emerald ash borer

Beech bark disease

Plants

Glossy buckthorn

Many of these are good gap colonizers

If logging, be aware!

Prey upon and compete with natives
Two of our late successional tree species are under siege:

- Beech bark disease
- Hemlock woolly adelgid
Climate is changing...

- Warmer
- Wetter,
- More intense storms

*Wake et al. (2014)*

Mean annual minimum temperature
Tree ranges will change – slowly

<table>
<thead>
<tr>
<th>DECREASE</th>
<th>INCREASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>White pine</td>
<td>Black oak</td>
</tr>
<tr>
<td>Beech</td>
<td>*Scarlet oak</td>
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<tr>
<td>Sugar maple</td>
<td>White oak</td>
</tr>
<tr>
<td>Paper birch</td>
<td>*Tuliptree</td>
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<td></td>
<td>Shagbark hickory</td>
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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
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.