AN INTRODUCTION TO FOREST ECOLOGY IN THE NORTHEAST

With a little bit of management

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www.ForestConnect.info

www.CornellForestConnect.ning.com

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USDA United States Department of Agriculture
National Institute of Food and Agriculture

Ecology

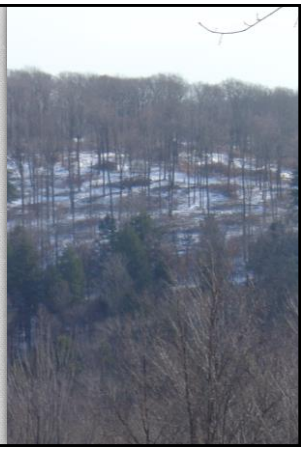
- The study of the interaction of organisms in their environment.
- Forests will change!
  - Why…ecological interactions forecast changes
  - Why…knowing may allow us to influence the interaction to favor some species or processes.

Ecology

The success of individual organisms (trees) during those interactions depends on

- landscape history
- human activity
- natural process
- organismal behavior
- environmental conditions

As decision makers, we have <u>some</u> influence over <u>some</u> of the factors that influence the forest.



The driving factors that influence an organism's success in a given environment include…

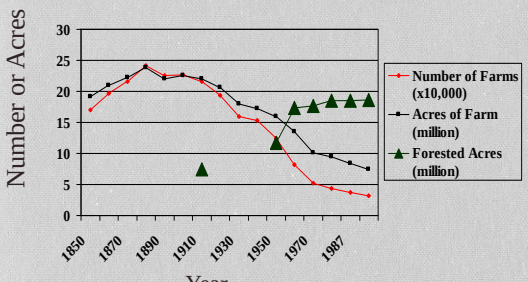
1. Landscape history and scale of disturbance
2. Wildlife (deer)
3. Pests, pathogen, and episodic events
4. Life history attributes (the define features of a species)
5. Light
6. Soil and site (water, rooting depth, nutrients, aspect etc.)

There are "winners" and there are "losers."

Landscape History

Large scale and infrequent events

NY Farm and Forest

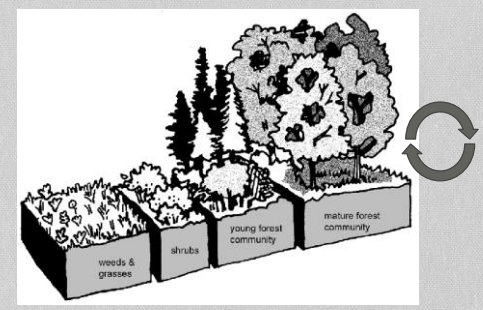


Stanton and Bills, 1996, Cornell
Alerich and Drake, 1995 USFS

Even-aged Forest Development

Uneven-aged: 3 or more age classes

Forest Succession – Dominant Vegetation



www.mainetreefoundation.org

Light

- Quantity (light intensity)
- Quality (wave length)

Light Quantity

- The intensity of light
- One of the most important variables in nature
- Major determinant of growth and yield
- PHS limited at 25% - 33% of full sunlight (species vary)
- Understory = 10% to 15% of full sunlight in pine
- Understory = < 5% of full sunlight in hardwoods

Light Quality

- PAR = 400 to 700 nm (blue to red)
- Far Red (FR) > 700 nm
- Upper layers absorb PAR
- Low R:FR
  - Reduced germination
  - Increased etiolation "spindley"
  - Reduced leaf area
- Ratio of 1.3 vs. 0.3 in hardwood forest canopy vs. herb layer

Smith 1982. Ann Rev Pl Phys
Ashton et al. Silvopasture text

Shade Tolerance

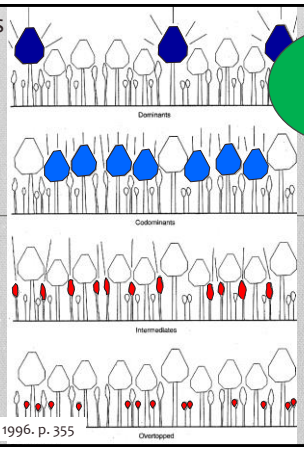
Shade Tolerance

Intolerant	Midtolerant	Tolerant
Needs full sunlight	Grows in partial sunlight	Endures forest shade
Common Tree Species		
Yellow-poplar	Red, black, and scarlet oak	Hemlock
Paper and gray birch	Shagbark hickory	Sugar, red, and striped maple
Bitternut and mockernut hickory	White and chestnut oak	Beech
Aspen	Eastern white pine	Basswood
Ash	Black and yellow birch	Spruce
Pin cherry	Blackgum	
Species Characteristics Analogy		
High stakes gambler	*Investor*	*Miser*
Fast growth rate	Moderate growth	Potentially slow growth rate
Few reserves	Some reserves	Large reserves
Short lifespan	Medium lifespan	Long lifespan
High mortality	Moderate mortality	Low mortality

Ward et al. 2013. Northeastern Forest Regeneration Handbook. NA–TP–03–06

Crown Class

The height of a tree relative to its neighbors WITHIN an age class.



MGMT – favor upper crown class trees

Growth response of upper canopy after release is 3x to 8x as much as in lower canopy. (Nyland, 2009)

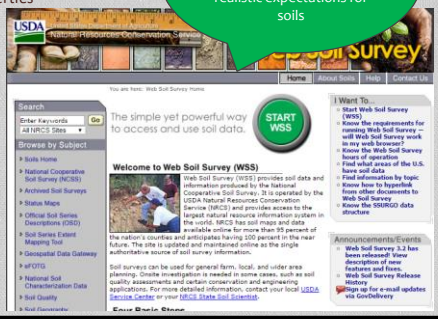
Non-responsive

Picture from Nyland, 1996. p. 355

Soil and Site

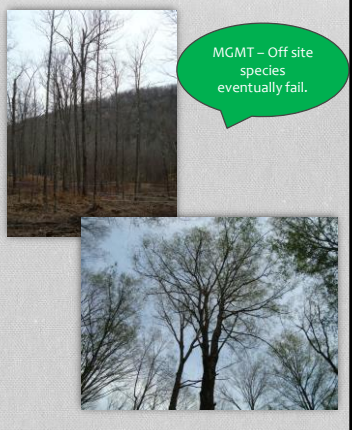
- Physical properties
- Chemical properties

MGMT – Don't degrade soils; improve soils if possible (OM); have realistic expectations for soils



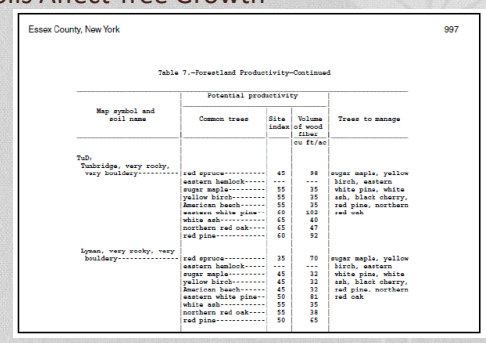
"On-site" and "Off-site" Trees

- Trees can survive on a range of soil and site conditions.
- Trees thrive on a narrower range of soil and site conditions.
- Access to oxygen, moisture and nutrients determines the suitability of a site for a species.
  - Soil texture
  - Drainage
  - Compaction
  - Organic matter
  - Slope position
  - Organisms



MGMT – Off site species eventually fail.

Soils Affect Tree Growth



Essex County, New York 997

Table 7.—Forestland Productivity—Continued

Map symbol and soil name	Potential productivity: Common trees	Site index	Volume of wood fiber, cu ft/ac	Trees to manage
TuD: Tunbridge, very rocky, very bouldery	red spruce	45	98	sugar maple, yellow birch, eastern
	eastern hemlock	---	---	white pine, white
	sugar maple	55	35	ash, black cherry,
	yellow birch	55	35	red pine, northern
	American beech	55	35	red oak
	eastern white pine	65	102	
	white ash	65	40	
	northern red oak	65	47	
	red pine	60	92	
Lyman, very rocky, very bouldery	red spruce	35	70	sugar maple, yellow birch, eastern
	eastern hemlock	---	---	white pine, white
	sugar maple	45	32	ash, black cherry,
	yellow birch	45	32	red pine, northern
	American beech	45	32	red oak
	eastern white pine	50	81	
	white ash	55	35	
	northern red oak	55	38	
	red pine	50	45	

Site index = predicted height of a tree at a given age. Height correlates with site quality.

Deer Impacts

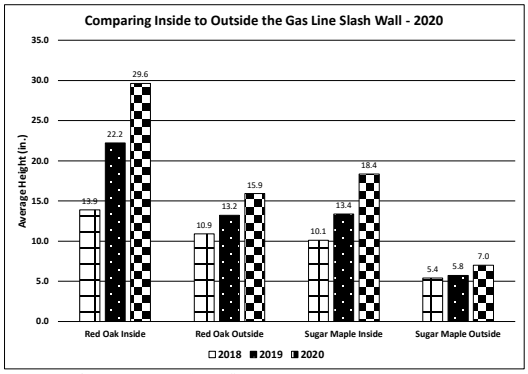
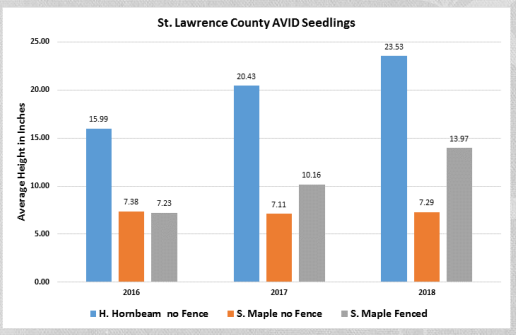


Figure x. Data from AVID plots in the "gas line" slash wall illustrate that seedling height growth rate inside the slash wall is greater than outside the slash wall. Seedling height growth inside fences inside the slash wall (data not shown) was similar to unfenced seedlings inside the slash wall. (Smallidge, Curtis, Chedzoy, Ashdown, unpublished data 2020)

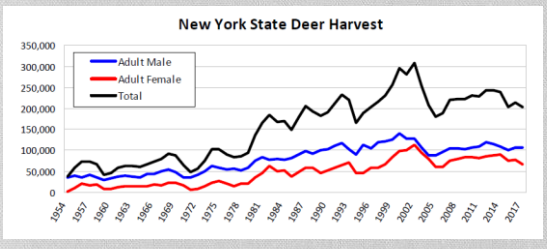
Palatable, Non-palatable, and Browsed Seedlings



Data and slide courtesy of Mike Ashdown 7/28/2018

NYS Deer Harvest Patterns

Does hunting regulate deer abundance?



https://www.dec.ny.gov/docs/wildlife_pdf/2017deerrpt.pdf

The Impact of Deer

- Deer eat 6 to 8 lbs, fresh weight per day
- 600 tree seedlings per pound
- 4200 seedlings per deer per day (*if exclusively feeding on seedlings*)
- November through May (7 months)
  - 882,000 seedlings per deer per "year"

Deer Exclosure

Paul Curtis, 9/2014. ALC

Stessors:
Pests, Pathogens and Episodic Events

- Pests, pathogens and episodic events create stress for trees.
- Trees can handle single stress events.
- Accumulated or persistent stressors increase risk of mortality.

Tree Health and Stress

- Stress – a condition or agent (stressors) that impairs the normal functioning ability of a tree and decreases its productive capacity.

- Manage stress to limit impact on tree health and productivity.
- Manage trees to improve their resilience to stress.

Examples of Stress

- January ice storm that rips branches
- June defoliation by Forest Tent Caterpillar
- Off-trail skidding damage
- Invasive insect species

Examples of Stress

- Skidder trail that shears roots

- Tractor damage that creates an open wound

The Reality of Stress Management

- Stress happens
- Stress reduces tree productivity
- Stress may shorten life span
- Stress requires extra energy from the forest owner & manager

Our goal regarding stress

- **Prevention**
  - Stressors interact
- **Prediction**
  - If
  - When
  - How much & long
- **Understand the injury**
  - Acute, chronic, natural, man-made, season, crown, root, etc.
- **Manage the stress**
- **Minimize the impact**
- ***Resistance/Resilience/Response***
  (Swanston and Janowiak 2012)

Interim Summary: Key Points

- The trees currently present were able to re-establish following agriculture.
- Each species has a suite of attributes, life history traits, that define the species and predict its response to environmental conditions.
- Survival is a result of adequate sunlight, suitable soils, avoidance of deer, and tolerance [sometimes avoidance] of stressors.

So What!

- The effects of soils, land use history, recent history, stressors, deer, etc. can change the look (= structure) and mixture of species (=composition) of your woods.
- The combination of these factors create similar areas known as "stands."
- A "woodlot stand" = "farm field"

Stands reflect similarity in:

- Soils & topography
- Age and size structure
- Species composition
- Land use and management history
- Management efficiency

Stand Structure and Composition

Stand Structure and Composition

Plantation

Stand Structure and Composition

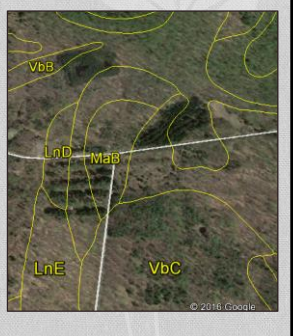
Exploited / High-grade

Stand Structure and Composition

Mixed Mature Forest

Summary

- Human and natural events influence what a forest looks like and what it produces.
- Sunlight is the primary environmental factor, especially that we can regulate.
- Soils and deer strongly influence plant survival and growth
- "Stand typing" allows us to optimize management activities



What should you do?

- Review materials on Teachable regarding Web Soil Survey and Google Earth Pro
- On Teachable, read fact sheet about GEP, WSS and woodland management.

What could you do?

- If you are really (really!) into soils…A relatively new mapping & soils integrated website
- **A lecture** - http://vapss.org/uploads/GOOGLE_EARTH_-_VAPSS_Fall_2103_Galbraith.pdf
- **The link** - https://casoilresource.lawr.ucdavis.edu/soilweb-apps/

Some Additional Resources

Some webinars which might be of great interest

- An Introduction to Forest Soils: Getting Grounded http://www.forestrywebinars.net/webinars/pinemap-professional-development-series-soils-crash-course/?searchterm=Soils
- Managing Soil Quality in Forests http://www.conservationwebinars.net/webinars/managing-soil-quality-in-forests/
- Conservation Tree/Shrub Groups; A Tool for Matching Woods Plants to Soils http://www.conservationwebinars.net/webinars/conservation-tree-shrub-groups-a-tool-for-matching-woody-plants-to-soils/