# Woodlot Regeneration:
## *Growing trees and limiting deer damage*

Peter Smallidge – State Extension Forester, Arnot Forest Director,
Cornell University Cooperative Extension

Brett Chedzoy – Regional Extension Forester, Arnot Forest Manager,
Cornell Cooperative Extension Schuyler County

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## New York's Forests

"…New York's forests are changing, and, without intervention on many fronts, will change our forests and the amenities and benefits they provide in profound ways." (p. 8 NYS DEC FRAS summary report)

## Foresters Suggest a Problem Looms

| | Statewide | Adirondacks | Southern Highlands | Other |
|---|---|---|---|---|
| Highly Successful | 13 | 12 | 16 | 8 |
| Moderately Successful | 17 | 31 | 13 | 16 |
| Marginally Successful | 45 | 50 | 47 | 38 |
| Complete Failure | 25 | 7 | 24 | 38 |

Connelly, NA, PJ Smallidge, GR Goff and PD Curtis. 2010. Foresters perception of forest regeneration and possible barriers to regeneration in New York State. Cornell University Department of Natural Resources Human Dimensions Research Unit HDRU 10-2. 37 pp.
http://www2.dnr.cornell.edu/hdru/pubs/HDRUReport10-2.pdf

## Permanent Plots Suggest A Potential Problem

Shirer, R and C Zimmerman. 2010. Forest regeneration in New York State. The Nature Conservancy. 25 pp. http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/newyork/placesweprotect/easternnewyork/final_nys_regen_091410_2.pdf

## Today's Objectives

- The ecology of regeneration
- Identify concern and risks
- Most common barriers
- Tree establishment options
- Protecting seedlings

## In the Northeast, Sunlight = Woody Plants

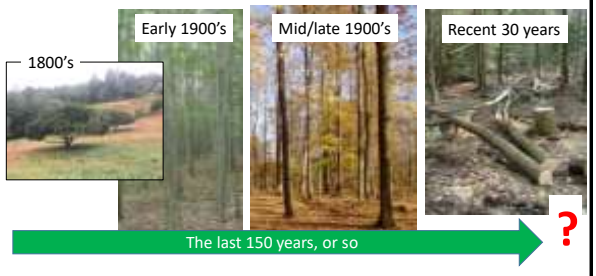
- How many seedlings do we need?
- When do we need them?
- What species?
- Barriers to seedling establishment and growth?
- Necessary actions?

## However, some plants don't need much sunlight



- rose
- buckthorn (x2)
- honeysuckle (x3)
- privet
- barberry
- beech
- hophornbeam
- striped maple
- fern
- *etc.*

## Why Do We Need Desirable Regeneration?




## What is Forest Regeneration?

(details matter)

**What is Present =** ***Composition***

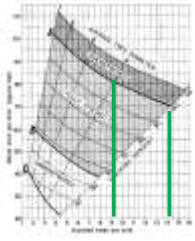
**How Many Stems =** ***Structure***

## Species Composition Depends On

- Seed source
- Selective pressures
- Soil conditions
- Aspect
- Historic and recent land use

## Structure: Desired species, in sufficient numbers to occupy growing space, need adequate stocking

*Upland Hardwoods*



Upland Hardwoods (e.g., oaks)
1971 Gingrich,USFS.NE-RP-195

*Northern Hardwoods*

Seedlings:
20,000/ac pre-harvest
9,000/ac post-harvest

Saplings:
550/ac

## "But, I'm not planning to harvest trees…"

ice storms
EAB
HWA

forest tent caterpillar
&
drought

wind

## The point is…

- Northeastern forests have matured
- Canopy disturbance provides sunlight that stimulates regeneration
- Desirable and undesirable plants grow in the understory
- The future forest depends on what survives in the understory

## Will Mature Woodlands Regenerate?

Photo credit J. Michael

**Weak evidence for successful regeneration**

- Shirer and Zimmerman 2010. **43%** good or very good.
- Connelly et al. 2010. **30%** highly or moderately successful.
- Vickers et al. 2019. < 1/3 permanent plots are "regeneration ready"

## Factors Present (%) in Stands with Marginal or Failed Regeneration

| | Statewide | Adirondacks | So. Highlands | Other |
|---|---|---|---|---|
| Deer | 65 | 38 | 59 | 91 |
| Interfering Vegetation | 47 | 47 | 46 | 49 |
| Owner Attitude | 25 | 16 | 25 | 32 |
| Owner Finances | 21 | 18 | 29 | 12 |
| Soil/Site | 14 | 18 | 9 | 17 |
| Forest Health | 10 | 12 | 8 | 11 |

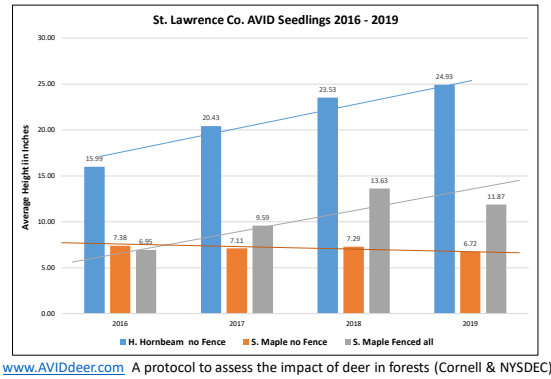
Connelly, NA, PJ Smallidge, GR Goff and PD Curtis. 2010. Foresters perception of forest regeneration and possible barriers to regeneration in New York State. Cornell University Department of Natural Resources Human Dimensions Research Unit HDRU 10-2. 37 pp. http://www2.dnr.cornell.edu/hdru/pubs/HDRUReport10-2.pdf

## The Impact of Deer

## Deer browsing impacts

- ~7 lbs fresh weight per day
- 600 seedling tips per pound
- Up to 4200 seedlings per deer per day

## Palatable, Non-palatable, and Fenced Seedlings




www.AVIDdeer.com A protocol to assess the impact of deer in forests (Cornell & NYSDEC)

## Deer Exclosure (8 deer / sq. mi)

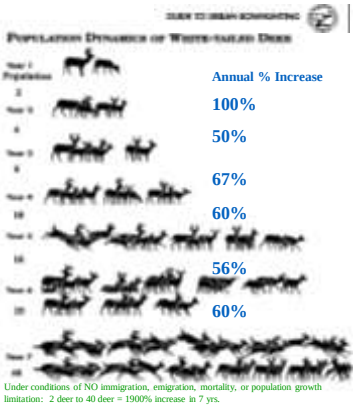
Paul Curtis, 9/2014. ALC

- With Minimal Deer Impacts
- Overwhelm the Population

## Don't Hunters Control Deer?

- Fewer hunters
- Aging hunters
- Less aggressive
- Less time in the woods

Detroit Free Press. 21% decline in numbers of Michigan hunters 1998 - 2018. https://www.freep.com/story/news/local/michigan/2018/11/09/michigan-hunting-big-decline-deer-fishing/1924497002/




Under conditions of NO immigration, emigration, mortality, or population growth limitation: 2 deer to 40 deer = 1900% increase in 7 yrs.

**That's a 19-fold increase in 7 years, with a 1:1 sex ratio.**

Bottom line:

Over ~50% of the herd must die or go elsewhere annually to stabilize herd

*Slide courtesy P. Curtis & G. Goff, 2013, Farm Show*

## Interfering Vegetation and the Legacy Effect

## A Perspective on "Invasive" Plants

- Defined:
  - Interfere with human/societal objectives
  - "Legally" non-native
- Context
  - Most exotics are NOT invasive
  - Many exotics are beneficial
  - Some native species act like invasive species
- Best label is "interfering vegetation"

## Interfering Vegetation

- After the deer
- After harvesting
- Plant problems persist…*Legacy Effect*

*"deer density reduction alone does not guarantee understorey recovery"*

*Nuttle et. al. 2014. J. Ecol.*

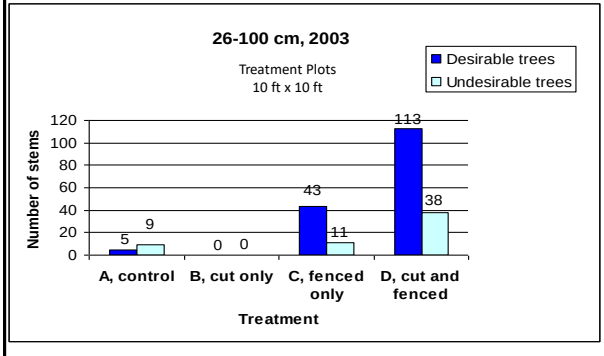
## Beech Saplings Dominate the New York Understory

| Species | Millions of Stems (2012) | % Change 1993 - 2007 | % Change 2007 - 2012 |
|---|---|---|---|
| Beech | 978 | 24 | 14 |
| Red maple | 871 | -5 | -9 |
| Sugar maple | 749 | 1 | -13 |
| Ash | 670 | 13 | -1 |
| Balsam fir | 348 | 16 | 2 |

Widmann, R. H. et al. 2015.New York Forests 2012. USDA Forest Service Northern Research Station. Resource Bulletin NRS-98

https://www.dec.ny.gov/docs/lands_forests_pdf/nyforests2012.pdf

## Effects of Deer + Shade



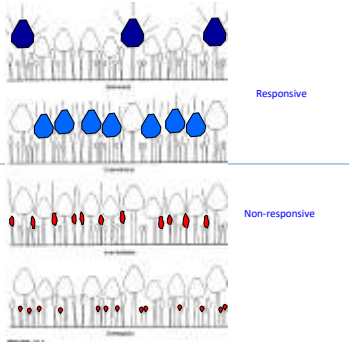

Kamprath, K., Curtis, P., and Goff, G. 2003. Summer Intern project. Unpublished data.

Forest Harvesting Practices

Selective Harvesting

Crown Class

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




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

Picture from Nyland, 1996. p. 355

Most forests are even-aged. Diameter doesn't predict age.

## Size doesn't matter, age does.

- The 4 inch maple and 25 inch oak are both ~90 years old.
- Just like a classroom of 6th graders, individuals grow at different rates, especially among different species.

## The point is…

- Understories are developing beneath mature forest canopies.
- Deer browsing favors undesirable species.
- Undesirable species inhibit desirable species.

## Artificial Regeneration

## Tree planting

1. Match species to the soils
2. Prepare well in advance
   - Remove competing vegetation
   - Acquire tree protection materials
3. Plant in spring, immediate deer protection
4. Control competing vegetation for several years

## Cages and Tubes

$3.32 each, plus

2 yr old coppiced cherry

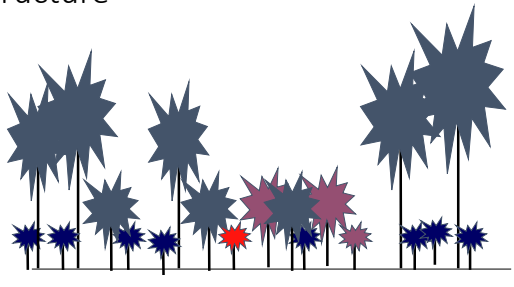
$4.50 each, plus

## Natural Regeneration: Controlling The Quantity of Light

**Uneven-aged Systems**

**Even-aged Systems**

## Profile of uneven-aged vertical structure



Single tree selection

Group selection

## Group selection in Genesee Co., NY

## Uneven-aged System Summary

- Useful to attain specific objectives
- Maintains a "high-forest" condition through time
- Favors tolerant and mid-tolerant species
- Group selection for mid-tolerant species
- Primary concerns:
  - deer browsing concentrated in patches
  - Injury to stems from repeated entry
  - shift to shade tolerant species
  - loss of species diversity
  - complexity of application

Photo credit: Gregg Sargis, TNC, patch cut

## Even-Aged Systems

- Clearcutting
- Seedtree
- Shelterwood
- Coppice

Strip clearcut Arnot April 2006 (cut in May 2005). 100 ft wide

## Arnot Forest, strip clearcut, June 10, 2016

Arnot Forest, strip clearcut, January 2019


**Seed Tree Harvest**

**Shelterwood Harvest**

## Why Even-aged Systems

- Species may (tree or wildlife) require full sunlight
- Desire contiguous, homogenous habitat conditions
- Site productivity won't sustain frequent, low-value entries
- Simple to apply, simple to maintain
- Reduced damage to residual forest from fewer entries

## Strategies for Successful Regeneration

1. Seed Source
2. Illuminate
3. Protect

**Deer Impact**

**Interfering Vegetation**

## Fencing

## "Inexpensive" Fence Options

## Mesh Better than Hi-tensile

- Simple tools
- Maintenance is essential
- About $0.52 per linear foot for low cost option

## Large acreage = High Fence

## Fence BMPs

- Mark post trees before harvest
- Two wires
- Apron + anchors
- External hot wire
- Requires regular maintenance
- High fence installed > $3.75/ft

## Brush Piles

- Slash piles restrict access of deer
- Most effective for established seedlings
- Doesn't ensure full stocking

## Slash Walls

## Progress to Date

- Nine harvests of 10 – 140 acres and 51,000 linear feet completed in 2017-2019.
- *Deer impacts?*
- *Slash wall durability?*
- *Beech development?*

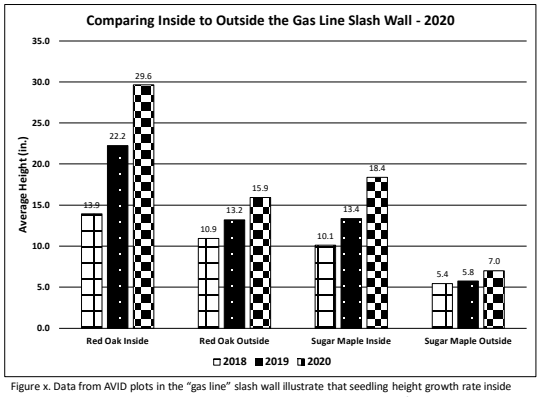



Figure x. Data from AVID plots in the "gas line" slash wall illustrate that seedling height growth rate inside the slash wall is greater than outside the slash wall. Seedling height growth inside fences inside the slash wall (data not shown) was similar to unfenced seedlings inside the slash wall. (Smallidge,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

## Changes in Slash Wall Dimension

| Hardwood (3 harvests) | Year 1 (ft) | Year 2 (ft) | Year 3 (ft) | % |
|---|---|---|---|---|
| width, horizontal | 23 | 22 | 23 | 3 |
| total height | 11 | 9 | 8 | -25 |
| height to 2" dia stem | 8 | 6 | 5 | -28 |

| Red Pine (1 harvest) | Year 1 (ft) | Year 2 (ft) | Year 3 (ft) | % |
|---|---|---|---|---|
| width, horizontal | 26 | 26 | 25 | -4 |
| total height | 9 | 8 | 6 | -33 |
| height to 2" dia stem | 5 | 5 | 4 | 20 |

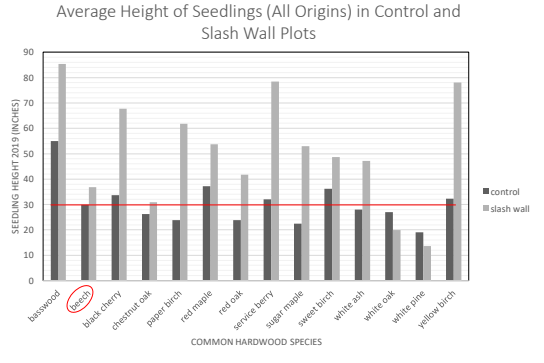



Figure 2. The total height of seedlings in the 2017 slash walls varied with controls for some species. Most species had greater height inside than outside the slash wall. Several species had better growth than beech inside the slash wall, but poorer growth than beech outside the slash wall. (Smallidge, Curtis, Chedzoy, Ashdown, unpublished data 2020)

## Slash Walls

- Mechanized directional felling
- Slash is not transported
- Hot saw cuts interfering veg ($100/acre)
- 13 slash walls 2017-2020, 51,000 feet, 438 acres

## 2017 Wall Labor & Machine Costs

| Sale | Acres | Perimeter (ft) | Machine Hours | $ / Ft |
|---|---|---|---|---|
| 01 – Gas Line | 74 | 7400 | 62 | $1.68 |
| 02 – Red Pine | 11 | 2800 | 14 | $1.00 |
| 03 – Sta. Rd. | 16 | 3800 | 15 | $0.80 |
| 04 - Wedge | 12 | 2700 | 25 | $1.88 |

## 2019 – Volume and Time In Walls

(volume as tons estimated per 100 feet of wall)

| Stand Type | Total (tons) | > 6" Hdwd (tons) | > 6" Conifer (tons) | Feet / minute |
|---|---|---|---|---|
| Hdwd Pole | 27 | 15 | 0 | 2.4 |
| HEM-Hdwd Small-SWT | 33 | 13 | 10 | 2.6 |
| Old-field Pole | 29 | 4 | 16 | 2.6 |
| Overall AVG | 31 | 12 | 9 | 2.6 |

- Avg. wall cost $2.25/ft ($1.50 – labor, $0.75 – wood)
- Negligible maintenance costs vs. fences
- ~ half the cost of fencing installation

## Harvest Layout Considerations

- Topography and natural obstacles
- Residual trees near wall
- Gates / future access

## Lessons Learned

- Crew needs to "buy in"
- Mechanized, not "hand" felling
- Negotiated, not bid sales (might change)
- Logger learning curve
- Prioritize low-grade into wall
- Avoid acute corners
- Anticipate future wall and harvest locations

## What's Next?

- Seedling stocking, height growth, and stand development
- Forecasting wall supply zone
- Sequence of silvicultural operations
- Wall functional longevity
- Economic metrics
- New locations and crews (RI, NY, CT, MA)
- www.slashwall.info

***… and Extension!***

Peter Smallidge
pjs23@cornell.edu
607-592-3640

Brett Chedzoy
bjc226@cornell.edu
607- 742-3657

Photo by RJ Andersen, CCE Media