



## 2017 Cannonsville Tornado Salvage

### Growth of a Naturally-regenerating Catskill Forest 20 Years after a Catastrophic Storm Event

Deborah Layton, MS, NYCDEP Forest Scientist

---

---

---

---

---

---

---

---

## History of the Study Area



- May 31, 1998: A tornado blew through the Catskills damaging property and timber near Cannonsville reservoir.
- Concern about the potential for erosion directly into the reservoir from the blowdown areas put into motion setting up timber sales by then-watershed forester, Randy Kelly. These would harvest fallen timber and damaged residual trees which, in turn, was expected to encourage faster regeneration.
- 2000: Harvest work was completed and DEP's Forest Science Program established 40 regeneration plots on an area of approximately 25 acres at the Apex North site. Twenty-three plots were established in the "clearcut" and 17 in the "partial cut".
- Subsequent measurements were taken in 2001, 2002, 2003, 2007-8, and 2017.
- This is the oldest silviculture study area west-of-Hudson on City lands.

2

---

---

---

---

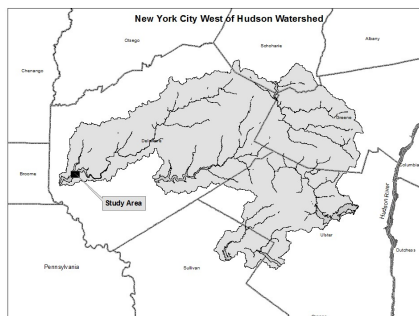
---

---

---

---

## Study Area Location in the Catskills



3

---

---

---

---

---

---

---

---

Research Questions

NYC

Department of Environmental Protection

- Would the salvage harvest encourage adequate regeneration over time? Null hypothesis: Quantity of regeneration would have no relationship with residual overstory density and/or level of timber harvest following the storm.
- Would deer herbivory be a challenge to regeneration? Null hypothesis: Deer herbivory stresses on regeneration would have no relationship with regeneration numbers.
- Given the size of the openings, would there be sufficient residual trees to provide a seed source for regeneration? Null hypothesis: The number of residual trees per acre on the site would have no relationship to the number of seedlings per acre.
- Would there be too many interfering species on the site, such as hay-scented fern or striped maple, to provide adequate regeneration? Null hypothesis: Percent cover of interfering species would have no relationship with numbers of seedlings or the progression of their growth over time.

4

---

---

---

---

---

---

---

---

Methods

NYC

Department of Environmental Protection

- Original plots were 1 m<sup>2</sup> circular plots placed 100' apart on transects. Transects were 200' apart running up and down the slope. Baseline residual overstory measurements were taken on variable-radius plots centered on 8 of the partial cut regeneration plots (about half). Residual trees on the clearcut area were considered to be so sparse that no measurements were taken.
- In 2017, 8 of the original plots in the clearcut and 8 in the partial cut were re-established and re-measured using a 0.1 acre circular plot centered as closely as possible on the old plots but skipping every other plot to be on a 200' spacing on the transects. These better capture the larger size of the growing stand and can be re-measured for many years to continue following stand growth and development. Milacre plots (0.001 acre) now measure the ground covers.
- Ground cover/regeneration plots capture percent cover by species as well as size classes of seedlings by species (0-1", 1-3", 3-4.5"). The 0.1 acre plots now capture both the residual and new overstory tree growth within that fixed area as well as sapling-size trees and shrubs by species and diameter class (0-1", 1-2", 2-3", 3-4").

5

---

---

---

---

---

---

---

---

Original Regeneration Plot Locations

NYC

Department of Environmental Protection

2000 Cannonville Tornado Salvage Regeneration Plots

6

---

---

---

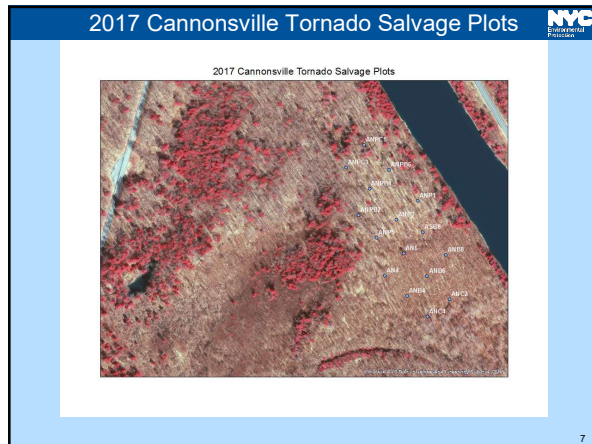
---

---

---

---

---




---

---

---

---

---

---

---

---

---

---

Post-harvest Conditions & Early Results

- The clearcut varied between areas of piled tops over 10' high to open areas where most timber was removed. Nearly all trees were blown down or snapped off, leaving uprooted root-balls, soil pits, and standing snags.
- The partial cut was, perhaps, 30-70% blown down with fewer piles of woody debris remaining and relatively few pits and root-balls. Residual tree basal area varied from 39 to 219 square feet per acre and averaged 91.
- Logging roads were carefully laid out along the topography, closed with a gate and water bars, and were used to access the site on foot.
- Early covers included ferns, stumps, woody debris and over 30 species of herbaceous and woody plant species—bindweed, blackberry, sedges, elderberry, mosses, violets, etc. Tree seedlings included maples, cherries, ash, and birches.
- The quantity of rock, woody debris, and hay-scented fern cover were a concern for regeneration—as was deer herbivory.
- In 2010, an analysis was done on some of the factors that were thought might have an impact on regeneration here.

8

---

---

---

---

---

---

---

---

---

---

2010 Analysis of Soil vs. Fern vs. Residuals

- In 2010, some analysis was performed to try to determine whether the underlying soils on the site played some role in the intensity of the blowdown and/or density of the residual stand as well as the percent cover of hay-scented fern (DEPU2).
- The analysis showed that there was an interrelationship between soils, residual stand density, and hay-scented fern cover
- Underlying soil types can influence species diversity and site productivity more than other factors. In this case, the Valois soil type was less susceptible to blowdown (hence the higher-density residual stand basal areas) but more prone to proliferation of hay-scented fern than the Oquaga soil type. The Lordstown soils were only present on 2 plots so it was not possible to see any real relationships with that one.

9

---

---

---

---

---

---

---

---

---

---



---

---

---

---

---

---

---

---



---

---

---

---

---

---

---

---



---

---

---

---

---

---

---

---




---

---

---

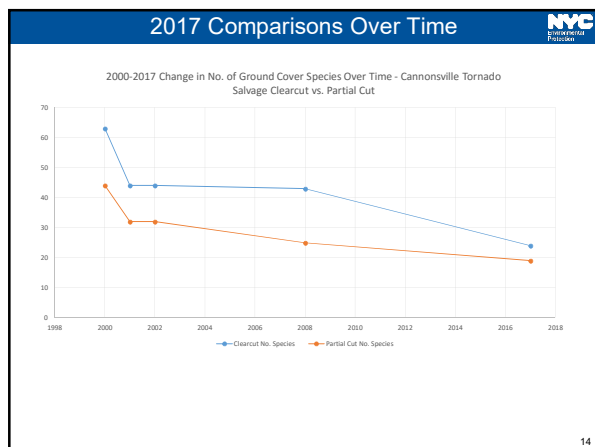
---

---

---

---

---




---

---

---

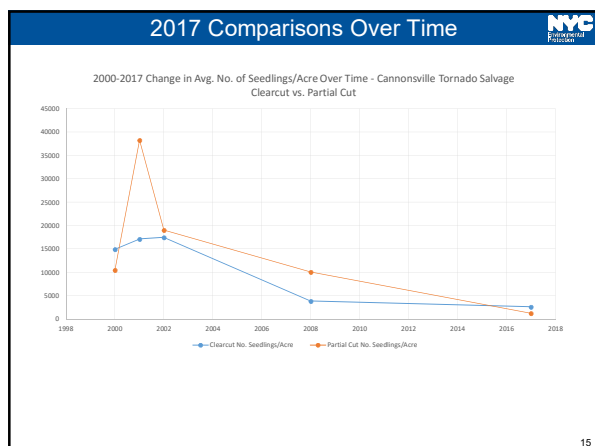
---

---

---

---

---




---

---

---

---

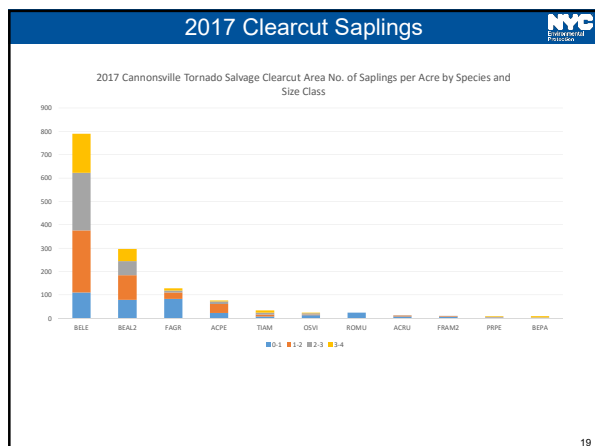
---

---

---

---






---

---

---

---

---

---

---

---

---

---

- ### 2017 Comparison of Overstories
- The "clearcut" is well-populated with small trees (about 270/acre) with an average dbh of about 5.5 inches. Black birch is the dominant species followed by yellow birch. Pin cherry is third.
  - A few larger trees did remain in the "clearcut"—mostly poor quality sugar maple. Enlargement of the plot size in 2017 resulted in residual stems comprising 0-33% of the overstory in the 8 plots measured.
  - The "partial cut", because of the residual overstory trees, has fewer stems per acre (about 120) but an average dbh of almost 11 inches. Because of the average size of the trees, there is more merchantable sawtimber and pulpwood and it could be feasible to carry out a second harvest in the near future.
  - In the "partial cut" the overstory consisted of 43-100% residual trees. Sugar maple was the dominant species here, followed by beech—almost all of which had beech bark disease. White ash was in third place, with some looking healthy and others showing signs of emerald ash borer.

---

---

---

---

---

---

---

---

---

---

### Cannonsville Residual Overstories

- Although not the rule, some of the partial cut looked healthy, as can be seen here →
- Often, the ground cover looked like this ↓

---

---

---

---

---

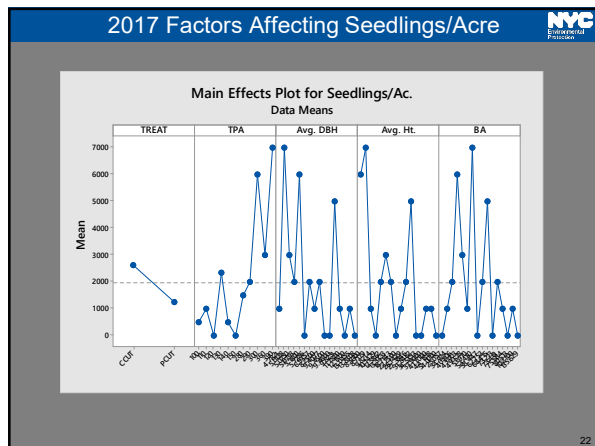
---

---

---

---

---




---

---

---

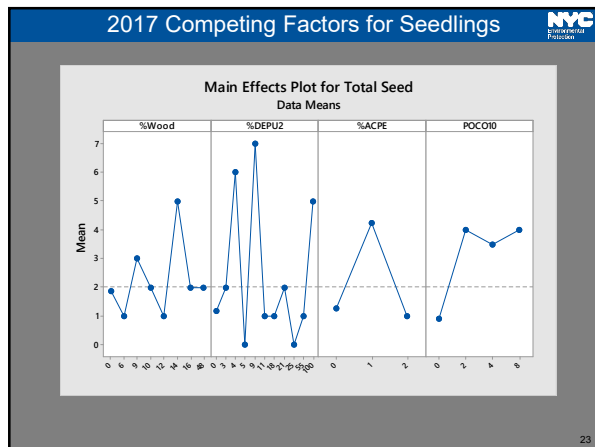
---

---

---

---

---




---

---

---

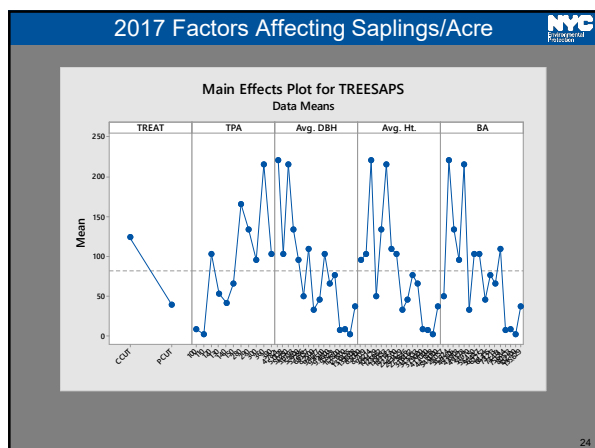
---

---

---

---

---




---

---

---

---

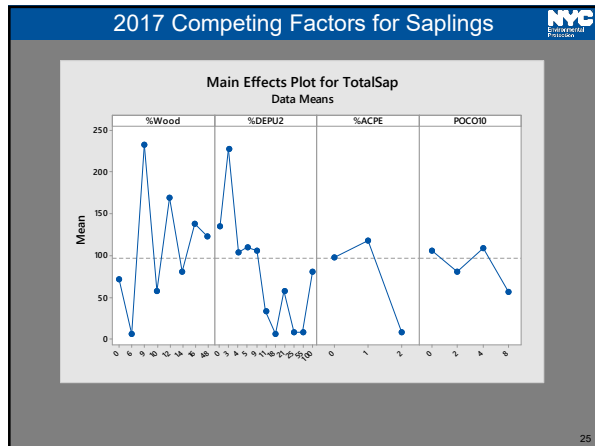
---

---

---

---






---

---

---

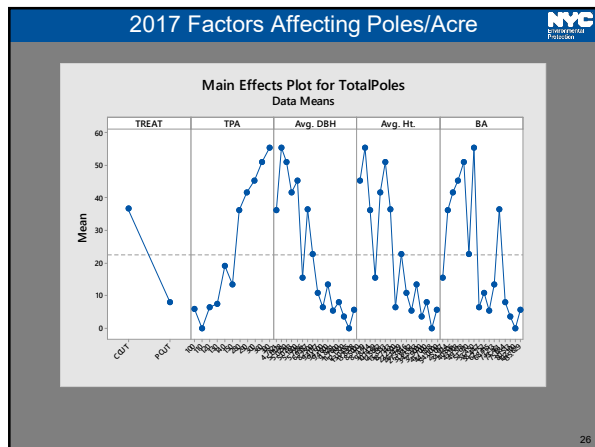
---

---

---

---

---




---

---

---

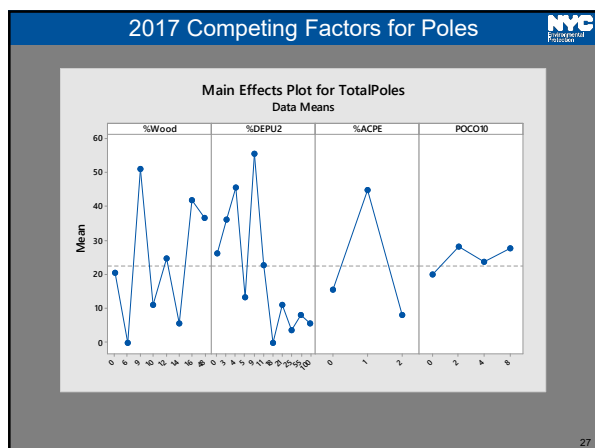
---

---

---

---

---




---

---

---

---

---

---

---

---

## Conclusions of Analysis



- **Seedling Numbers.** By the time 20 years had passed post-storm event, the number of seedlings per acre was most affected by the level of damage/salvage harvest, with the clearcut area having about twice as many seedlings per acre as the partial cut. The number of overstory trees per acre (which at this time included a large number of pole-size trees 4-8" dbh), especially above 300 stems/acre, positively affected the number of seedlings, as well, likely because these were now producing seed. Hay-scented fern, striped maple, and bindweed covers and numbers of striped maple saplings per acre had no strong correlation with seedling numbers, nor did overstory basal area, average dbh or average height. Bindweed, rather than being a competing force may actually be more of a site indicator for increased numbers of seedlings.
- **Sapling Numbers.** Numbers of saplings per acre were also positively influenced by the clearcut harvest rather than the partial cut. Hay-scented fern at levels higher than 10% cover appeared to have a negative effect on numbers of saplings as did larger overstory tree diameters, heights, and basal areas, while there appeared to be a positive relationship with numbers of trees per acre above 250. This seems to reflect the idea that a reduced residual overstory will positively encourage recruitment and growth of saplings and poles.

28

---

---

---

---

---

---

---

---

## Conclusions of Analysis



- **Pole-size Tree Numbers.** Small trees between 4-8" dbh were positively correlated with treatment (higher in the clearcut), lower percentage cover of hay-scented fern (10% or less), and lower residual basal area (60 square feet or less). Percent cover of striped maple or woody debris did not appear closely correlated with numbers of poles present on the site after 20 years. Percent cover of bindweed appears to be positively correlated, however, this may be an artifact of collinearity, indicating that bindweed serves as an indicator species rather than acts as a competitor.
- **General Conclusions.** Creating larger openings, leaving a low level of residual overstory (60 sq. ft. of BA or less), and having a level of hay-scented fern cover below 30% early in stand development which is extinguished to 10% or less over time appears to be positively correlated with increased numbers of seedlings, saplings and poles by age 20 following storm event (and possibly other types of harvest) in natural Catskill forests. Note that this is only a single case study and more sites will be required to bear out these results.

29

---

---

---

---

---

---

---

---

## Discussion of Hypotheses



- The density of residual overstory (expressed as basal area) did correlate with regeneration over time, disproving the null hypothesis. The quantity of regeneration at all levels (overstory, understory, and seedlings) has been correlated with the level of harvest intensity, with the clearcut area having higher regeneration than the partial cut.
- Deer herbivory never appeared as an issue on this study area therefore no correlation could be drawn between deer and numbers of seedlings in either the clearcut or partial cut areas. The null hypothesis of no effect by deer remains as stated.
- The hypothesis that the number of residual trees would have no relationship to the number of seedlings per acre has been shown to be true. The result shows the method of seed dispersal (i.e. wind dispersal for black birch seeds) can be more important than the quantity of residual trees present on-site.
- As for the research question about how interfering species affected regeneration, the potentially interfering species of concern for the site were hay-scented fern, bindweed, striped maple, and blackberry—however, only hay-scented fern appeared to have much impact on tree regeneration over the longer term. Hay-scented fern was detrimental to the quantity of seedlings and their development into saplings and poles over time.

30

---

---

---

---

---

---

---

---

## Take-aways



- Deer have not apparently been a major factor in how the forest regenerated at this site, however, density of hay-scented fern appears to have reduced regeneration.



- Growth and development of seedlings, saplings, and small overstory trees has been much better in the area that resembled the clearcut than in the partial cut.

- The residual stand in the partial cut, however, provides an overstory that has a larger average diameter and basal area and, from an economic perspective, provides another opportunity for short-term management that the clearcut does not have.



- The partial cut's overstory has more desirable, diverse species than the new overstory in the clearcut.

Meanwhile, there is more diversity in the sapling layer in the clearcut. It is unclear which would be more beneficial in the event of a disease or insect outbreak that impacts one or more major species.

31

---

---

---

---

---

---

---

---

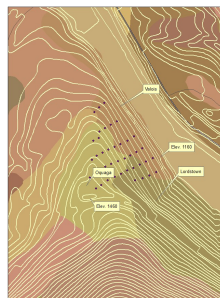
## Discussion



- Black birch, the primary species of regeneration in both areas, is one of the least favored species for deer herbivory. Even if herds expand, this type of forest is not likely to suffer detrimental effects. Adequate light favors proliferation of this species.

- The large amount of slash left on-site and a short-term prevalence of blackberry species may have contributed to successful germination, survival and growth of regeneration.

- It appears that soil types present impacted the level of storm impacts as well as post-harvest levels of hay-scented fern present. Further GIS analysis could help confirm these relationships elsewhere which could, in turn, prioritize stands to maintain in younger age classes to protect water quality.



32

---

---

---

---

---

---

---

---

## Recommendations



- When carrying out harvests (especially salvage harvests) in the Catskills, it seems prudent to consider the following:
  - Where possible, leave higher-quality, undamaged trees and a variety of species in the residual stand. If there is sufficient residual basal area to warrant a maximum residual stand during salvage, consider using about 60 sq.ft.
  - Where public perception isn't a problem, leave more slash piles to deter deer herbivory.
  - Consider removing fire cherry and striped maple and selectively thinning around less abundant, but desirable species—like oaks and black cherries—to improve stand diversity at age 10-20 after harvest.
  - If feasible, consider some type of mechanical or chemical vegetation management for hay-scented fern if the percent ground cover is 50% in the first 3 years and beech sprouts if they become the predominant woody species in the first 5 years.

33

---

---

---

---


---

---


---

---

Questions?



34



---

---

---

---

---

---

---

---