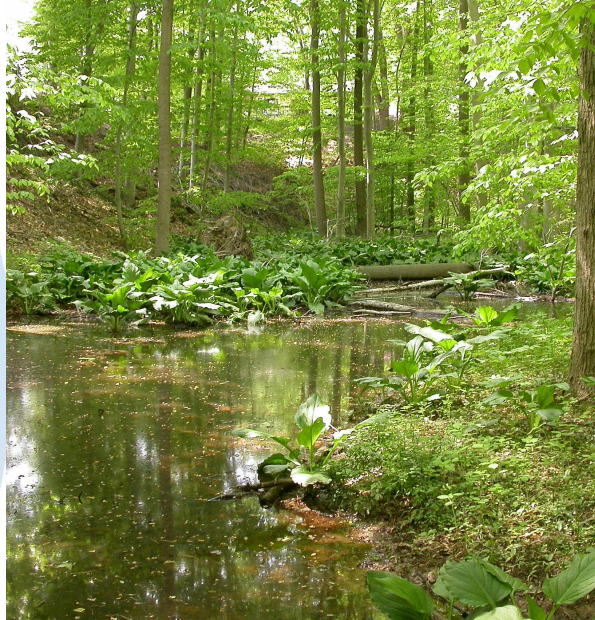




What Matters in Achieving Desired Forest Restoration Outcomes



DELAWARE CENTER FOR THE
INLAND BAYS
Research. Educate. Restore.

Meghan Noe Fellows, CERP FEBRUARY 15, 2024

Establishing and Maintaining Vegetation Quality in a Built Landscape

- ❖ Site Selection
- ❖ Design & Implementation
- ❖ Monitoring & Maintenance



See one to know one

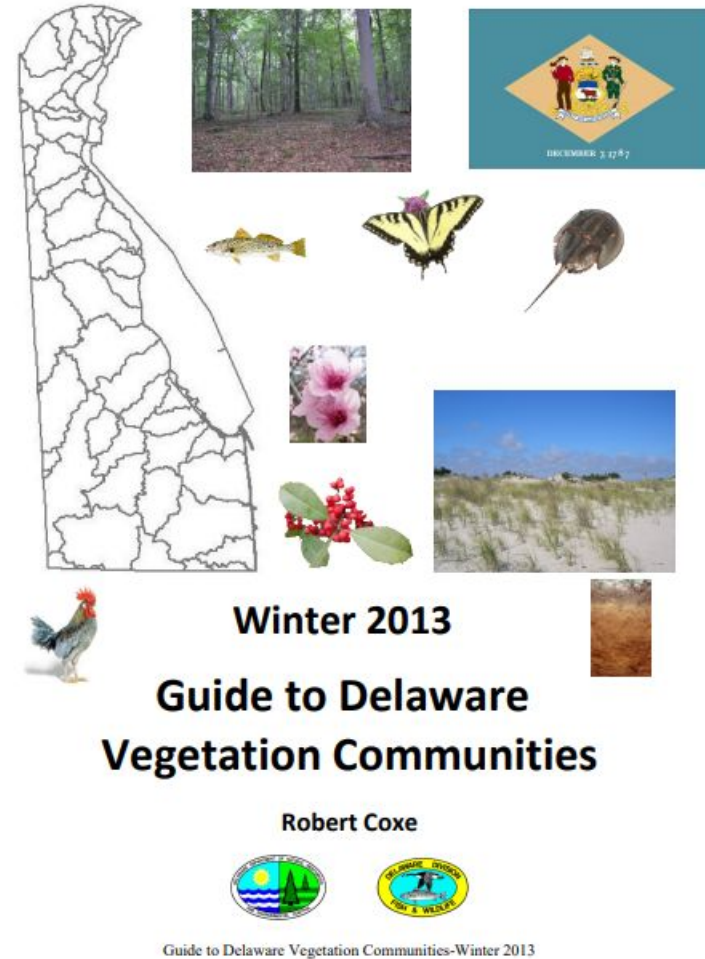
- Native Vegetation Communities
- Invasives
- Restorative Continuum



Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp: Forest co-dominated by red maple (*Acer rubrum*) and green ash (*Fraxinus pennsylvanica*) and having a well-defined herbaceous layer of lizard's tail (*Saururus cernuus*). (CEGL006606) Indian River; Mispillion River; Nanticoke River

Early to Mid-Successional Loblolly Pine Forest: A forest that is dominated by at least 60% coverage of loblolly pine (*Pinus taeda*) and has a distinct canopy and understory (CEGL006011) Broad Creek; Broadkill River; Cedar Creek; Deep Creek; Gravelly Branch; Gum Branch; Indian River; Indian River Bay; Marshyhope Creek; Mispillion River; Nanticoke River; Pocomoke River; Rehoboth Bay; Slaughter Creek

Northeastern Dry Oak-Hickory Forest: A forest that is dominated by oaks (*Quercus* spp.) and lacks a prominent presence of tuliptree (*Liriodendron tulipifera*) and American beech (*Fagus grandifolia*). (CEGL006336) Rehoboth Bay

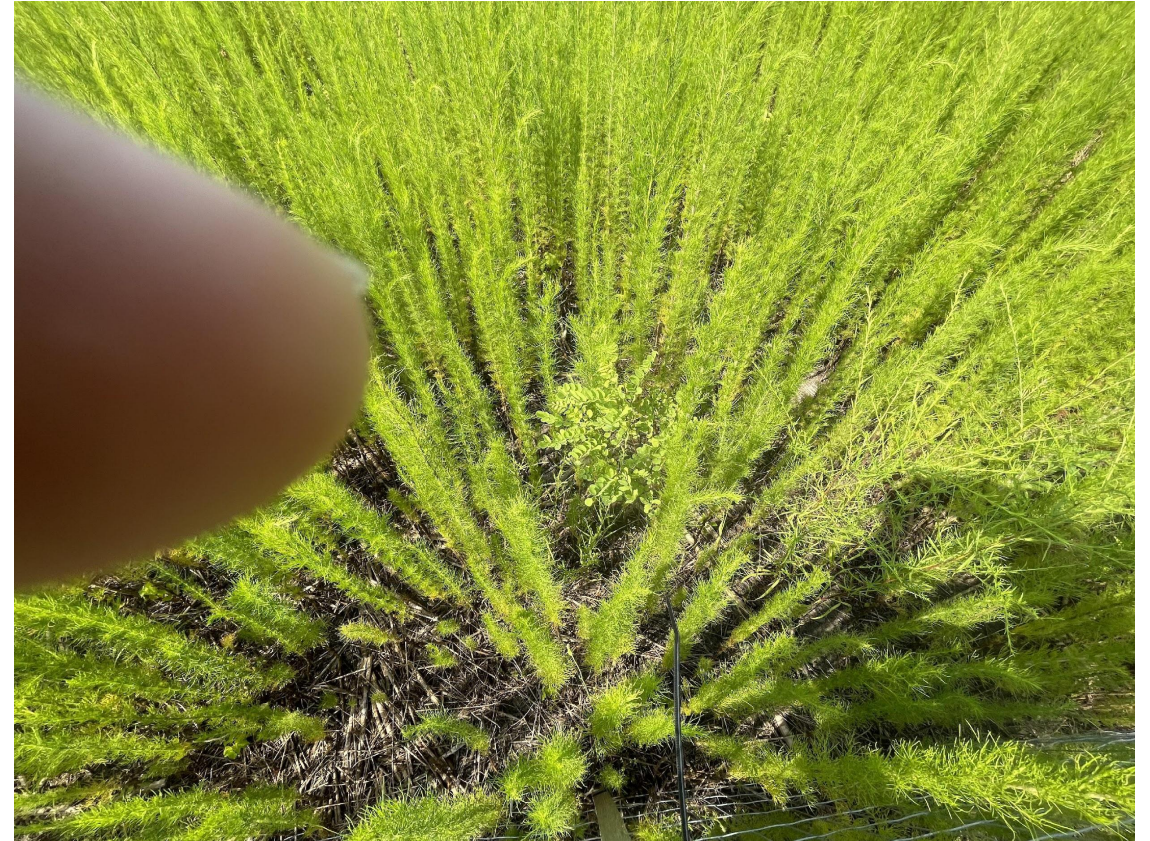


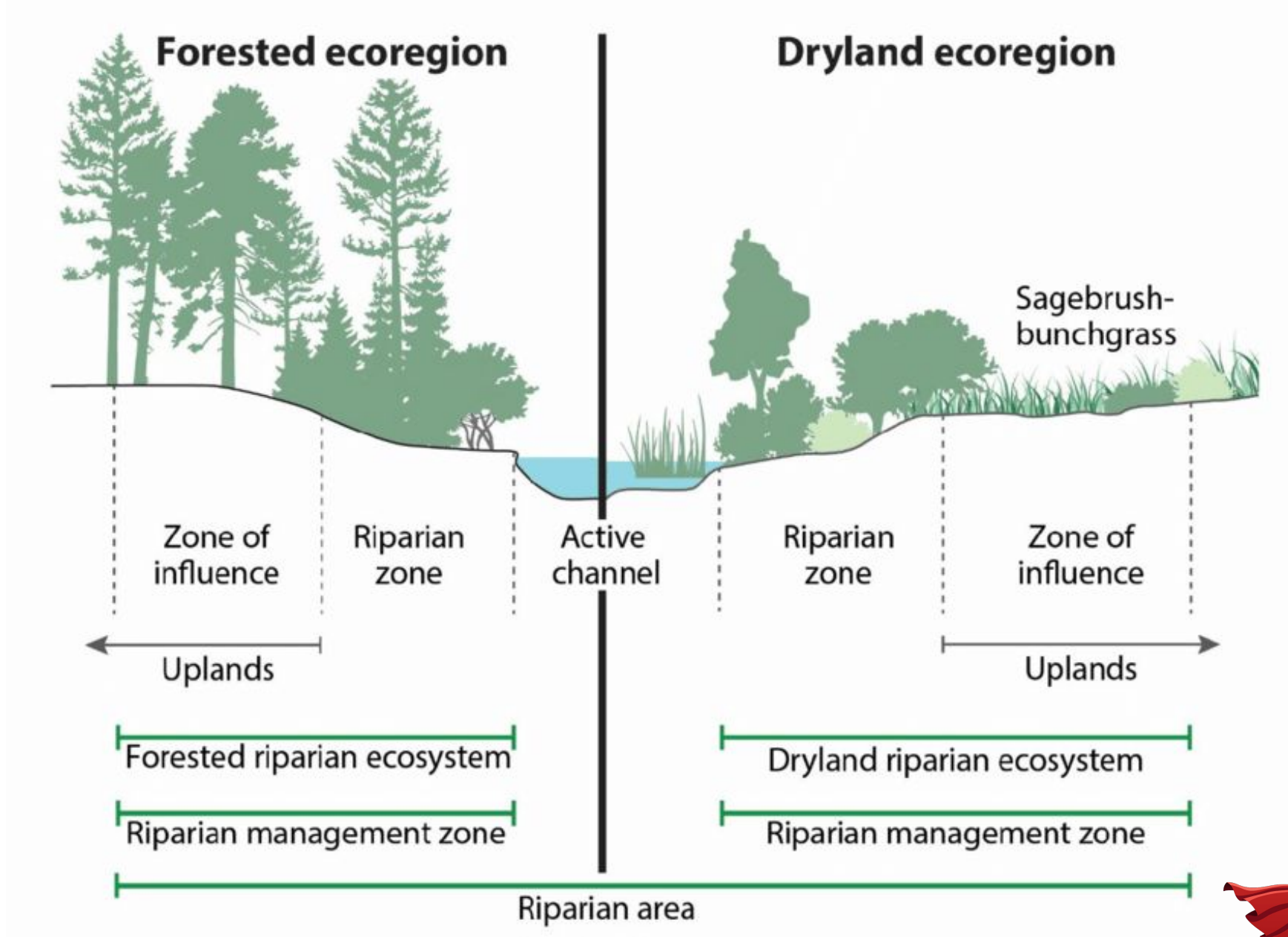
<https://www.wrc.udel.edu/wp-content/heritage/NVCS/Guide-to-Delaware-Vegetation-Communities-Winter-2013.3.pdf>



Right Tree for the Right Place, Right Purpose

Native Communities
Respect the Built
Landscape
Understand the
Watershed Position





Best we can, given the constraints – be realistic



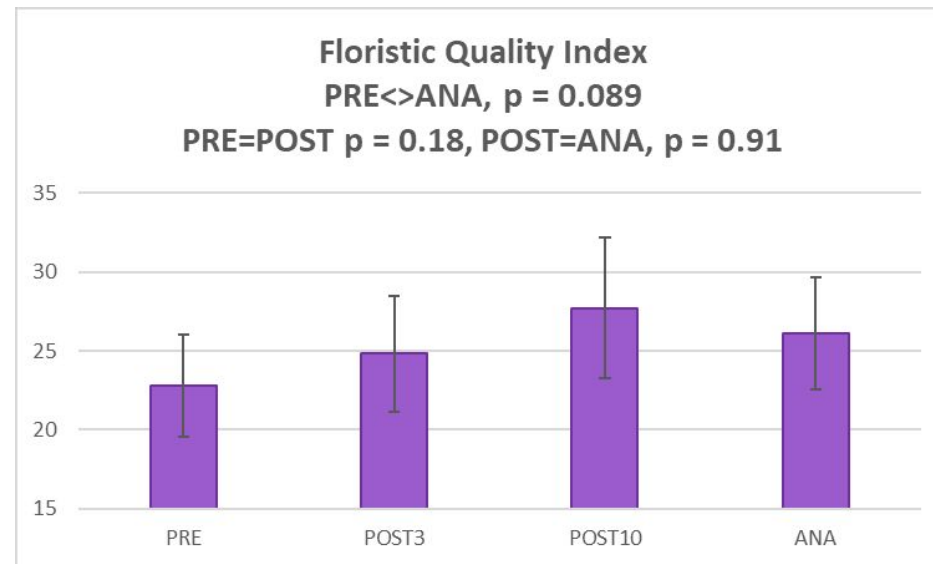
Figure 1. Restorative continuum. Ecological restoration and restorative management can be seen to be aligned along a 'restorative continuum' where a broad range of activities undertaken by society to repair damage to the broader environment, complement ecological restoration and provide improved conditions for broad scale recovery. Photo credits (from left) 1. Shutterstock.com, 2: S.Triggs. Inglis Rural, 3: Marcel Huijser; 4 and 6: T. McDonald; 5: J. Jonson.



Site-specific design



- Even when the goals are driven by a specific purpose, there is room for ancillary benefits
- Choosing the best techniques for the benefits







Denser Plantings Make Better Forests

- ❖ Miyawaki (1980's)
- ❖ Hall (1990's)
- ❖ Mid-Atlantic Trials (2010's)
- ❖ & as of last year, in Delaware too!



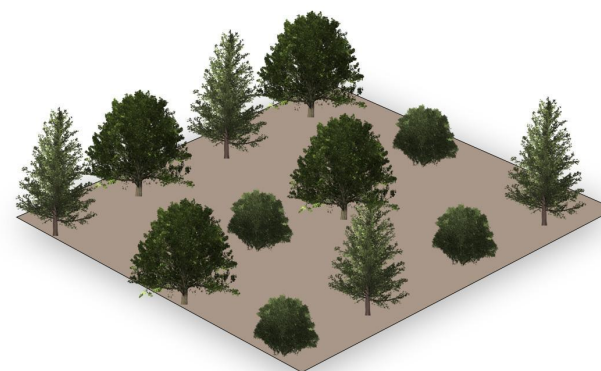




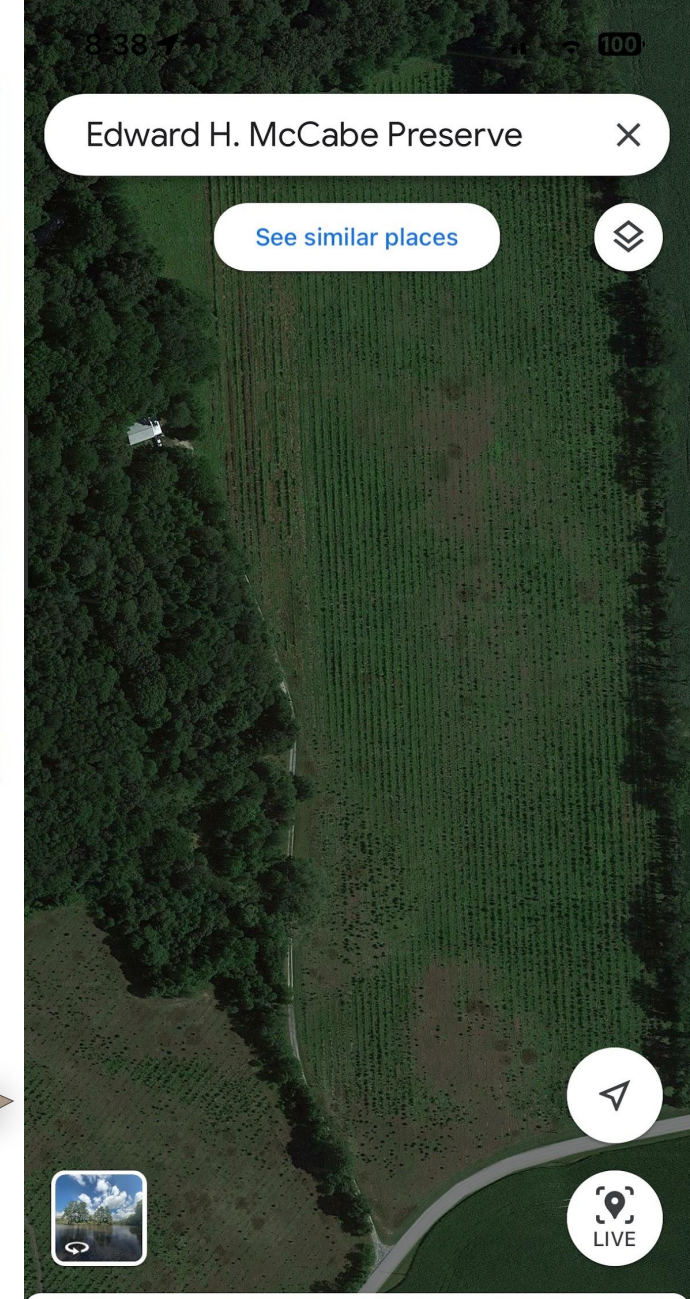
A ladybug sits on the leaf of an oak part of an effort to transform 39 and into native forest. June 2020. ©



Restoring a Forest: In 2019, an opportunity arose to transform 39 acres of former farmland into native forest, pursuing a long-term vision that included planting 11,700 shrubs and native trees. © John Hinkson / TNC



PLANTATION



Edward H. McCabe Preserve
4.6 ★★★★★ (66)







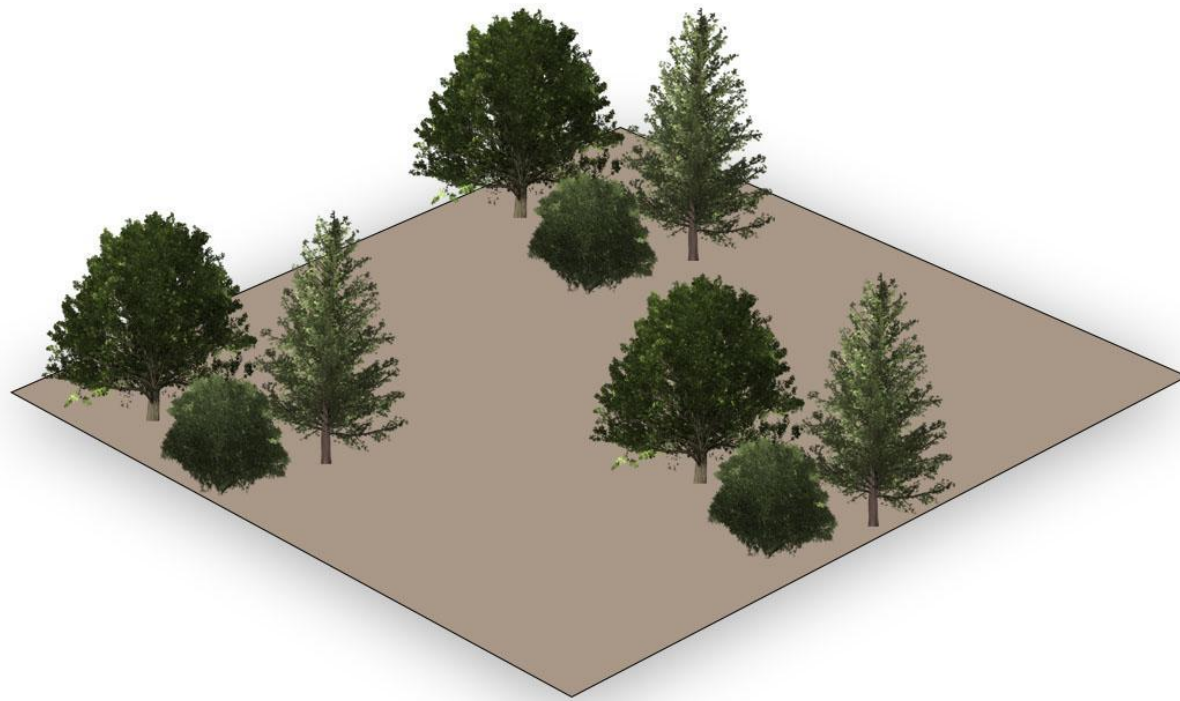


Sussex County protects more than 300 acres

Forest of the Broadkill Preserve: Land trust to manage largest land purchase in its history



The Forest of the Broadkill River tract includes 294 acres of land along Gravel Hill Road (Route 30) to the right and Shingle Point Road, bottom, near



APPLIED NUCLEATION

The role of animal seed dispersal in accelerating native forest regeneration on degraded tropical lands

Joseph M. Wunderle Jr.

International Institute of Tropical Forestry, USDA Forest Service, PO Box 490, Palmer, PR 00721, USA

Accepted 9 May 1997

Abstract

This paper reviews the characteristics of animal seed dispersal relevant to tropical forest restoration efforts and discusses their management implications. In many tropical regions seed dispersal by animals is the predominant form of dissemination of propagules and has the potential to facilitate recolonization of native vegetation on degraded sites. The site traits relevant for attracting seed dispersers include the availability of perches, the structural complexity of the vegetation and the presence of food resources, especially fruit, as an attractant. Tree plantations with these traits will be particularly attractive to animal seed dispersers and therefore will have higher rates of seed rain than plantations lacking these traits. The efficacy of animal seed



[https://commons.wikimedia.org/wiki/File:Cedar_Waxwing_\(Bombycilla_cedrorum\)_\(24565193890\).jpg](https://commons.wikimedia.org/wiki/File:Cedar_Waxwing_(Bombycilla_cedrorum)_(24565193890).jpg)

https://www.researchgate.net/profile/Joseph-Wunderle-Jr/publication/222494282_The_role_of_animal_seed_dispersal_in_accelerating_native_forest_regeneration_on_degraded_tropical_lands/links/59edf5f60f7e9bc3652526a3/The-role-of-animal-seed-dispersal-in-accelerating-native-forest-regeneration-on-degraded-tropical-lands.pdf

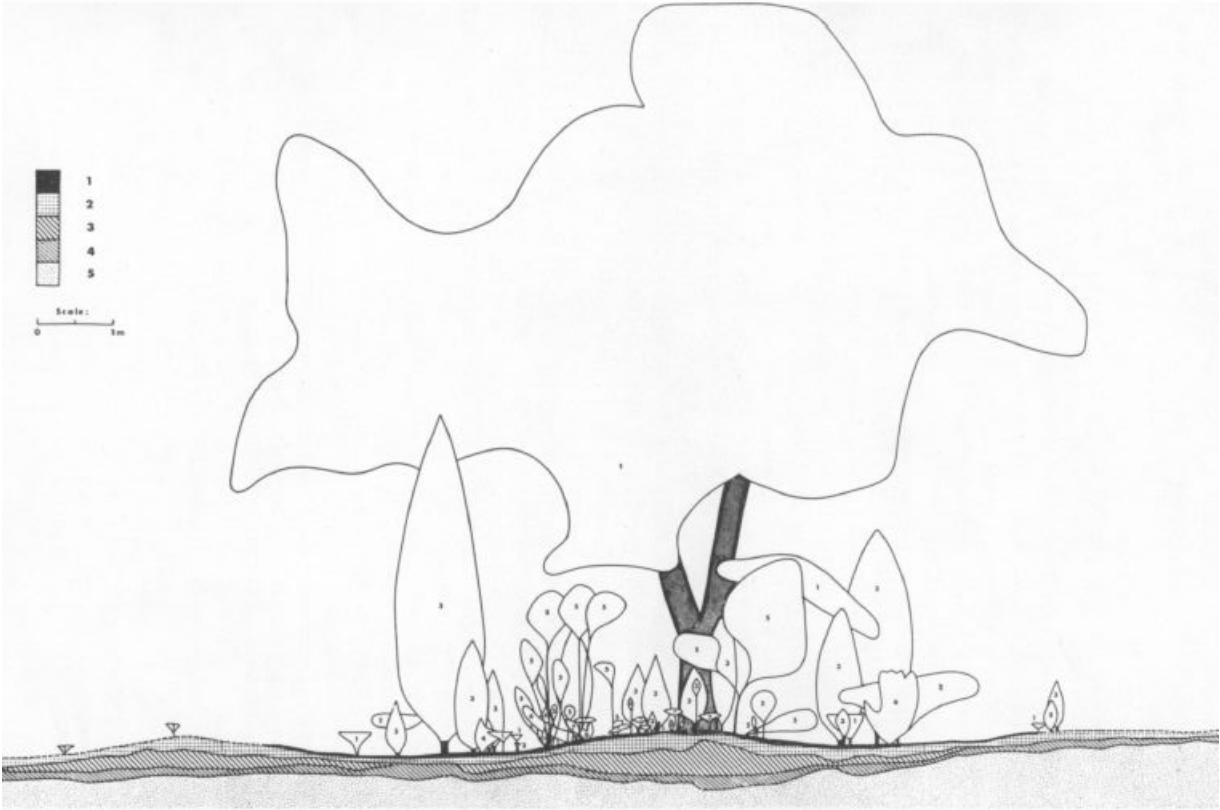
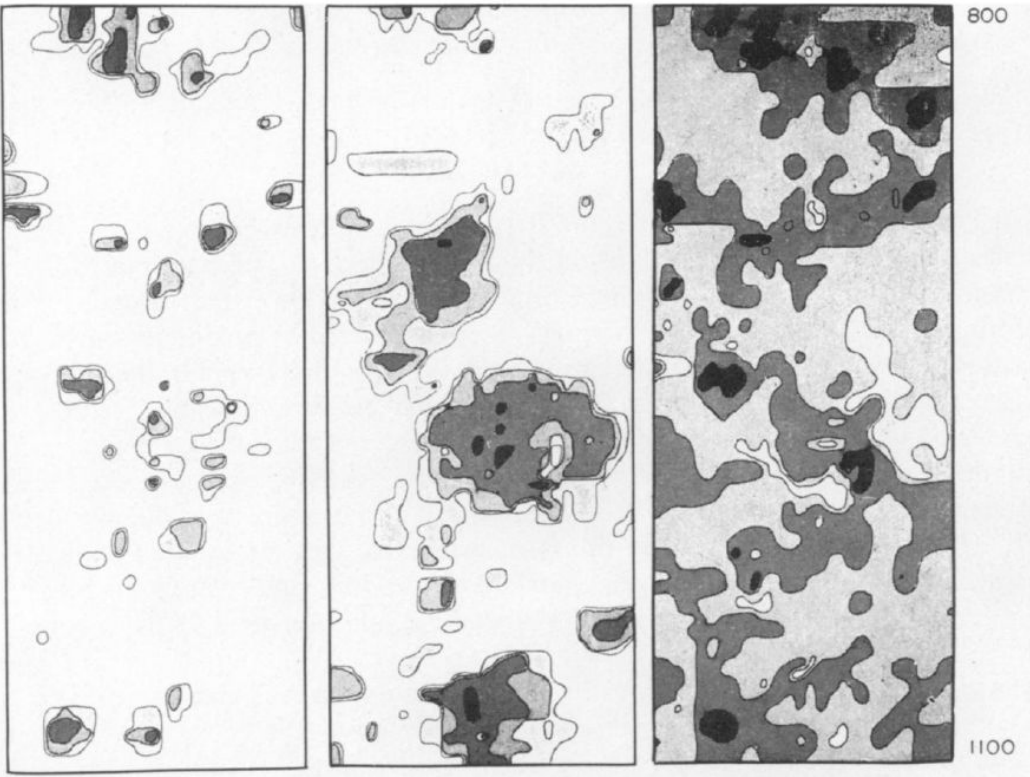


FIG. 2. Transect through a patch of persistent vegetation on the 1100-year-old dune at Grand Bend. Key to species: (1) *Quercus rubra* x *velutina*; (2) *Q. prinoides*; (3) *Juniperus virginiana*; (4) *J. communis*; (5) *Prunus virginiana*; (6) *Shepherdia canadensis*; (7) *Symphoricarpos racemosus*. Key to soil layers: (1) humus layer, black; (2) grey black layer; (3) dark brown-black layer; (4) brown to reddish-brown layer; (5) parent material, blown sand.

Everglades Tree-Islands

Vegetation Patches, Geologic Landforms, and Landscape Features

by Peter A. Stone, Columbia SC



Tree-islands are visually distinct patches of forest or tall bushes surrounded

The northern and middle Everglades and the Shark Slough portion of the southern

[HOME](#)

[CATEGORIES](#) ▾

[MORE](#) ▾

[Home](#) > [Science](#) > [Tree Islands in the Alpine Zone](#)

SCIENCE

Tree Islands in the Alpine Zone

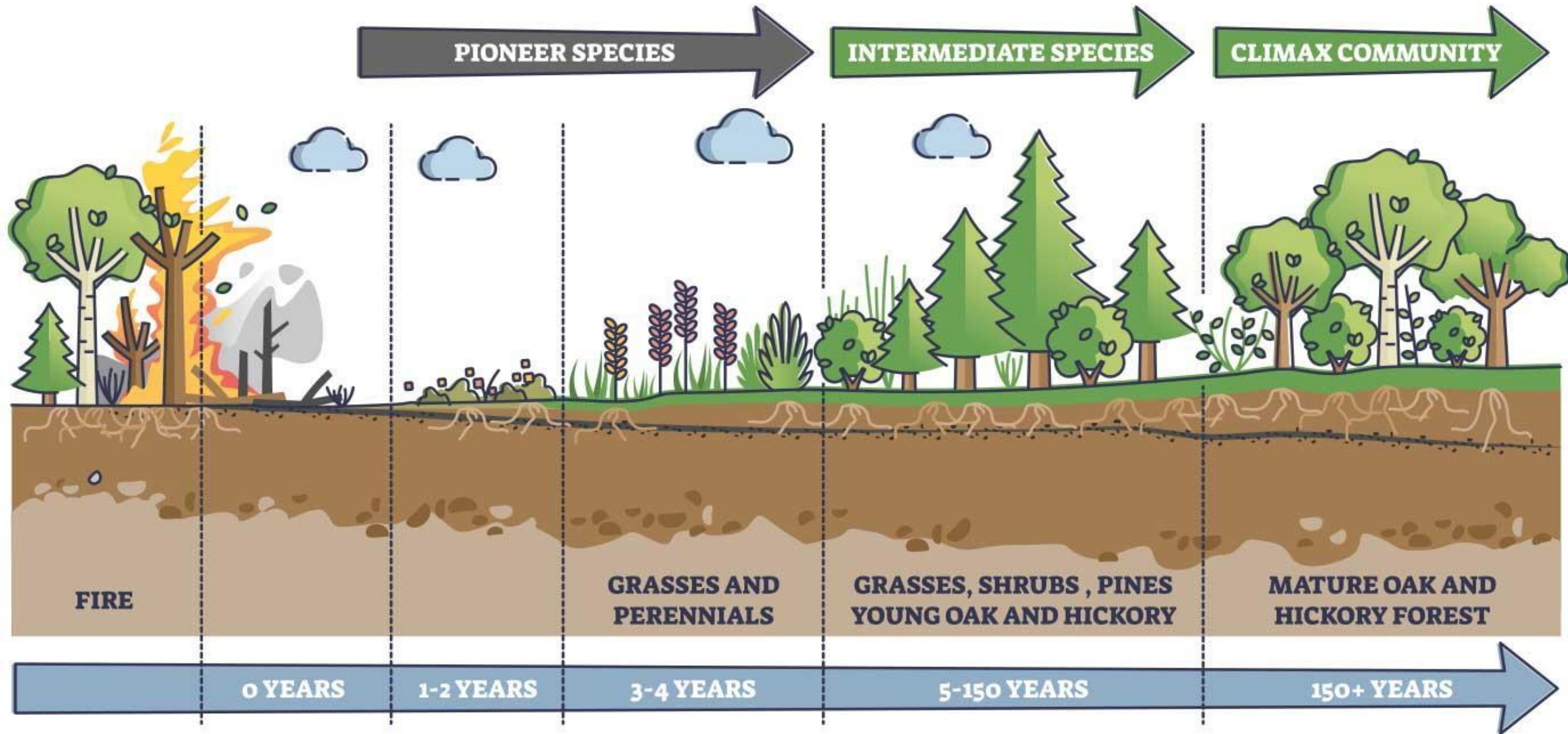
By **Harry** -

 50

 0



SECONDARY SUCCESSION



Case Study: Applied Nucleation in Dead Run 2/3



April 2019



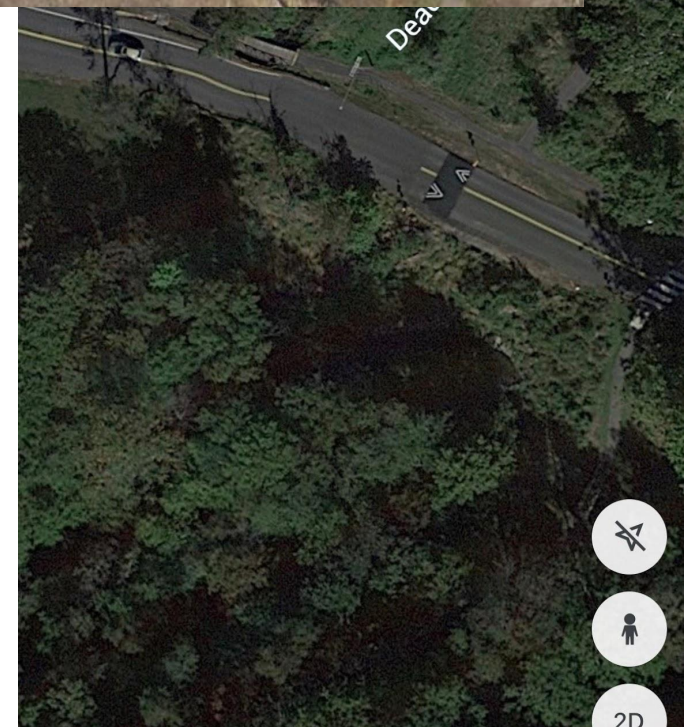
June 2019



October 2019

- At 1.5 years of growth, 90-100% cover in dense plantings
- Open plants are shorter, but greater dbh
- Closed canopy plants are taller (some >2 x high as initial planting height; 15+ feet)
- At 5 years - greater soil carbon and herbaceous community





June, 2022



August 2023



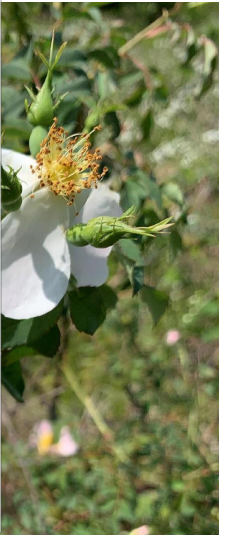
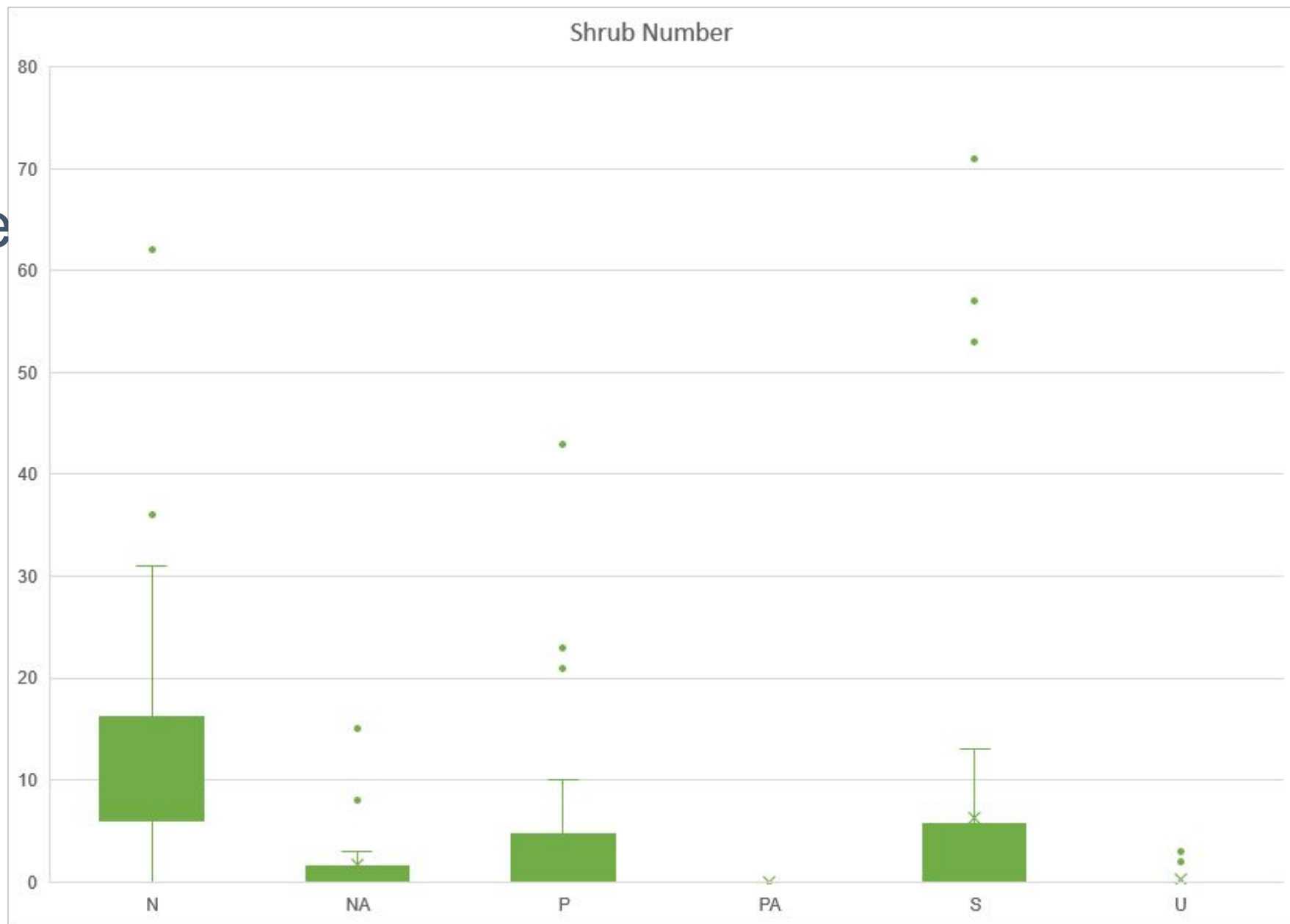
Better survival

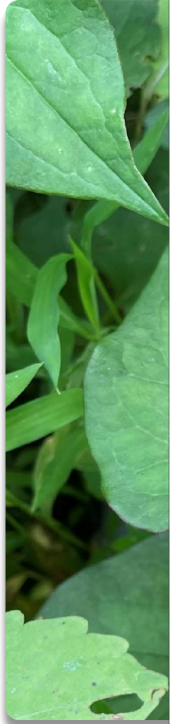


Species	Site	Type	Field 4-yr survivorship	Nucleation 4-yr survivorship
Tulip tree	Site L	Deer Guard	0.57	0.82
Black gum	Site L	Deer Guard	0.63	0.81
Willow oak	Site L	Deer Guard	0.62	0.95
White oak	Site C	Deer Guard/Fence	0.96	0.95
Willow oak	Site C	Deer Guard/Fence	0.86	0.90
Sycamore	Site R	Deer Guard/Fence	0.10	0.92
Black locust	Site R	Deer Guard/Fence	0.15	0.89

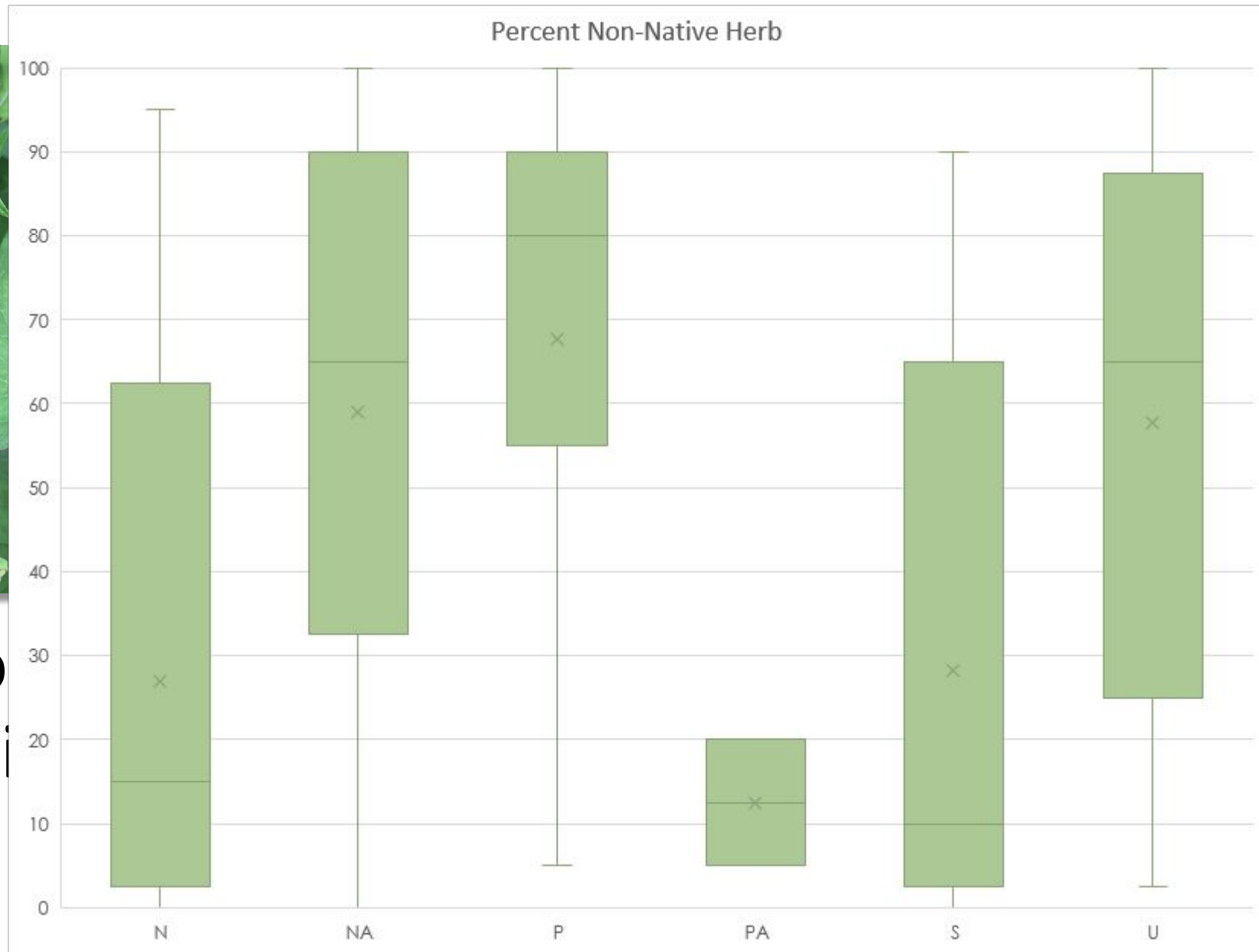
Bette

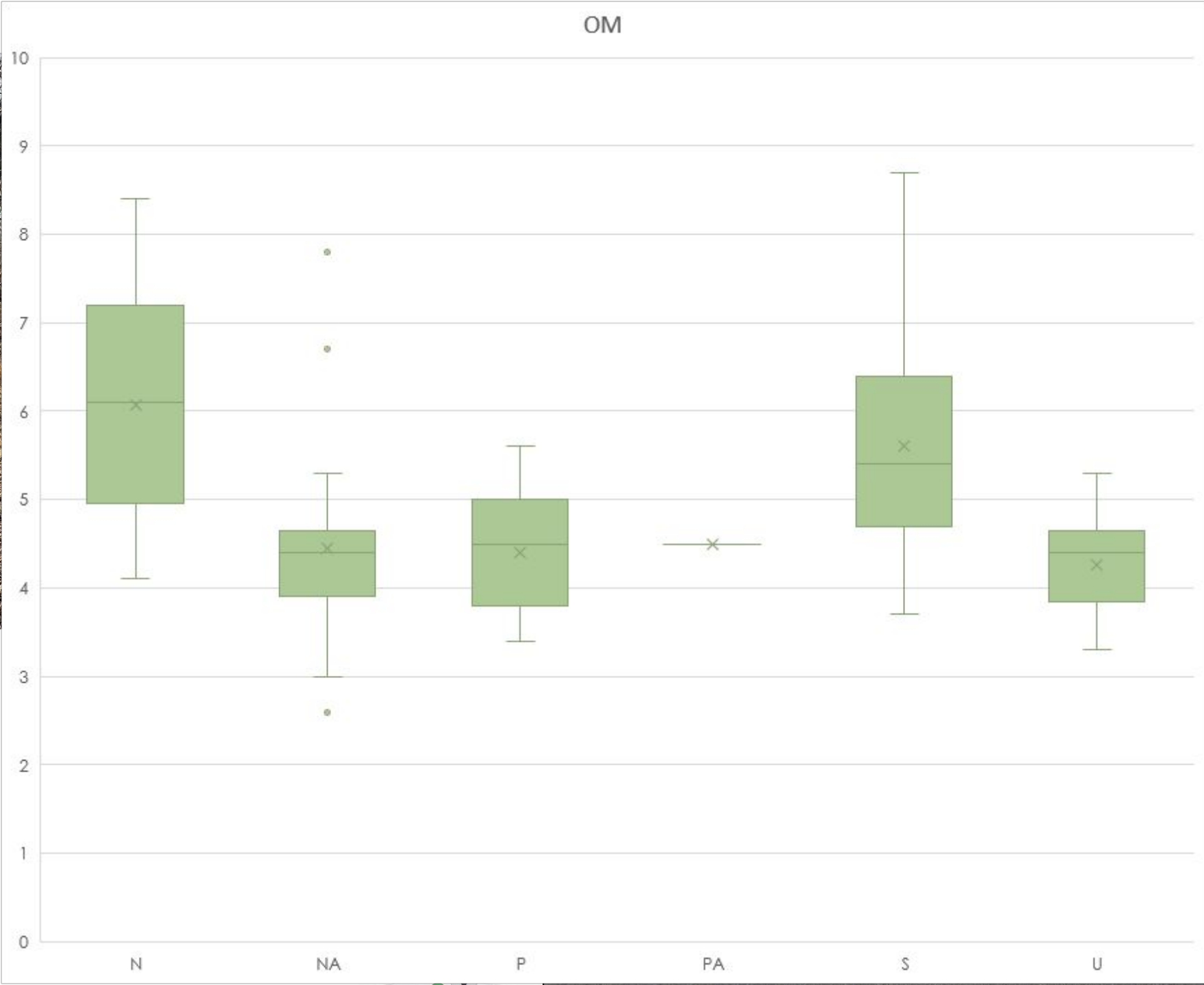
•



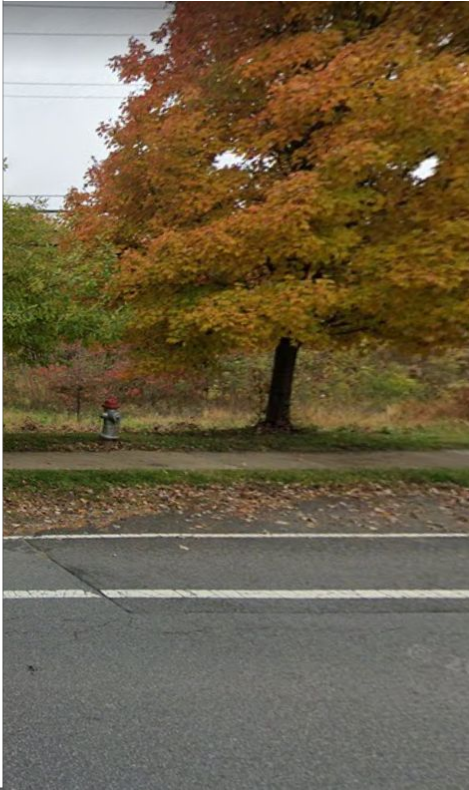


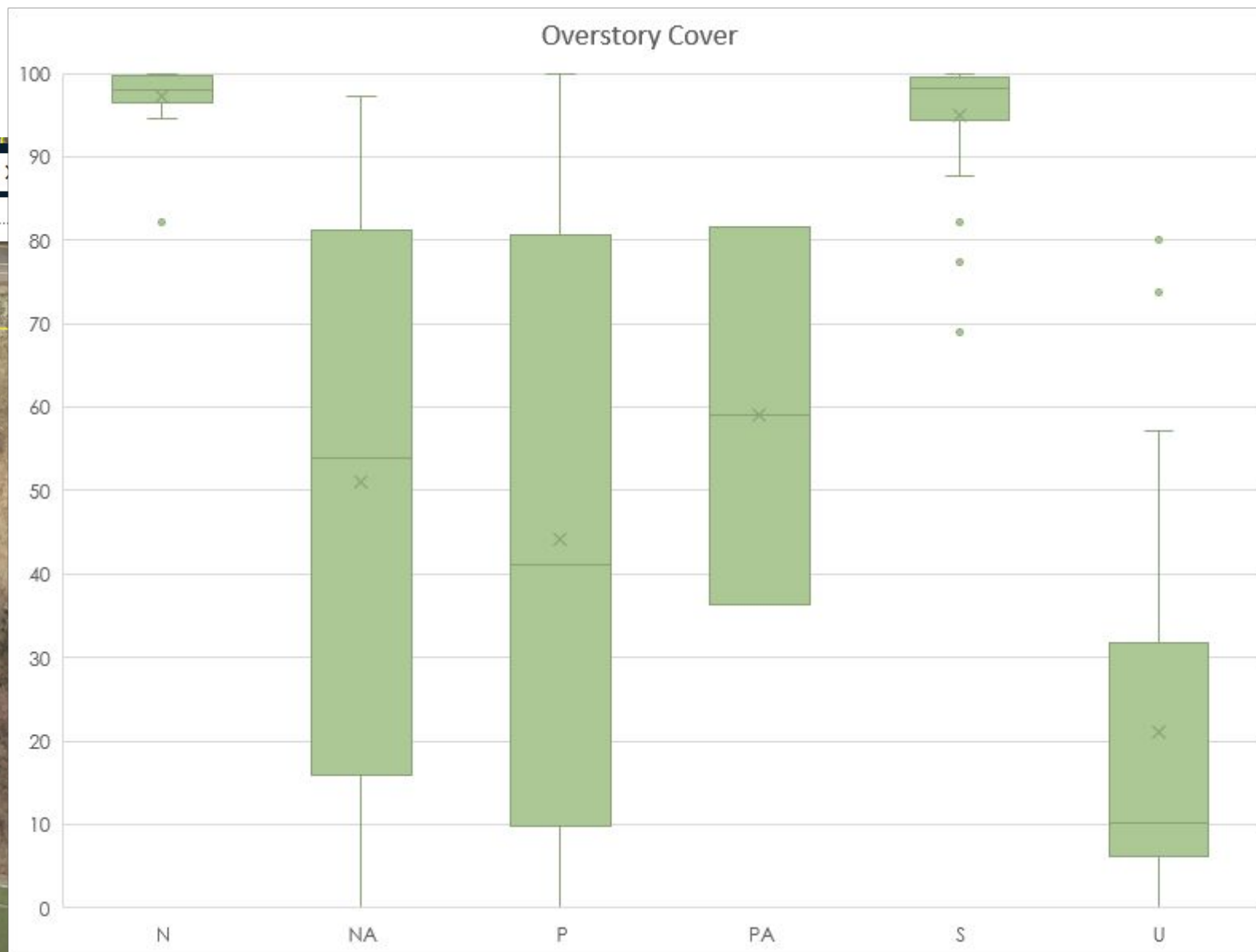
Pro
mai





pment!





Canopy!



Birds!



Costs



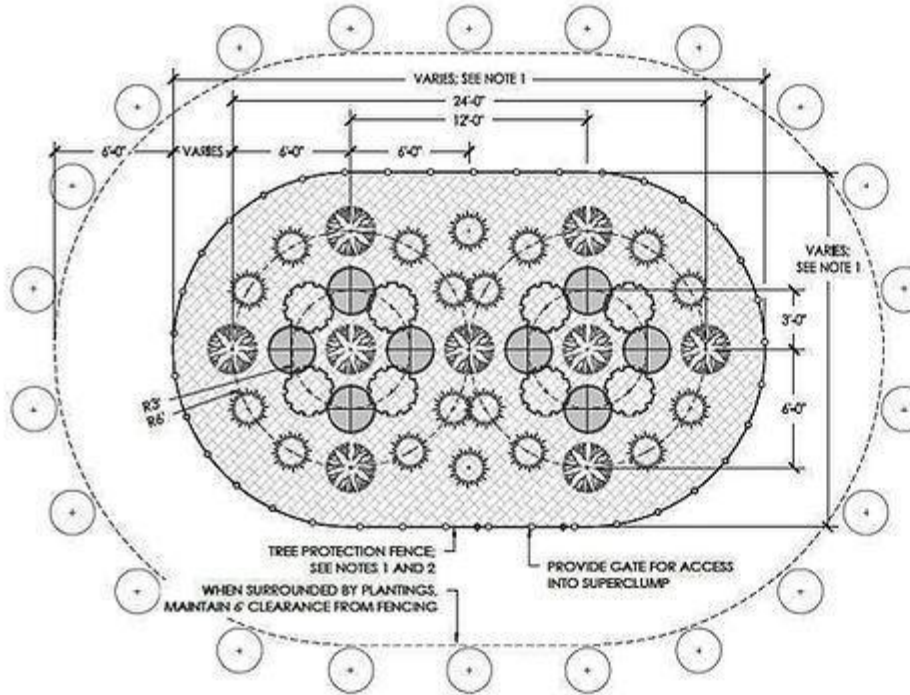
Figure 3: Summary of the costs and benefits of different commonly used restoration techniques over the first 15-20 years (adapted from 2). Note that benefits and costs are context dependent - in some degraded sites natural regeneration is slow or unable to occur and would show far fewer benefits. In this figure it is assumed that the site would be amenable to any of the three restoration techniques. The land degradation metric is suggesting when natural regeneration vs applied nucleation vs plantations interventions should be applied (along a gradient of increasing degradation).



Essentials



- Fence?
- Ground layer?
 - Seed/mulch/bareground
- Species?
- Density?
- Size of stock?



SUPERCLUMP DETAIL 2X8
SCALE: NTS

LEGEND

- (8) CLIMAX CANOPY TREES GROUP 1
- (9) EARLY SUCCESSIONAL TREES GROUP 2
- (8) UNDERSTORY TREES GROUP 3
- (18) SHRUBS GROUP 4
- EXTERIOR PLANTINGS
- TREE PROTECTION FENCE
- 3' SHREDDED HARDWOOD MULCH

- NOTES:**
1. LOCATION OF TREE PROTECTION FENCING TO BE DETERMINED IN THE FIELD AND APPROVED BY OWNER.
 2. TREE PROTECTION FENCING SHALL BE 4' HT., 14 GAUGE WELDED-WIRE FENCE, UNLESS OTHERWISE DIRECTED BY OWNER.

Fence



- No fence
- Cluster fencing
 - Stake Choice
- Individual fencing

Ground Layer

- Mulch
- Leaf litter
- Seed
- Bare
- Pre-emergent



Species

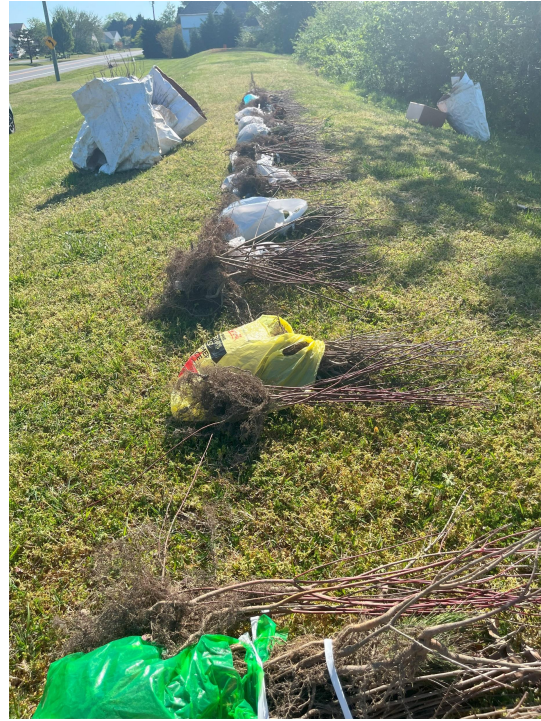
- Native!!
- Final Height
- The mix:
 - Overstory
 - Understory
 - Shrub
 - Fast

Ecological superheroes

This palette should be no closer than 20 feet from the house, as native forest trees can be quite tall at final height.

	Species	Common Name
Overstory Trees	<i>Carya glabra</i> <i>Carya tomentosa</i> <i>Nyssa sylvatica</i> <i>Quercus alba</i> <i>Quercus rubra</i> <i>Quercus phellos</i>	Pignut Hickory Mockernut Hickory Black Gum White Oak Red Oak Willow Oak
Fast-growing Trees	<i>Acer rubrum</i> <i>Rhus</i> spp. <i>Robinia pseudoacacia</i>	Red Maple Sumac species Black Locust
Understory Trees	<i>Carpinus caroliniana</i> (wetter sites) <i>Cercis canadensis</i> (western Fairfax County) <i>Cornus florida</i> (plant on edges only) <i>Ilex opaca</i> (drier spots) <i>Nyssa sylvatica</i> (slow growing, if you only find small ones) <i>Ostrya virginiana</i> (drier sites) <i>Sassafras albidum</i>	American Hornbeam Eastern Redbud Flowering Dogwood American Holly Black Gum Ironwood Sassafras
Shrub	<i>Corylus americana</i> <i>Lindera benzoin</i> (plant two or more for best flower production) <i>Sambucus canadensis</i> <i>Viburnum acerifolium</i> <i>Viburnum dentatum</i> <i>Viburnum prunifolium</i>	American Hazelnut Spicebush American Elderberry Maple-leaf Viburnum Arrowwood Viburnum Blackhaw Viburnum
Understory Herbaceous	<i>Asarum canadense</i> <i>Carex</i> spp. <i>Eurybia divaricata</i> <i>Polystichum acrostichoides</i> <i>Solidago caesia</i> <i>Solidago flexicaulis</i>	Wild Ginger Sedge species White Wood Aster Christmas Fern Bluestem Goldenrod Broadleaf Goldenrod
Perimeter Meadow	<i>Asclepias syriaca</i> <i>Elymus</i> spp. (avoid if goal is to spread forest) <i>Eupatorium</i> spp. <i>Monarda didyma</i> <i>Solidago</i> spp.	Common Milkweed Rye species Joe Pye Weed species Bee Balm Goldenrod species

Density and Size



- Smaller means more stems/holes to dig
- Completed with bare roots up to 1 ½" caliper
- Cost vs. time vs. long-term health vs. control

Possible Future Uses - Considerations



- Paths/Benches
- Ball Fields
- Solar Panels



A wide-angle photograph of a sunset over a calm body of water. The sun is a bright orange orb on the horizon, casting a long, shimmering reflection across the water's surface. The sky is filled with soft, wispy clouds in shades of orange, yellow, and blue. In the distance, a small, dark silhouette of a person is visible in the water, creating concentric ripples. The overall mood is peaceful and contemplative.

Thank You!

Meghan Noe Fellows
Director of Estuary Science and
Restoration
mnoefellows@inlandbays.org