

Impacts of Deer and Invasive Plant Species on Forests in Central New Jersey



RARITAN
VALLEY
COMMUNITY COLLEGE



Closter Nature Center
May 2, 2018

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Raritan Valley Community College

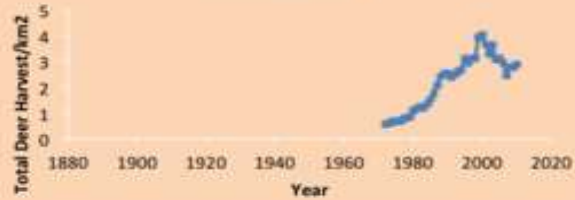
SENCER
SCIENCE EDUCATION FOR NEW CIVIC ENGAGEMENTS AND RESPONSIBILITIES



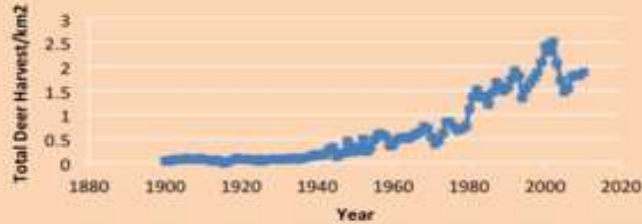


Deer Population Trends in the Northeastern US

New Jersey



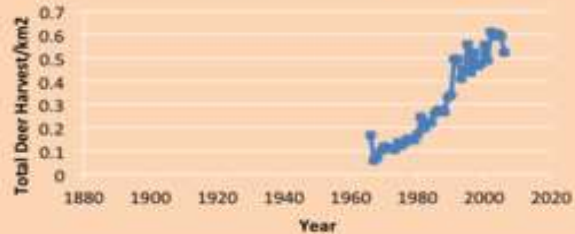
New York



Connecticut



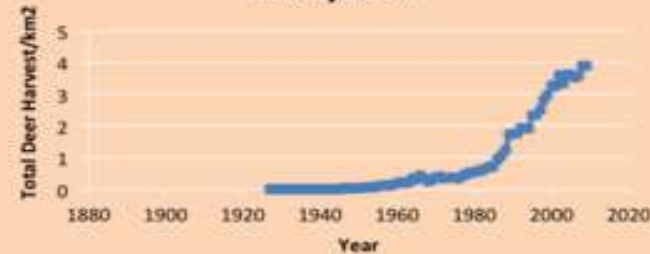
Massachusetts



Indiana



Maryland



Reasons for Deer Population Growth

1. Extermination of Predators
2. Cessation of Commercial Hunting
3. Warming Winters
4. Suburban Development

Infographic by
Peter Smallidge, Berndt Blossey
Cornell University



Deer Population Benchmarks

>10 deer/mi²

Impact preferred
browse species

>20 deer/mi²

Prevent forest
regeneration

>100 deer/mi²

Without deer
management

(Drake et al. 2002, Almendinger pers.
Comm.)

Historic: **8-11 deer/mi²**



Healthy forest with dense understory
vegetation and native plant species.

Current: **13-76 deer/mi²**



Overbrowsed forest at Hutcheson
Memorial Forest in Franklin Township
(2012)



Overbrowsed forest with invasive
barberry shrubs at Peter's Tract in
Bernardsville (2016)

Effects of Deer on Ground/Shrub Nesting Birds

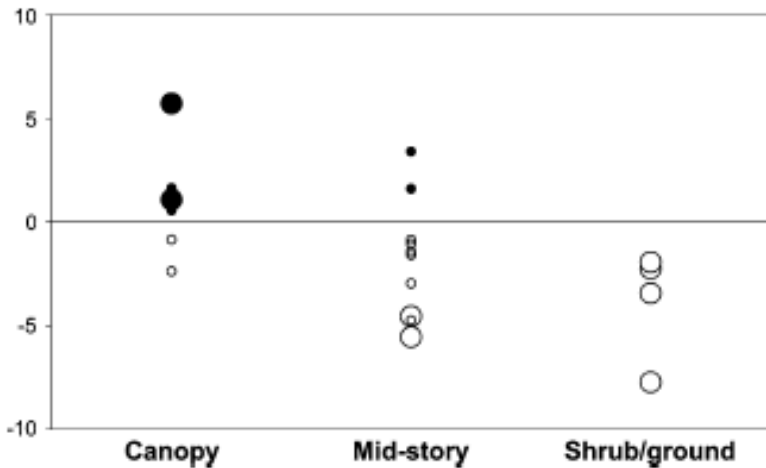


Fig. 1 Time series of photos from Hutcheson Memorial Forest (HMF) in Somerset County, New Jersey. HMF is mixed oak-hickory forest with 26 ha of old growth surrounded by secondary forest, old fields, and farm fields. (a) Shows the forest in 1976 with an intact shrub layer. Overbrowsing by deer and non-native plant invasion have changed the forest understory and midcanopy from native saplings, shrubs and

Fig. 3 Plotted abundance trend estimates from 1980 to 2005 for 21 forest breeding bird species in New Jersey. Estimates are classified based on dominant vertical nesting location (canopy, midcanopy, or shrub/ground). Solid circles indicate species that show a positive trend in annual abundance change, whereas open circles represent species experiencing a negative trend. The zero line represents no change in abundance through time. Large circles indicate that the trend is statistically significant, whereas small circles indicate nonsignificance. On the y-axis labels can be translated as a percentage. For example, a species sitting at the -5.0 level can be said to declining in abundance by an estimated 5% per year

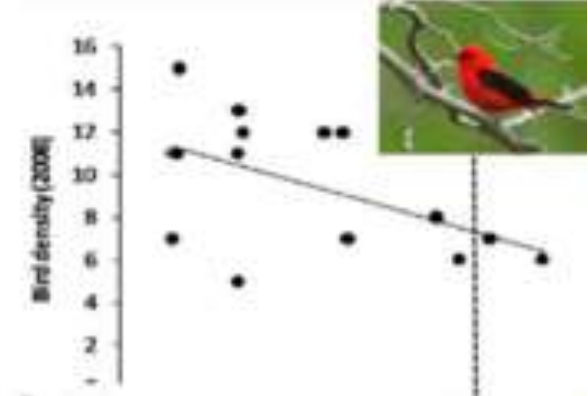
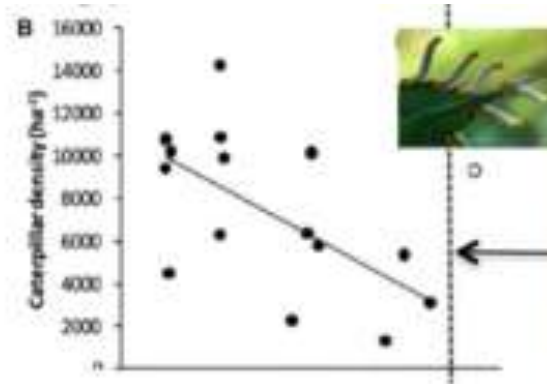
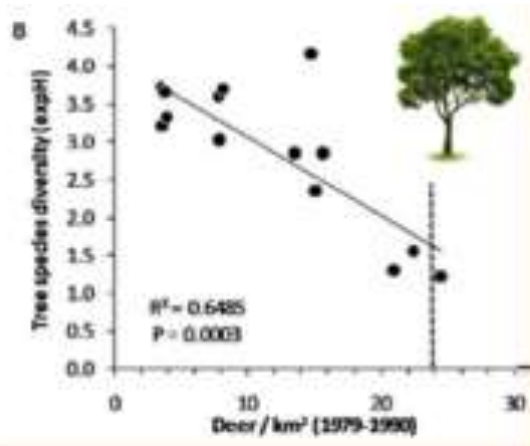
herbs such as *Viburnum acerifolium*, *Circaea lutetiana*, and *Podophyllum peltatum* (Davison 1981) to, (b) a dense understory composed mostly of *Microstegium vimineum* and another exotic invasive, *Alliaria petiolata* (foreground) (2005) and (c) leaf litter with small patches of *Microstegium vimineum* (2005). Photograph (a) is courtesy of Jim Quinn and (b) and (c) are courtesy of Myla Aronson



Effects of Deer on the Food Web

90% of insects are specialists and feed on one or few species of plants

96% of terrestrial bird species rely on insects, spiders, and other arthropods as a food source





Public Safety - Vehicle Damage from Deer Collisions



>1,000,000 DVCs/yr in U.S.; >200 deaths

(Conover et al. 1995, Luedke 2011)

26,860 deer collisions in NJ in 2013

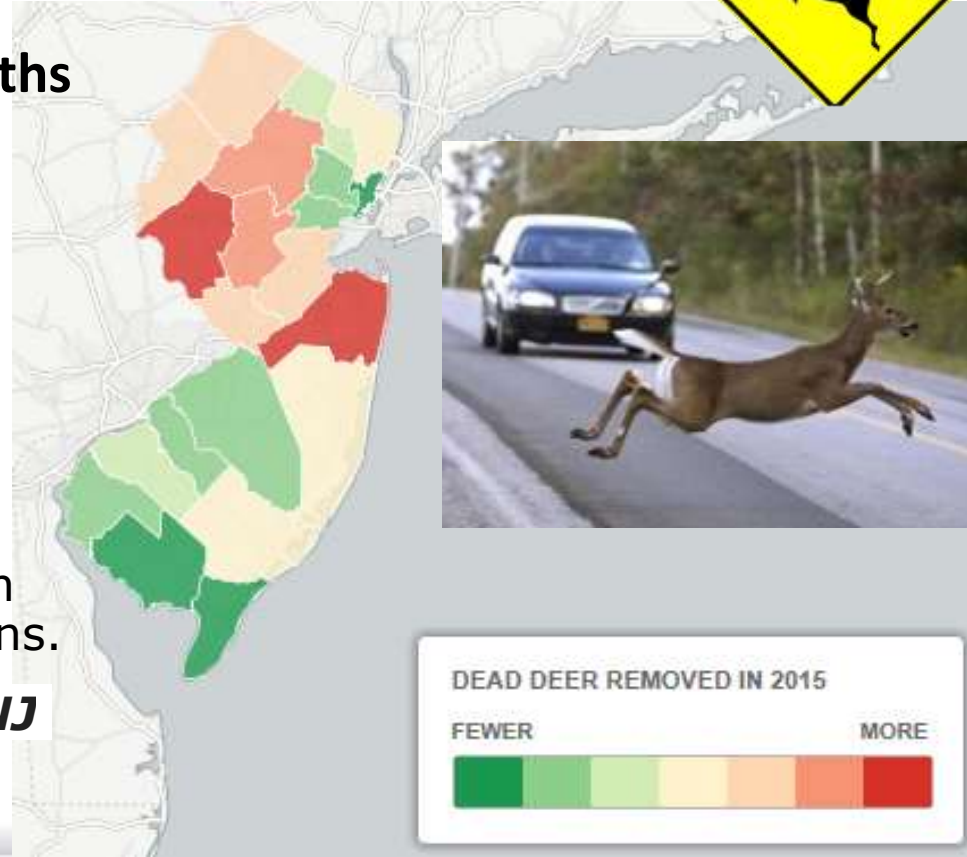
- #1 – Monmouth County
- #2 – Morris County
- #3 – Somerset County
- #4 – Hunterdon County
- #5 – Middlesex County

(State Farm Insurance, NJ.com 2014, NJTPA 2015)

New Jersey spends > \$111 million/yr. in insurance claims related to deer collisions.

- \$10-13 million/county in central NJ

(NJ.com 2015)





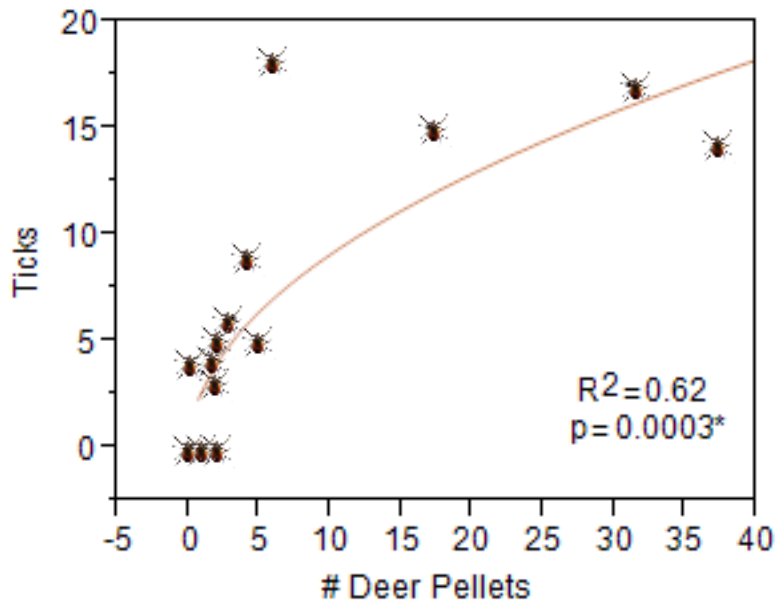
Public Health - *Lyme Disease*

330-640 cases/yr in Morris County since 2000

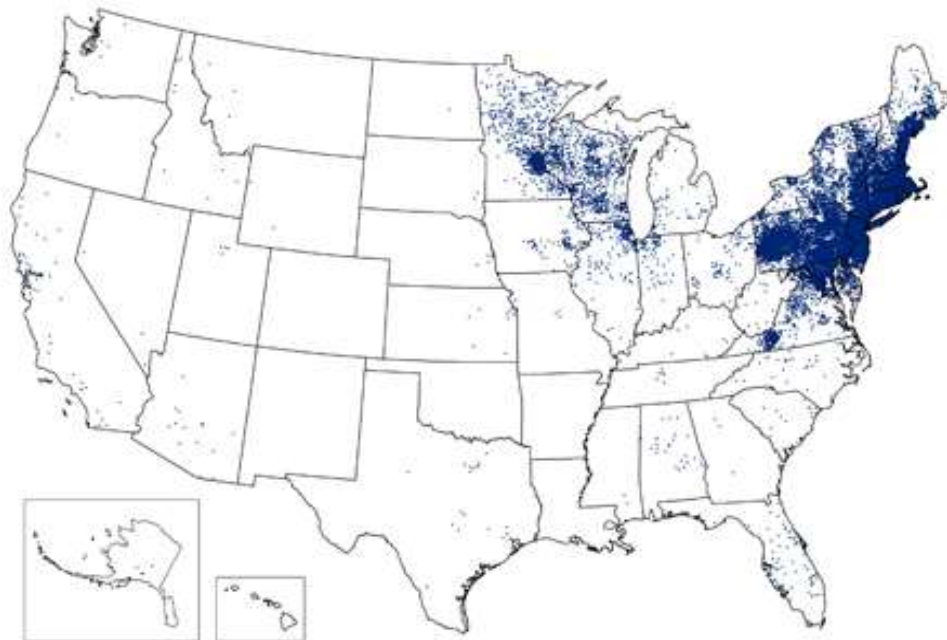
207-528 cases/yr in Hunterdon County

Center for Disease Control and Prevention (2016)

Effect of Deer on Tick Abundance



Reported Cases of Lyme Disease -- United States, 2014



1 dot placed randomly within county of residence for each confirmed case



Exotic Invasive Plant Species

2,200 native (indigenous) plant species in New Jersey...

4000 exotic species introduced to NJ

- 1,400 escaped into the wild
- 400 have become invasive

Ecological Impacts:

Compete with native species; Threat to endangered species; Disrupt ecosystem processes (nutrient cycling, pollination/dispersal, trophic interactions)

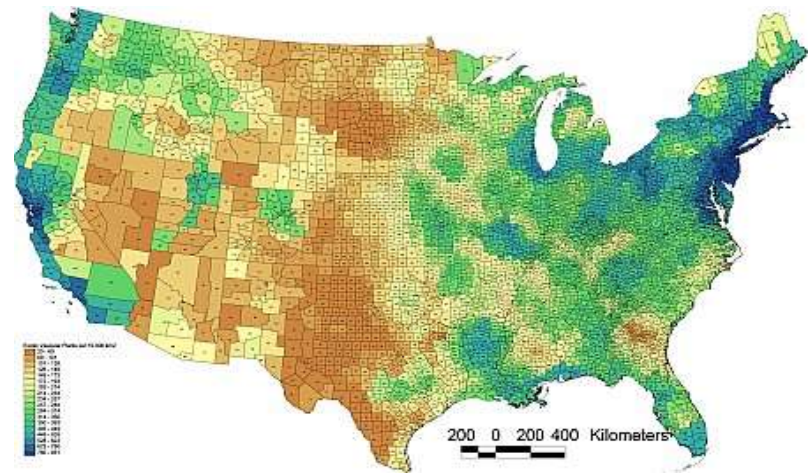
(Snyder and Kaufman 2004)

Economic Impacts:

Invasive species cause over **\$100 billion** of damage in the United States every year with **\$290 million** being in NJ alone!

(New Jersey Invasive Species Council 2009)

exotic species = 39% of state flora!!!



Density of Exotic Species - **#/10,000 km²**

(BONAP 2011)



Exotic vs. Native Species – Food Web Effects

Zelkova

Zelkova

Supports **0** different species of moths and butterflies.



Ulmus

Elm

Supports **206** different species of moths and butterflies.



Sorbaria

False Spiraea

Supports **2** different species of moths and butterflies.



Spiraea

Meadowsweet

Supports **86** different species of moths and butterflies.



(Tallamy n.d.)



Invasive Plant Species Effects on Food Web

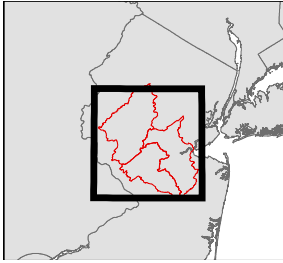
HOSTING CAPACITY OF ALIEN PLANTS INTRODUCED TO NORTH AMERICA

Plant Species	Herbivores Supported in Homeland	Herbivores Supported in North America	Years Since Introduction to North America	Reference
<i>Clematis vitalba</i>	40 species	1 species	100	Macfarlane & van den Ende 1995
<i>Eucalyptus stellulata</i>	48 species	1 species	100	Morrow & La Marche 1978
<i>Melaleuca quinquenervia</i>	409 species	8 species	120	Costello et al. 1995
<i>Opuntia ficus-indica</i>	16 species	0 species	250	Annecke & Moran 1978
<i>Phragmites australis</i>	170 species	5 species	300+	Tewksbury et al. 2002

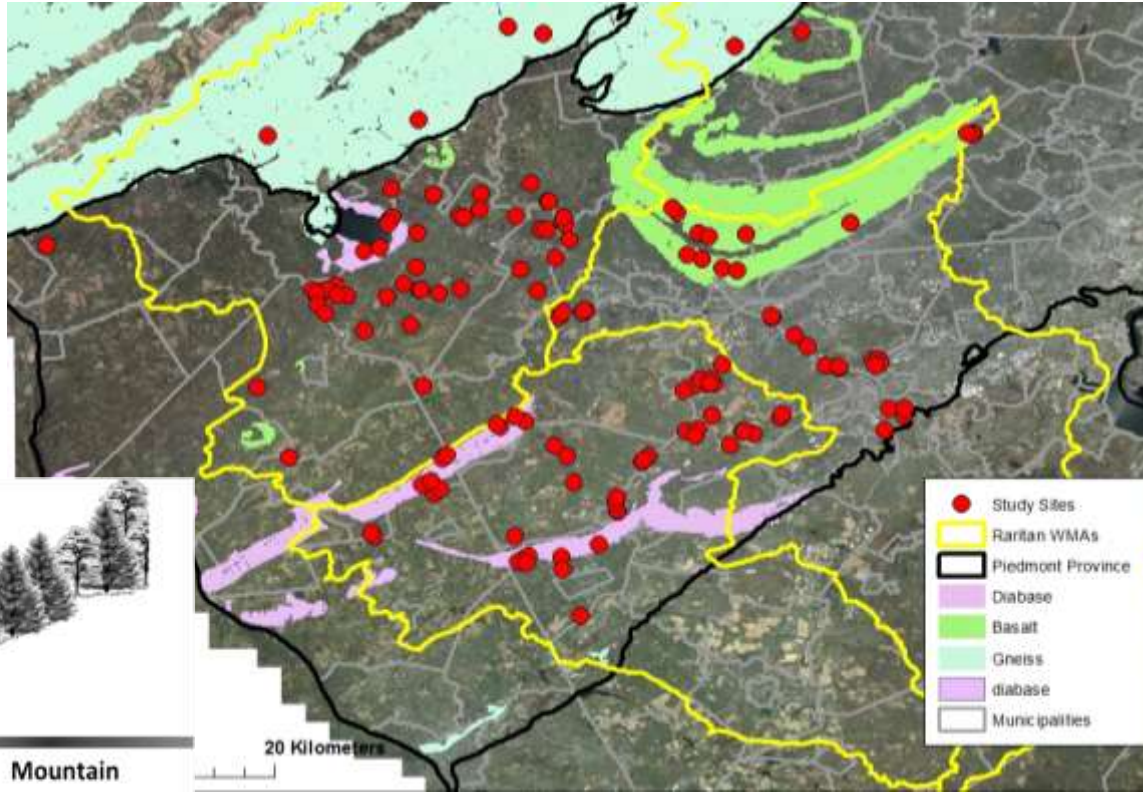
(Tallamy 2009)



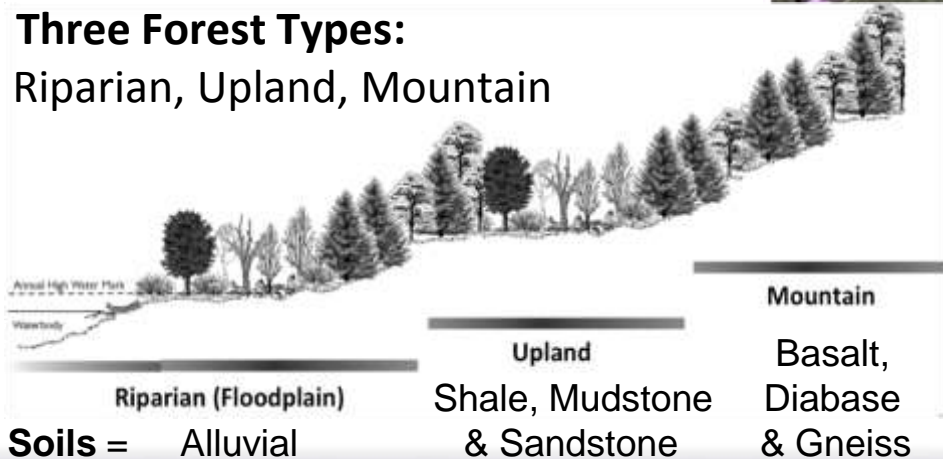
Study Area and Design



- *Raritan Watershed*
 - *Piedmont Province*
- 135 Study Sites**



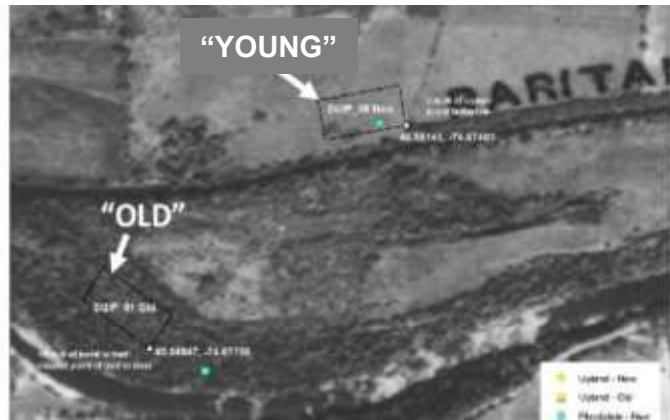
Three Forest Types:
Riparian, Upland, Mountain



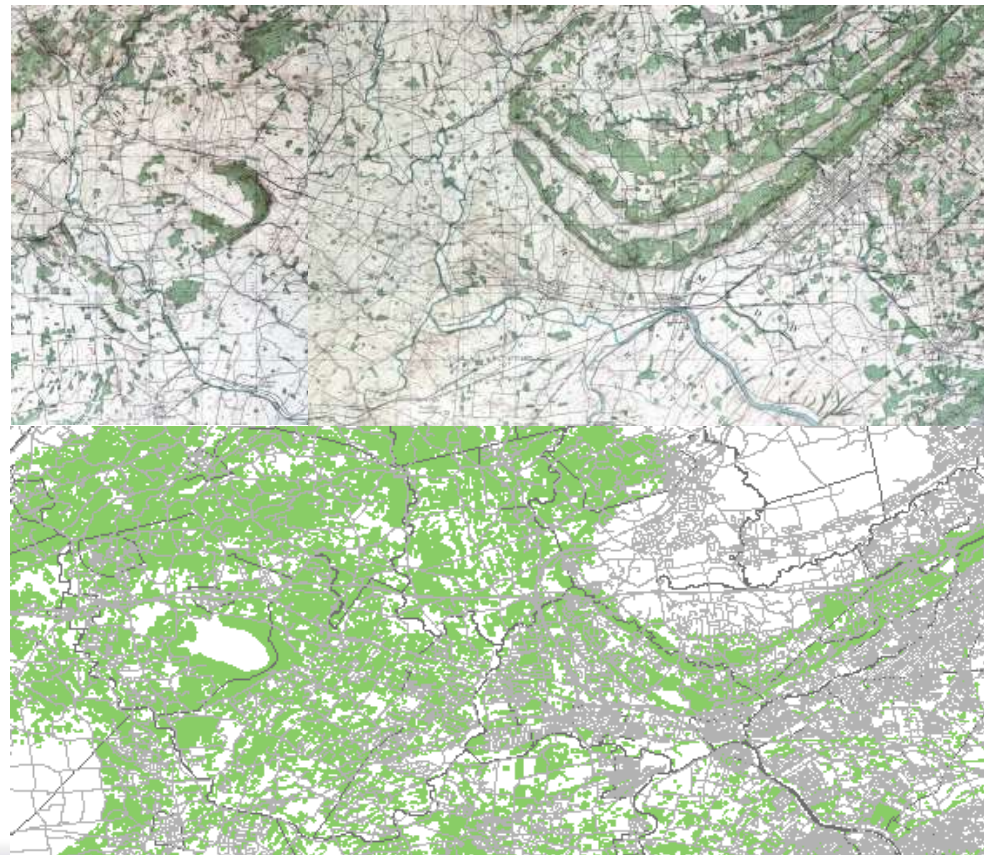


Forest Age

“Old” and “Young” (before or after 1930)



Forest Development in Central NJ – late 1800's to 2012





Historical Comparisons

Murray Buell Plant Ecology Lab

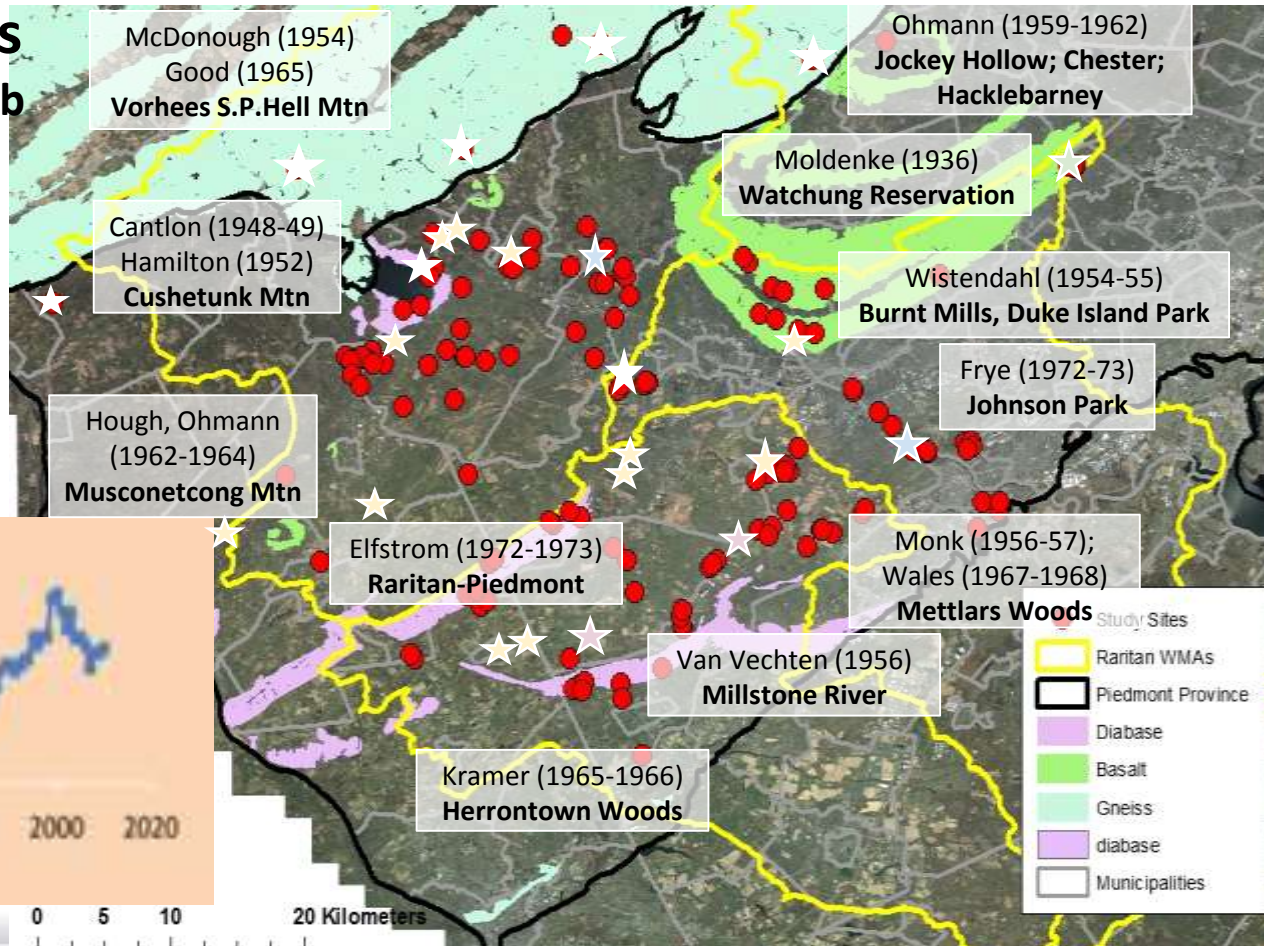
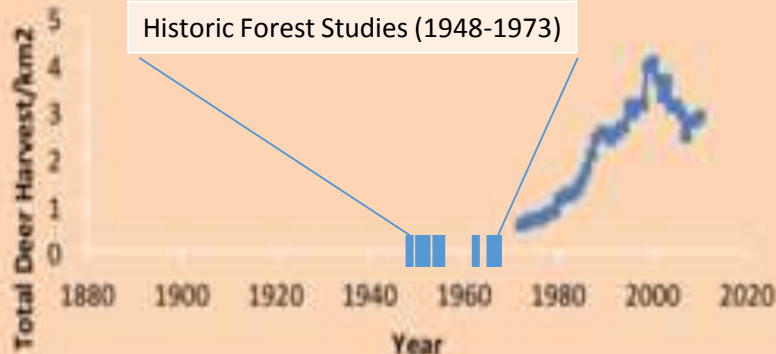
Rutgers University

(1948-1973)

22+ Studies

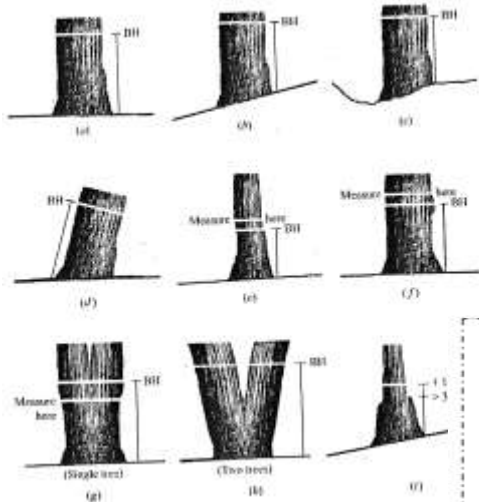
137 Locations; 216 Stands

NJ Deer Population Trends





Forest Study Methodology

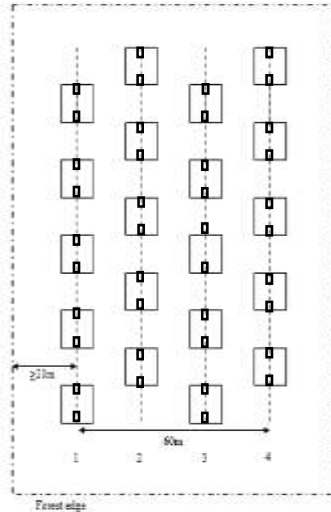


Four 100 m Transects (20 m apart)

Twenty 100 m² plots (~0.5 acres)

Forty 1 m² plots (herbaceous cover)

Minimum 30 m from edge



Size Class Categories

Seedlings: <1' height
<1" diameter

Saplings: >1' height
<1" diameter

Small trees: 1 - 3.9" dbh

Med-Lg. trees: > 4" dbh





2014-2017 Vegetation Studies: Forest Ecology Interns



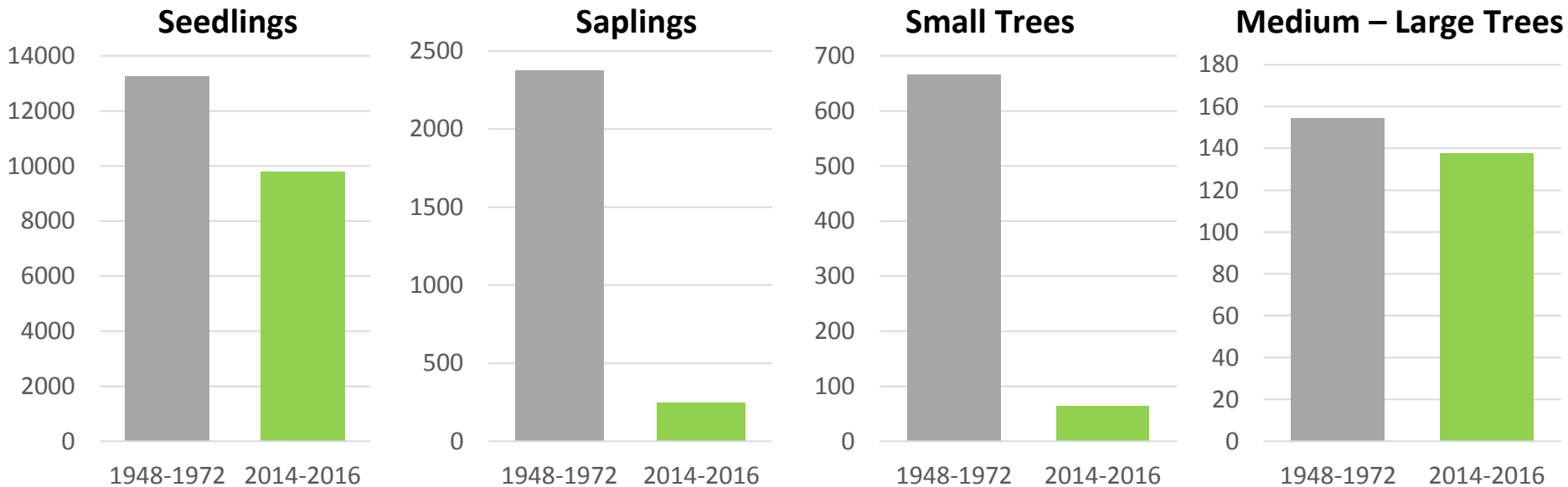
Counted / Measured:

- >50,000 trees
- >550,000 seedlings
- >4,000 herb plots
- >22 km shrub/liana data





Comparison of Past and Present Forest Size Class Structure



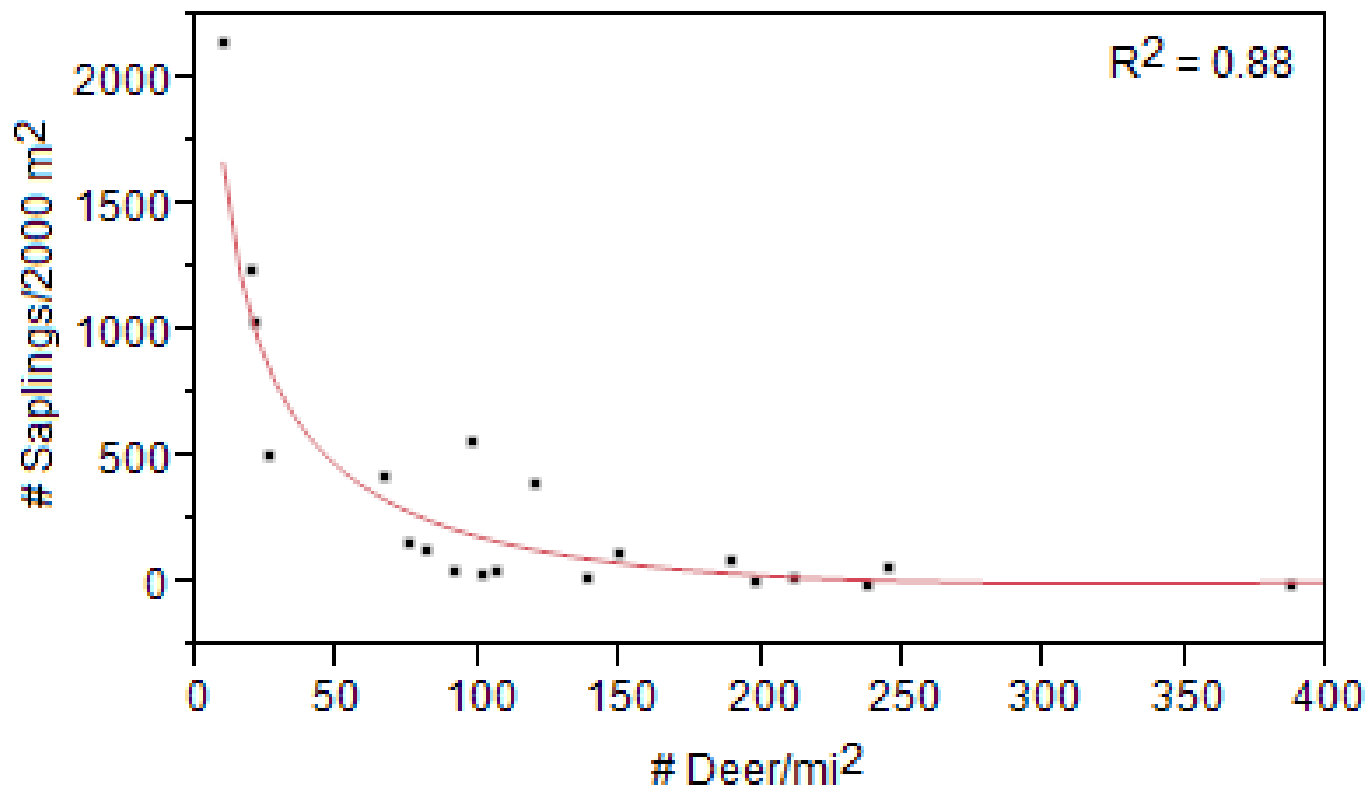
% Change from Past (1948-73) to Present (2014-17)

Seedlings	Saplings	Small	Medium - Large
-26%	-90%	-90%	-11%





Empirical Evidence of Deer Effects: Relationship of # Saplings to Deer Densities

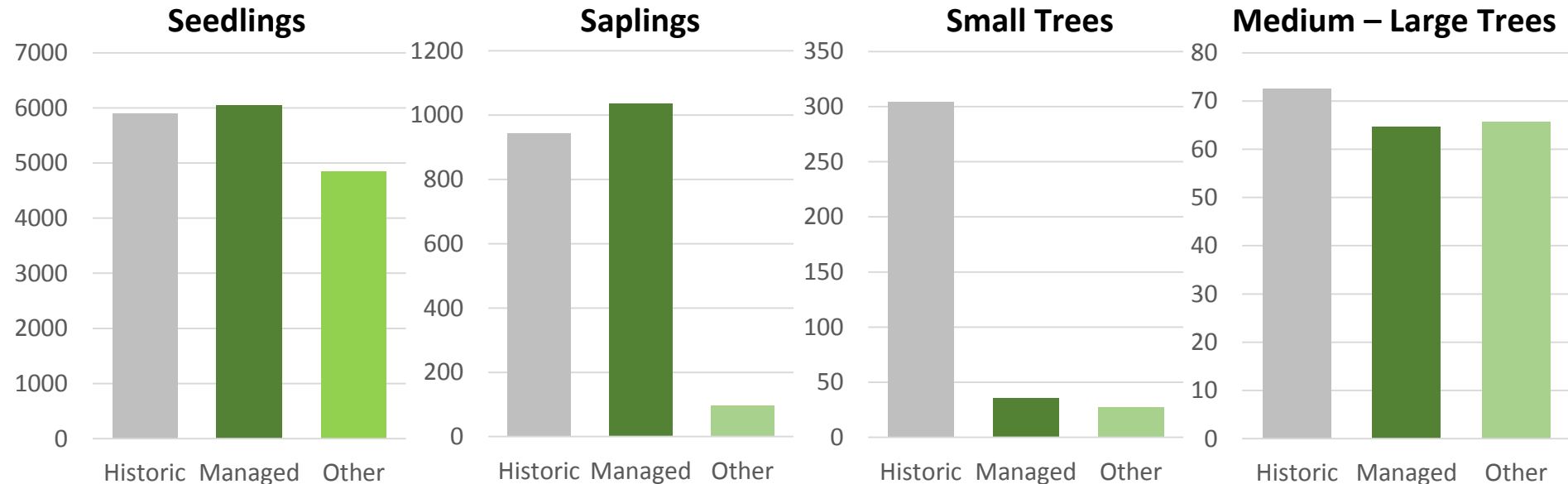




Experimental Evidence of Deer Effects

19 Study Sites with Deer Exclosures or Intensive Hunting

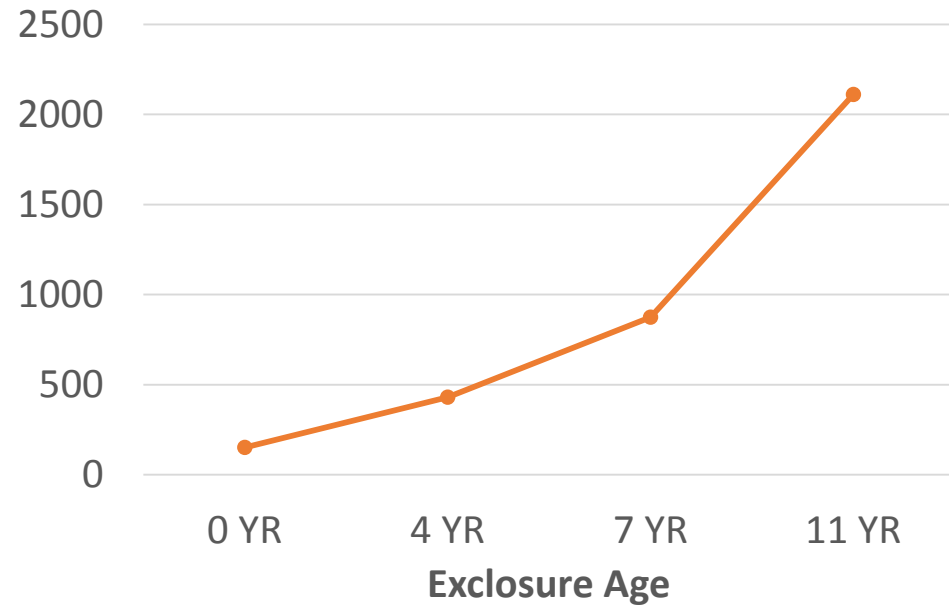
(Duke Farms, Great Swamp, Greenbrook Reservation, Princeton Twp, Duke Farms)



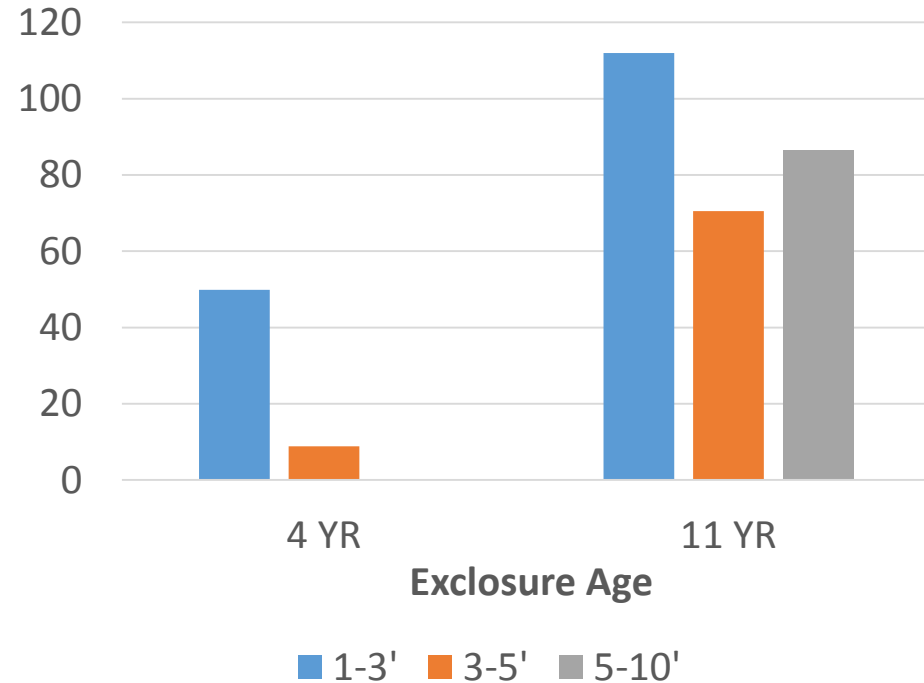


Increasing Number and Size of Saplings in Deer Exclosures Over Time

Saplings/2000m²



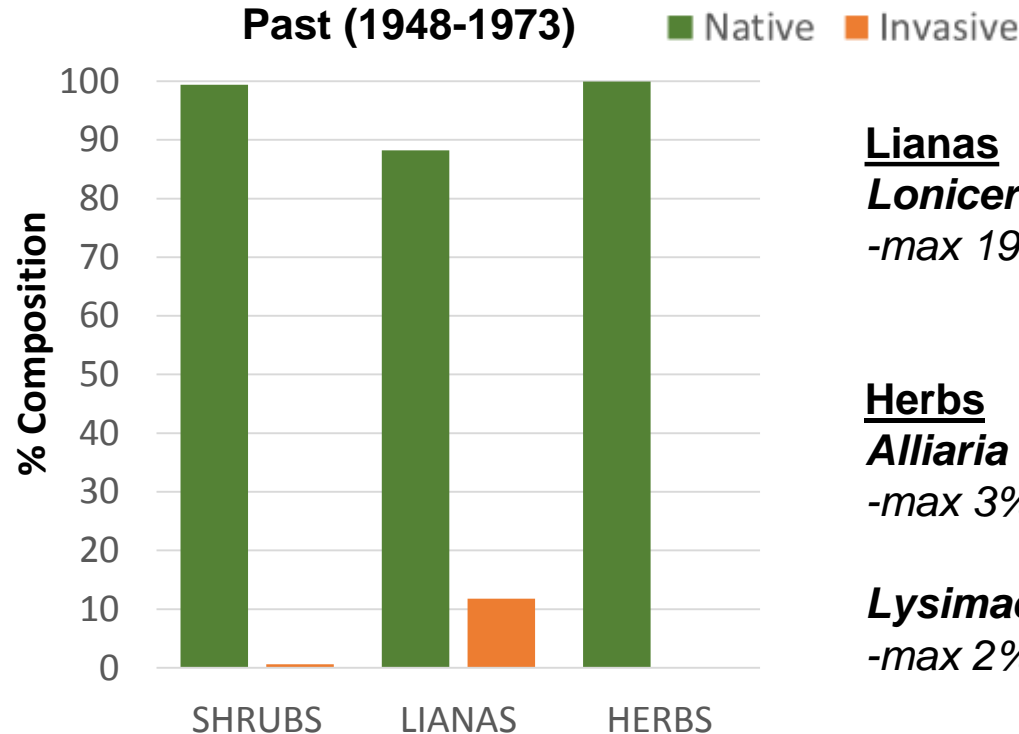
Sapling Height (cm)





Invasive Plant Species in Forest Understories – 1948-1973

- ◆ Low Levels of Invasive Cover in Foresty Understories
- ◆ Much Higher Native Cover than Invasive



Shrubs

Berberis thunbergii

-max 1% cover

Ligustrum vulgare

-max 2% cover

Rosa multiflora

-max 4% cover

Rubus phoenicolasius

-max <1% cover

Lianas

Lonicera japonica

-max 19% cover

Herbs

Alliaria petiolata

-max 3% cover

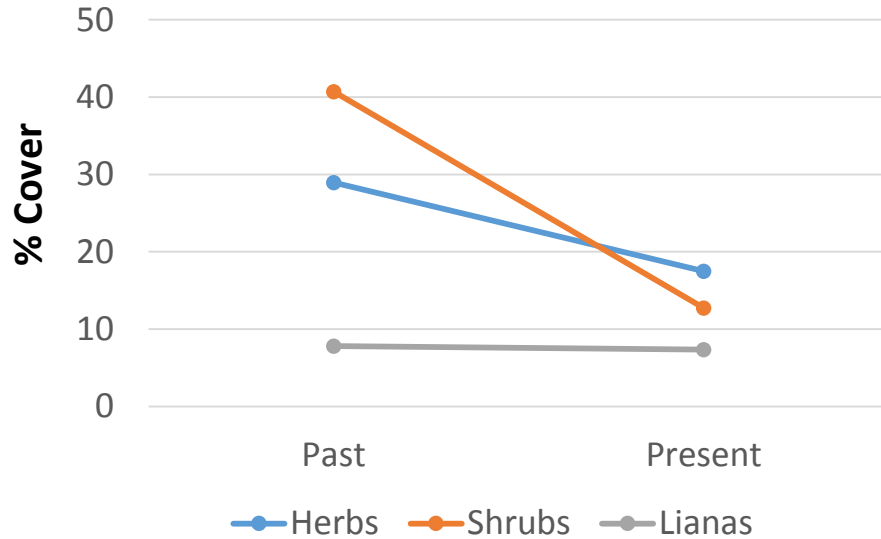
Lysimachia nummularia

-max 2% cover

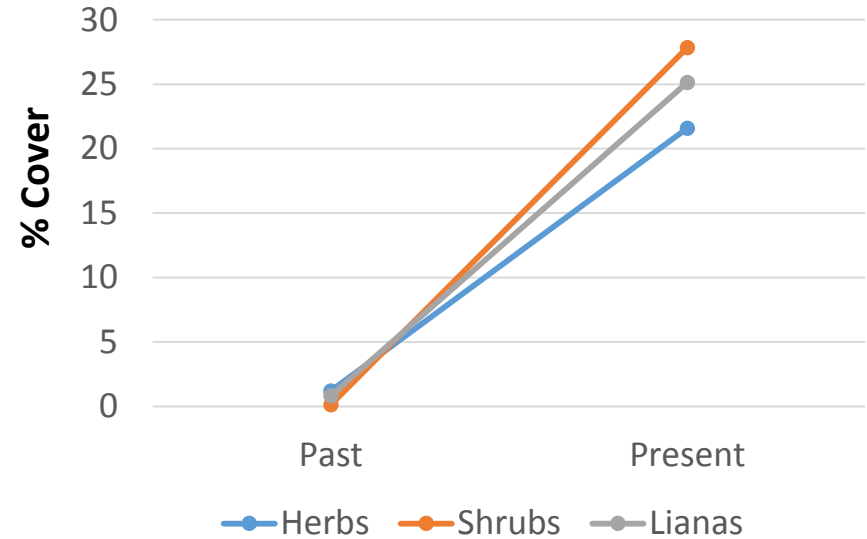


Changes in Native and Invasive Cover in Forests – *Past to Present*

Native



Invasive





Invasive Plant Species in Forest Understories – 2014-2017

Shrubs

Berberis thunbergii

-max 49% cover

Eleagnus umbellata

-max 59% cover

Ligustrum vulgare

-max 32% cover

Photinia villosa

-max 44% cover

Rhamnus cathartica

-max 21% cover

Rosa multiflora

-max 83% cover

Rubus phoenicolasius

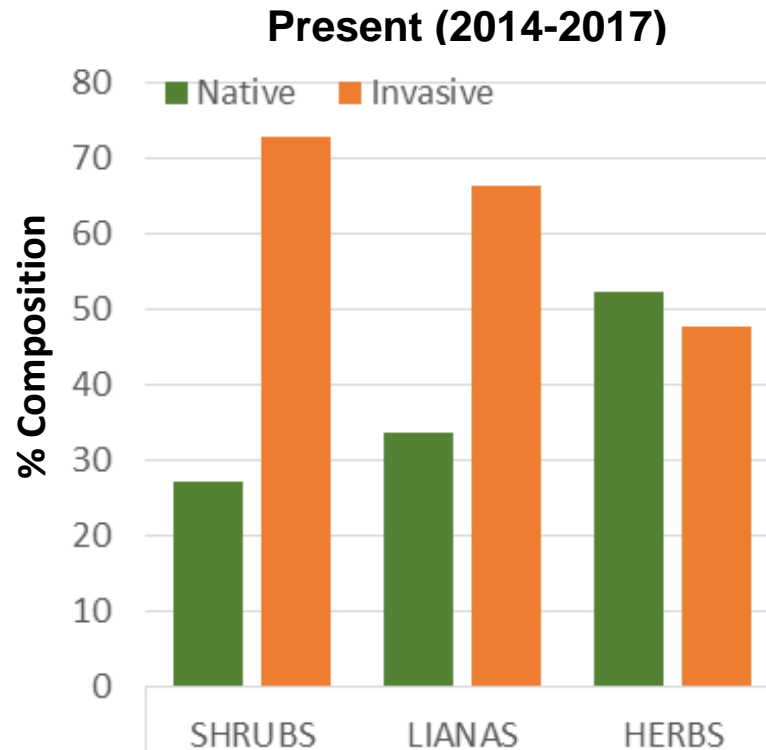
-max 46% cover

Viburnum dilatatum

-max 38% cover

◆ High Levels of Invasive Cover in Foresty Understories

◆ More Invasive Than Native in Most Forests



Lianas

Lonicera japonica

-max 95% cover

Celastrus orbiculatus

-max 50% cover

Herbs

Alliaria petiolata

-max 10% cover

Lysimachia nummularia

-max 39% cover

Microstegium vimineum

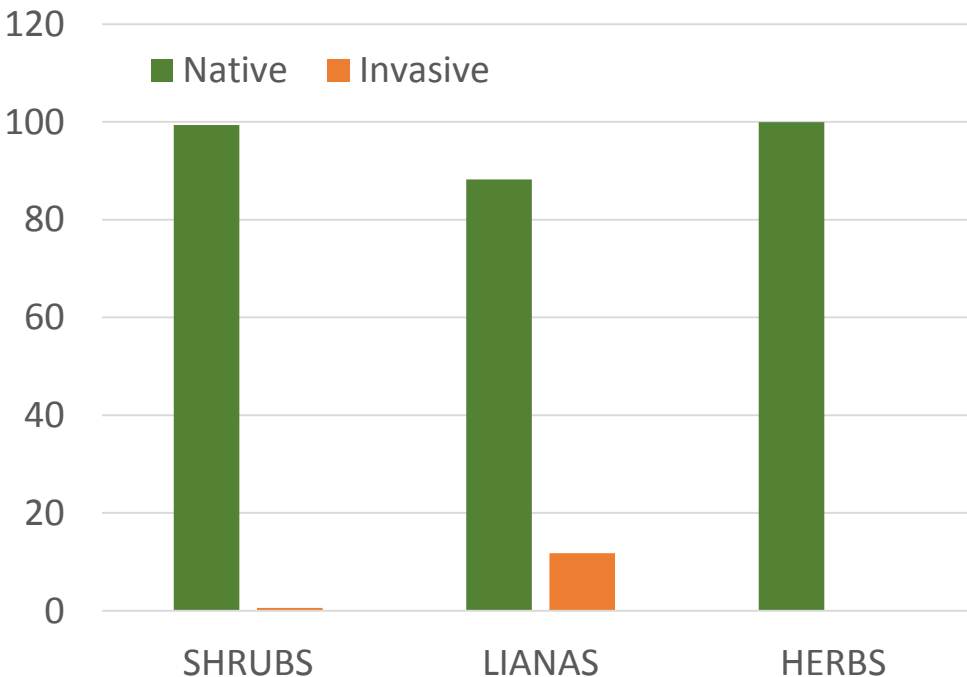
-max 66% cover



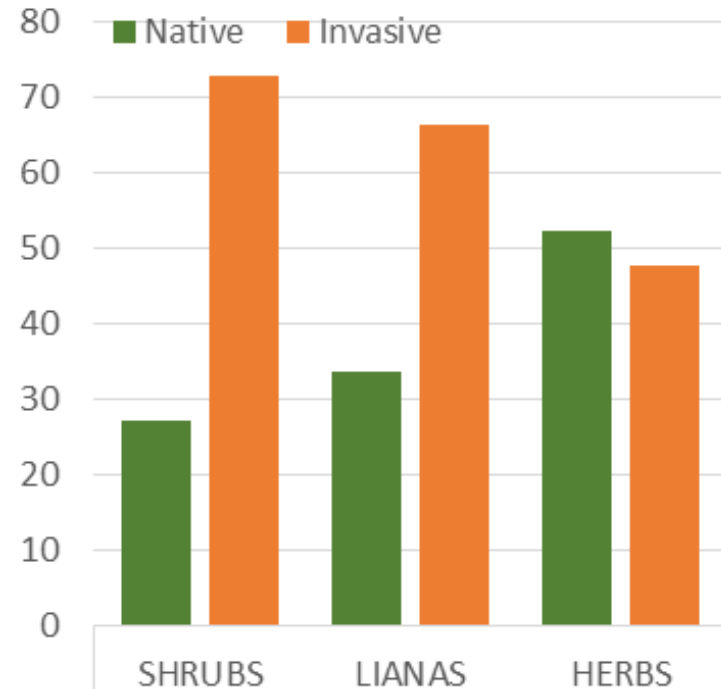
Invasive Plant Species in Forest Understories – *Past to Present*

- ◆ Dramatic Increase in Invasive Understory Vegetation from Historic to Present
- ◆ Present Forest Understories are More Invasive Than Native

Historic (1948-1973)



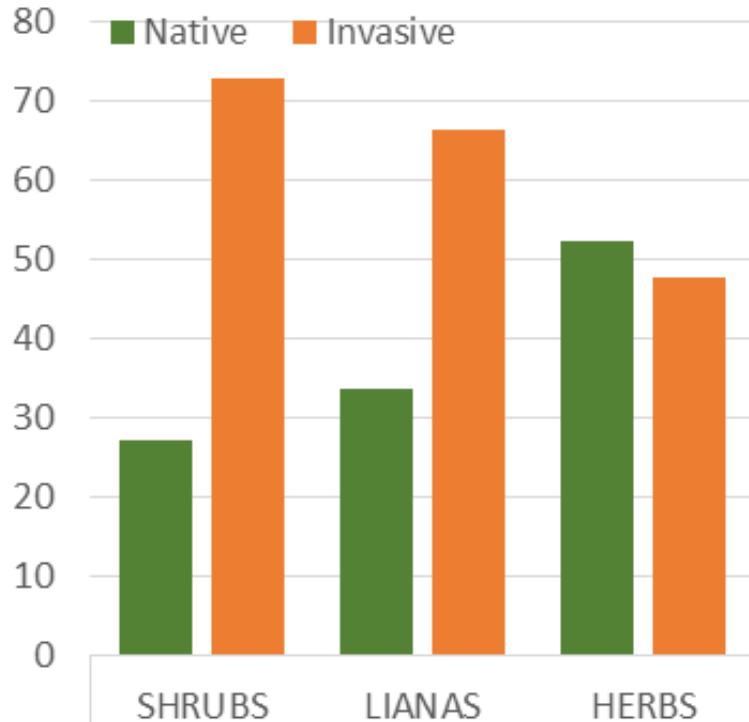
Present (2014-2017)





Invasive Plant Species in Forest Understories – *Dominant Species*

◆ More invasive than native on average



Japanese Stiltgrass – 87%



Multiflora Rose – 62%

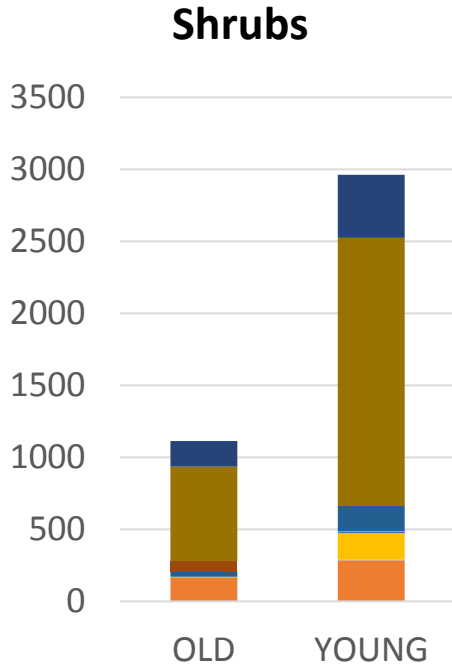


Japanese Honeysuckle
89%

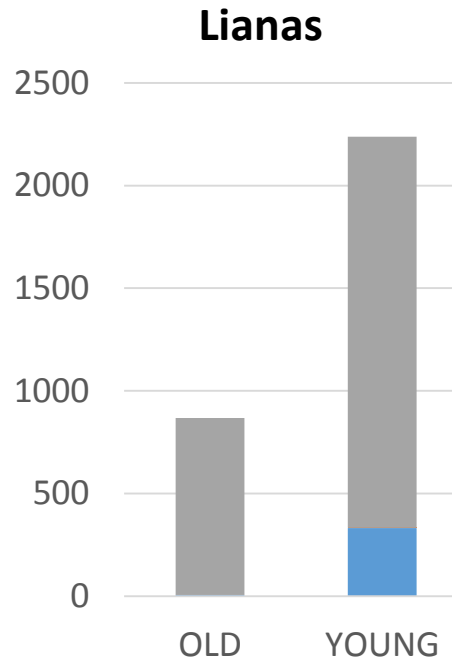


Invasive Plant Species in Forest Understories – *Young vs. Old Forests*

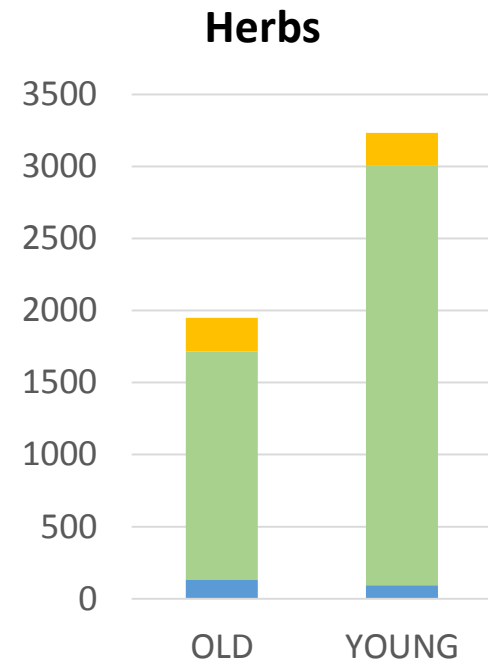
◆ More Invasives in Young Forests Than Old



166% more



158% more



55% more



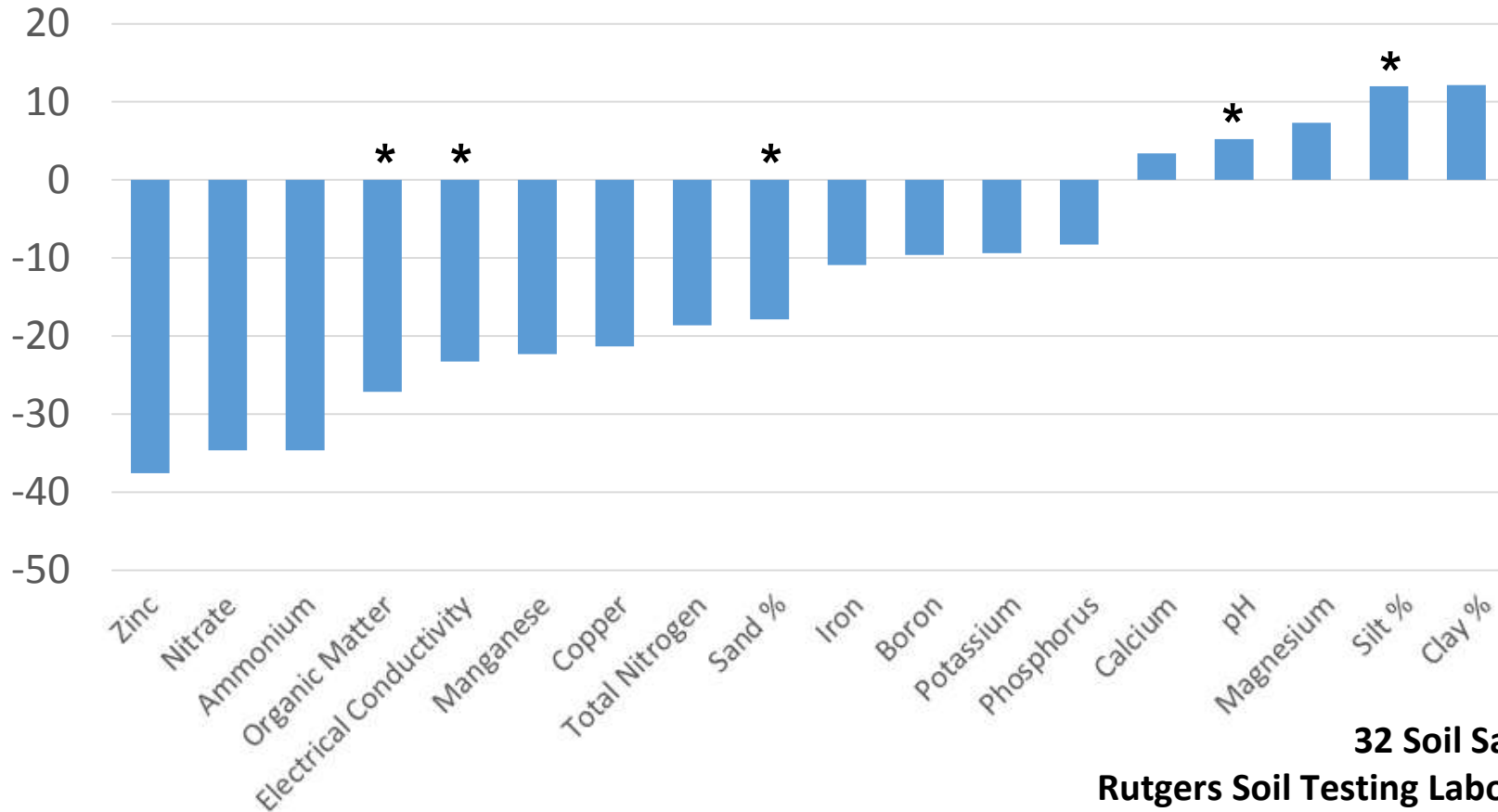
Old

(Back Wall)

Young

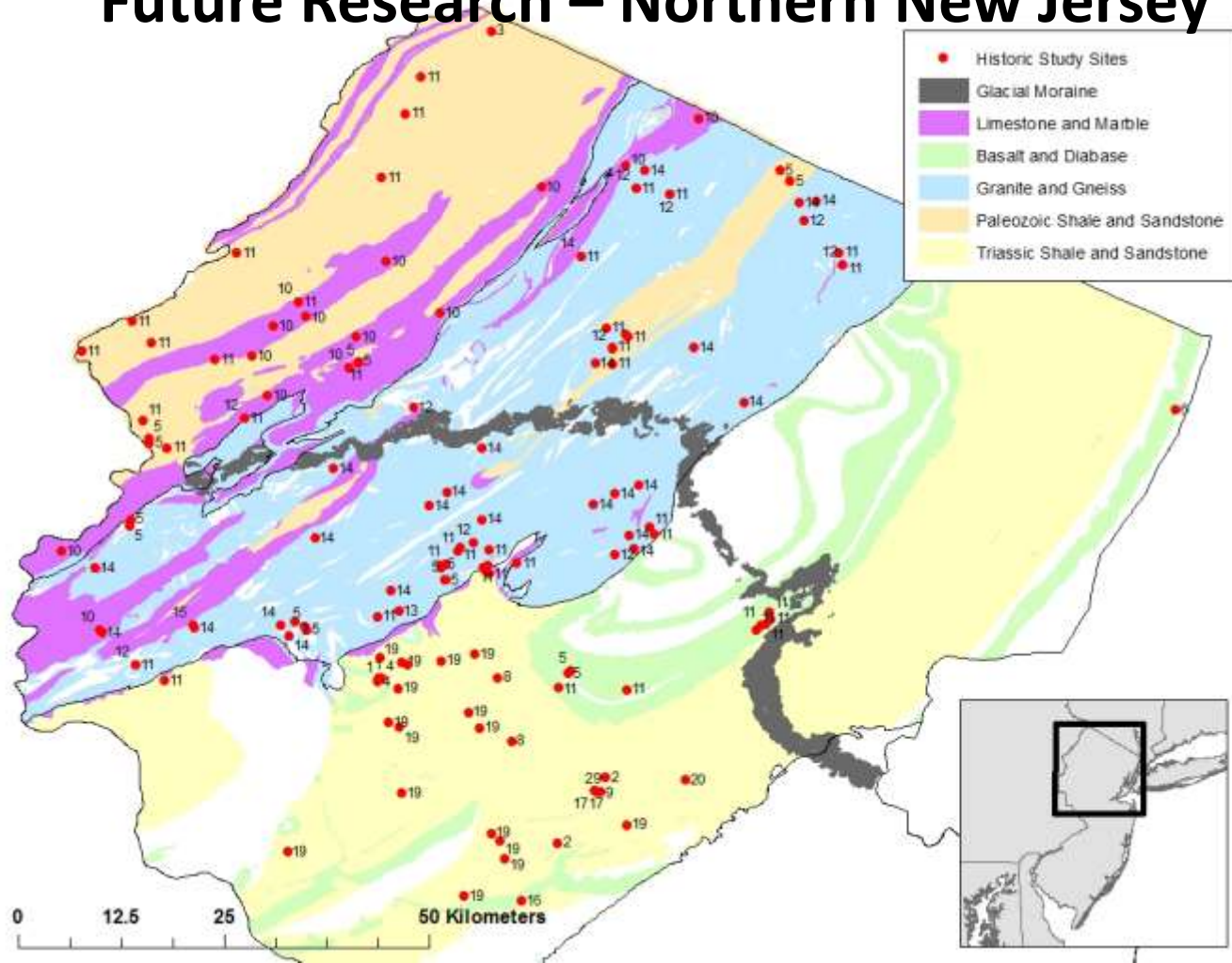


% Difference of Soil Variables (Young vs. Old Forests)



32 Soil Samples
Rutgers Soil Testing Laboratory

Future Research – Northern New Jersey





Possible Solutions for Forest Restoration: Re-Planting

Approximate Cost for Replanting 76 Acres of RVCC Forest: **\$567,996**

Replanting Understory Trees on a 76 Acre Plot

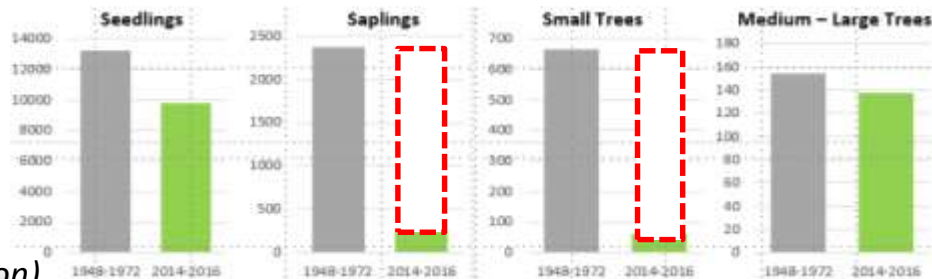
Plantings	Approximate Quantity	Average Cost (Per Tree) ^{1,2}	Total Cost ³
Saplings	232,408	\$2.29	\$532,214
Small Trees	8,968	\$3.99	\$35,782
Total			\$567,996



¹ Tree prices based off Rutgers Nursery (Rt. 202)

² Medium trees not included in total cost

³ Browse protection (pictured) not included in total cost
(An additional \$2.50 - 3.00 per unit not including installation)



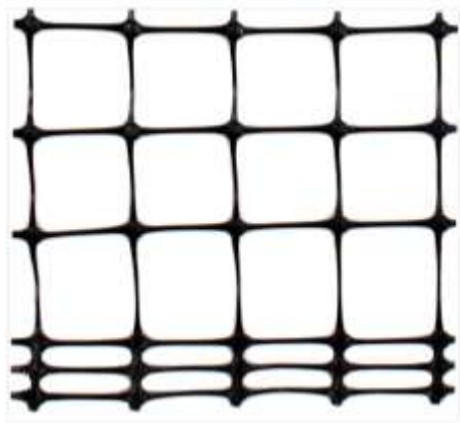


Possible Solutions for Forest Restoration: Deer Fencing

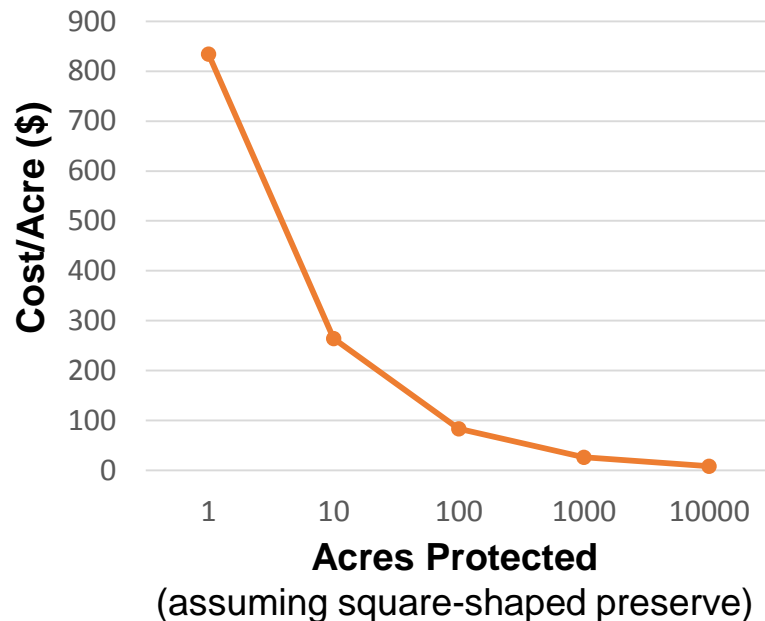
Costs Depend on Materials Selected:

Plastic = \$1-2/ft.

Metal (Fixed Knot) = \$3-5/ft.



**Efficiency Increases With Size
(Cost per Acre Protected)**



Prices obtained from Deer Busters (www.deerbusters.com)





Possible Solutions for Forest Restoration: Deer Fencing

Approximate Cost for Fencing 76 Acres of Forest on RVCC Campus:

Metal Fencing & Posts: **\$144,100**

or Plastic Fencing & Trees: **\$28,500**

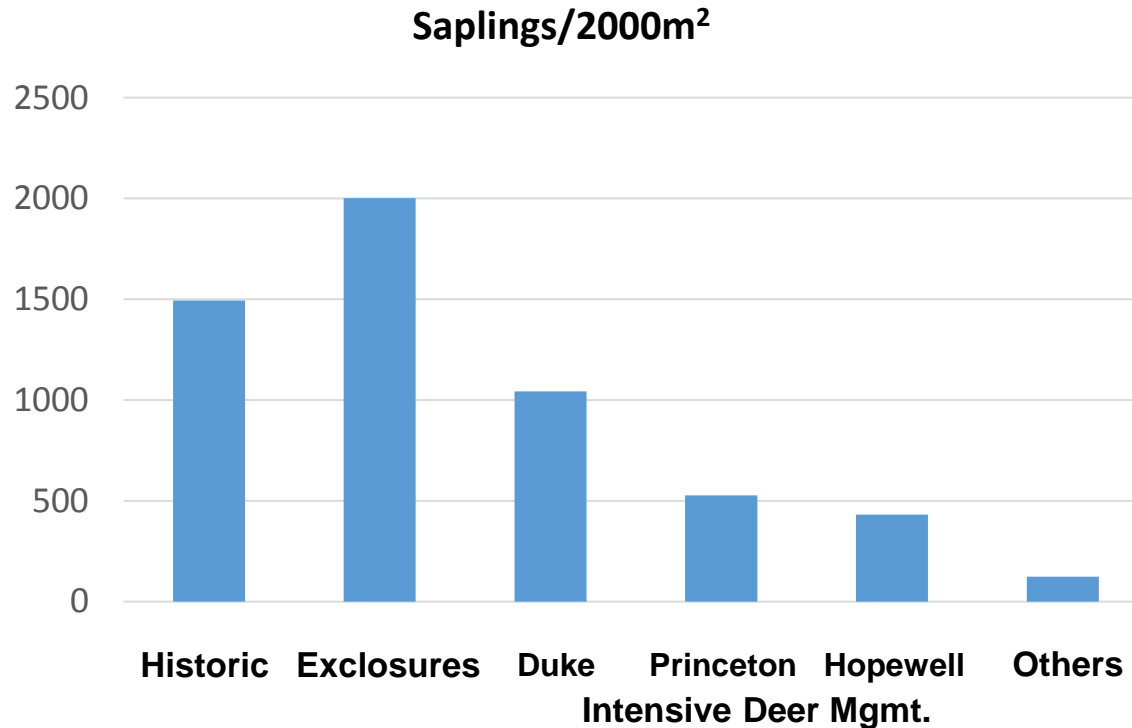


Material	Quantity	Cost (Per Item)	Total Cost
Wooden Posts (8')	2,827	\$7.50	\$21,203
Wire Fencing	28,269 ft.	\$4.00 - 4.50/ft.	\$120,143
<i>or Plastic Fencing</i>		<i>\$0.91/ft.</i>	<i>\$25,699</i>
Gate	1	\$250.00	\$250.00
		TOTAL:	\$28,449 - \$144,096

Estimate done by BASH Contracting, in conjunction with NJ Ecological Solutions. Gate: Brenner's Gardens, Pressure treated wood: Lowes



Effects of Different Methods of Deer Management on Sapling Numbers





Possible Solutions for Forest Restoration: Hunting Programs

Recreational Hunting (Private Clubs/Permit) – Readington, Raritan, County Pks

Revenue-positive/low cost but less effective

Sharpshooters/Community-Based Deer Management – Princeton, Bernards, Millburn, Duke Farms, others

High-cost (\$208-292/deer) but very effective

Ecological Deer Management/Management Hunting – Duke Farms, HLT, FoHVOs, some County Pks

Low cost (\$30-50/deer) and very effective

Non-lethal Methods (Contraceptives) – Princeton, Rutgers, Jockey Hollow

High-cost (\$430-1,100/deer) and ineffective/experimental



Other Benefits of Intensive Deer Management – Public Safety

Case studies of Organized Hunting in NJ (deNicola et al. 2008)

Duke Farms – reduced deer from 80-350/mi² to 12/mi²

Princeton – reduced deer from 43/mi² to 17/mi²

Bernards – reduced deer from 34/mi² to 18/mi²

Proportionate Reduction in Deer Collisions
e.g., 60% Reduction in Princeton

Bernards Twp - Road kill numbers reduced
from 289 in 2001 to 49 in 2016 (-83%)





Public Education and Outreach

Importance of public outreach and evidence-based decision-making
Collect data on deer, forest regeneration, invasives &
monitor effectiveness of management



Monitoring – Evidence Based Decision-making

Figure 1. Results of Deer Spotlight Surveys in Raritan Township in April 2017

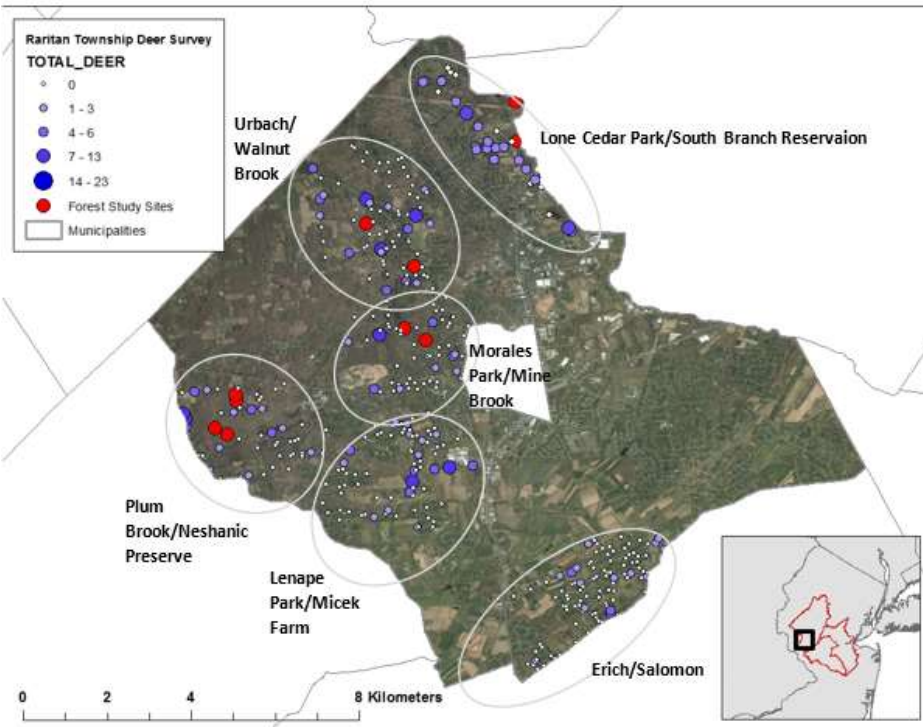
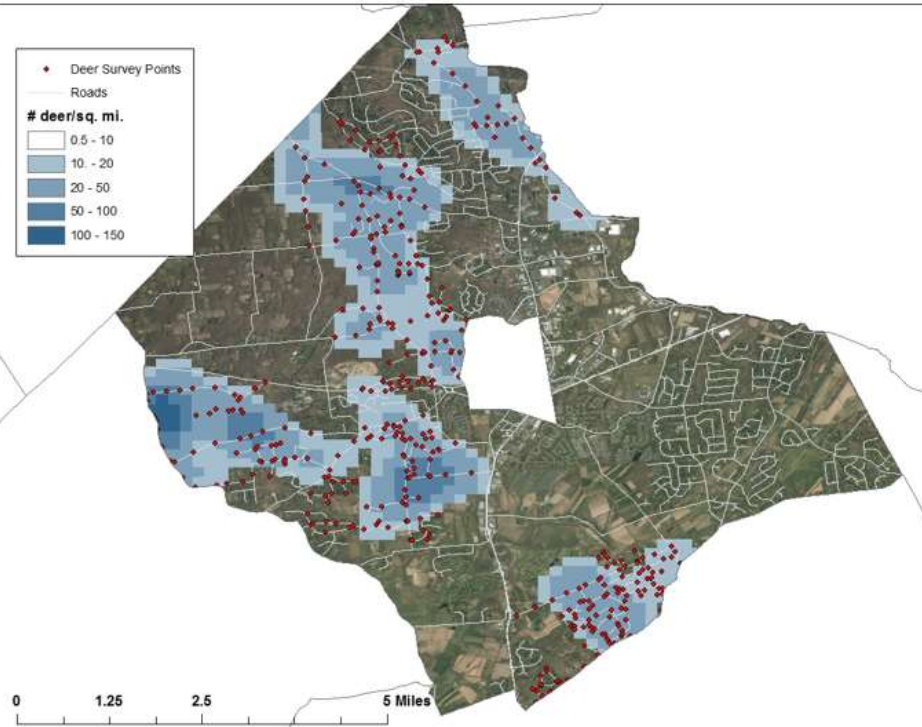
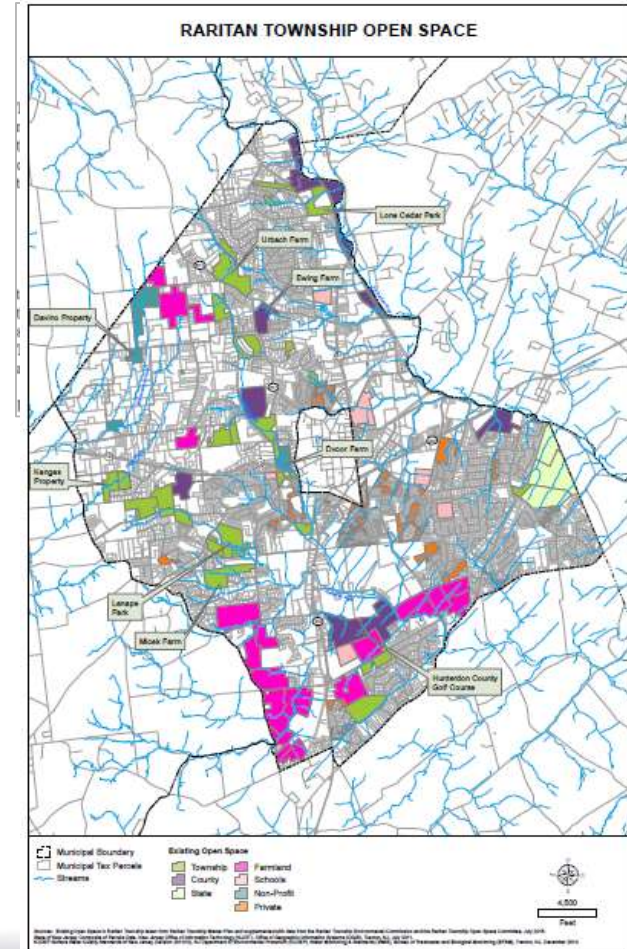


Figure 2. Map of Localized Deer Density Along Survey Routes in Raritan Township in 2017







Hunters Helping the Hungry

Since the program's inception [1997], hunters have donated over 430,000 pounds of venison to the *HHH* providing approximately 1.7 million meals to those in need (Les Giese 2017)



Donation Policy

- Deer <50 lbs costs \$30/deer to process
- Deer <50 lbs costs \$10/deer to process
- In Pennsylvania, cost is \$0



Preservation and Restoration Priorities – *Old Forests!*

Conservation Blueprint (www.njmap2.com)

Bing Maps

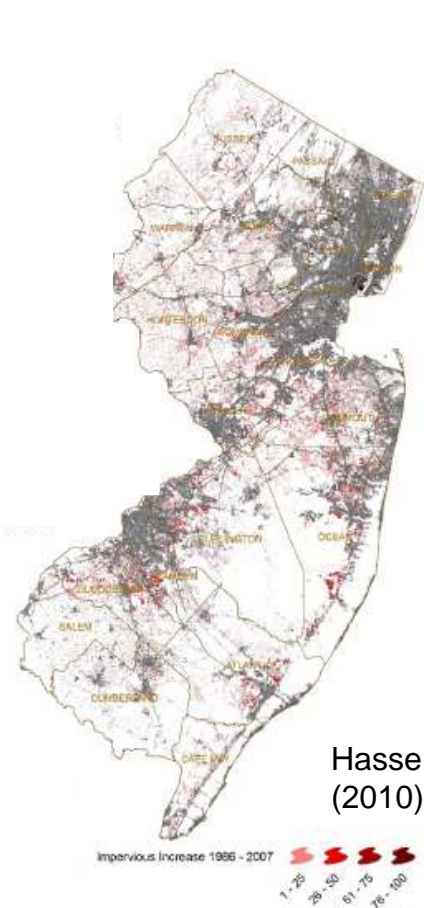
1930's Aerials

1899 Forest Map

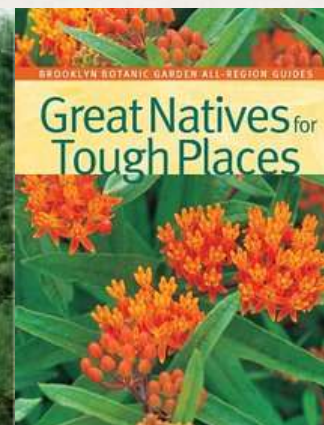
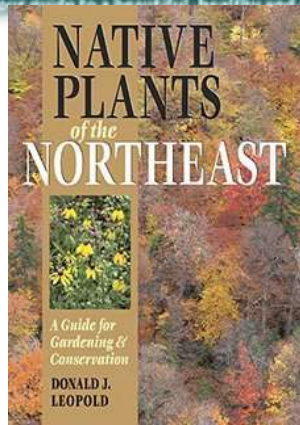


An Ounce of Prevention

Planting Natives Instead of Exotic Invasives



Hasse and Lathrop
(2010)



Wild Ridge Plants
Native Plant Nursery

NATIVE NURSERY | WHOLESALE | CONSULTING | EVENTS | ABOUT US | PORTFOLIO | RESOURCES

Native Plant Nursery



WHOLESALE
AVAILABILITY LIST

Find our current plant
availability list here

2018 NATIVE PLANT
CATALOG



<http://wildridgeplants.com/>

<http://www.toadshade.com/>

Toadshade
Wildflower Farm

NATIVE PERENNIAL PLANTS & SEEDS
NURSERY GROWN & PROPAGATED

Preserving Native Perennial Plants for 22 years!
All our plants propagated in Fretastown, NJ

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Upcoming Events

Thursday, March 27th, 2018 7:30 pm. Highland Park Chapter of the **Nature Plant Society** at C.D. Frazee Young Environmental Education Center, 20 River Road Highland Park, NJ 08904 "Native Plants and the Creatures that Love Them." Native plants and seeds will be for sale. For more information contact Mary at highlandpark@npsny.org

Thursday, March 29th, 2018 9:30 am to 12:30 pm. **Master Gardeners of Passaic County**, Passaic County Public Safety Academy, 100 Olmstead Road, Wayne, NJ 07470 "Landscaping with a Purpose: What's Diversity got to do with it?" Native plants and seeds will be for sale.

When buying wildflowers, make sure they are propagated, not removed from the wild! If you have any doubts, ask: most plant species have been down to extinction in the wild due to the collection of wild plants!

There is always music amongst the trees in the garden, but our hearts must be very quiet to hear it.

Shirley Annester

Buwan's Hill
Wildflower Preserve

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Grow Native Plants

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NATIVE PLANT NURSERY

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Native Plant Nursery

Join us for the opening of the Native Plant Nursery on April 14, 2018, during the Preserve's Spring Celebration Weekend! Learn more about this exciting event.

The Native Plant Nursery at Buwan's Hill Wildflower Preserve is open April 14 - October 31.

<https://bhwp.org/grow/native-plant-nursery/>

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Greenbelt
Native Plant Center

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Website funding provided by NYC Environmental Fund

The Greenbelt Native Plant Center is a facility of the New York City Department of Parks & Recreation. We are a 13-acre greenhouse, nursery, and seed bank complex. We are located on Staten Island, NY.

<https://www.nycgovparks.org/greening/greenbelt-native-plant-center>



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