NYBG/125

INVASIVE SPECIES SUMMIT: CHALLENGES, STRATEGIES, AND PERSPECTIVES

FRI, NOV 6, 2015

Afternoon Session C: Strategic Invasive Species Management and Restoration Practice

Co-presented with Lower Hudson Partnership for Regional Invasive Species Management

LOWER HUDSON PRISM

NEW YORK BOTANICAL GARDEN

Urban Forest Assessment: Providing a Framework for Regional Prioritization

Helen Forgione
Clara Pregitzer
November 6, 2015

Outline

Forest Assessment

Citywide Results

Framework for Prioritization

Future Applications

Natural Areas Conservancy

Central Park
Manhattan

840 acres

Central Park Conservancy

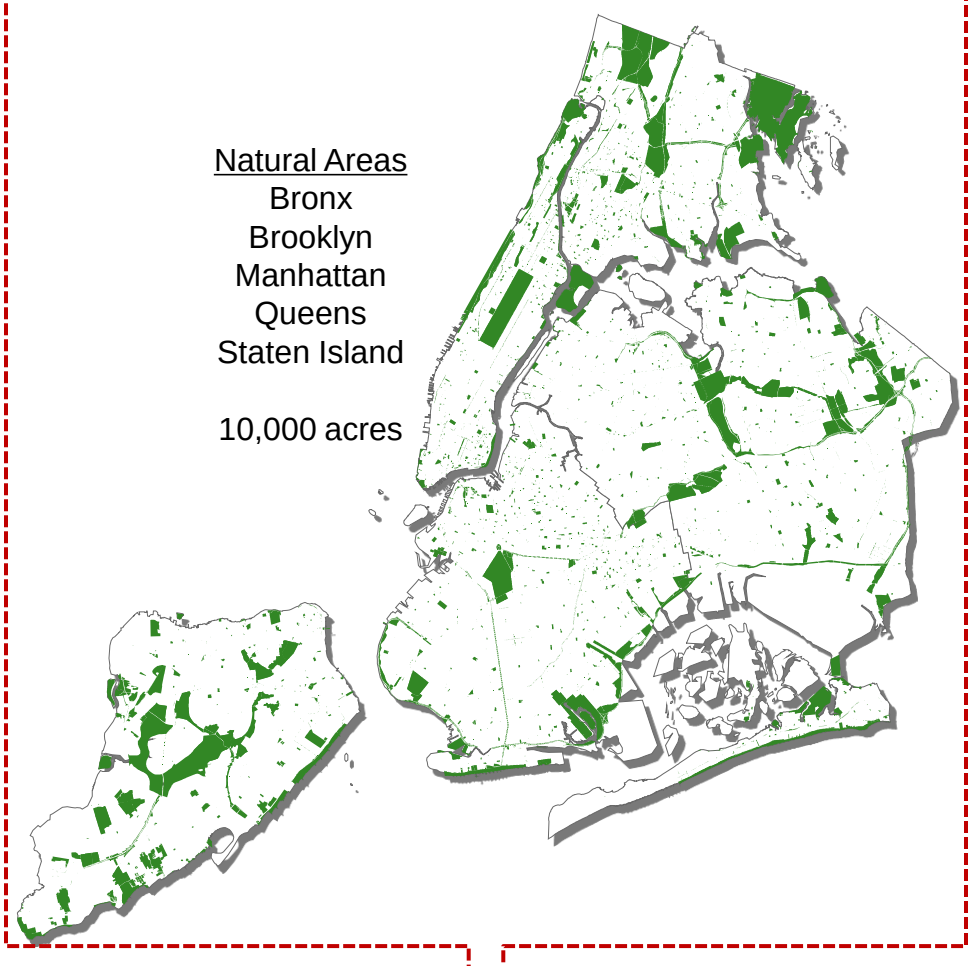
Prospect Park
Brooklyn

585 acres

Prospect Park Alliance

Natural Areas
Bronx
Brooklyn
Manhattan
Queens
Staten Island

10,000 acres



Natural Areas Conservancy

Current NYC Parks Forest Management Goals

Citywide

- Plant Tree Seedlings and Herbaceous Plants
- Reduce Invasive Species
- Create Closed Canopy Forest

Site Specific

- Preserve and protect forests by reducing dumping and arson
- Remove invasive plants and restore native forests
- Engage volunteers in restoration and stewardship of forests to increase the restoration impact

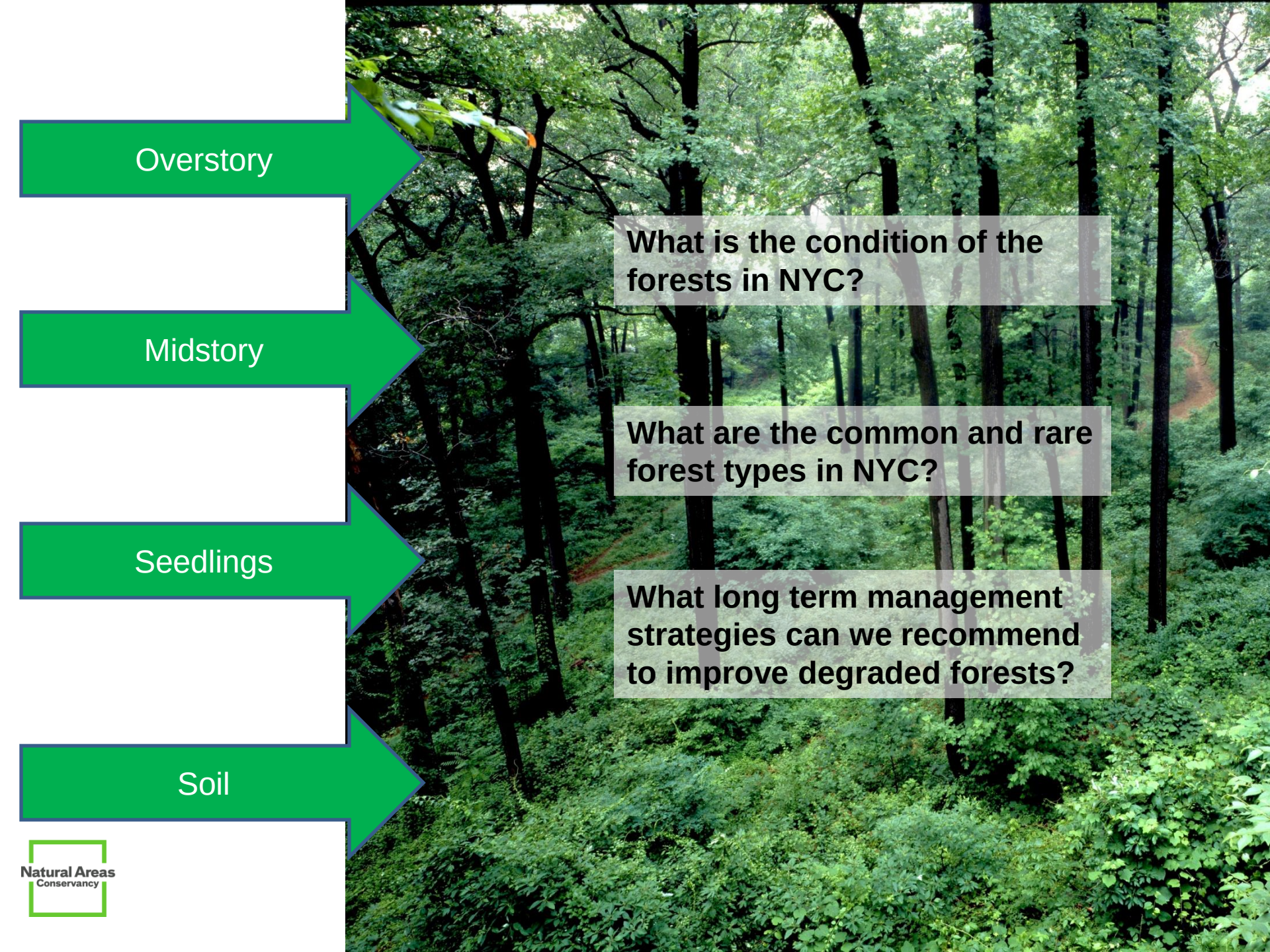
Natural Areas Conservancy

Need for a Forest Management Framework

- 30 years of active management driven by funding and programmatic opportunities.
- MillionTreesNYC program advanced best practices, but also highlighted the lack of a citywide goals and strategy for forest ecosystem management
- Limited data to describe target conditions in an urban setting- at the site level and citywide level.
- Missing framework leads to boom-bust cycle in funding and management

Natural Areas Conservancy

Natural Areas Conservancy Forest Assessment


Overstory
Midstory
Seedlings
Soil
What is the condition of the forests in NYC?
What are the common and rare forest types in NYC?
What long term management strategies can we recommend to improve degraded forests?
Natural Areas Conservancy

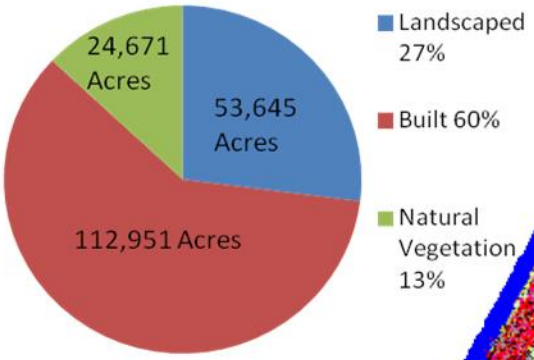
Citywide Assessment of NYC Forests

- Baseline Data: Extent of Natural Area Type
- Baseline Data: Condition of Forests
- Use Data: Comparative Analysis & Decision-making
- Use Data: Establish Management Priorities
- Use Data: Set Quantitative Management Targets & Goals

Natural Areas Conservancy


Citywide Assessment Results

Percent of NYC Landcover



- Other Tree Canopy
- Maintained Lawn\Shrubs
- Bare Soil
- Water
- Buildings
- Roads\Railroads
- Other Paved Surfaces
- Atlantic and Gulf Coastal Plain Freshwater Tidal Marsh
- Atlantic and Gulf Coastal Plain Pondshore and Wet Prairie Group
- Eastern North American Wet Meadow
- Eastern North American Freshwater Marsh
- Northern and Central Shrub Swamp Group
- Eastern North American Lake Flat and Beach
- Northern and Central Ruderal Wet Meadow and Marsh
- North American Atlantic Brackish Tidal Marsh
- North American Atlantic High Salt Marsh
- North American Atlantic Low Salt Marsh
- North American Atlantic Tidal Flat and Panne
- North and Central Ruderal Meadow and Shrubland
- Northern and Central Sand Barrens Group
- Eastern Coastal Beach Group
- Northern Atlantic Dune and Coastal Grassland and Shrubland
- Eastern North American Freshwater Aquatic Vegetation
- Rockweed
- Coastal Plain Hardwood Swamp
- Silver Maple-Green Ash-Sycamore Floodplain
- Northern and Central Conifer and Hardwood Acidic Swamp
- Northern and Central Hardwood and Conifer Ruderal Forest
- Northern and Central Conifer and Hardwood Plantation
- Mid-Atlantic Mesic Mixed Hardwood Forest
- Coastal Oak-Hickory Forest
- Serpentine Forest
- Post Oak-Blackjack Oak Barrens
- Oak-Tulip Forest
- Hemlock-Northern Hardwood Forest
- Maritime Post Oak Forest
- Maritime Shrubland and Successional Maritime Forest

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0 1 2 4 Miles

N W E S

Most Common Forest Trees Citywide

Sweetgum, Black Cherry, Red Oak, Red Maple, Sassafras

Bronx
Black Cherry
Black Locust
Red Oak
Bitternut Hickory
Sassafras

Brooklyn
Black Cherry
Black Locust
White Mulberry
Tree of Heaven
Ash

Manhattan
Black Cherry
Red Oak
Sassafras
Black Locust
Tulip-tree

Queens
Sweetgum
Red Maple
Red Oak
Sassafras
Pin Oak

Staten Island
Sweetgum
Red Maple
Red Oak
Sassafras
Pin Oak

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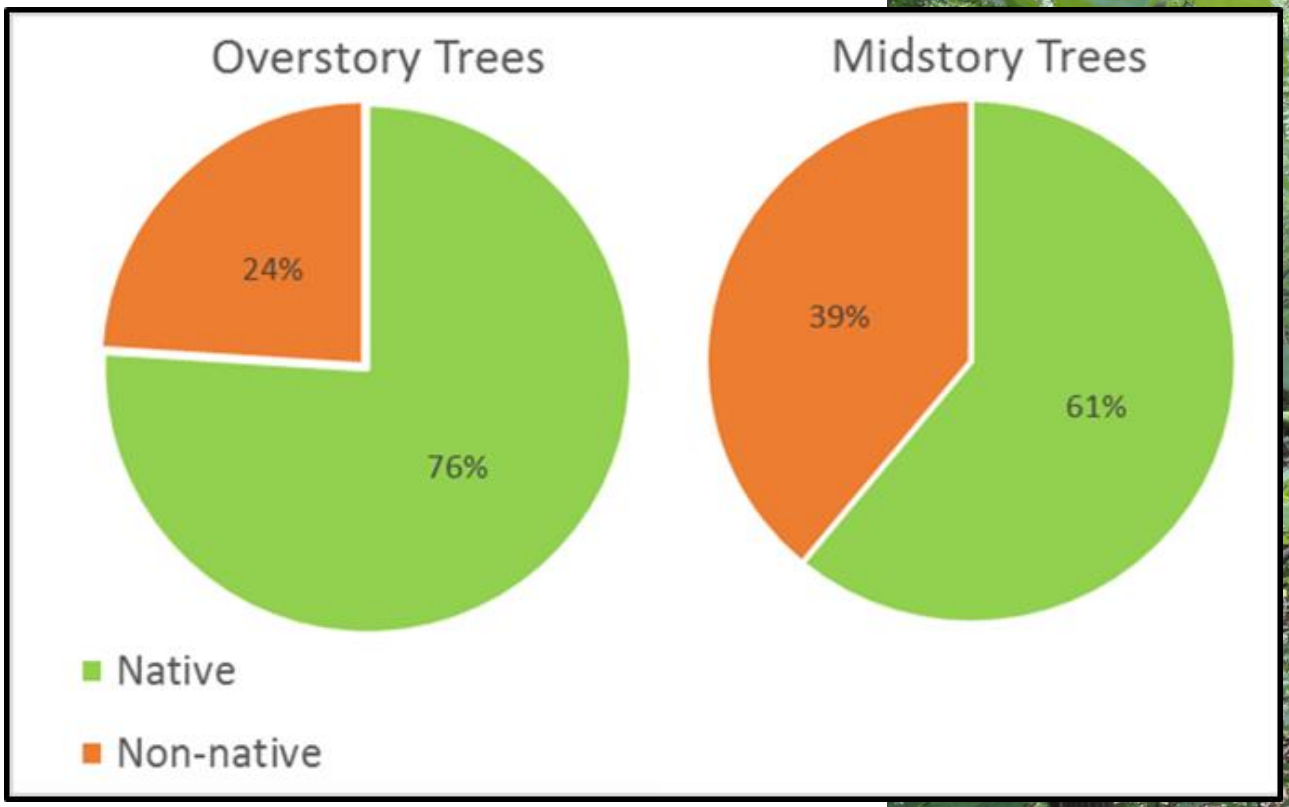
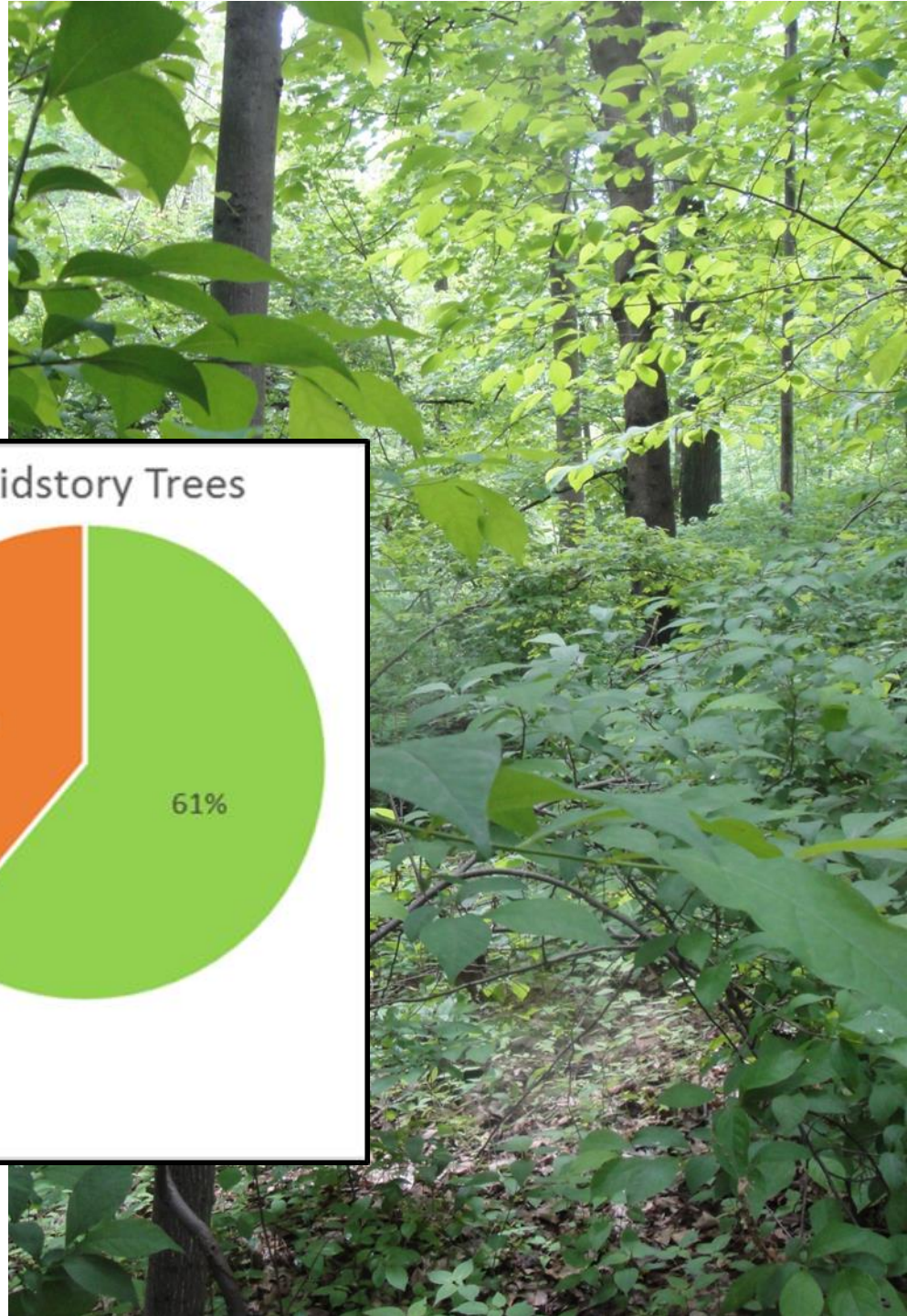
Forest Conditions

What will our Forest look like in the future?

15% difference in Native Tree Species from Overstory to Midstory Trees





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Ecological Assessment Mean Percent Overstory Trees with Invasive Vines by Park

Mean Percent

- 0 - 10%
- 10.1 - 20%
- 20.1 - 30%
- 30.1 - 40%
- 40.1 - 50%
- 50.1 - 60%
- 60.1 - 70%
- 70.1 - 80%
- 80.1 - 90%
- > 90%
- Other NYC Parks

0 12,500 25,000 Feet

N

Natural Areas Conservancy

Map created January 15, 2015

Invasive Vines

Ecological Assessment Mean Percent Native Overstory Species by Park

Assessment Parks

Mean Percent Native Species

- 14.34 - 20%
- 21 - 30%
- 31 - 40%
- 41 - 50%
- 51 - 60%
- 61 - 70%
- 71 - 80%
- 81 - 90%
- 91 - 100%
- Other NYC Parks

0 12,500 25,000 Feet

N

Natural Areas Conservancy

Map created January 15, 2015

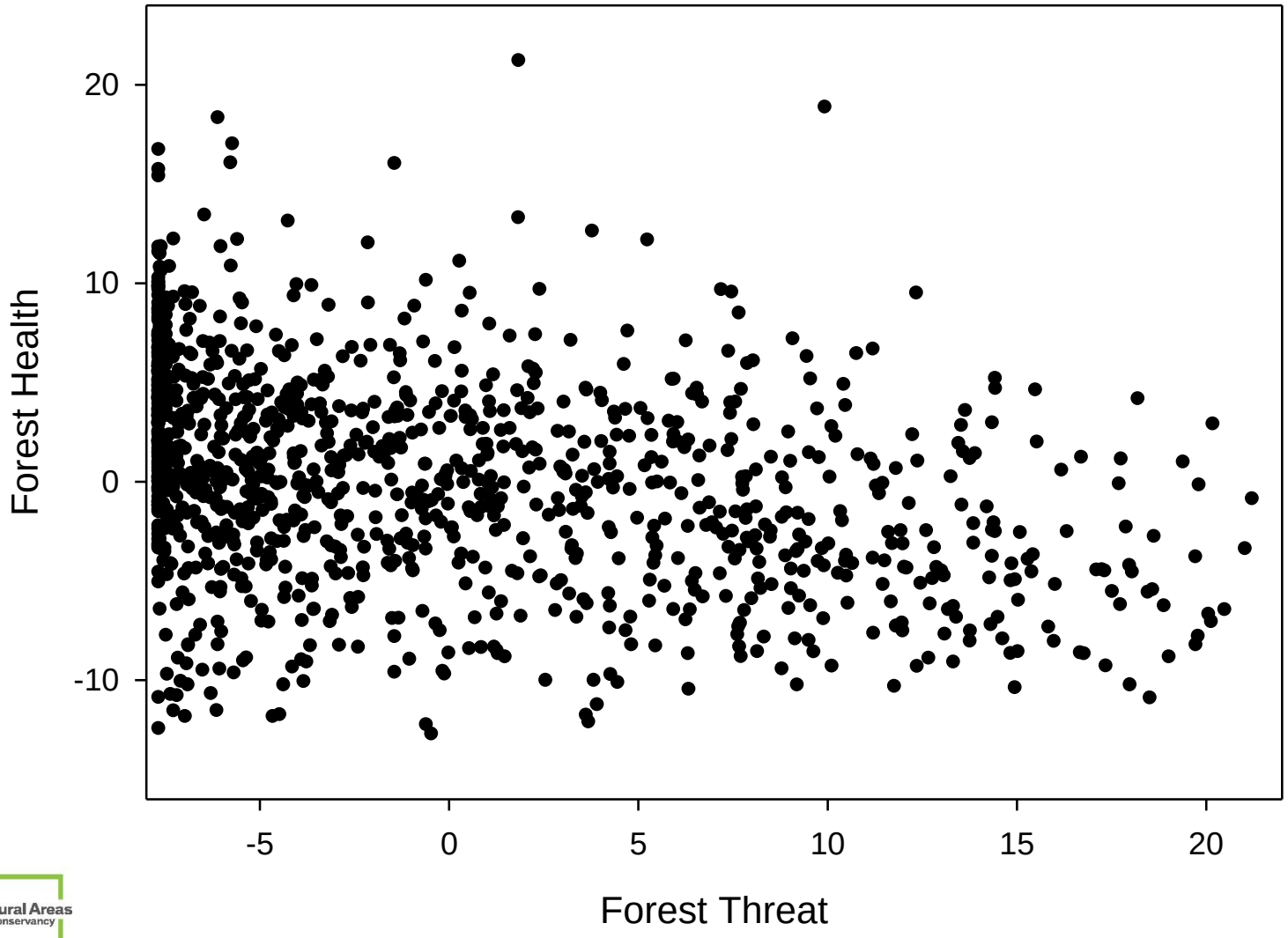
Native Canopy

Framework for Prioritization

Natural Areas Conservancy

What is the Condition of New York City's Forest?

Forest Health/Threat Matrix



Natural Areas Conservancy

What is the Condition of New York City's Forest?

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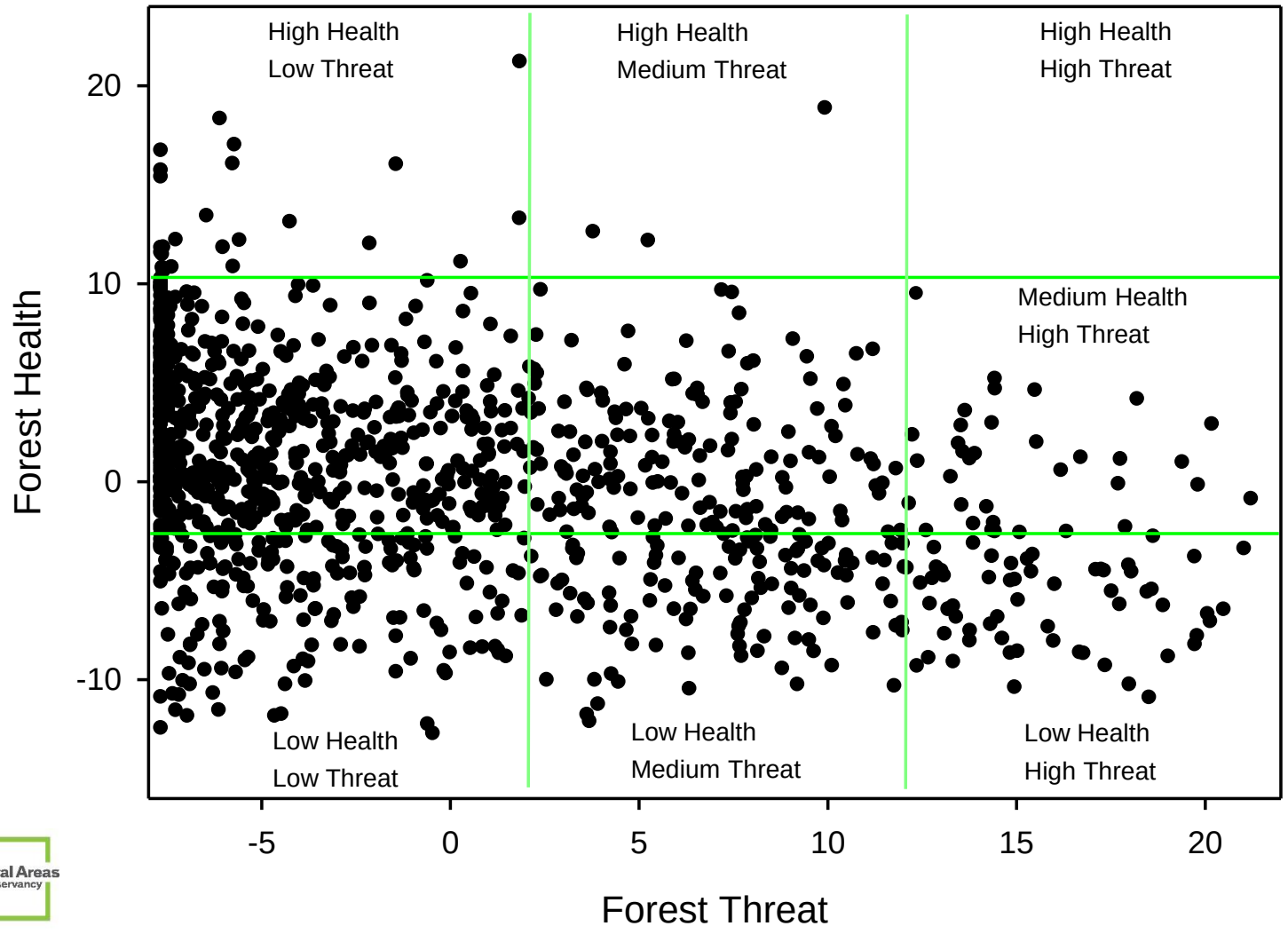

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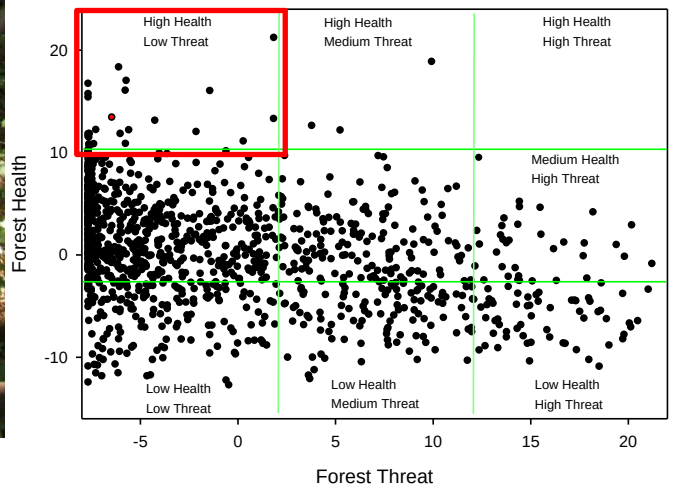
High Health/Low Threat

Van Cortlandt Park, Bronx

Health	
Native Basal Area/Ha	35.7
Native Midstory stems/ha	31.84
Native Tree Seedling/Ha	60,000
% Native Species Richness	75%
% Canopy Closure	84%
Average Leaf Litter Depth (cm)	2.08
% Native understory cover	92%
Threat	
% Overstory tree with invasive vine	0%
% Dumping	0%
Invasive Midstory stems/ha	31.84
% Invasive understory cover	7%



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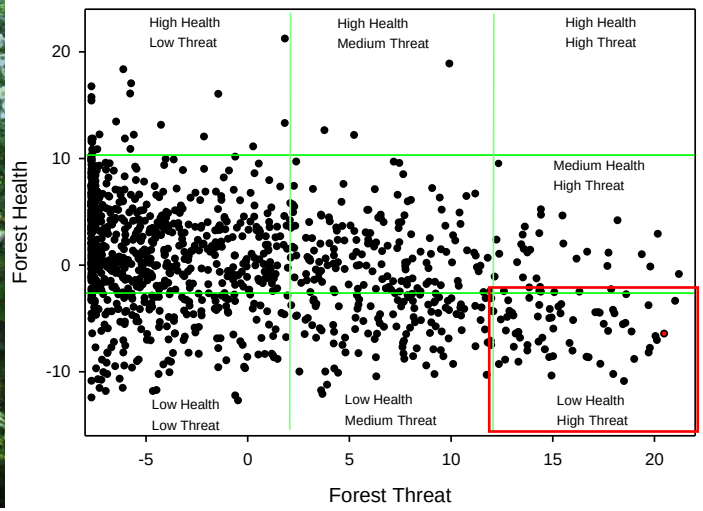
Low Health / High Threat

Alley Pond Park, Queens

Health	
Native Basal Area/Ha	15.28
Native Midstory stems/ha	191.08
Native Tree Seedling/Ha	625
% Native Species Richness	35.29%
% Canopy Closure	84%
Average Leaf Litter Depth (cm)	3.14
% Native understory cover	11%
Threat	
% Overstory tree with invasive vine	100%
% Dumping	0
Invasive Midstory stems/ha	414.01
% Invasive understory cover	88%



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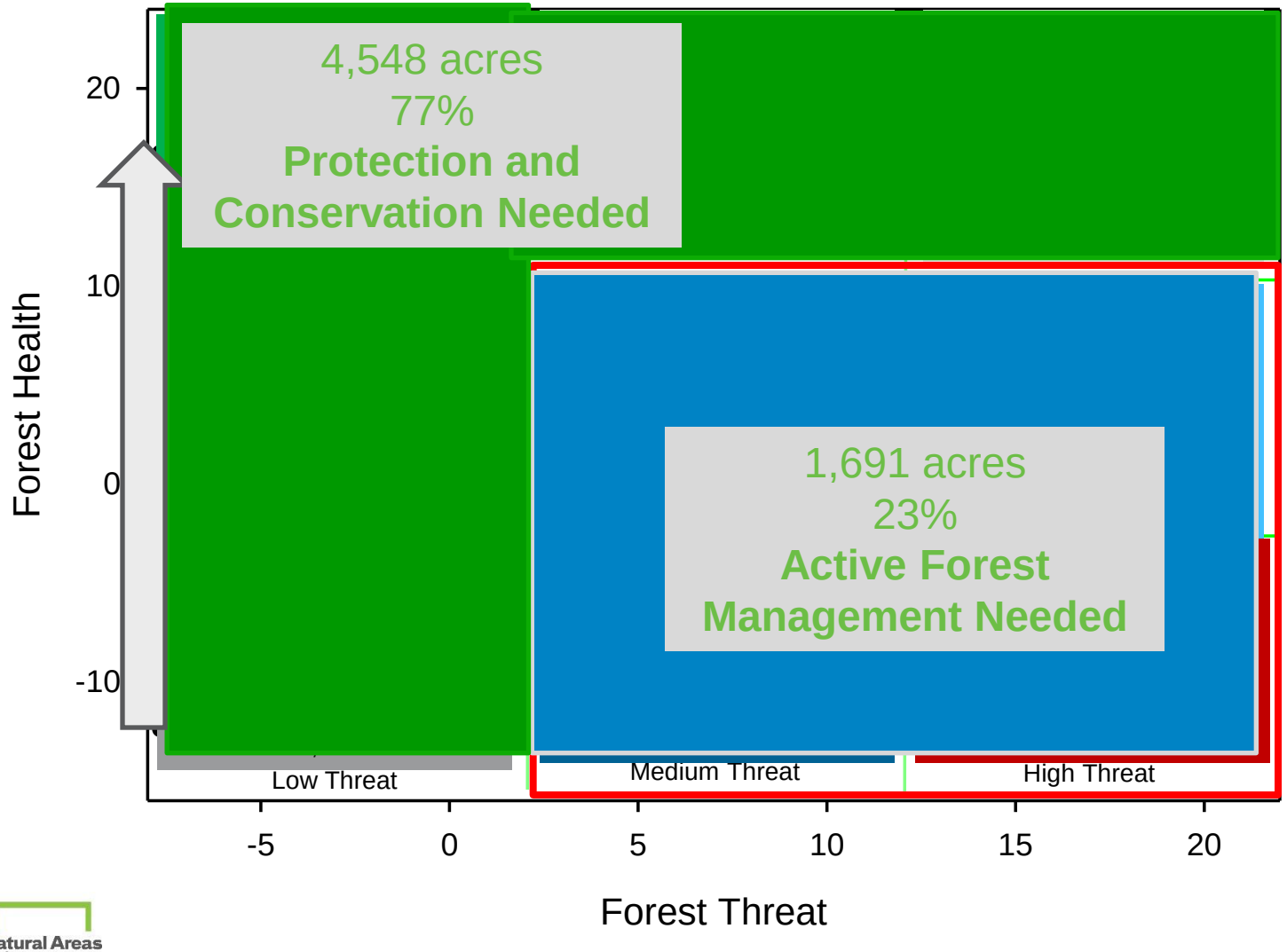
Future Applications

Strategic Forest Management

Forest Health/Threat Matrix
Preliminary Results



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Site Management Approaches

Site Management Approaches

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0 500 1,000 Feet

In Summary. . .

- NAC has developed and is using data to inform current restoration projects, and to select future work locations
- NAC goal to collaborate with NYC Parks to create a Long-term Citywide Forest Management Plan focusing on ecology, engagement, and policy
- Enable more reliable and predictable funding

Natural Areas Conservancy

Funding provided by:
Doris Duke Charitable Foundation
Tiffany & Co. Foundation
Mayor's Fund to Advance New York City

Thanks to:
NAC field biologists
USDA Forest Service
NYC Parks Natural Resources Group.

Visit us at:

www.naturalareasnyc.org

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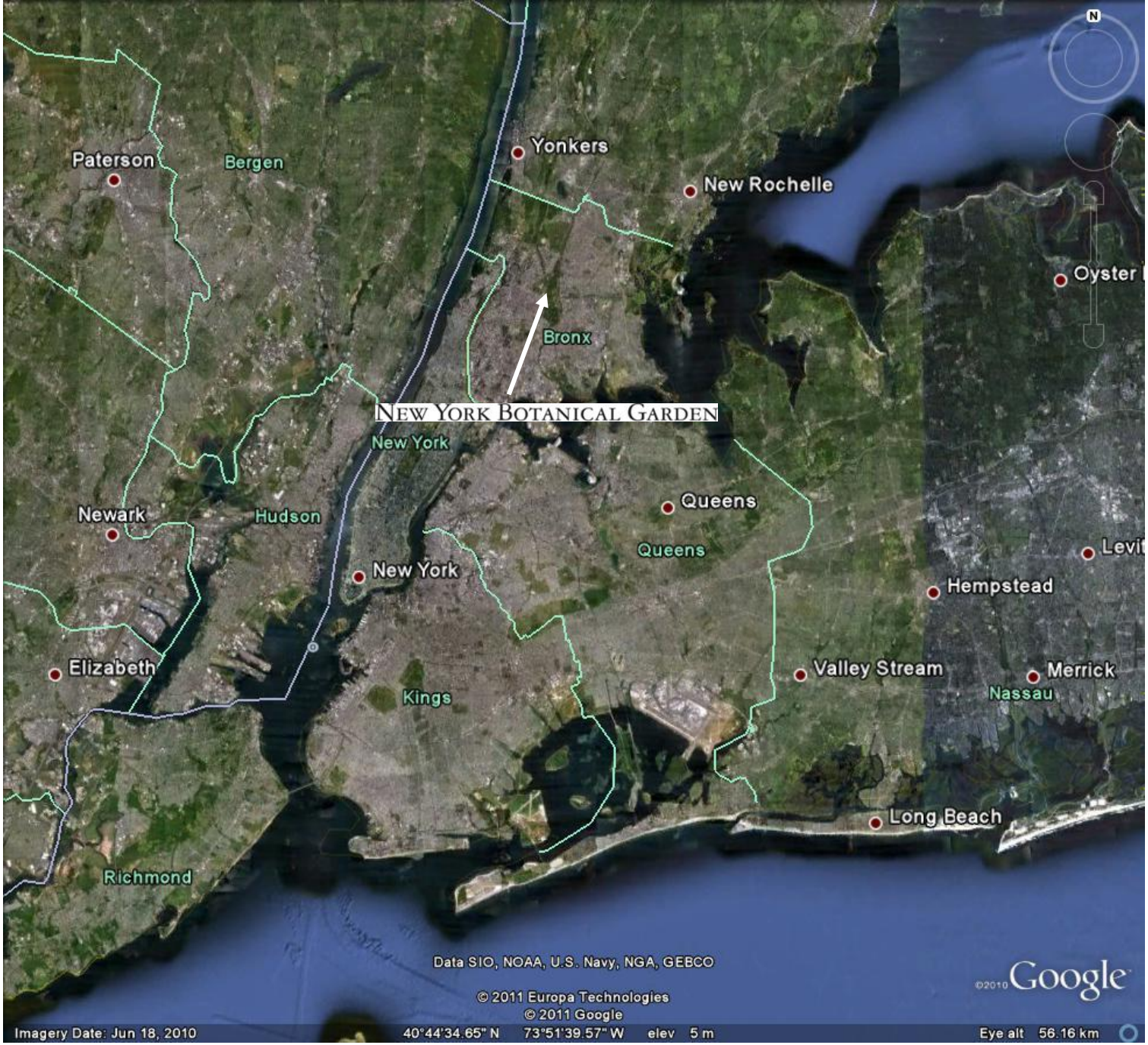
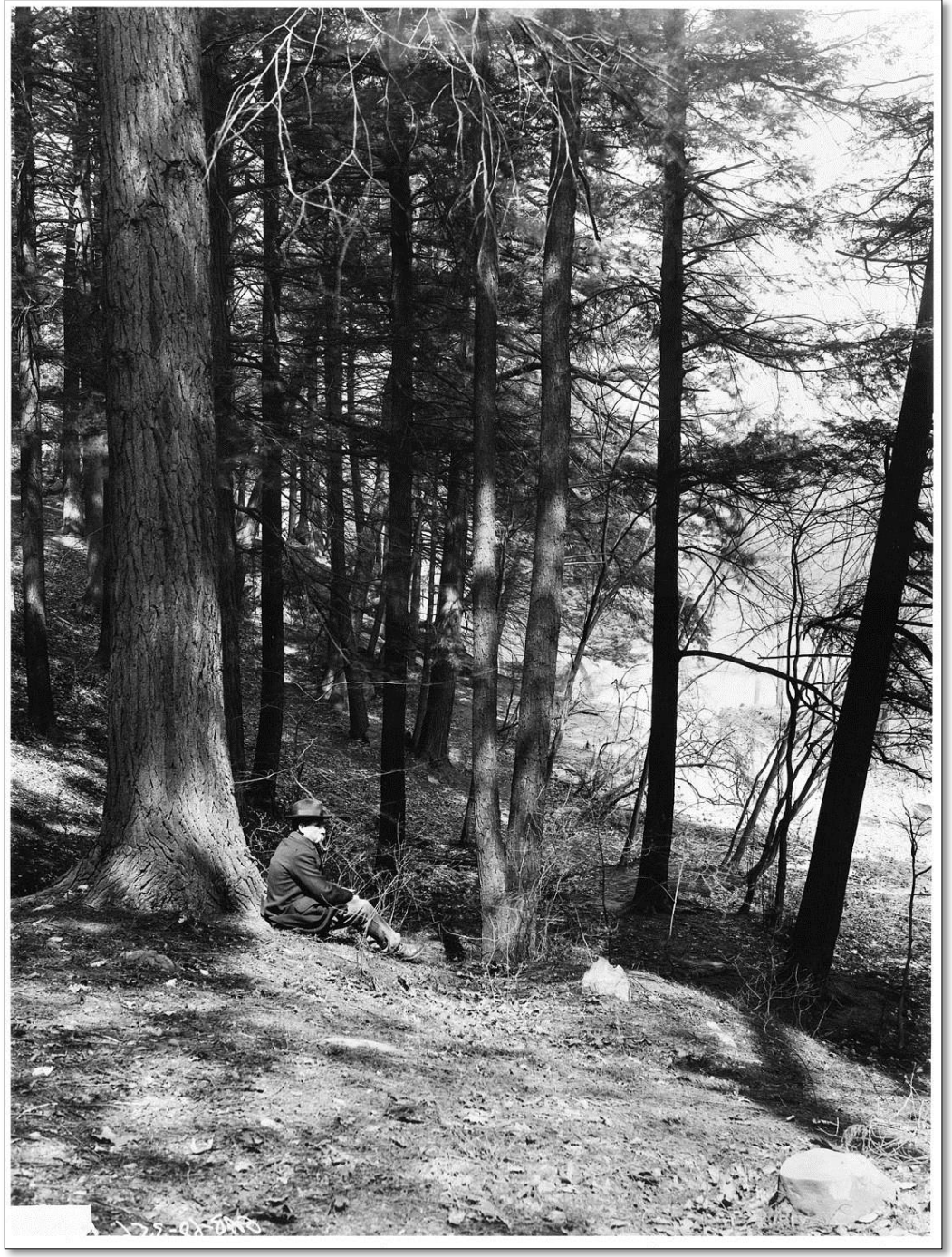
LOWER HUDSON PRISM

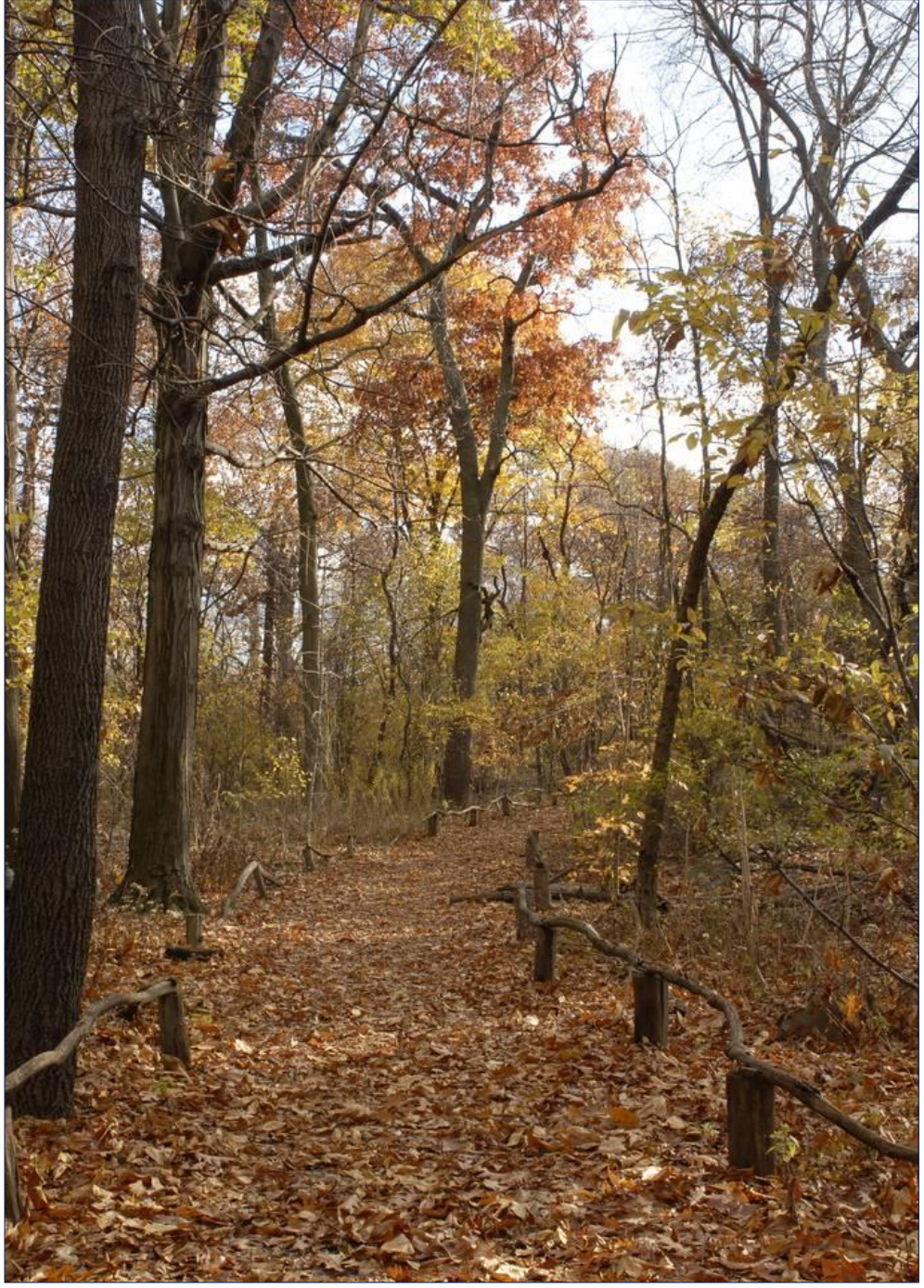
NEW YORK BOTANICAL GARDEN

Restoring a 50 acre Urban, Old Growth Forest

Jessica Arcate Schuler
jarcate@nybg.org


Paterson
Bergen
Yonkers
New Rochelle
Oyster
Bronx
NEW YORK BOTANICAL GARDEN
New York
Newark
Hudson
Queens
Queens
New York
Hempstead
Elizabeth
Valley Stream
Merrick
Nassau
Kings
Long Beach
Richmond
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2011 Europa Technologies
© 2011 Google
©2010 Google
Imagery Date: Jun 18, 2010
40°44'34.65" N
73°51'39.57" W
elev 5 m
Eye alt 56.16 km





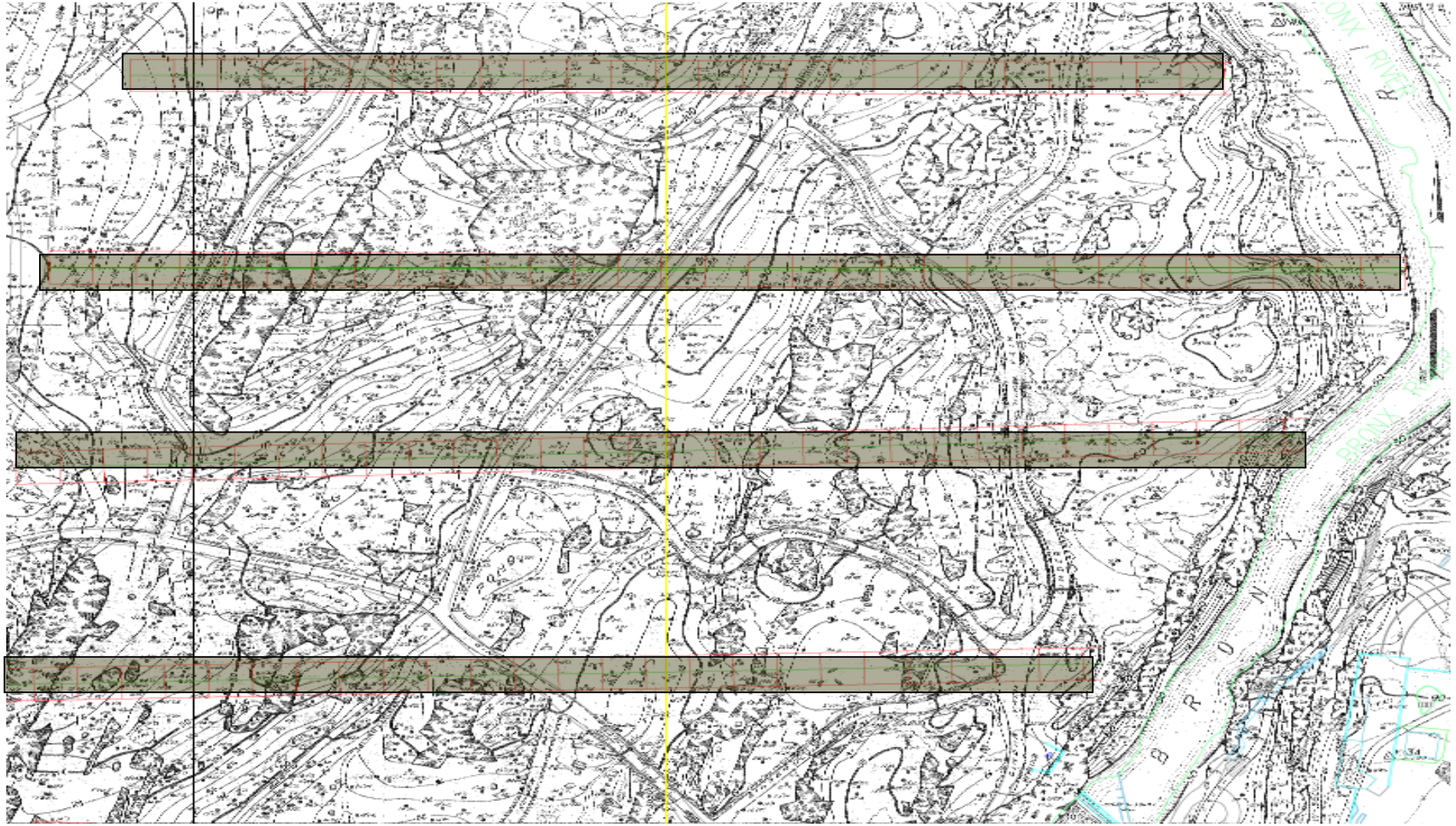
Forest Restoration Goals (2008-2015)

1. Improve forest health through active management informed by research.
2. Improve visitor access through trail restoration and maintenance.
3. Educate Garden visitors about local, regional, national, and global importance of forests through interpretive signage, workshops, classes, symposia, and publications.
4. Use the Forest as an outdoor living laboratory to study the impacts of the urban environment and environmental change on biodiversity, forest health, and ecosystem processes.
5. Document the Forest's unique and changing biodiversity.

Active Management Informed by Research

1. Forest Inventory
2. Analyze Data
3. Establish Priority Species and Management Areas
4. Manage with BMPs
5. Restore
6. Repeat

Forest Inventory



Forest Inventory

Forest Intern measures the diameter at breast height (DBH) of a tree.

TRANSECT DATA SHEET FOR THE NYBG FOREST SURVEY 2011

Transect: _____ Plot: _____

Collected by: _____

Date: _____/_____/___2011__

Indicate the Following

Tree Vigor: Live = 1-3 Dead = 4

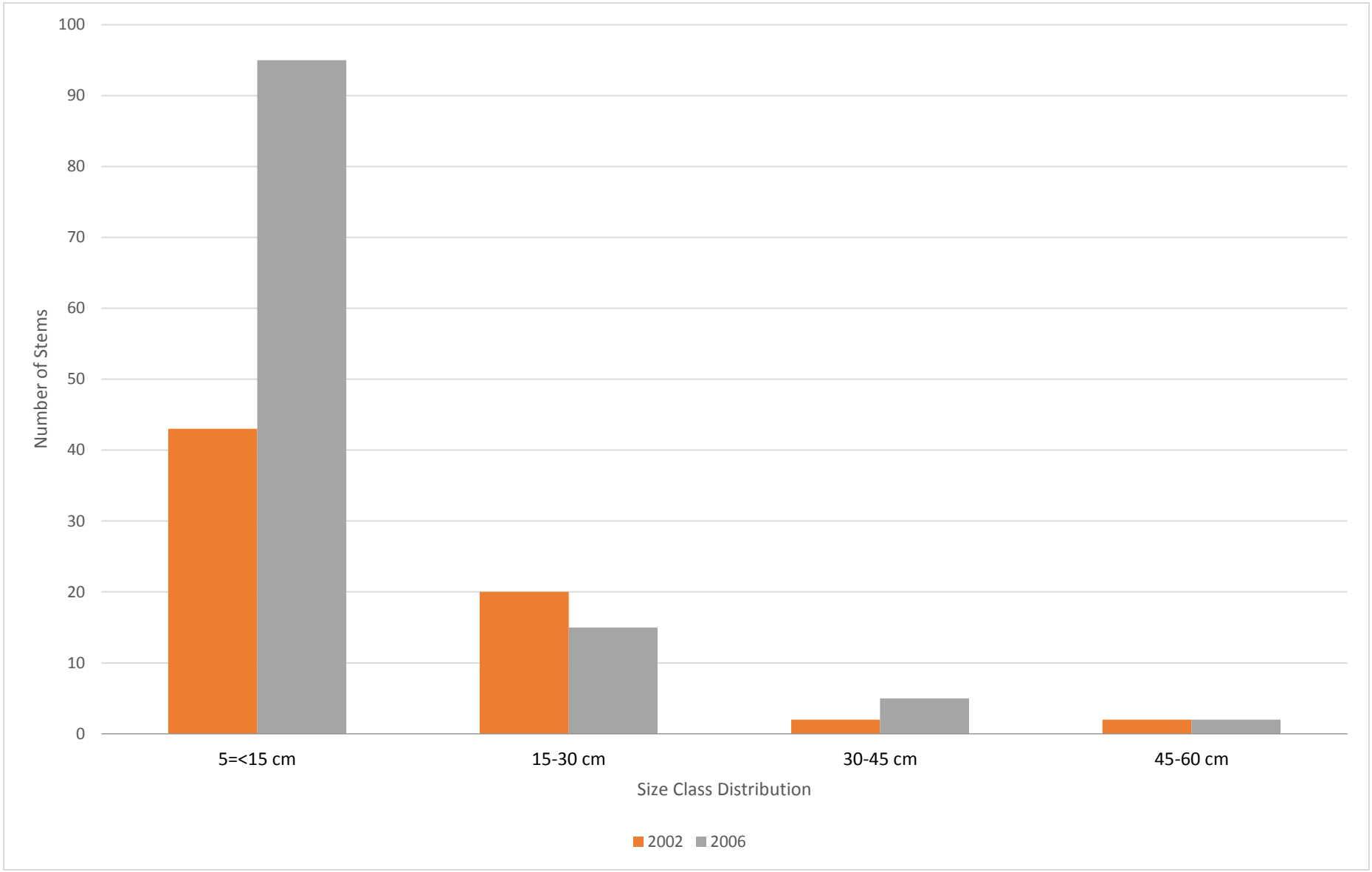
Crown Class: D/C/S

Topographic Relief:
Top (t) Slope (s) Bottom (b) Concave(c)
Convex (x) Flat (f)

Other Features: Road (r) Path (p) with % of plot
Fallen Trees(ft) with % of plot
Herbs/Invasives (h/i) with % of plot (ID)

ıt #	Plot Slope	N/S	Tree#	Species	DBH (cm)	Stem	Tree Vigor	Crown Class	Notes

Amur Cork Tree Canopy Change 2002-2006



History of Introduction of Invasive Species to the Garden

1. *Viburnum dilatatum*, Linden Viburnum **(1895)**
2. *Phellodendron amurense*, Amur Cork Tree **(1896)**
3. *Aralia elata*, Japanese Angelica Tree **(1901)**
4. *Reynoutria japonica*, Japanese Knotweed **(1905)**
5. *Cryphonectria parasitica*, Chestnut Blight **(1905)**
6. *Ficaria verna*, Lesser Celandine **(1921)**
7. *Pyrrhalta viburni*, Viburnum Leaf Beetle **(2008)**

Phellodendron amurense

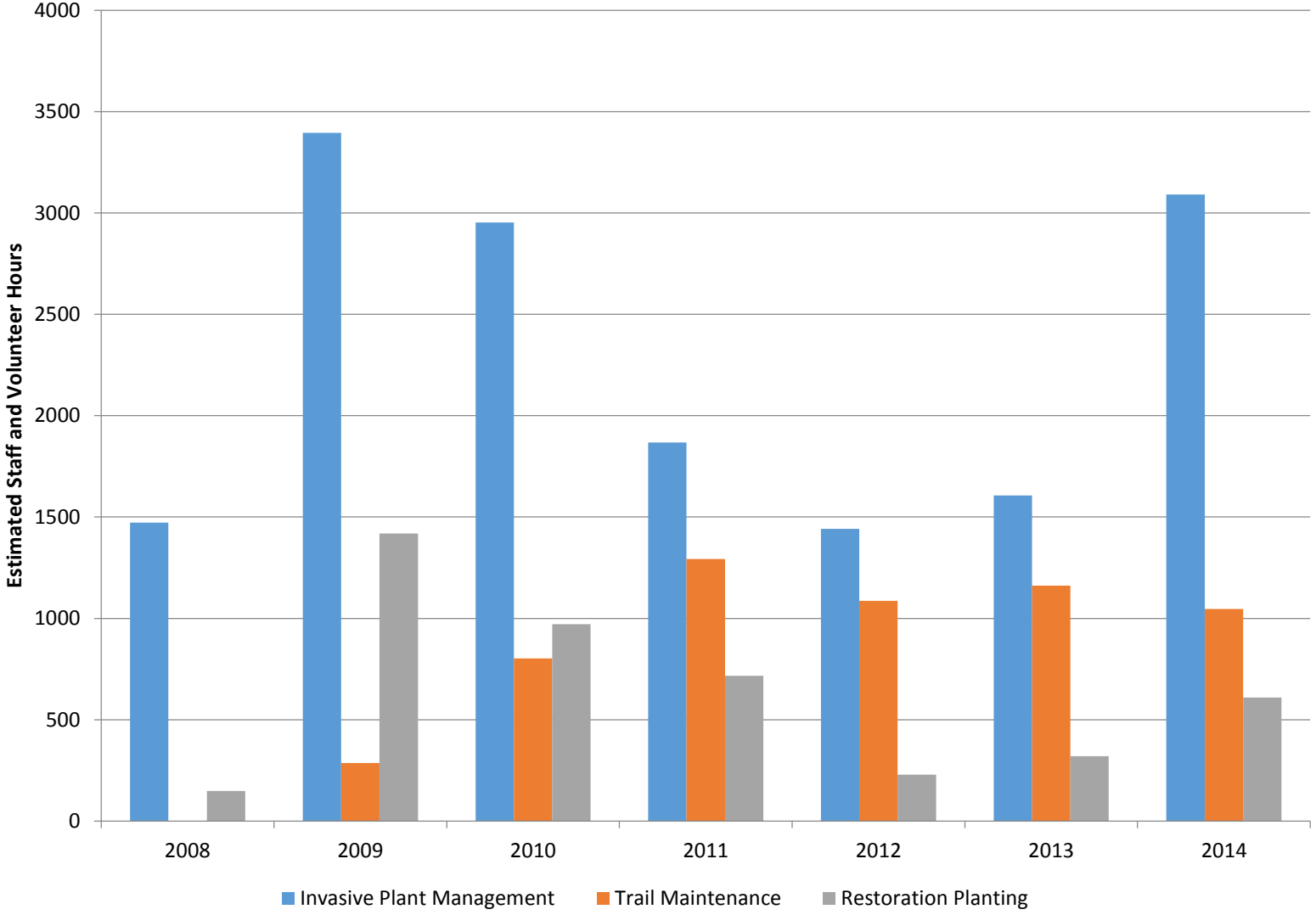
Amur cork tree

Removed/Injected
800 Trees
6 inches >= DBH

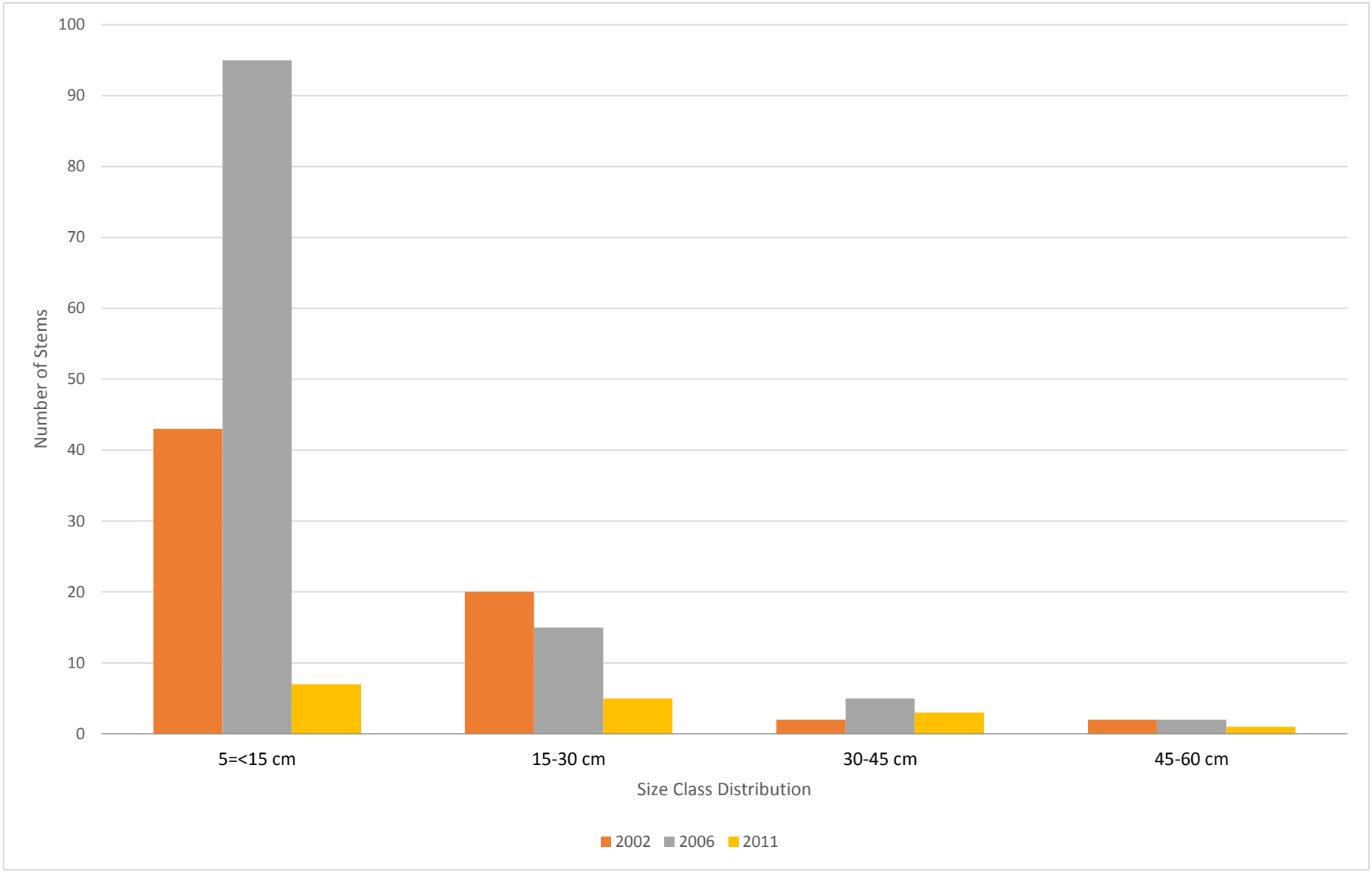
Restoration Plantings 2008 to 2014 in the Thain Family Forest

20459	TOTAL
7446	Trees
1491	Shrubs
11515	Herbs

Top 3 Forest Restoration Tasks 2008-2014



Amur Cork Tree Canopy Change 2002-2011



Change in Amur Cork Tree Stem Density 2006-2011

Amur Cork Tree Stem Density (No. of Stems/100 m²)

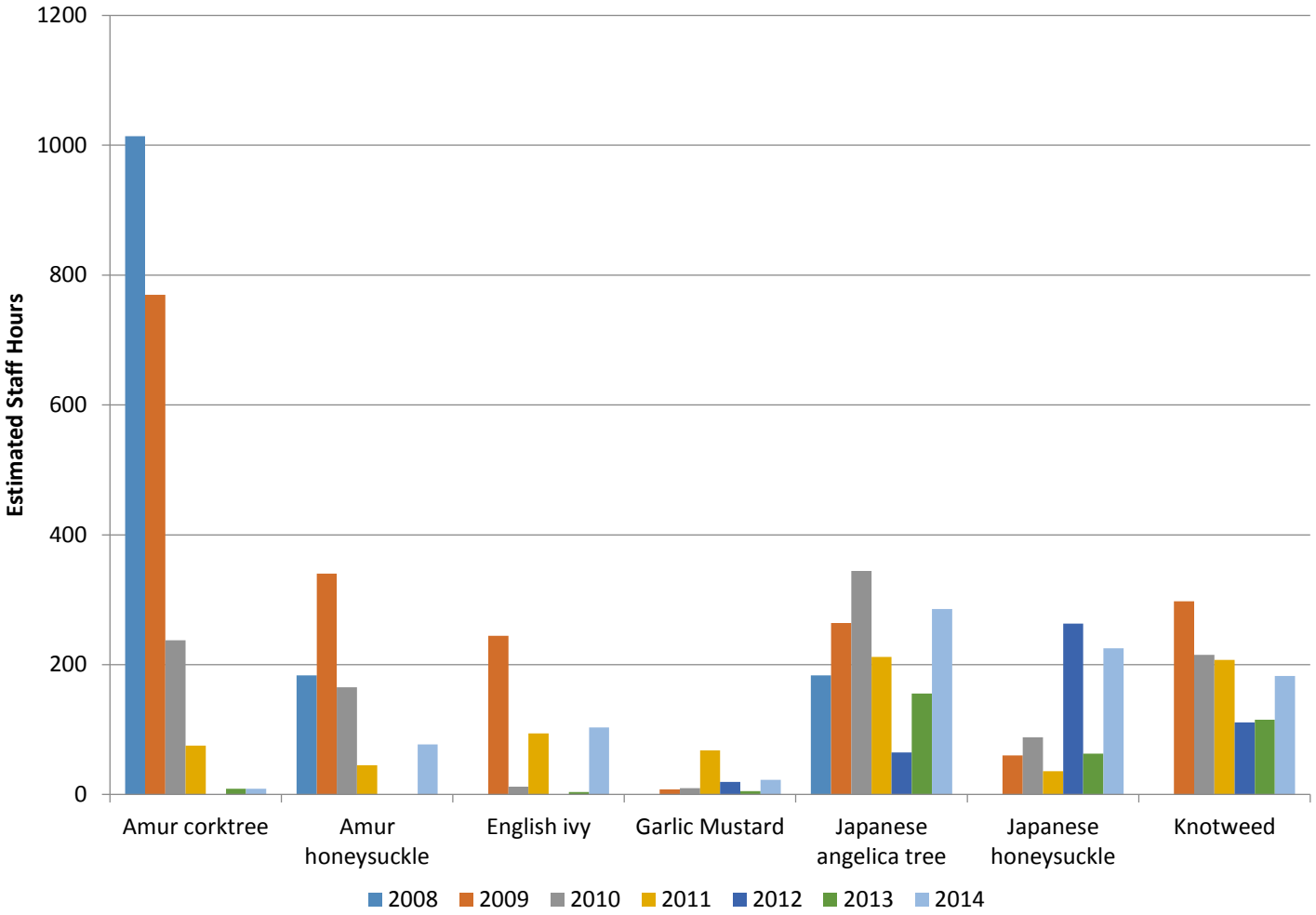
0 - 2	4.01 - 5	7.01 - 8
2.01 - 3	5.01 - 6	8.01 - 9
3.01 - 4	6.01 - 7	9.01 - 10

0 70 140 280 Feet

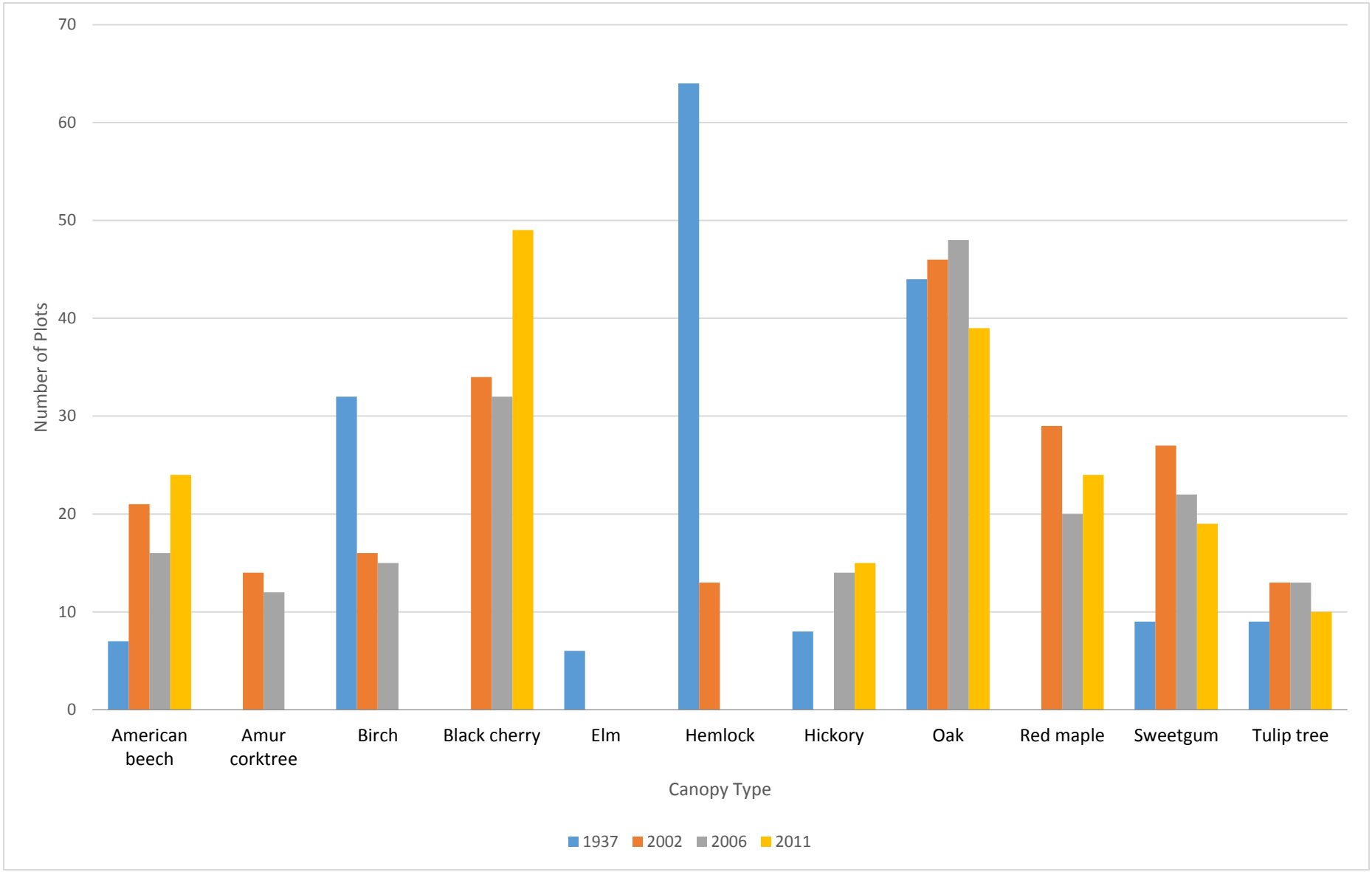
N

Change in Japanese Angelica Tree Stem Density 2006-2011

Management of Key Invasive Plant Species



Forest Canopy Change (1937-2011)



Data Analysis performed by S. Kuebbing, 2015

Visit the Forest Website:

http://www.nybg.org/gardens/thain-family-forest/

Jessica A. Schuler
Director of the Thain Family Forest
jarcate@nybg.org
(718) 817-8061

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LOWER HUDSON PRISM

NEW YORK BOTANICAL GARDEN

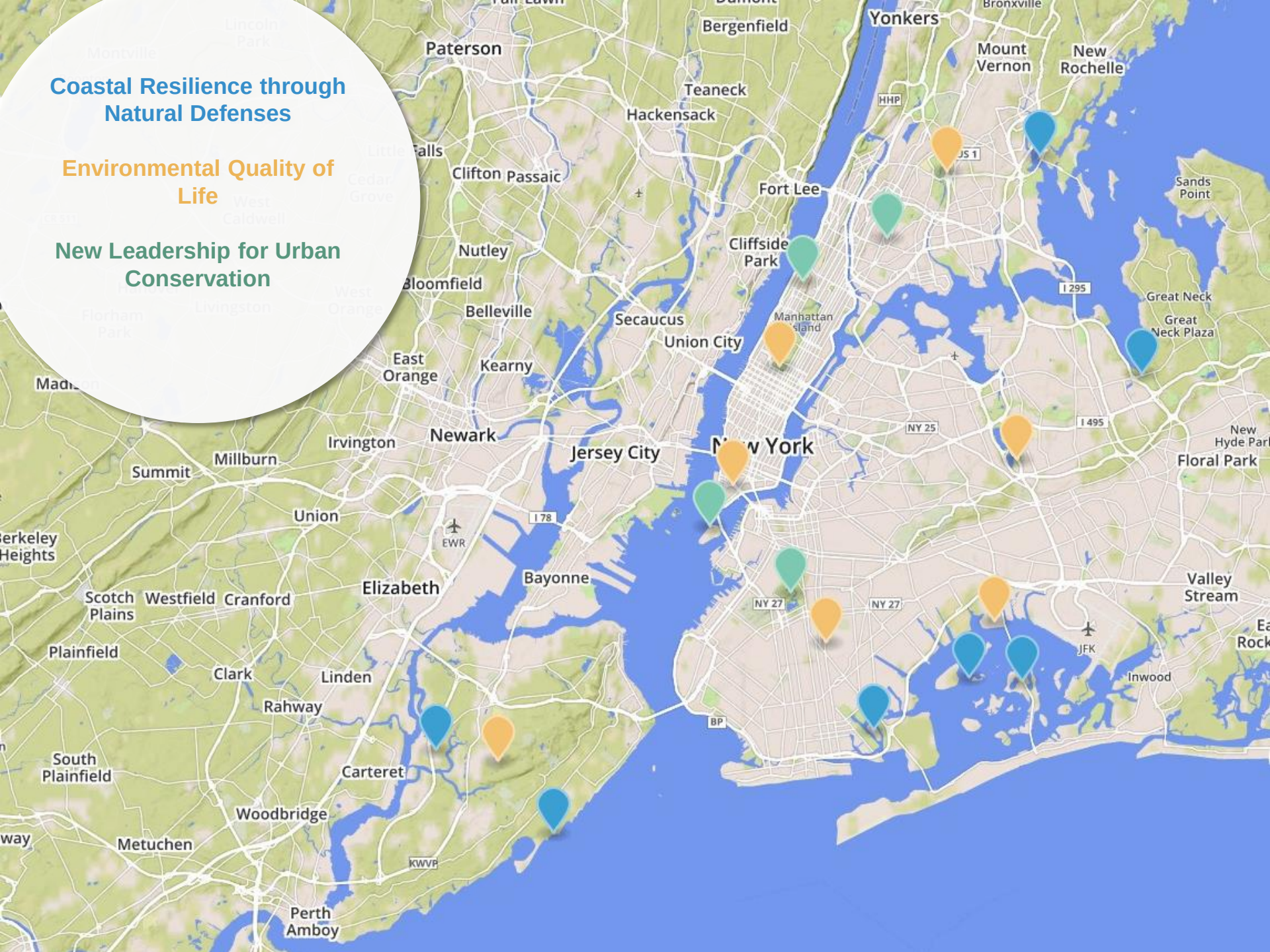
The Nature Conservancy

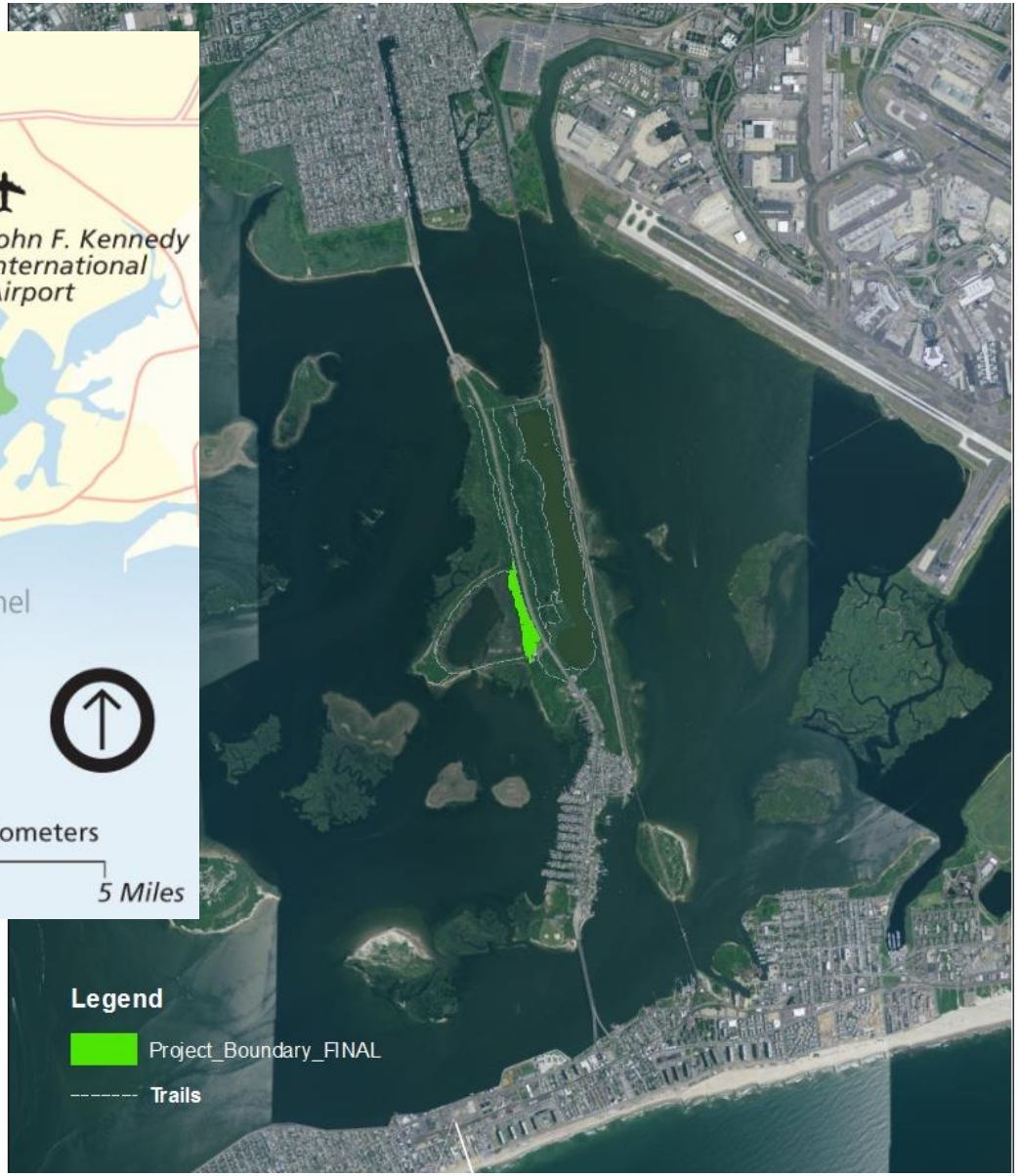
Restoring Maritime Forest for Songbirds in Jamaica Bay Wildlife Refuge

NEW YORK CITY PROGRAM

The Nature Conservancy

Protecting nature. Preserving life.


Coastal Resilience through Natural Defenses
Environmental Quality of Life
New Leadership for Urban Conservation
Paterson
Bergenfield
Yonkers
Mount Vernon
New Rochelle
Teaneck
Hackensack
Clifton
Passaic
Fort Lee
Sands Point
Cliffside Park
Nutley
Bloomfield
Belleville
Secaucus
Union City
Manhattan
Great Neck
Great Neck Plaza
East Orange
Kearny
Newark
Irvington
Jersey City
New York
Floral Park
Millburn
Summit
Union
Elizabeth
Bayonne
Scotch Plains
Westfield
Cranford
Plainfield
Clark
Linden
Rahway
Valley Stream
Inwood
South Plainfield
Carteret
Woodbridge
Metuchen
Perth Amboy
EWR
JFK
I 78
I 295
I 495
NY 25
NY 27
HHP
BP
KWVP



NATIONAL PARK SERVICE

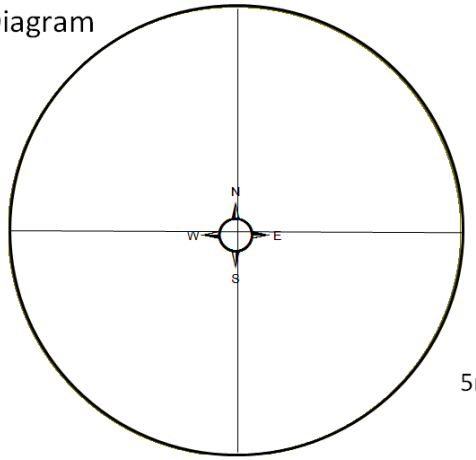
JAMAICA BAY-ROCKAWAY PARKS CONSERVANCY

The Nature Conservancy

EXISTING CONDITIONS

- Vegetation structure, diversity (27)
- Soil nutrients, texture, salinity (27)
- Bird abundance and diversity (9)
- Pollinator abundance and diversity (14 ac)

Plot Diagram



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Monitoring canopy, midstory, and understory layers

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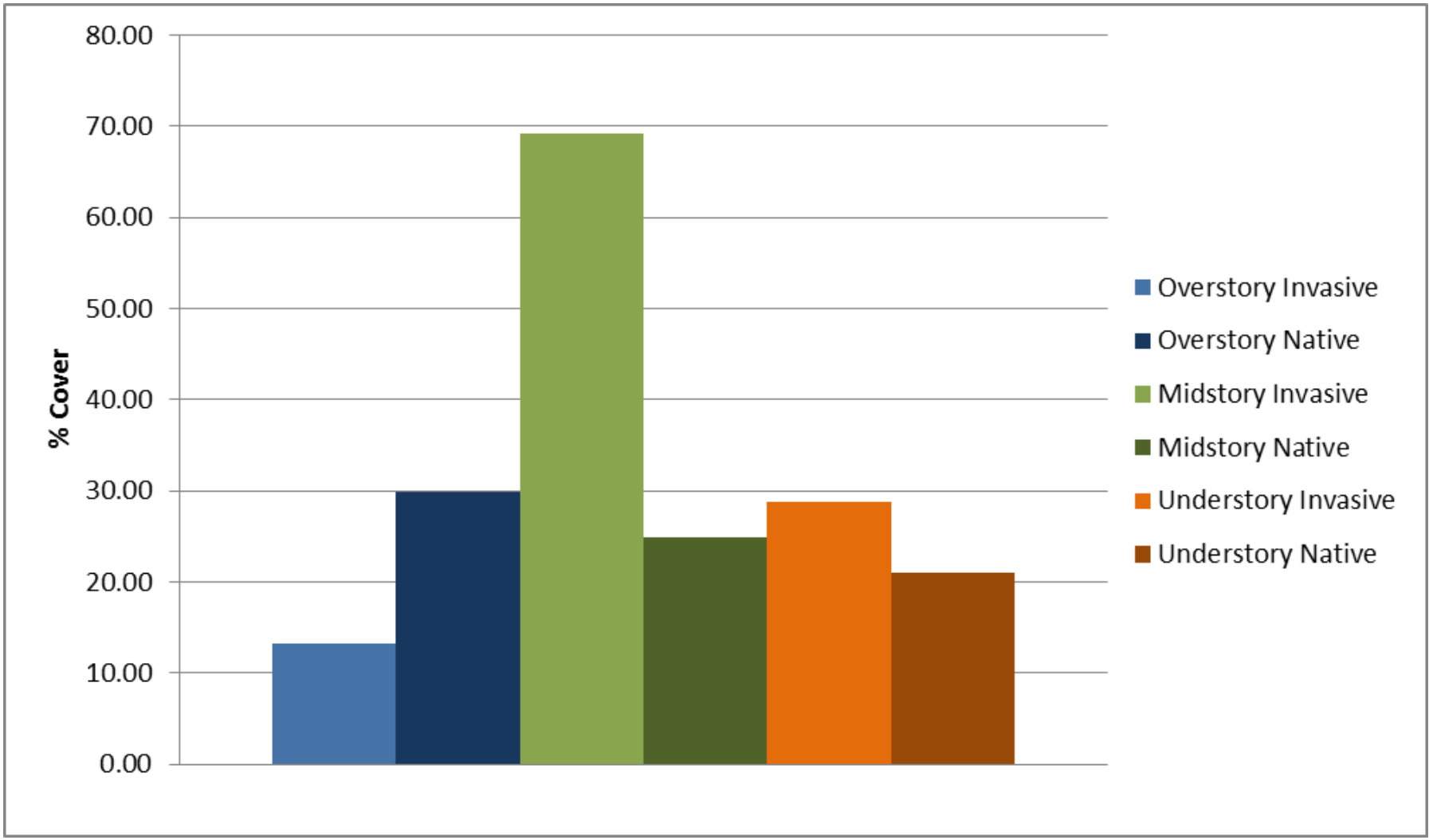

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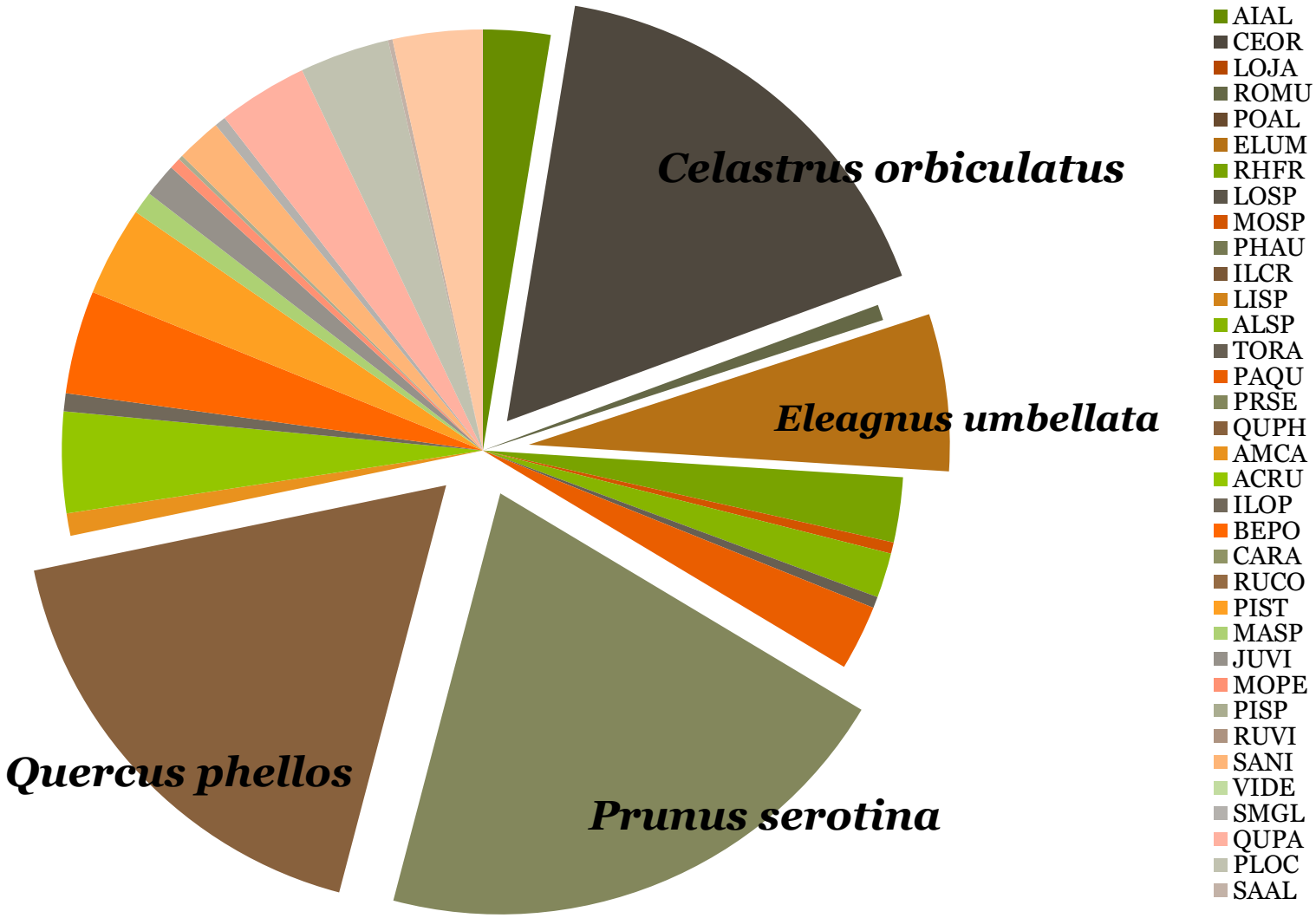
Canopy (% Cover)



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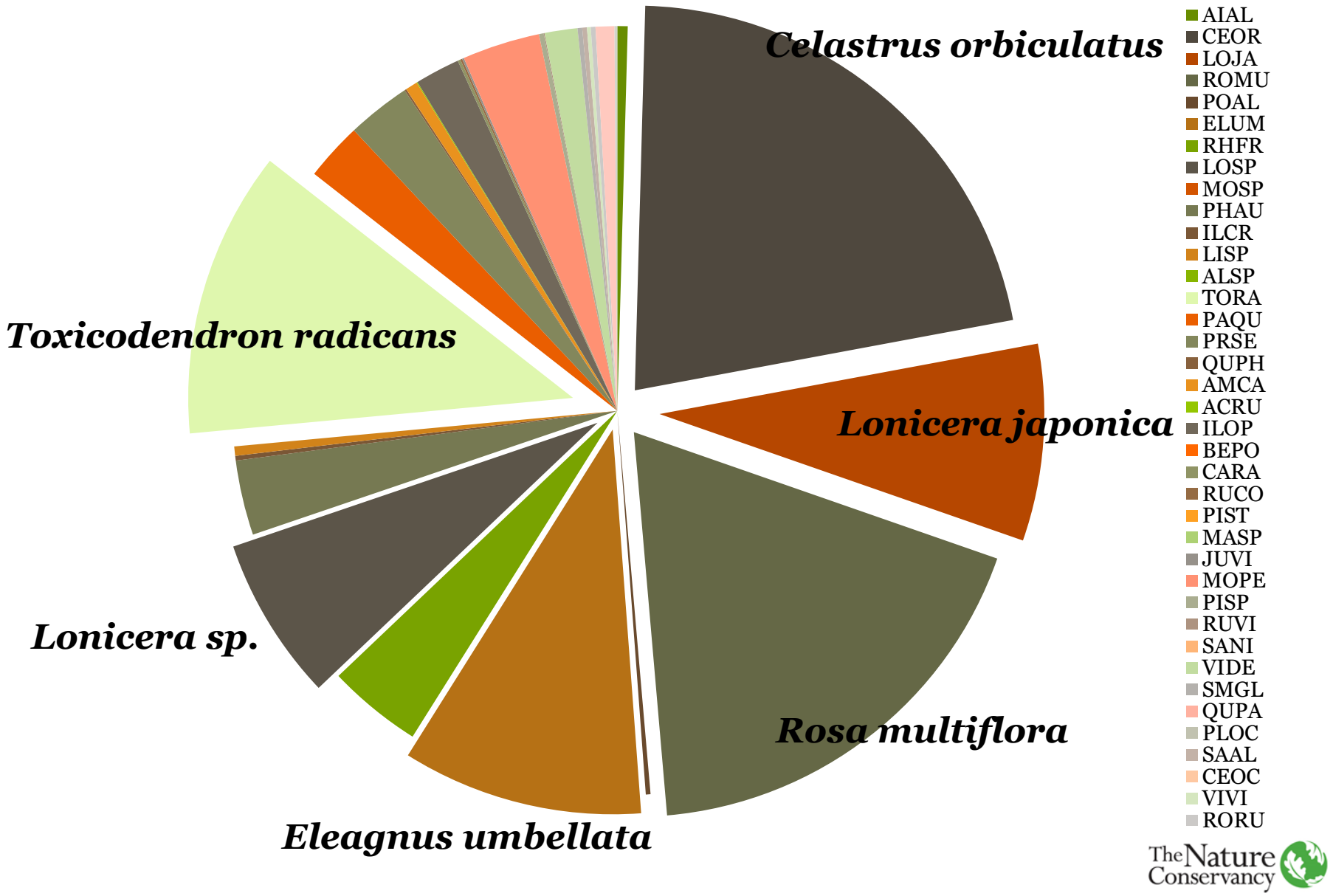
Midstory (% Cover)



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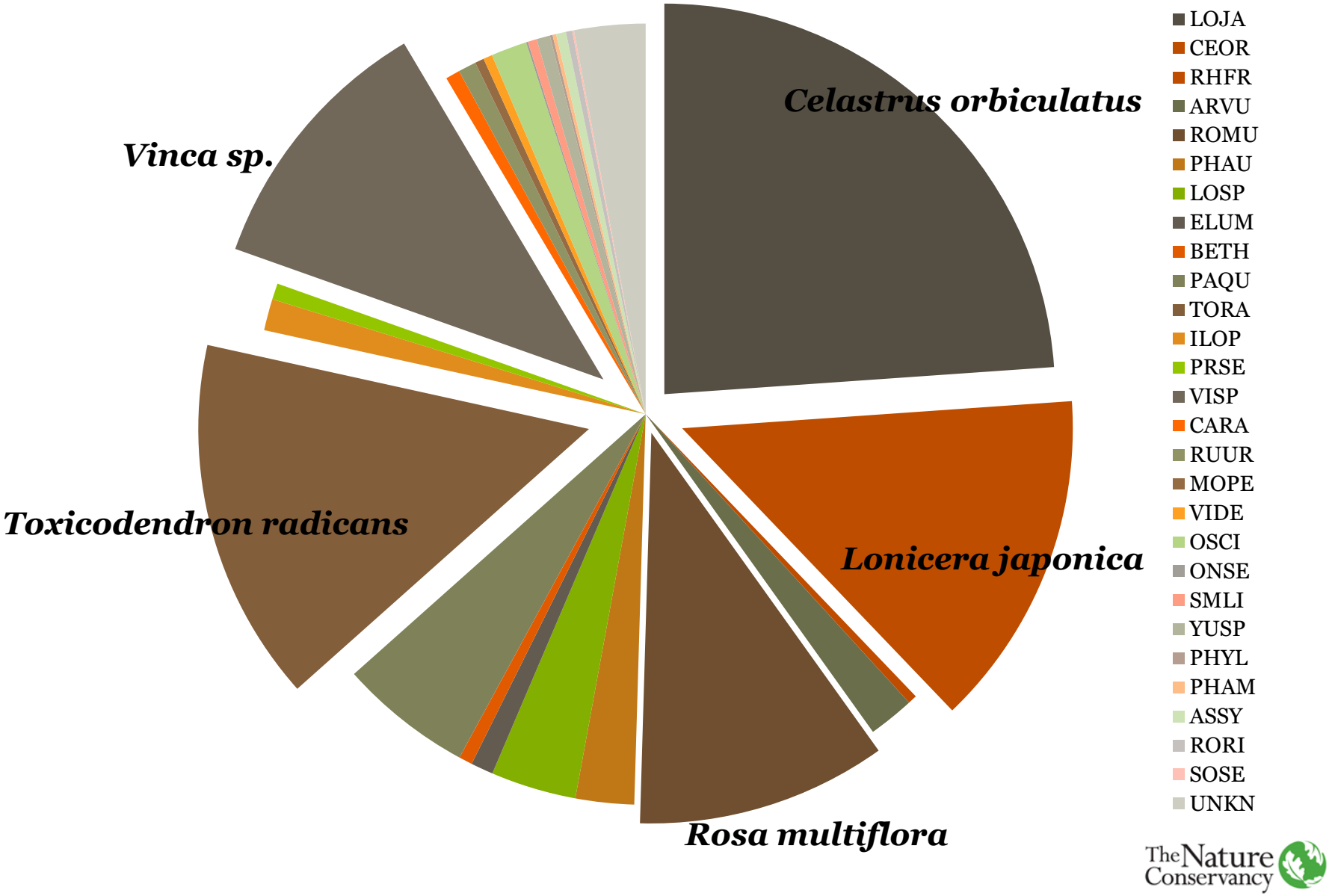
Understory (% Cover)



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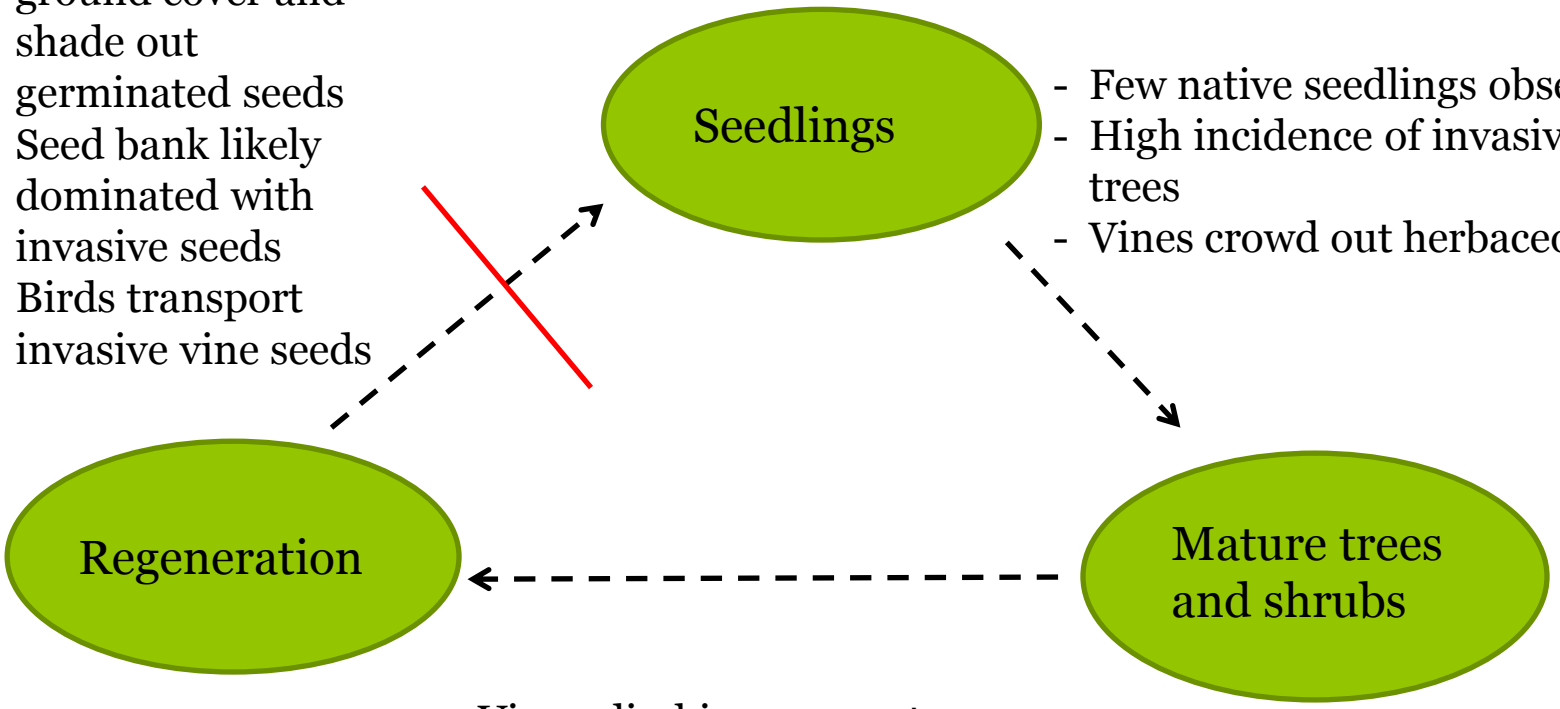
- 62% of trees and shrubs have vines growing above DBH or into the canopy
  - 246 counts of invasive vines (Oriental bittersweet, Japanese honeysuckle)
  - 80 counts of native vines (poison ivy, Virginia creeper, trumpet creeper)

The Nature Conservancy

Impacts of invasive vines on structure and function of maritime forest

- Vines create dense ground cover and shade out germinated seeds
- Seed bank likely dominated with invasive seeds
- Birds transport invasive vine seeds



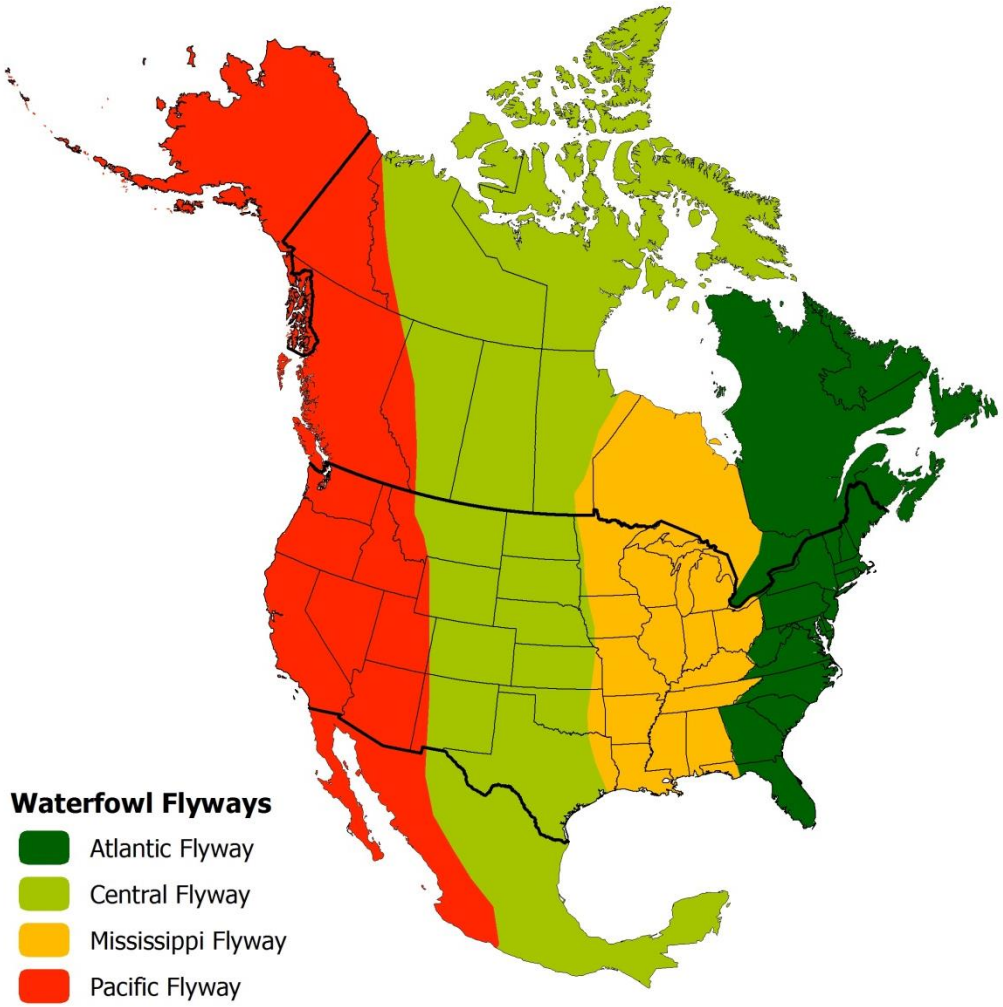
- Few native seedlings observed
- High incidence of invasive shrubs and trees
- Vines crowd out herbaceous layer

- Vines climbing up most canopy trees cause stress to trees
- Stressed native shrubs and trees will produce fewer seeds and berries
- Vine berries are less nutritious than native berries
- Native plants support native insects (food for songbirds)

The Nature Conservancy

Fruits of native shrubs have 6-49% fat and 18-29 kcal/g energy content; fruits of invasive shrubs have only 1% fat content <17 kcal/g energy

(Smith et al. 2013 Northeastern Naturalist)



Source: http://friendsofncc.org/the-dinners/

The Nature Conservancy

Migratory bird surveys

May, June, September, October 2015 and 2016

Point Count ID	Veg Plot ID
Point 1	1a
Point 2	3,2,1
Point 3	10,7,11,12
Point 4	14,15
Point 5	27,17
Point 6	19,6a
Point 7	21,22,23
Point 8	8a
n = 8	n = 18

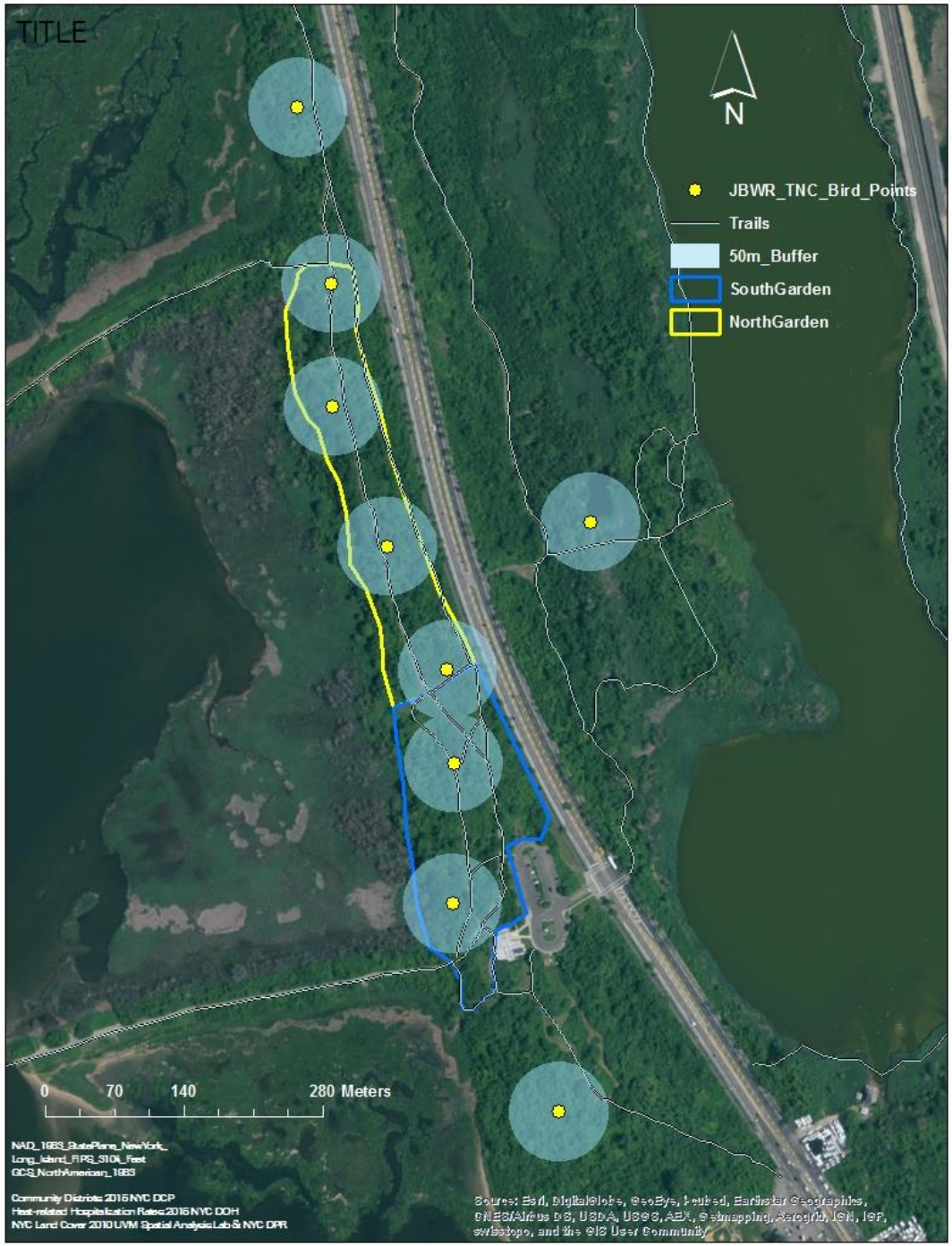


Photo credits: allaboutbirds.org

The Nature Conservancy

Insects and native plants are host plants to Lepidopterans

(*Tallamy 2007*)

Invasive	Native
Buckthorn (unk) Autumn olive (9)	Black oak, post oak (534) Black gum (42) Serviceberry (124)
Honeysuckle (37), Multiflora rose (135)	Blueberry (294) Bayberry (108) Beach plum (546) Elderberry (42) Pitch pine (201) Viburnum (104)
Oriental bittersweet (7)	Virginia creeper (32) Poison ivy

The Nature Conservancy

Partial Species List for JBWR North and South Gardens

Species	Habitat	Salt Tolerant
Eastern red cedar (*Juniperus virginiana*)	X	X
Highbush blueberry (*Vaccinium corymbosum*)	X	
Bayberry (*Morella pensylvanica*)	X	X
Oaks – post, black, scarlett (*Quercus* spp)	X	X
Beach plum (*Prunus maritima*)	X	X
Pitch pine, Virginia pine (*Pinus* spp.)		X
Groundselbush (*Baccharis halimifolia*)		X
Hackberry (*Celtis occidentalis*)	X	
Black gum (*Nyssa sylvatica*)	X	
Serviceberry (*Amalanchier canadensis*)	X	
Chokeberry (*Photinia* spp)	X	
Winterberry (*Ilex verticillata*)	X	
Arrowwood (*Viburnum dentatum*)	X	

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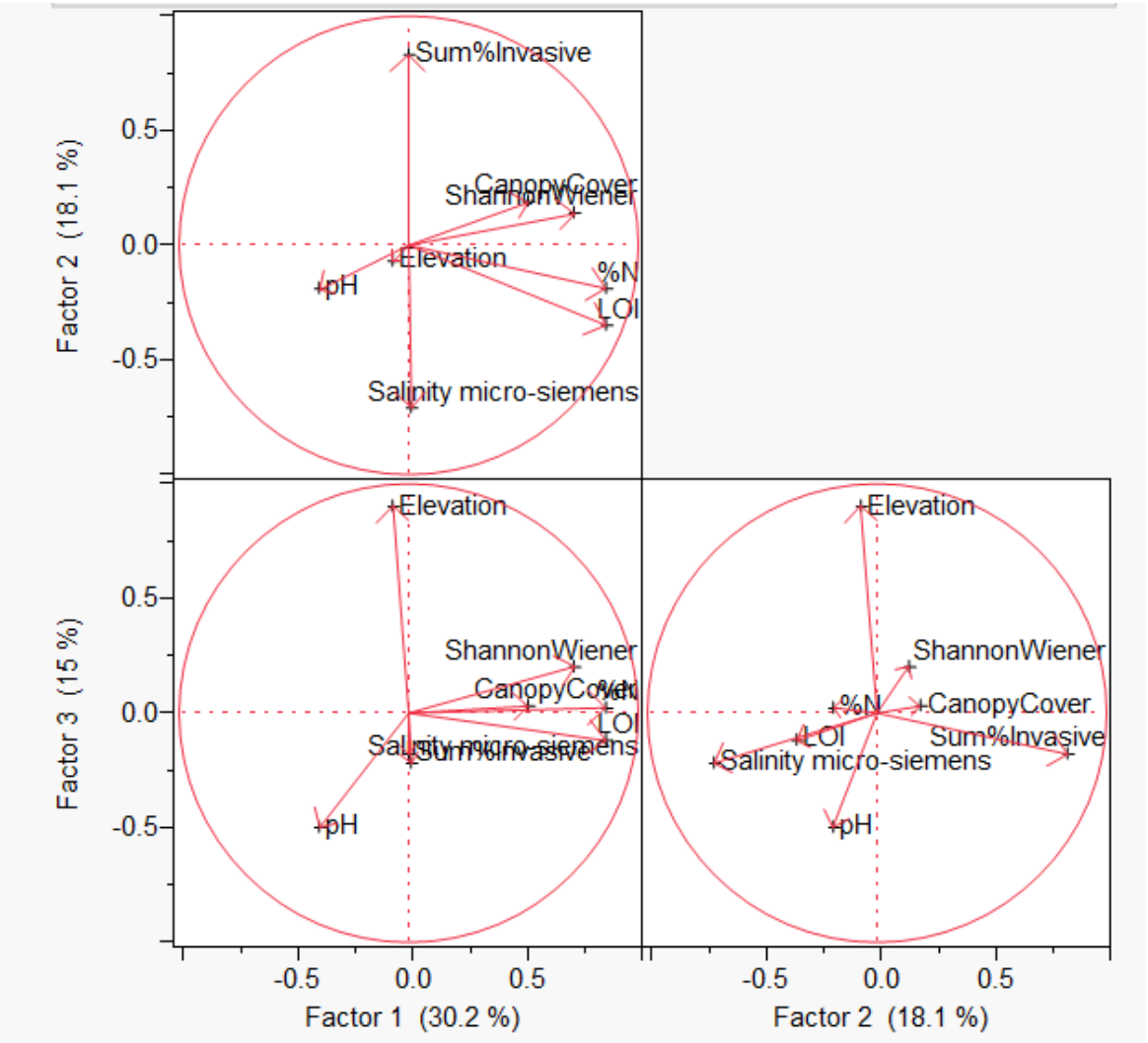
Community Ecology Analysis

Nitrogen, LOI, canopy cover and Shannon Wiener load positively on Factor 1

Invasive species and soil salinity load on different ends of Factor 2

Elevation doesn't explain any of the patterns in soil or vegetation (Factor 3)



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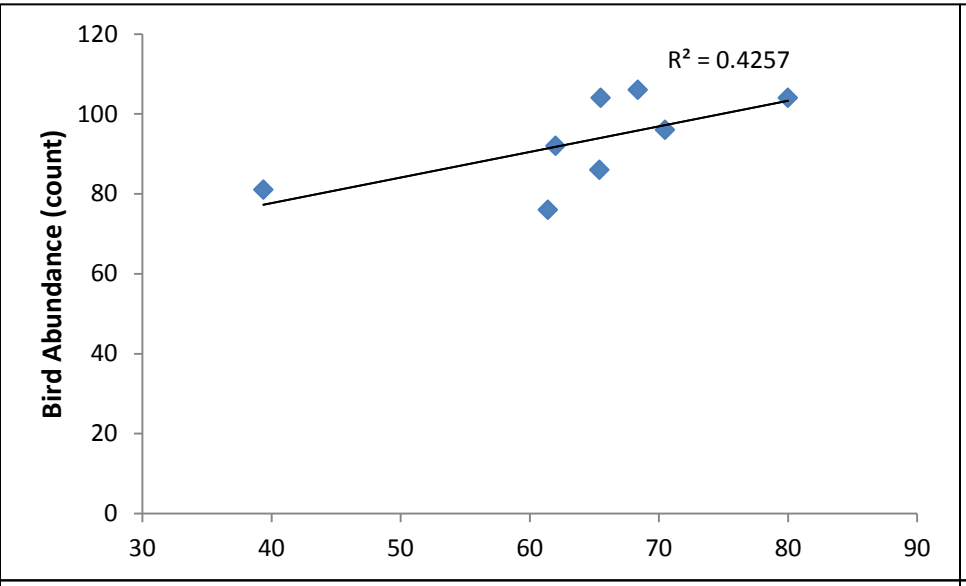
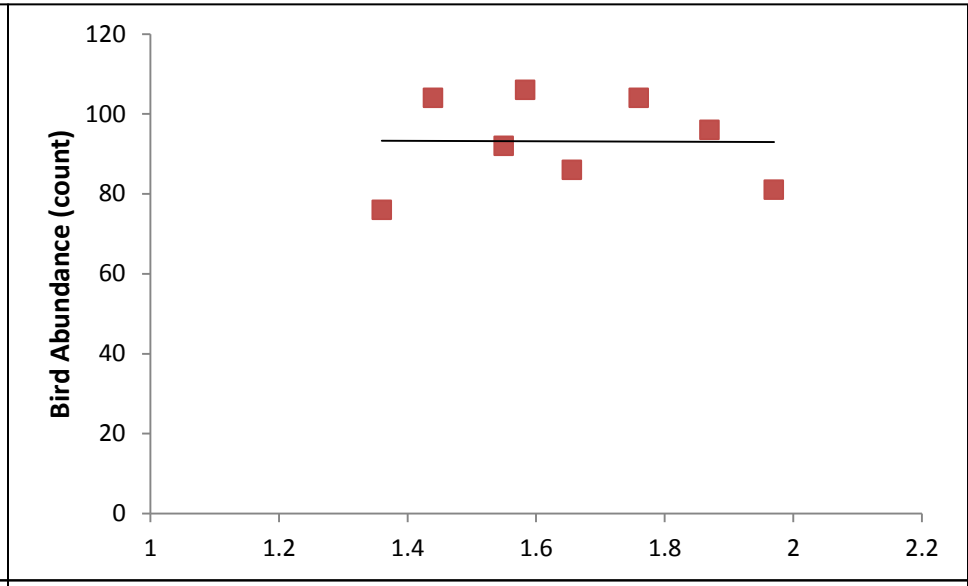
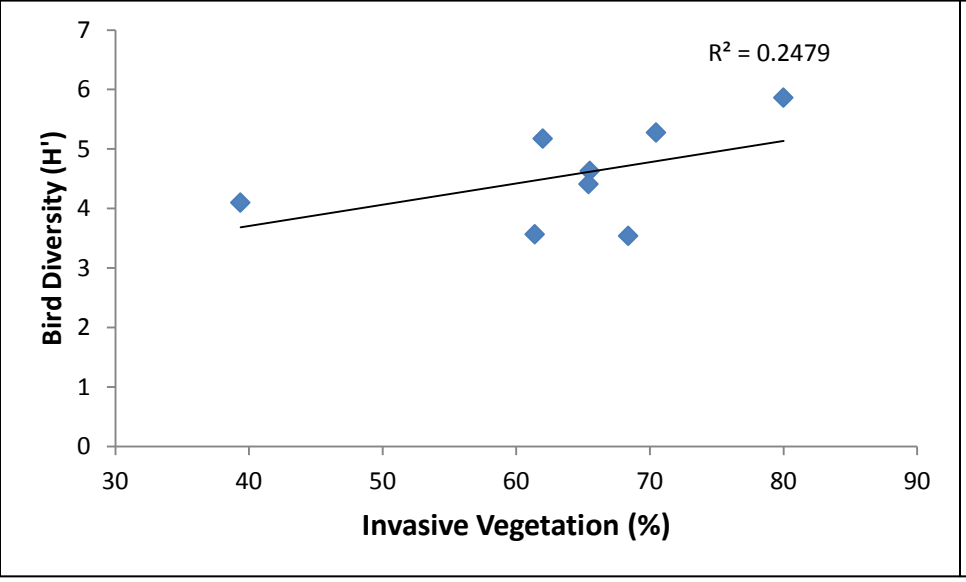
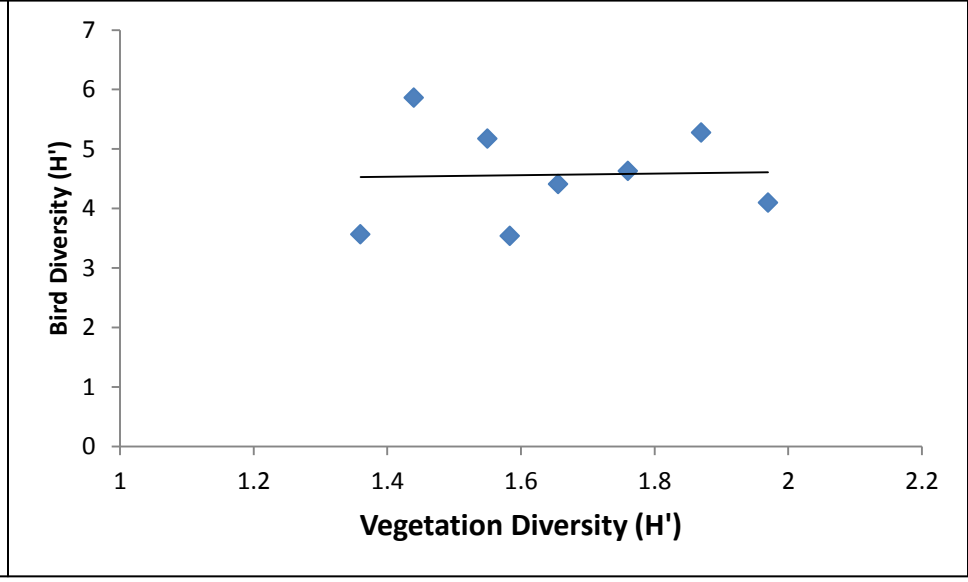




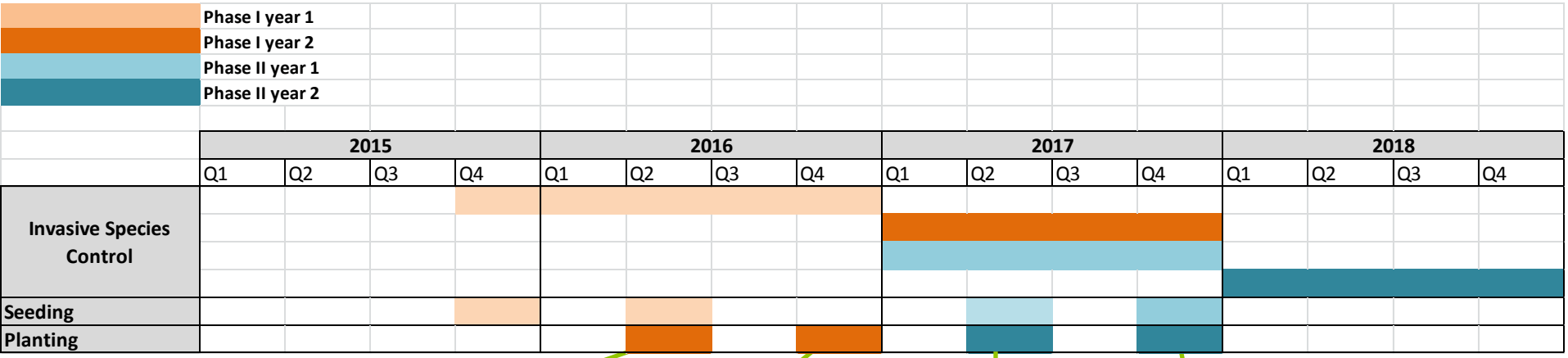




**Veg Abundance and Diversity:*
Average of plots within 50 m of bird point count

**Bird Abundance and Diversity:*
All species, 8 point count locations, May-September 2015

Invasive Species Treatment and Native Planting Schedule



6,700 plants
South Garden

6,600 plants
South Garden

5,000 plants
N and S Garden

15,000 plants
N Garden

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Invasive Species Treatment – Chemical/Mechanical

Basal Bark Spray

Foliar Spray

Cut Stem/Stump Spray

Hack and Spray

Masticate and Retreat

http://www.recyclingproductnews.com/product/502/bc2100xl-brush-chipper

http://www.hostedsites.us/weedcontrolinc/services/utilities.htm

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Lauren Alleman
Urban Ecologist, NYC Program
Phone: (646) 465-5890 | Email: lalleman@tnc.org

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LOWER HUDSON PRISM

NEW YORK BOTANICAL GARDEN

Managing Plant Invasions for Ecosystem Impacts:

Insights from a Japanese stiltgrass invasion

Noah W. Sokol, PhD Candidate

Yale School of Forestry & Environmental Studies

YALE UNIVERSITY
School of Forestry
& Environmental Studies
environment.yale.edu

Acknowledgements

Collaborators: Regional Water Authority of Southern Connecticut, Dr. Sara Kuebbing & Dr. Mark Bradford

NSERC CRSNG

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& Environmental Studies
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Yale University
Institute for Biospheric Studies

Regional Water Authority

How do invasive plants impact ecosystems?

Invasive plants can alter ecosystem carbon and nitrogen cycling

Research

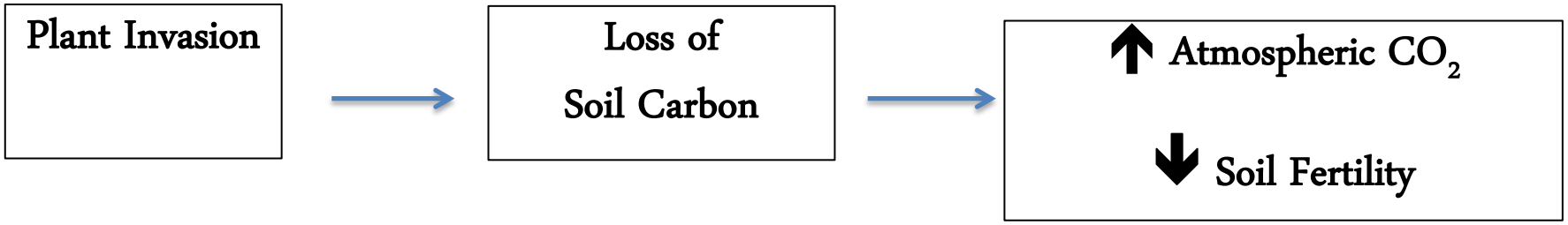
New Phytologist

Altered ecosystem carbon and nitrogen cycles by plant invasion: a meta-analysis

Chengzhang Liao[1,2], Ronghao Peng[1], Yiqi Luo[1,2], Xuhui Zhou[2], Xiaowen Wu[2], Changming Fang[1], Jiakuan Chen[1] and Bo Li[1]

Soil Carbon:

Largest Terrestrial Carbon Pool & Dominant Indicator of Soil Health



Japanese Stiltgrass →
Known Impacts on C and N Cycling

Global Change Biology

Global Change Biology (2010) **16**, 1338–1350, doi: 10.1111/j.1365-2486.2009.02042.x

Grass invasion of a hardwood forest is associated with declines in belowground carbon pools

Oecologia
DOI 10.1007/s00442-012-2309-9

COMMUNITY ECOLOGY - ORIGINAL RESEARCH

Positive feedbacks to growth of an invasive grass through alteration of nitrogen cycling

Goal of Regional Water Authority Land Managers:
Understand Invader Impacts around Drinking Water Supply

Taking A Step Back:

How Do We Typically Study Invasive Impacts?

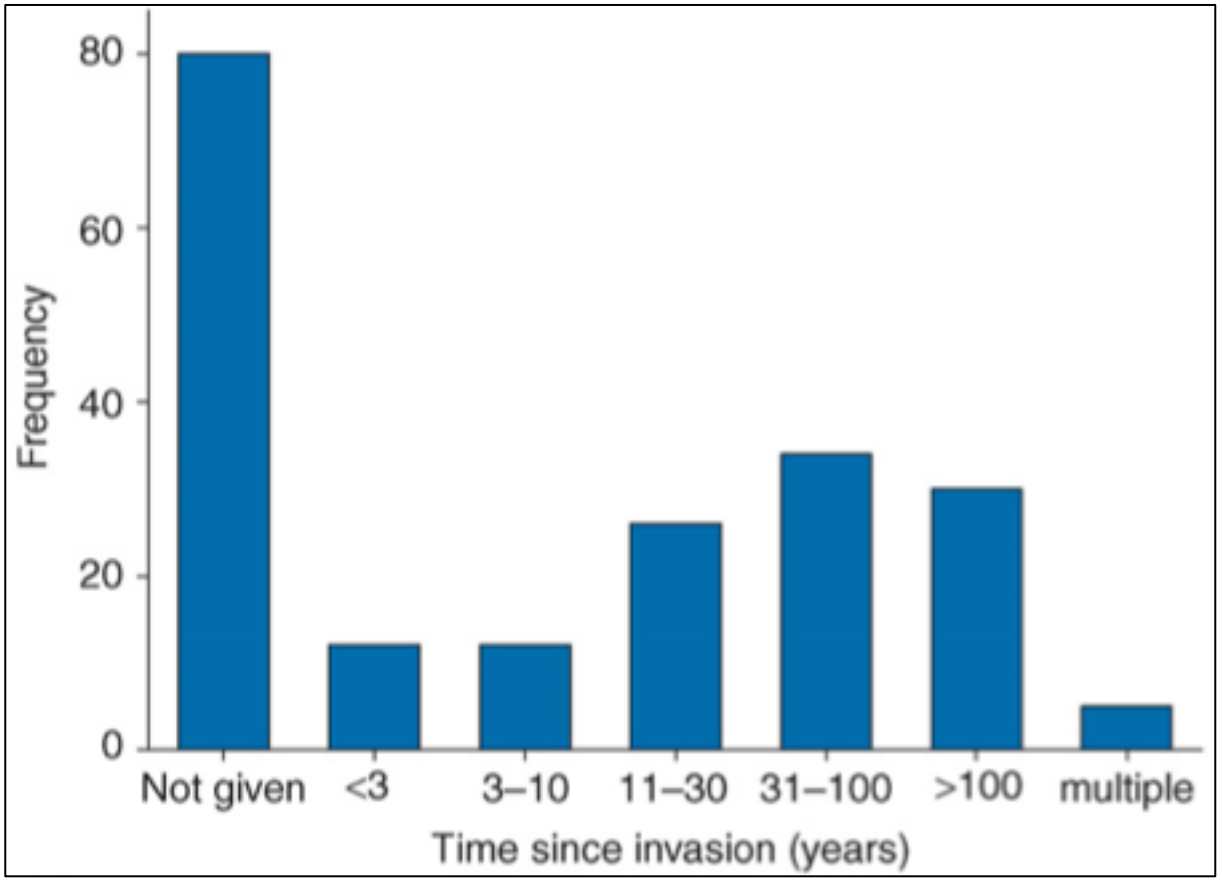
"Uninvaded"

VS

.

"Invaded"

Limitation #1: Minimal Information on Invasion History

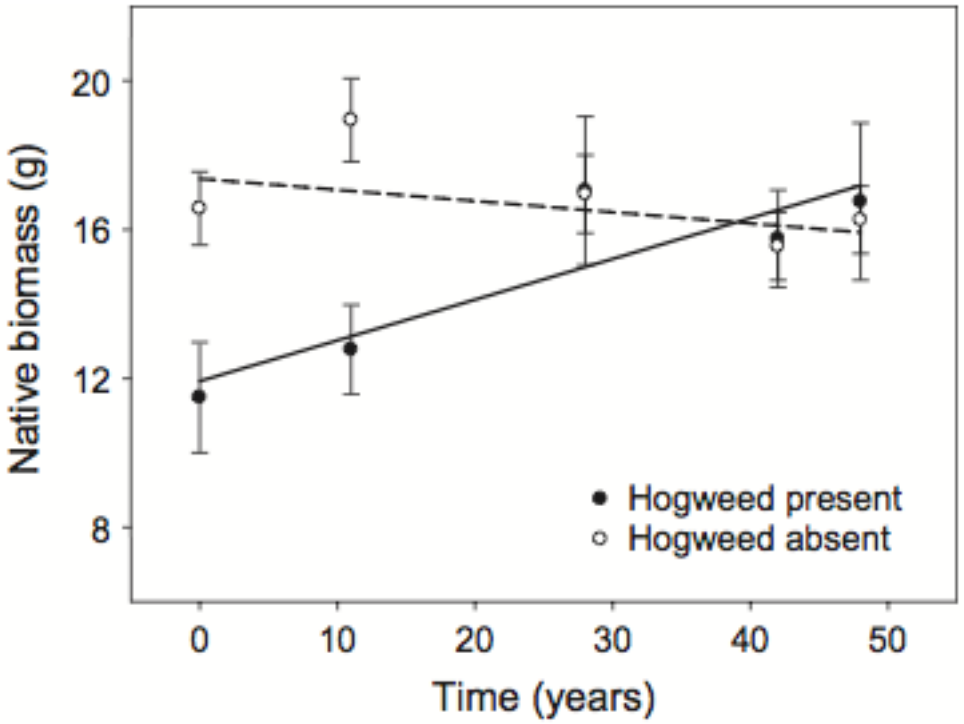


Strayer *et* al. 2006. *Trends Ecol. Evol.*

ECOLOGY LETTERS

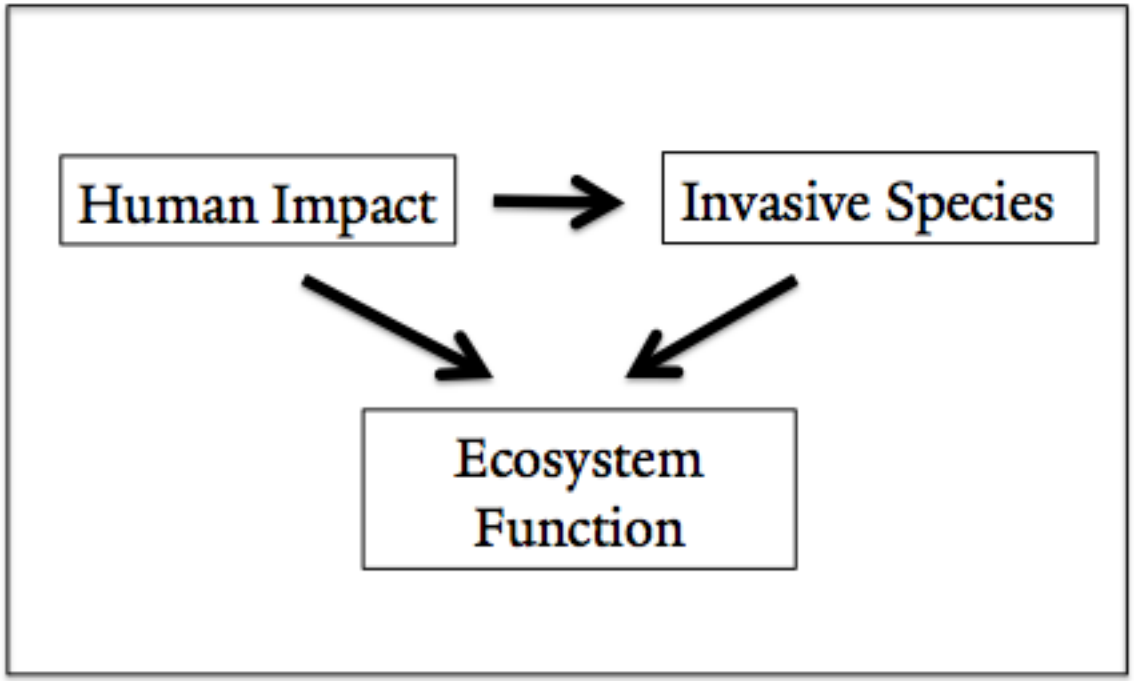
Ecology Letters, (2013) **16**: 1277–1284

The impact of an invasive plant changes over time



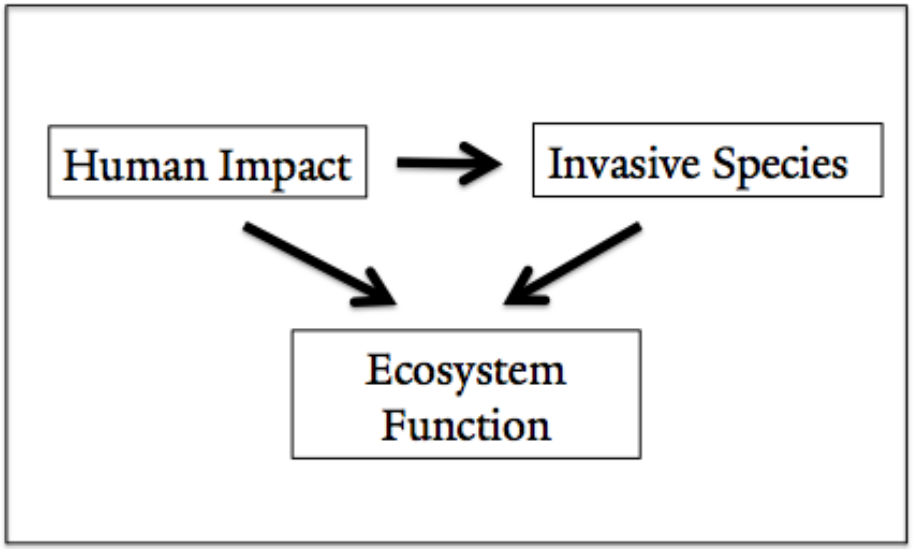
Dostal *et al*. 2013. Ecol. Lett.

Limitation #2: Invasions Do Not Occur In Isolation



Strayer. 2012. *Ecol. Lett.*

Logging



Japanese Stiltgrass

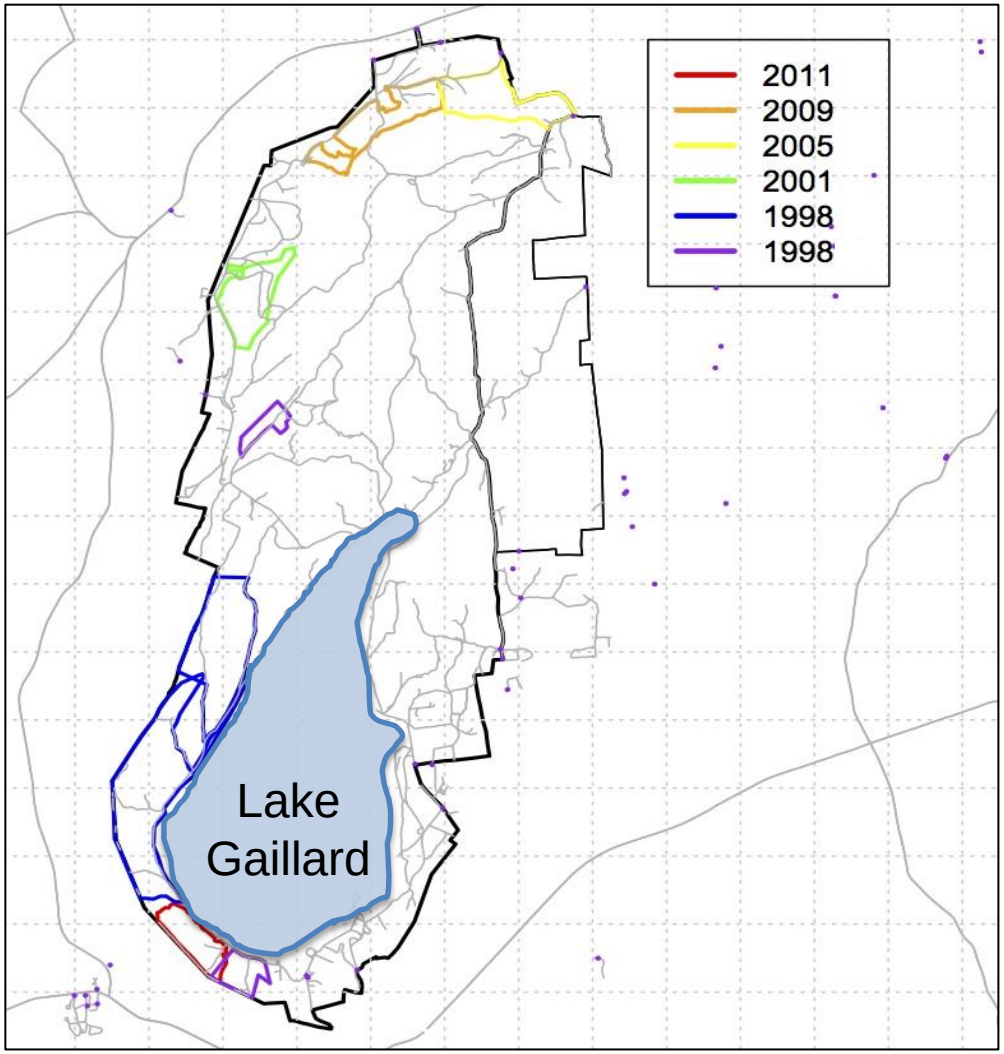
Soil C and N

How to Address These Two Compounding Issues:

1) Track ecosystem changes over time: invasion chronosequence

2) Appropriate controls: controls for invasive plant *and* other disturbances

Lake Gaillard: Forest Stands with Different Logging & Invasion Histories



Clear Differences in Japanese Stiltgrass Invasions Between Logged Forest Stands

Logged 5 Years Prior

Logged 15 Years Prior

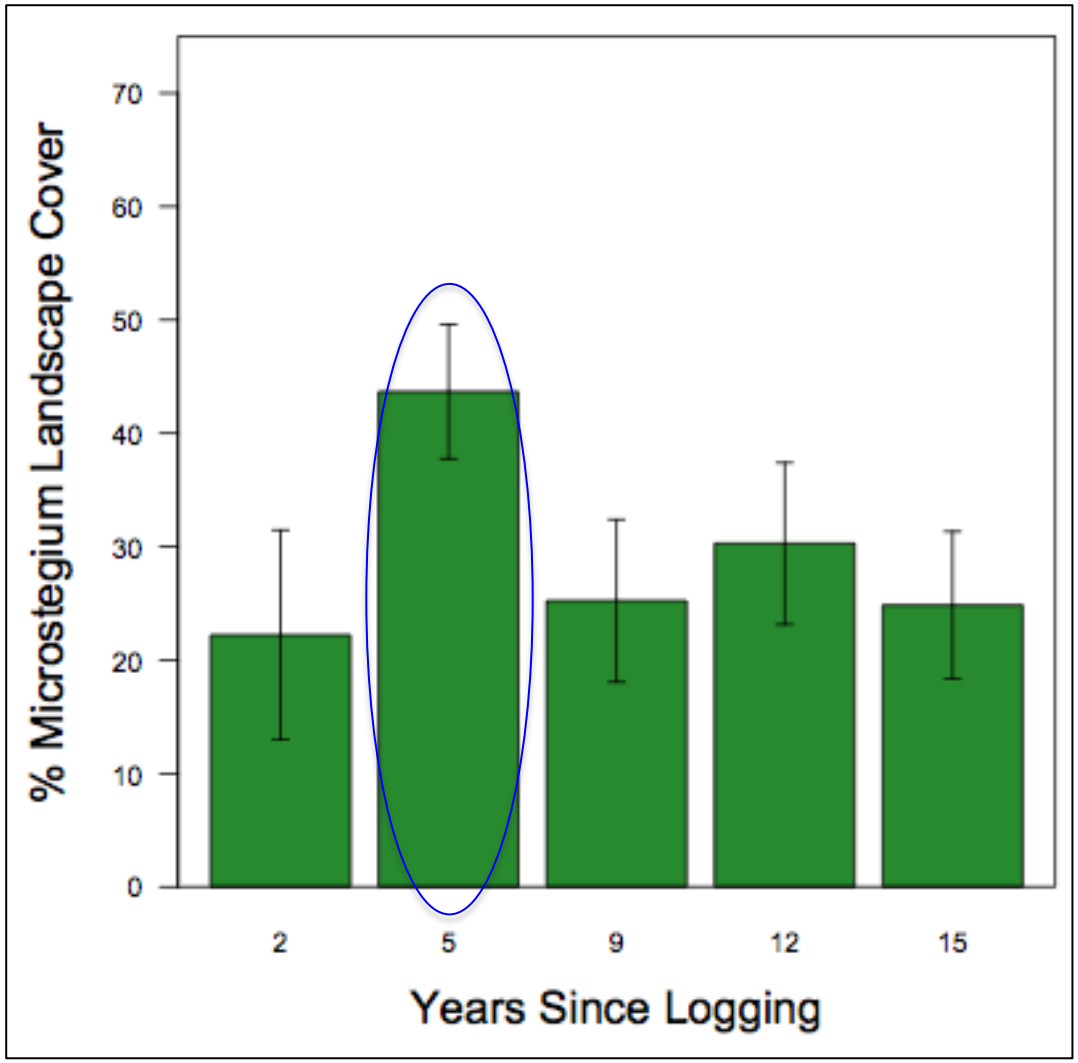
Study: Invasion Chronosequence at Lake Gaillard

- Stands logged 2, 5, 9, 12, 15 and 50+ years ago
- Two controls:

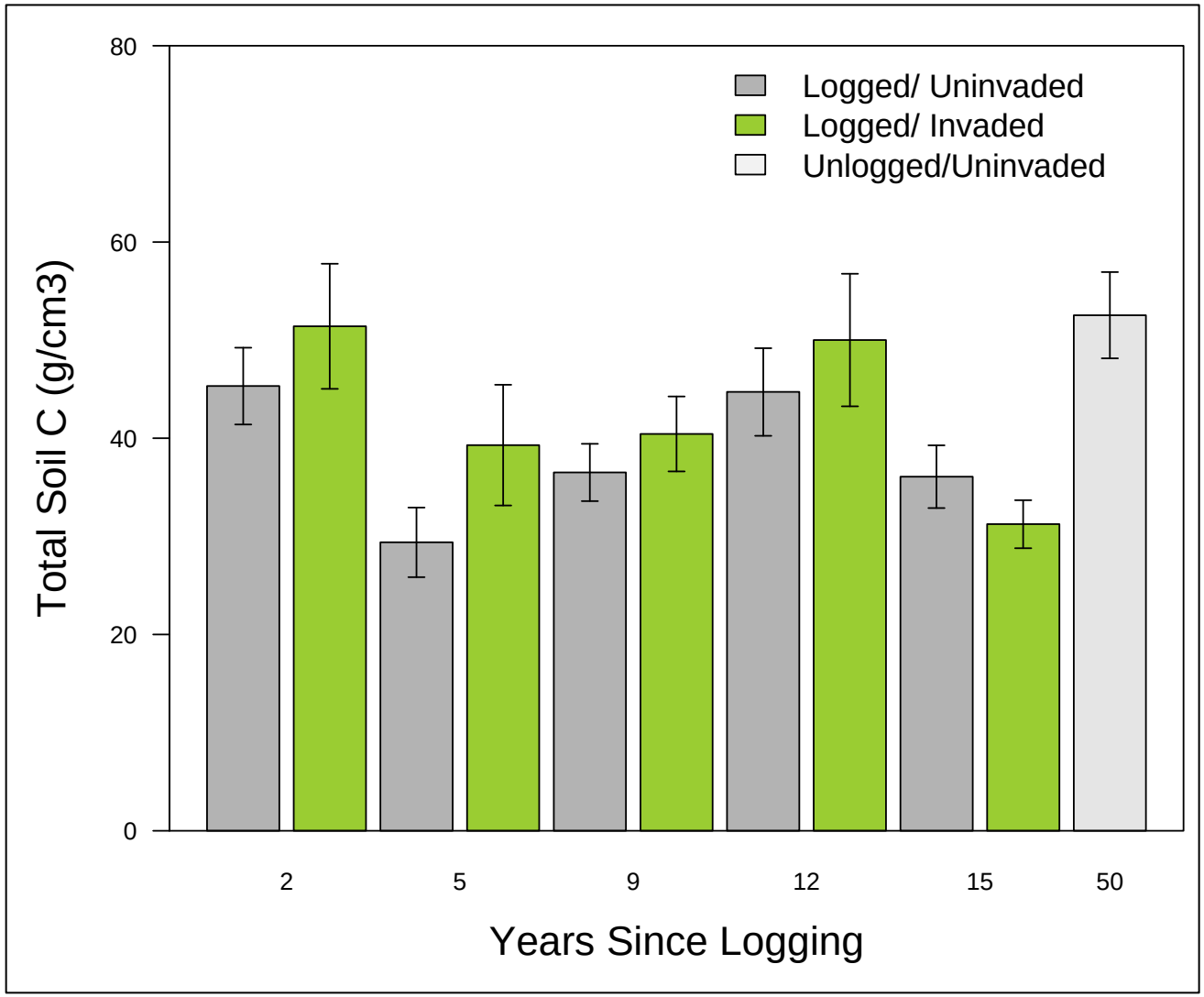
  (a) Logged/Uninvaded

  (b) Unlogged/Uninvaded

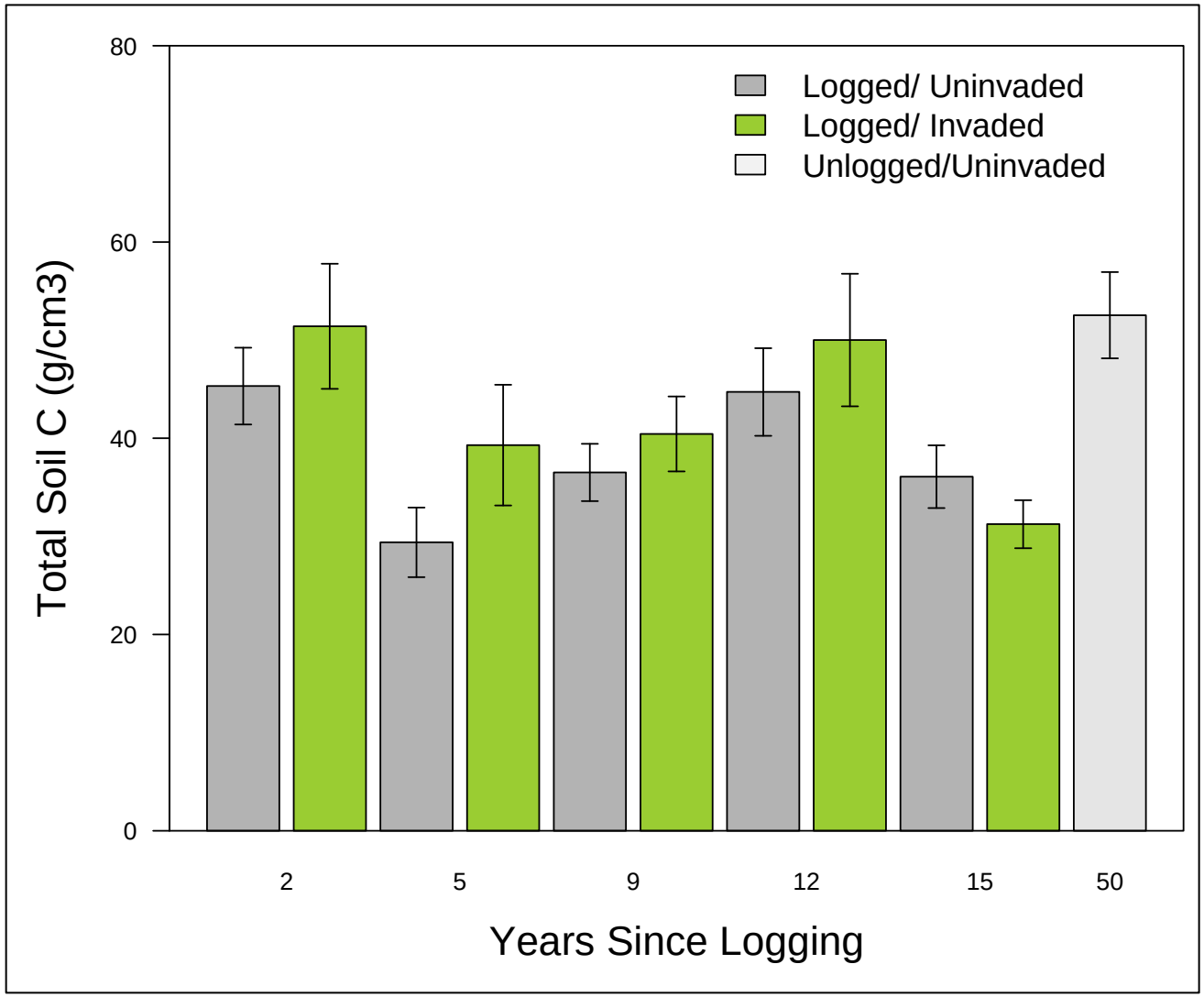
Invader Abundance Changes Through Time



#1: Soil Carbon Effects Over Time Do Not Directly Track Invader Abundance



#2: Soil Carbon Effects Driven by Logging, Not Invasive Plant



Take Home Messages

- Understand invader impacts as **changing through time** and **interacting with other disturbances**
- To minimize impacts: **manage for human disturbance, not just Japanese stiltgrass**
- Similar collaborations between land managers and researchers: *context-dependent, locally relevant* invasion research

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LOWER HUDSON PRISM

NEW YORK BOTANICAL GARDEN

Mile-a- Minute Management

Stories from the Northern Frontier

Presenter: Nate Nardi-Cyrus, Scenic Hudson

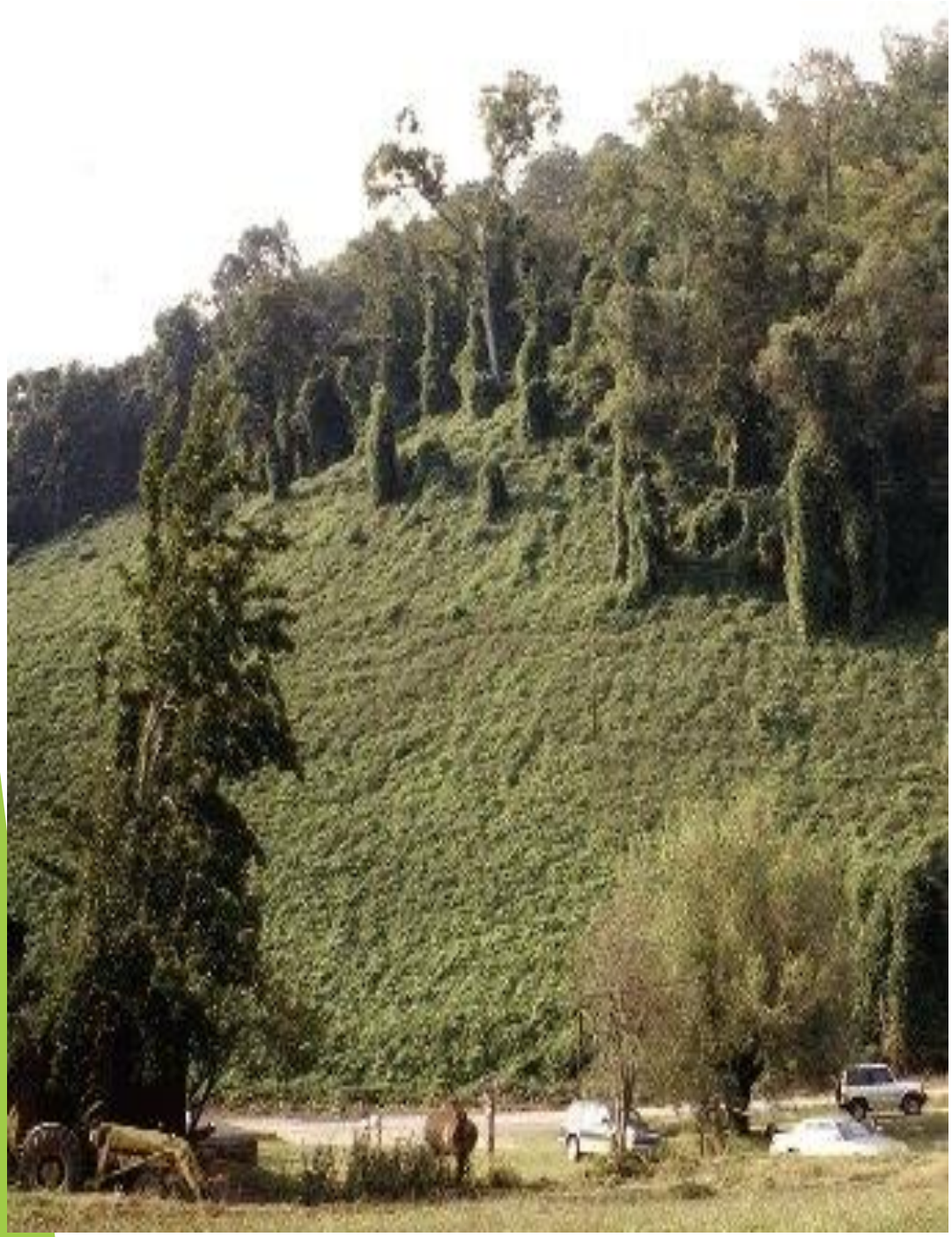
LOWER HUDSON PRISM

SCENIC HUDSON

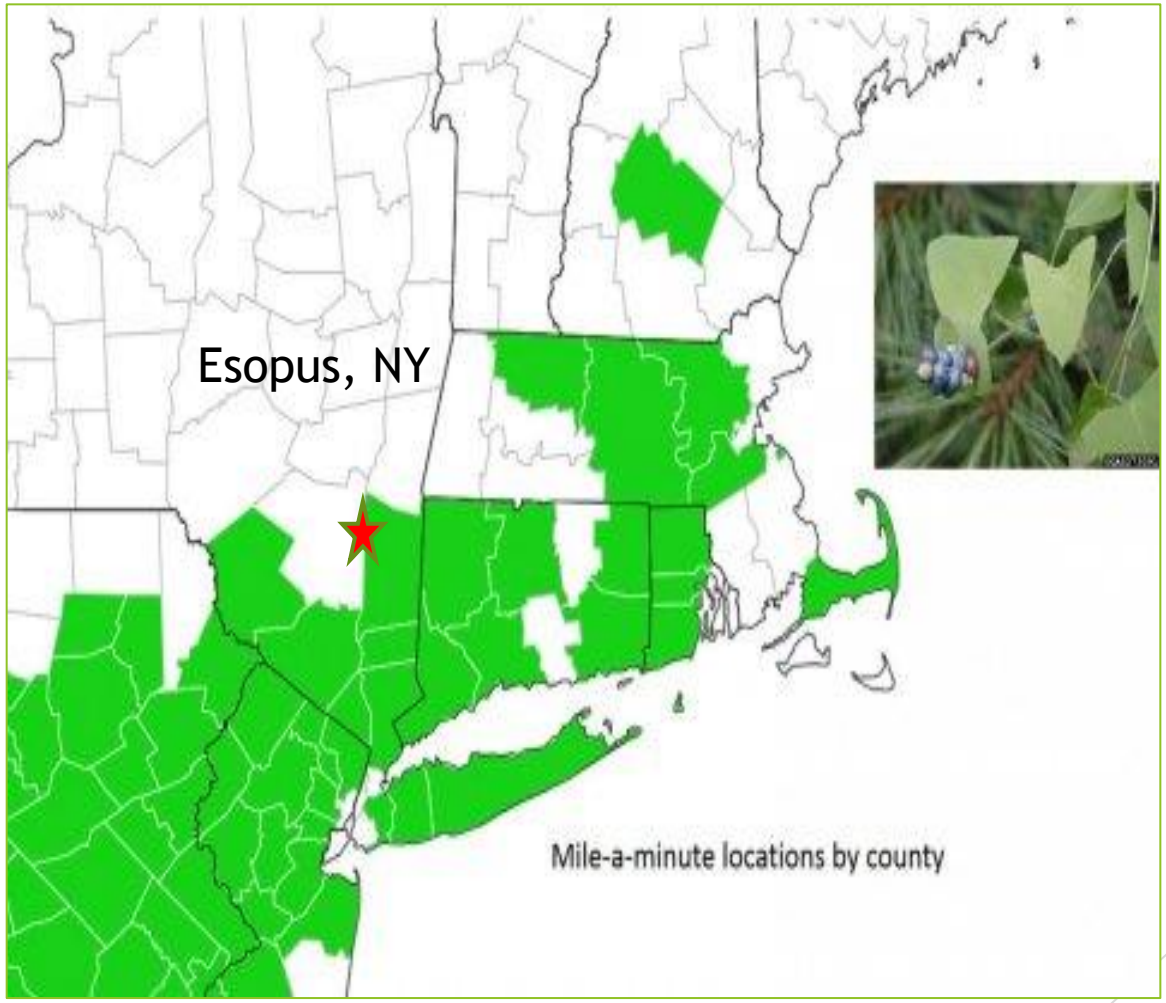

Our Mission:
Scenic Hudson is dedicated to protecting and restoring the Hudson River, its riverfront and the majestic vistas and working landscapes beyond as an irreplaceable national treasure for America and a vital resource for residents and visitors.
SCENIC HUDSON
land ■ parks ■ advocacy

Mile-a-Minute Vine (*Persicaria perfoliata*)

- Introduced in 1930 – York County, PA
- Herbaceous annual vine
  - Up to 6 years in seed bank
- ID Characters
  - Triangular leaves
  - Recurved spines
  - Prominent ocreae at nodes
  - Blue and green fruit



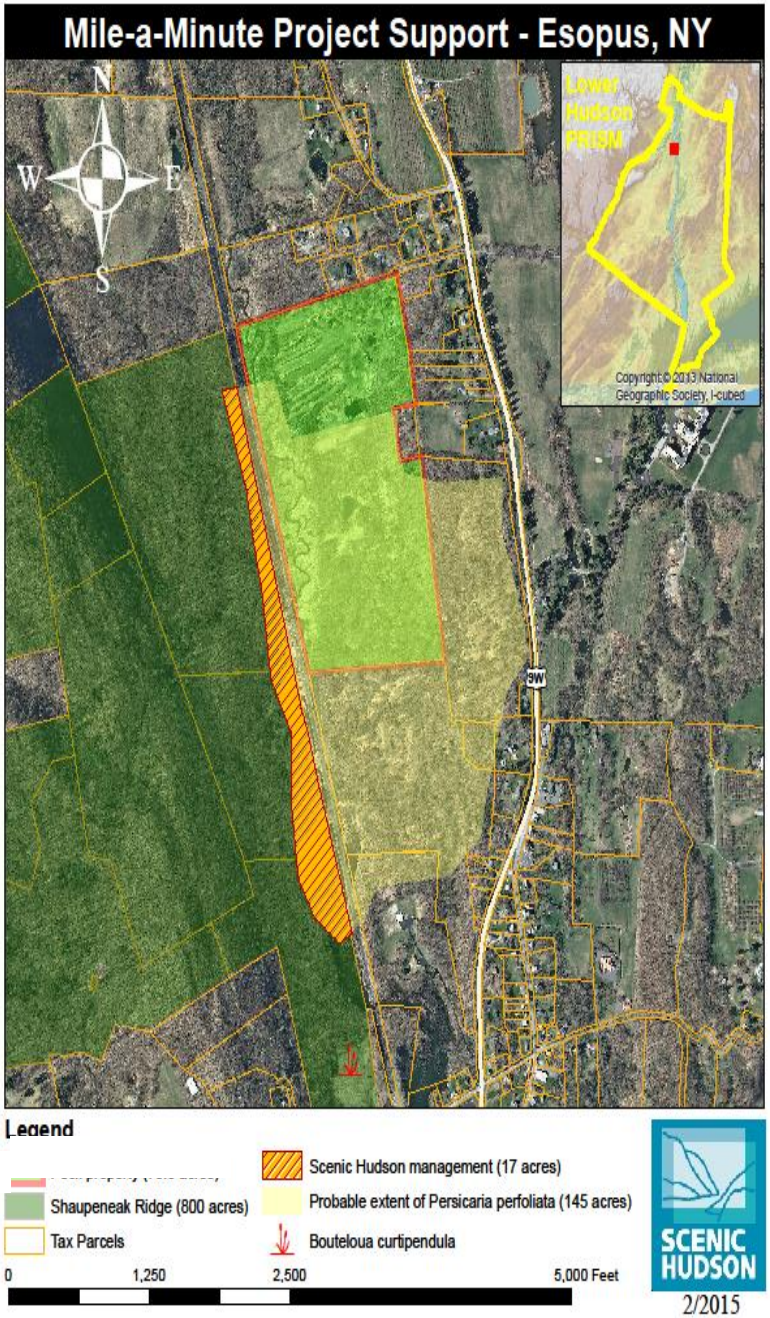
Discovery in Esopus, Ulster County, NY (2014)



Objective: Regional Suppression

Goals:

1) Limit seed production
2) Introduce Biocontrol to suppress
3) Educate public



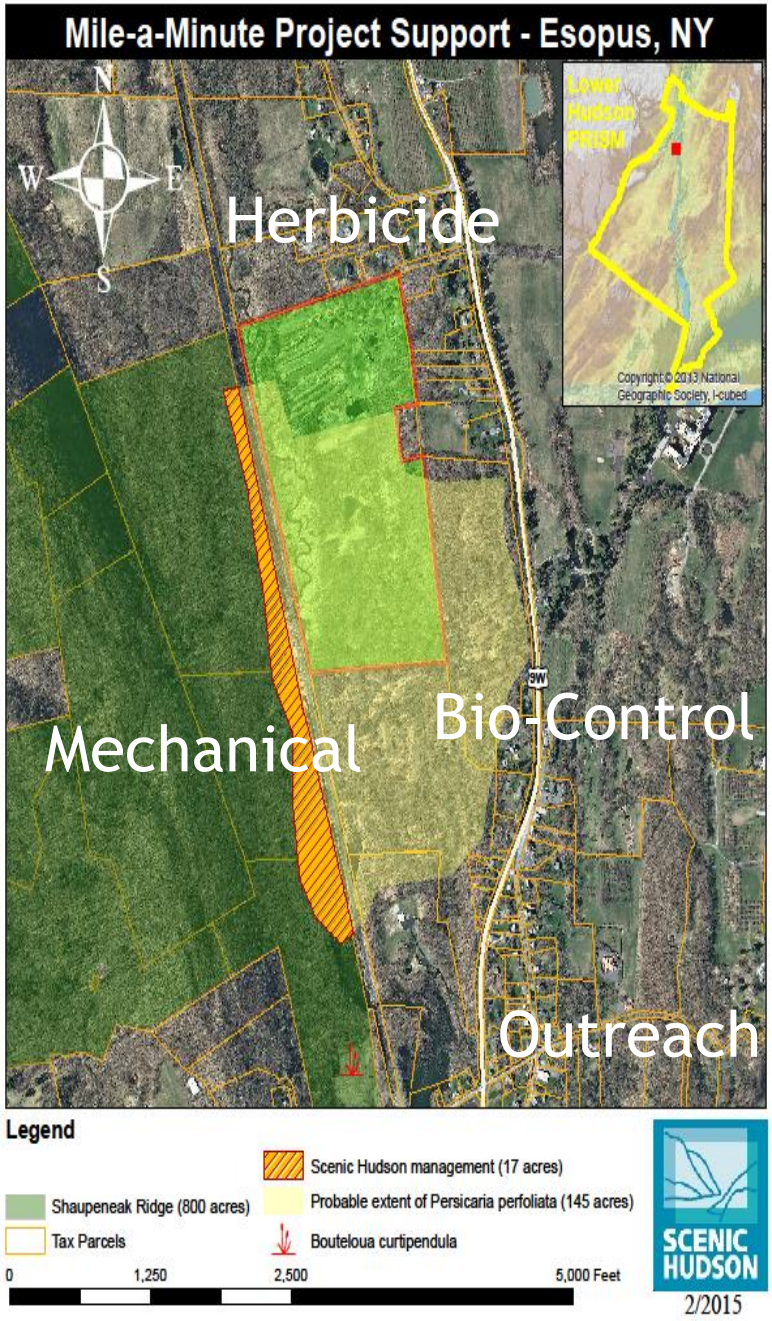
Lower Hudson PRISM Involvement

- PRISM provided funding to Trillium ISM
  - Match from Landowner – Herbicide/labor
  - Match from Scenic Hudson – Biocontrol/labor/outreach
  - Match from CRISP - Outreach

LOWER HUDSON PRISM

2015 Treatments

All can help reduce seed production!



On Site Considerations

- Wood turtle (*Glyptemys insculpta)*, *S3*
- Side oats gramma *(Bouteloua curtipendula)*, S1
- Perennial stream and associated wetlands
- Conservation easement (landowner)

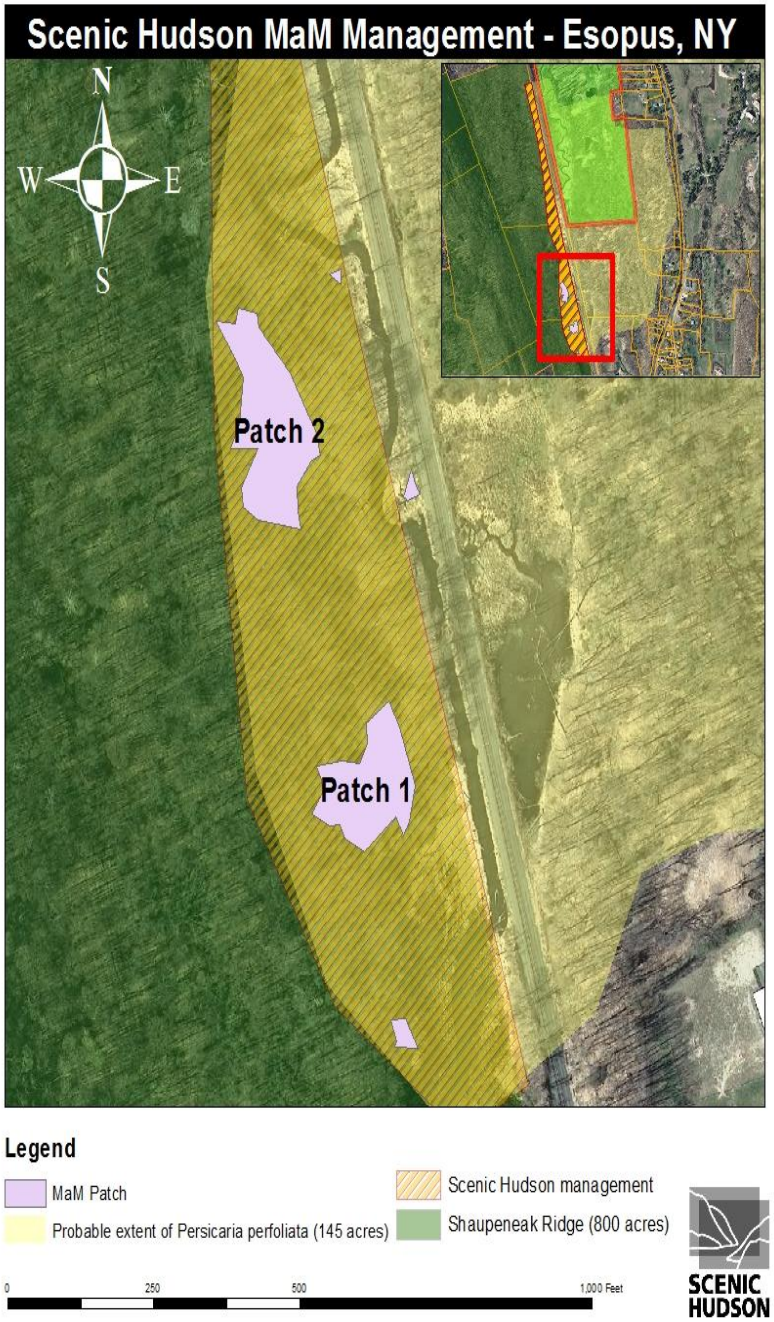
Trillium ISM Mgmt

Monitor

Herbicide

Bio-control

Hand Pull



Scenic Hudson Mgmt

Monitor

Mechanical

Hand Pull

Winter/Spring 2015

- Late Winter
  - Cut honeysuckle and rose
    - Chainsaws & brush cutter

Early Summer 2015

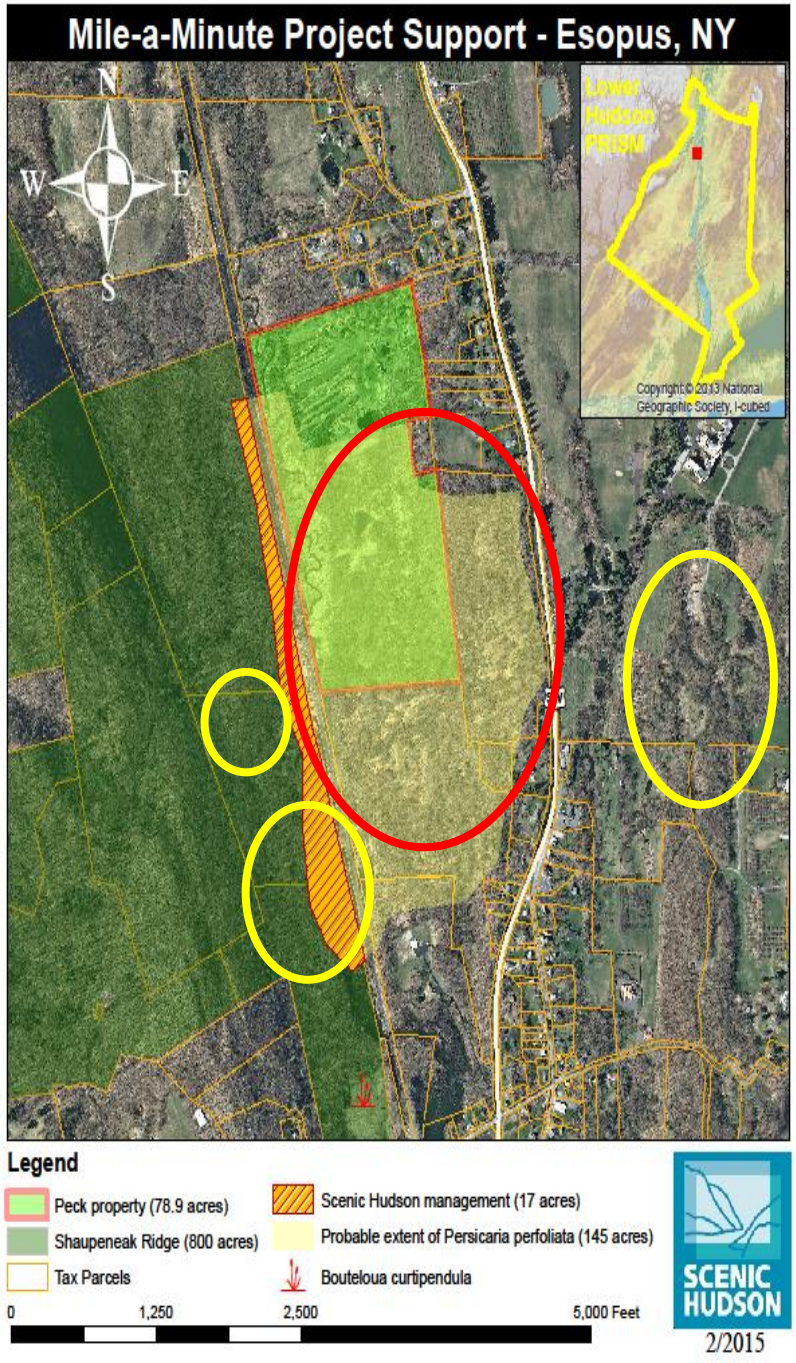
- Early Summer
  - Hand pulling
  - Mechanical treatments
    - Brushcutters & Power scythe

Late Summer / Fall 2015

- Late Summer
  - Mechanical treatments
    - Weed Wacker
  - Hand pulling
  - Seed bagging

Outreach

- 2 Community meetings
  - 40 attendees
  - 2-5 new property leads



2016 Management

OBJECTIVE: Containment

- Delineate & manage edges of core
- Spot treat satellite infestations
- Continue to release bio-control within core
- Engage more landowners

Photo References

- Title Slide Photo 1 (left to right): http://www.dcnr.state.pa.us/forestry/plants/invasiveplants/invasiveplanttutorial/invasivemanagement/chemapp/index.htm
- Title Slide Photo 2 (left to right): Scenic Hudson, Inc.
- Title Slide Photo 3 (left to right): http://www.hort.uconn.edu/mam/biocontrol.html
- Slide 3 & 4 Photos: http://www.nyis.info/index.php?action=invasive_detail&id=31

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