

USDA Forest Service

URBAN FOREST CONNECTIONS

webinar series

Second Wednesdays | 1:00 – 2:00 pm ET

www.fs.fed.us/research/urban-webinars

● This meeting is being recorded. If you do not wish to be recorded, please disconnect now.

USDA is an equal opportunity provider and employer.

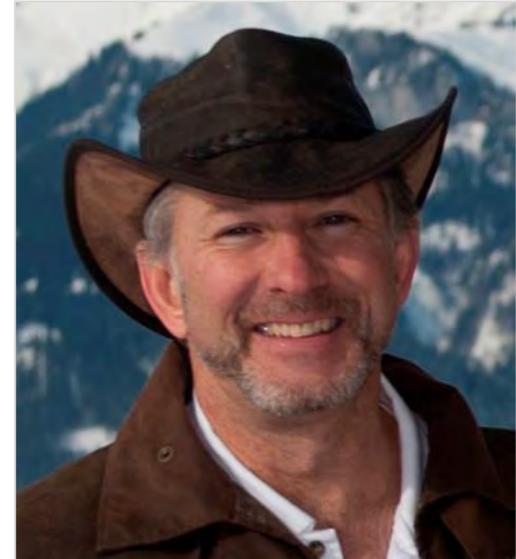


RESTORING URBAN ECOSYSTEMS WITH TREES: CLEANING AND GREENING



Ronald S. Zalesny Jr.

*Research Plant Geneticist
Northern Research Station
USDA Forest Service*



Richard A. Hallett

*Research Ecologist
Northern Research Station
USDA Forest Service*

Restoring Urban Ecosystems with Trees: Cleaning and Greening

R.S. Zalesny Jr.¹, R.A. Hallett²

**U.S. Forest Service
Northern Research Station**

**¹ Institute for Applied Ecosystem Studies
Rhineland, WI, USA**

**² Center for Research on Ecosystem Change
New York City Urban Field Station
Bayside, NY, USA**



Phytoremediation

Afforestation

**Restoration Ecology
Primer**

Partnerships

**Ecosystem
Degradation**

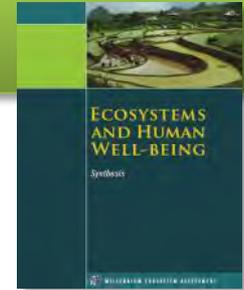
**Ecosystem
Restoration**



Ecosystem Services

“The benefits people obtain from ecosystems”

(Source: <http://www.greenfacts.org/glossary/def/ecosystem-services.htm>)



Millennium Ecosystem Assessment (MEA). 2005. Ecosystems and Human Well-Being: Synthesis. Island Press, Washington. 155pp.

Cultural Services

The nonmaterial benefits obtained from ecosystems (e.g., values)



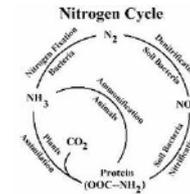
Spiritual



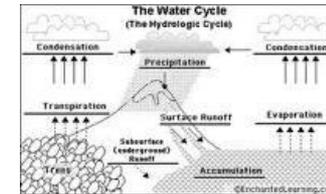
Educational

Supporting Services

The natural processes that maintain the other ecosystem services



Nitrogen



Water

Provisioning Services

The goods or products obtained from ecosystems



Freshwater



Biomass

Regulating Services

The benefits obtained from an ecosystem's control of natural processes



Erosion Control



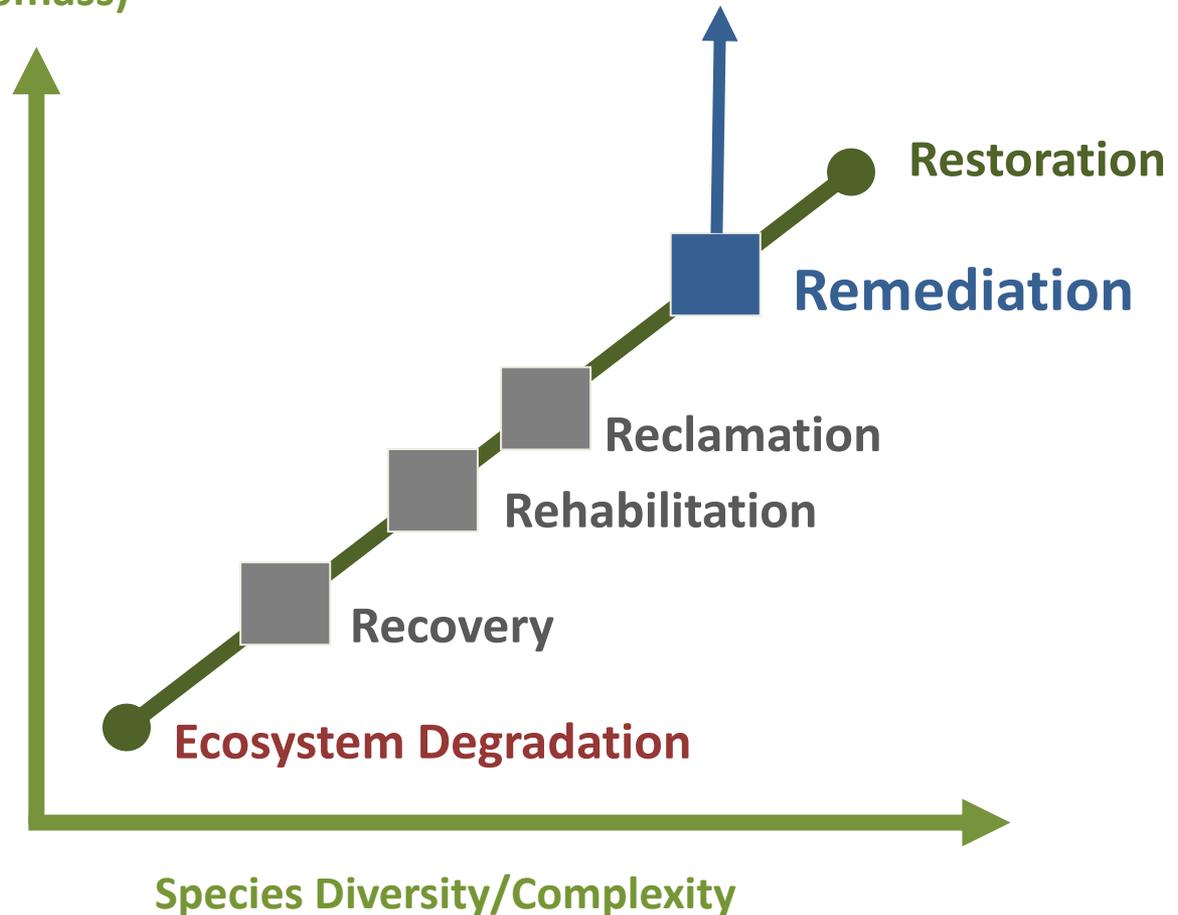
Soil Quality

The “Re-” Continuum

Positive Ecosystem Function
(e.g., Plant Biomass)

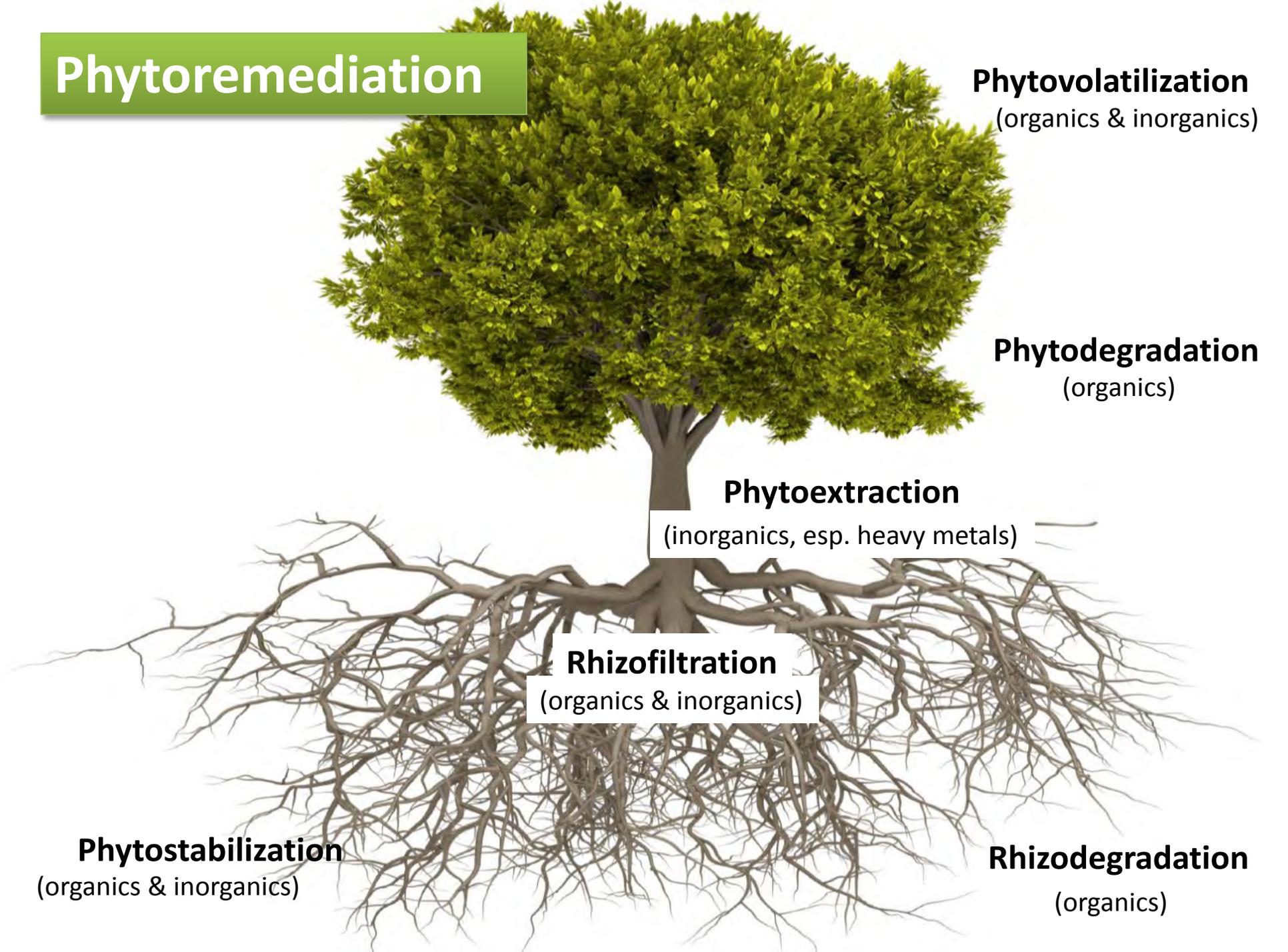
Need plants that are workhorses

Continuum between complete ecosystem degradation & pre-disturbance condition (restoration) for positive ecosystem function & species diversity / complexity.





Phytoremediation



Phytovolatilization
(organics & inorganics)

Phytodegradation
(organics)

Phytoextraction
(inorganics, esp. heavy metals)

Rhizofiltration
(organics & inorganics)

Phytostabilization
(organics & inorganics)

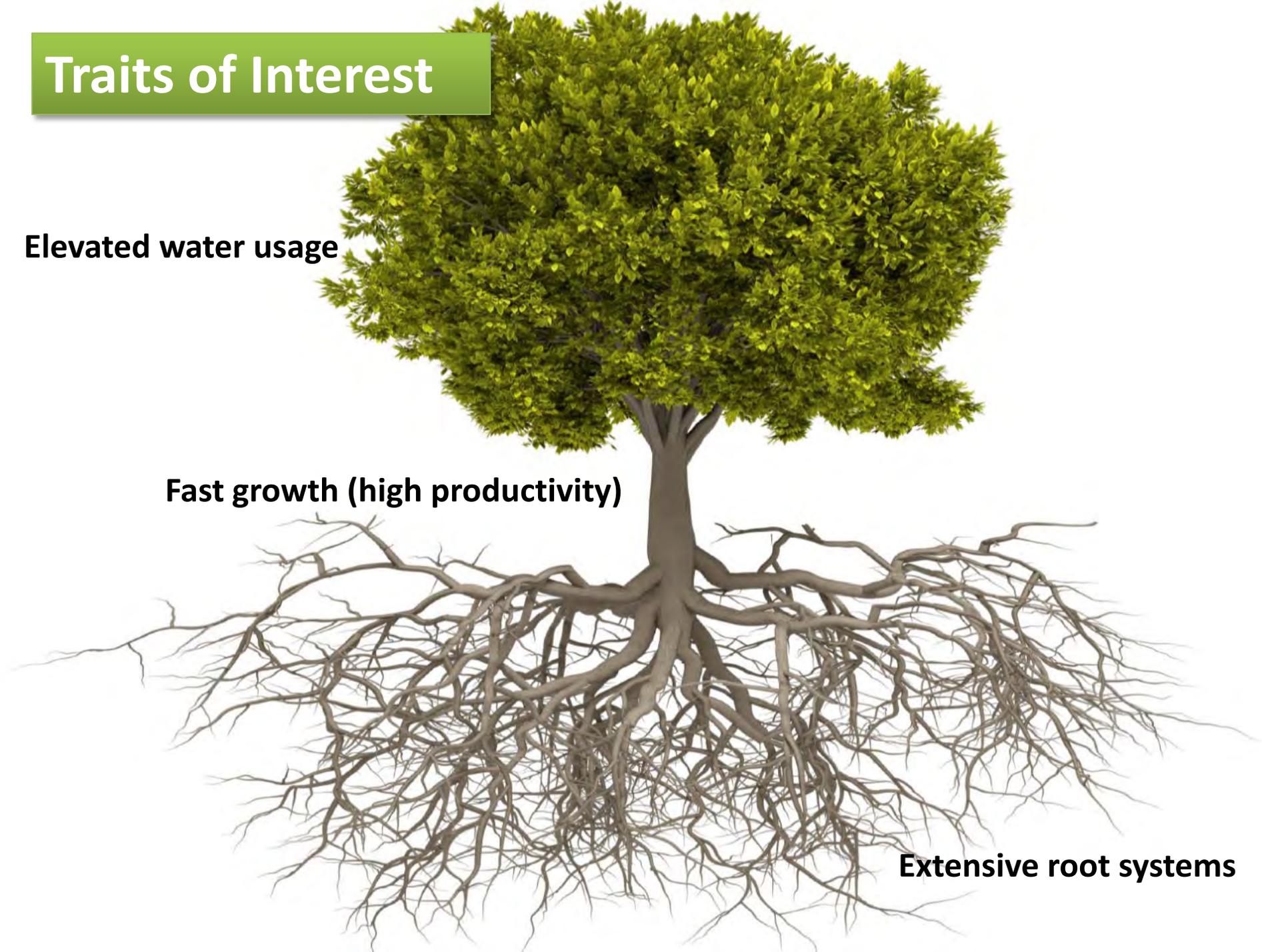
Rhizodegradation
(organics)

Traits of Interest

Elevated water usage

Fast growth (high productivity)

Extensive root systems



Poplars



Willows



Rationale



Site	System	Issue
Oneida County Landfill	Leachate Fertigation	Salts / Heavy Metals
Oneida County Landfill	Leachate Fertigation	Soil Fauna Diversity
Oneida County Landfill	Fiber Cake Effluent Fertigation	NPK plus OM for Compost
Rhinelander City Landfill	Fertigation / Hydraulic Barrier	Ammonia / Nitrates
Rhinelander City Landfill	Fertigation	Inorganics + Organics
Freshkills Landfill	Afforestation / Soil Improvement	Inorganics + Organics
ISU BioCentury Farm	Biochar for Propagation	Inorganics
POET Ethanol Plant	Fly Ash (Foliar Fertilizer)	Inorganics
Indiana Harbors Canal	Riparian Buffer	Petroleum Hydrocarbons
Lake States Waterways	Riparian Stabilization	Erosion
Midwest Ag Facility	Riparian Buffer / Overland Flow	Salts / Heavy Metals / Nitrates
Industrial Battery Facility	Soil Remediation	TCE, PCE
Urban Brownfields	Hydraulic Control / Overland Flow	Inorganics + Organics
Egyptian Tree Farms	Municipal Wastewater	Inorganics + Organics

Phytoremediation Examples



LaSalle, IL



- ❑ Industrial Brownfield (TCE, PCE)
- ❑ 11 yrs
- ❑ 19 clones

Crandon



20.3 cm

7300501



26.3 cm

220-5



34.5 cm

+ 19% versus expected diameter in the region

Elizabeth City, NC

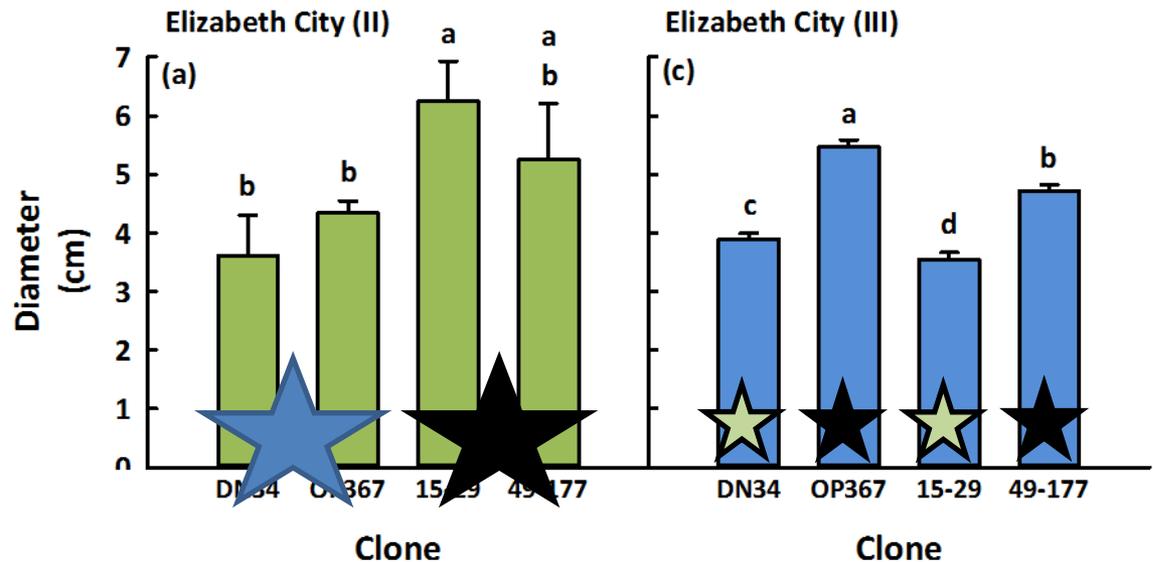


- ❑ US Coast Guard Base
- ❑ Petroleum Hydrocarbons
- ❑ 3 Plantings

E1: 6 yrs, 4 clones

E2: 5 yrs, 4 clones

E3: 5 yrs, 4 clones

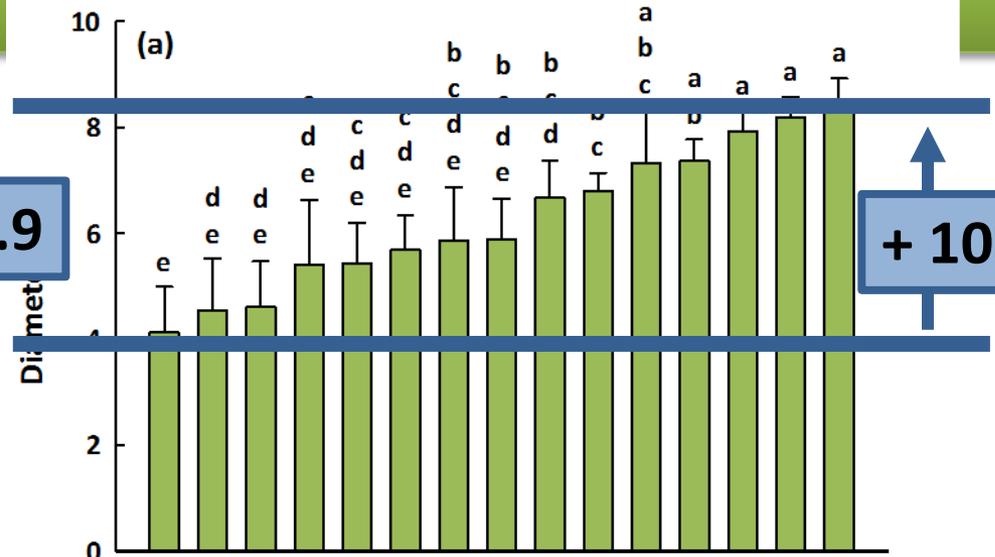


$DBH_{exp} = 8.1$
E2 = - 40%
E3 = - 46%

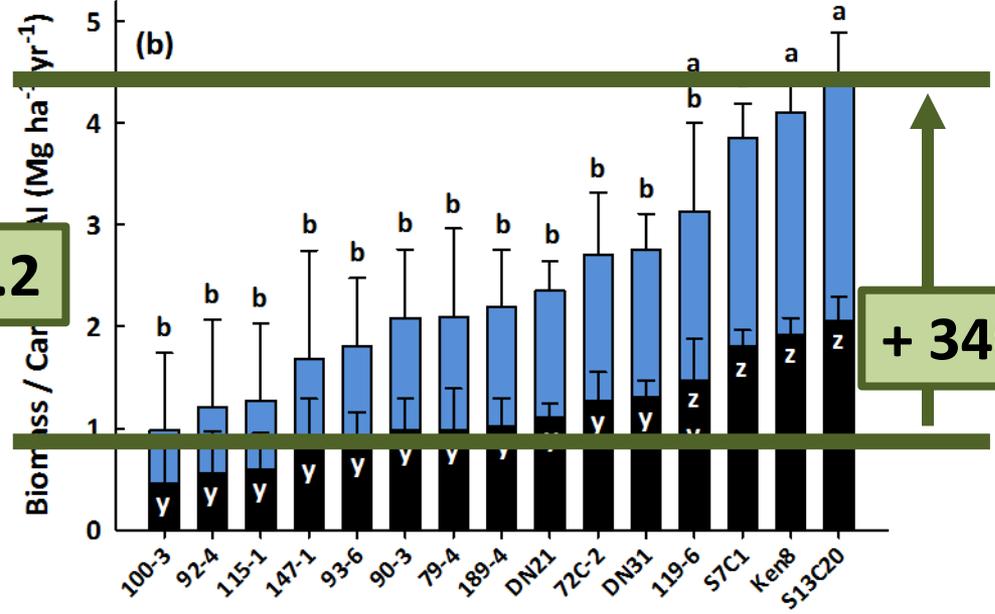
Panama City, FL

- Industrial Brownfield
- Arsenic
- 5.4 yrs
- 15 Clones

$DBH_{exp} = 8.9$



+ 102%

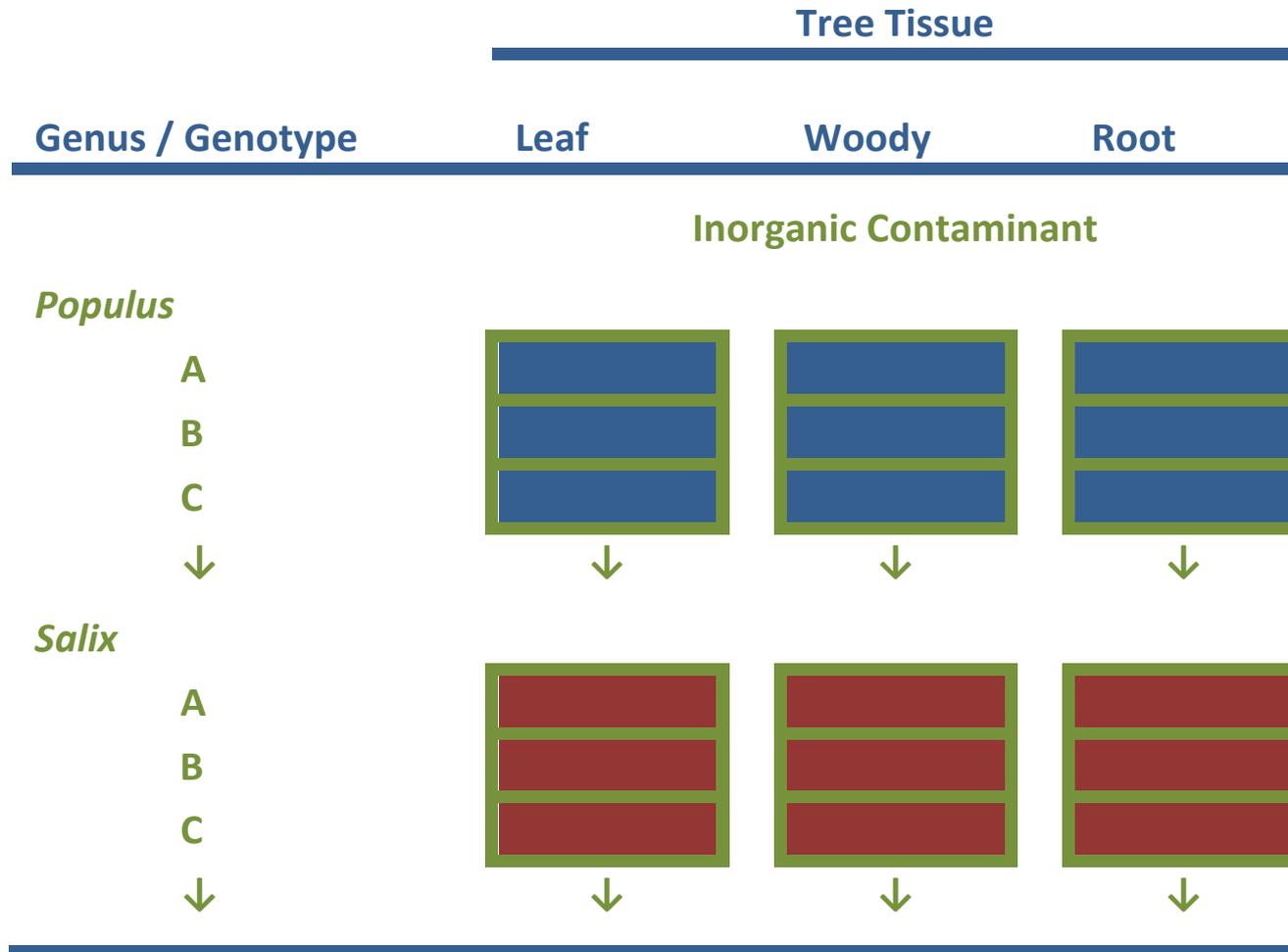


+ 340%



$Biomass_{MAexp} = 7.2$

The Phyto Matrix





Industrial Production Facility
Salts, metals, nitrates
11 years

Landfill

Salts in leachate

8 years



Landfill
Fiber cake recycling
12.5 years



Tree Planting is Strategic!

Ecology

- Buffer Great Lakes (TMDLs)
- Redirect surface water
- Increase tree canopy
- Carbon sequestration

Redevelopment

- Create green space (livability)
- Urban amenity plantings
- Direct contact issues
- Economic value of trees







US FOREST SERVICE NORTHERN RESEARCH STATION

Research *Review*

NO. 19 | WINTER 2013

**Fast-Growing Poplars Provide
Solutions for Both Energy and
Pollution Problems**

<http://www.nrs.fs.fed.us/news/review/19>

Afforestation & Reforestation

Afforestation

- ❑ The establishment of a forest or stand in an area where the preceding vegetation or land use was not forest

Reforestation

- ❑ The reestablishment of forest cover either naturally (by natural seeding, coppice, or root suckers) or artificially (by direct seeding or planting)



It's not just semantics.

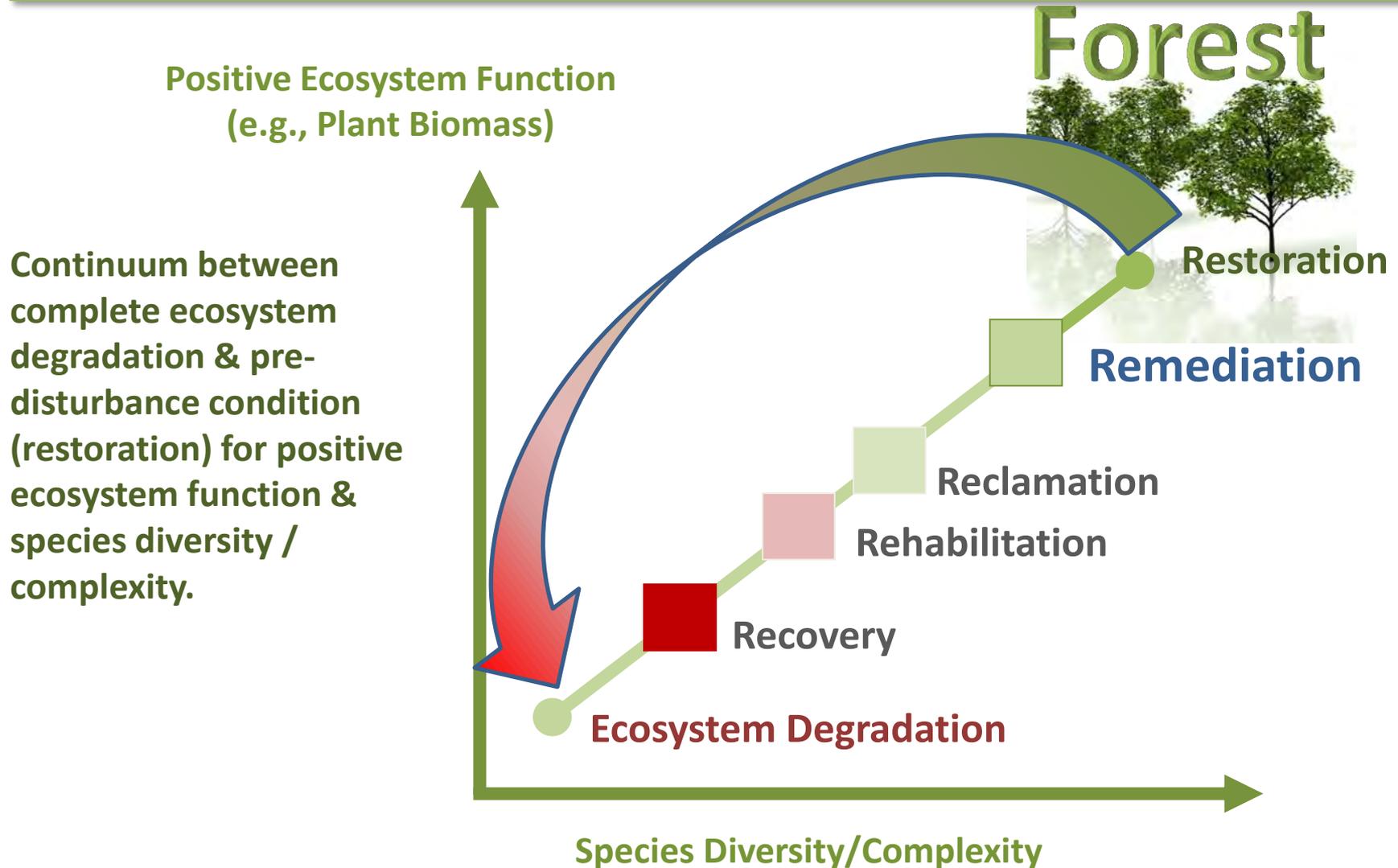
Forest Restoration?

Reforestation?

Afforestation?

<https://www.mannahatta2409.org/>

Revisiting the “Re-” Continuum



by the way..... It needs to be sustainable and resilient.

We need our urban forests to outperform traditional forests in many important ways. We need them to out compete exotic invasive plant species which are capable of consuming mature established forests and trees. We need them to absorb storm water runoff from hectares of surrounding sidewalks, streets and buildings. We need them to create soil and sustain themselves in an environment that they never evolved with. We need, therefore, to create something new.



*Kissena Park Afforestation
Planted four years ago with 3-5 year old stock.*

This one started from a seed.



Planted at the same time.



Project Design

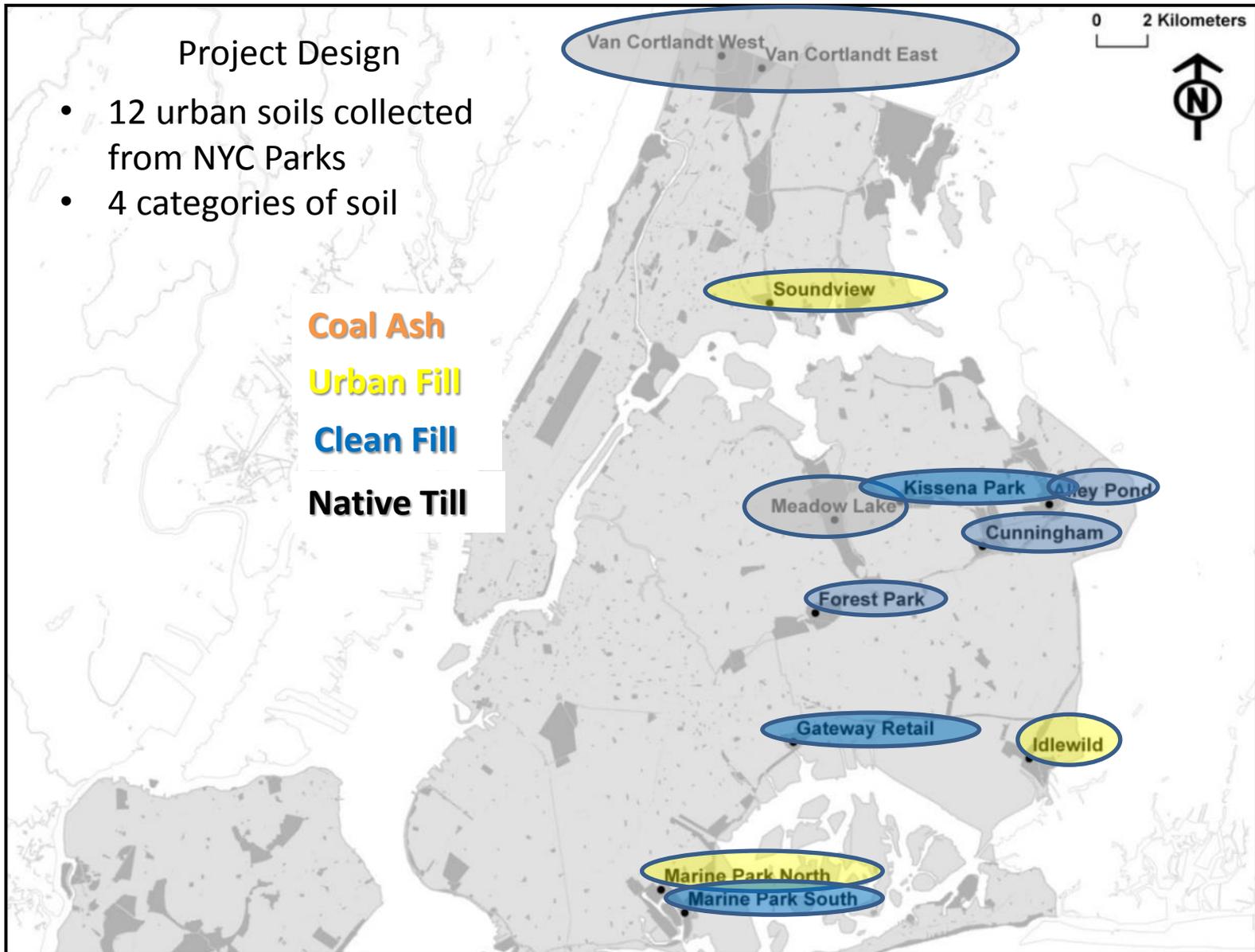
- 12 urban soils collected from NYC Parks
- 4 categories of soil

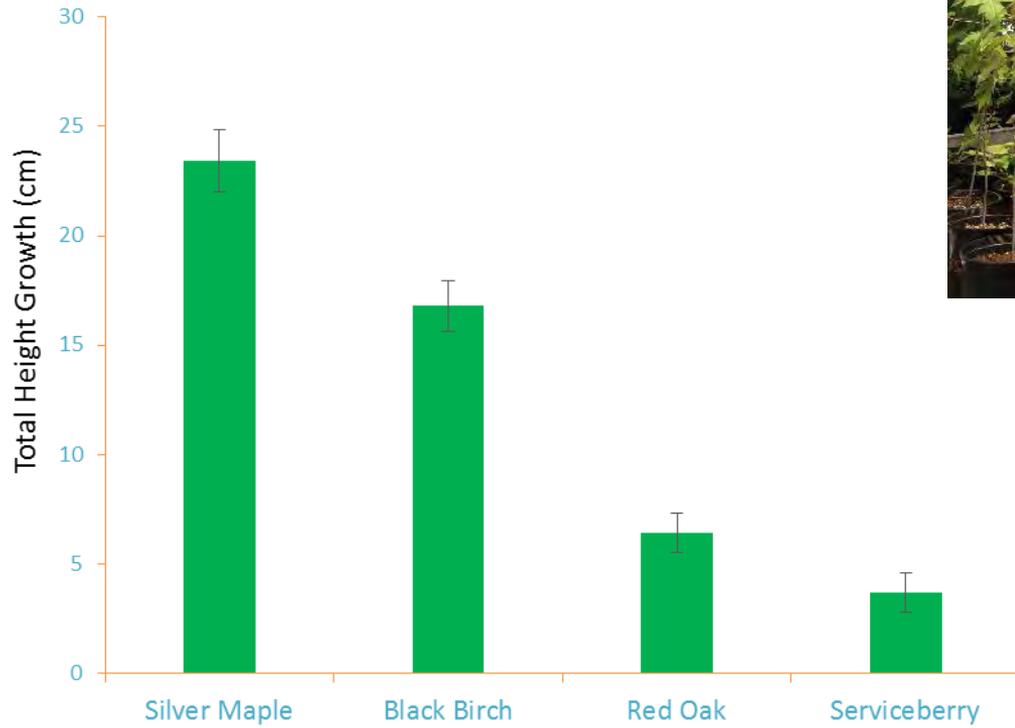
Coal Ash

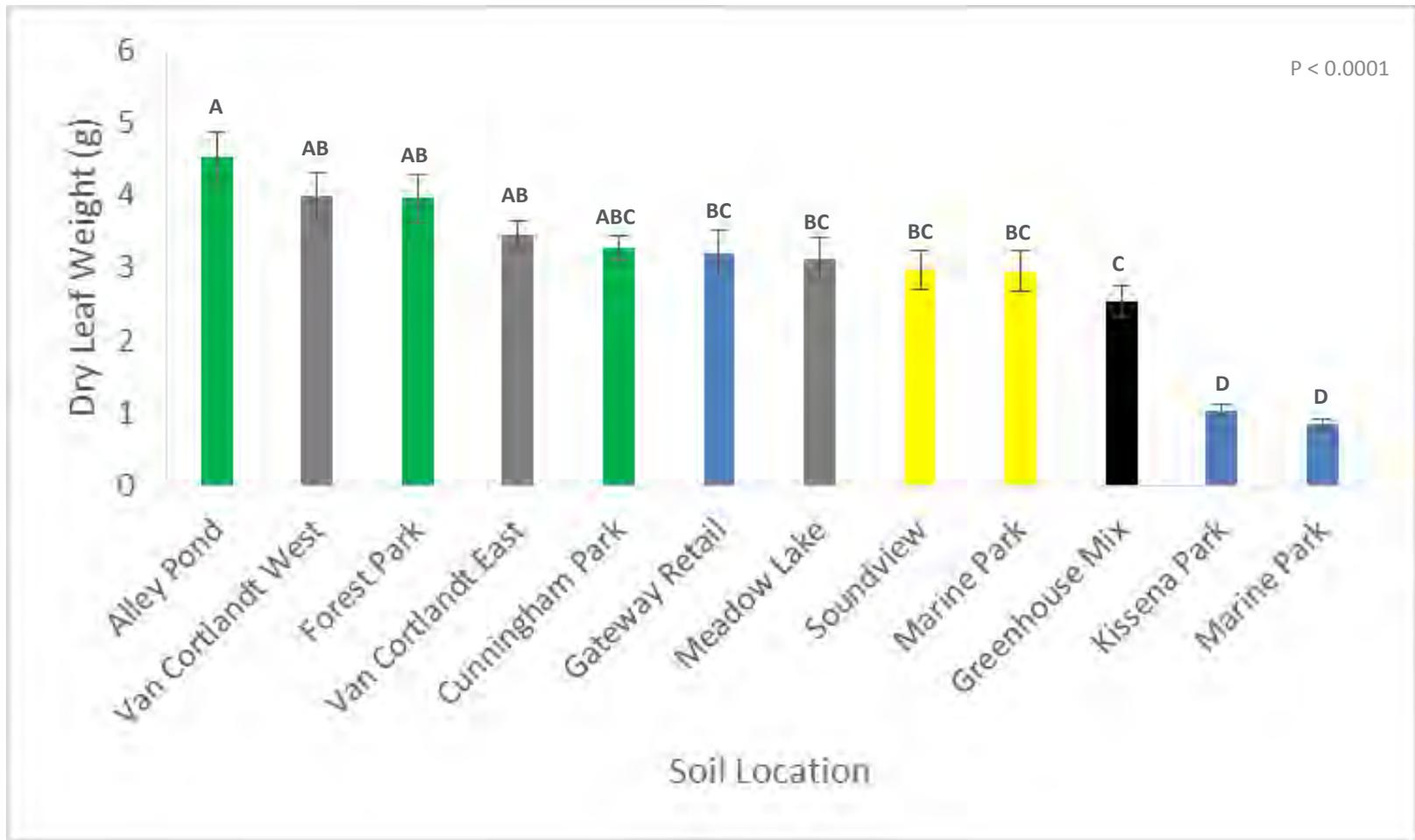
Urban Fill

Clean Fill

Native Till







Native Till

Coal Ash

Clean Fill

Urban Fill



Partnerships



DEPARTMENT OF SANITATION NEW YORK CITY

Yale School of Forestry & Environmental Studies

FreshkillsPark
THE FRESHKILLS PARK ALLIANCE



RUTGERS

School of Environmental
and Biological Sciences

Department of Ecology, Evolution, and Natural Resources

Jersey Roots, Global Reach



NYC Parks

Northern Research Station Locations



Key

- ★ Headquarters
- Offices, Research Laboratories and Assistant Director Location
- Offices and Research Laboratories
- ◆ Experimental Forests and Associated Research Sites

Staten Island, New York

Freshkills Afforestation Project

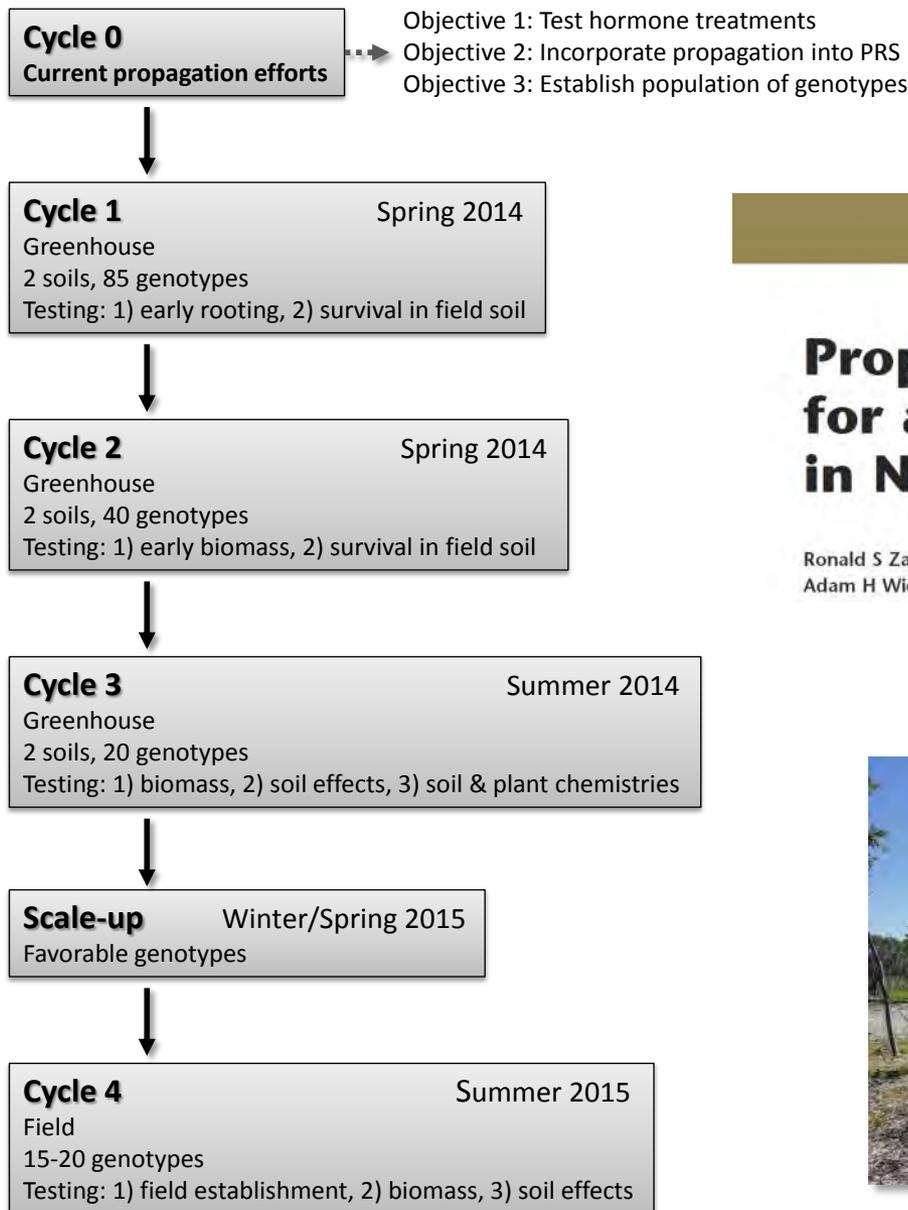
❑ Objectives

- ❑ Utilize poplar & willow as part of a forest succession program to achieve more rapid canopy closure on urban afforestation sites
- ❑ Use phyto-recurrent selection to identify superior genotypes capable of growing under the harsh site conditions
- ❑ Incorporate ozone treatments into phyto-recurrent selection
- ❑ Enhance the physical, chemical, biological, & agronomic characteristics of the soils
- ❑ Prevent the establishment of invasive plant species
- ❑ Encourage the establishment of native vegetation & invertebrates

Urban Afforestation



Phyto-Recurrent Selection for Planned Urban Afforestation



REFEREED RESEARCH

Propagating native Salicaceae for afforestation and restoration in New York City's five boroughs

Ronald S Zalesny Jr, Richard A Hallett, Nancy Falxa-Raymond, Adam H Wiese, and Bruce A Birr

Native Plants 15:29-41.



Project Description

Freshkills Afforestation Project

Standard Palette

Border made up of a few rows standard palette and then shrubs

Serviceberry
Eastern red cedar
Pitch pine
Eastern white pine
Box elder
White oak
Scrub oak
Pin oak
Willow oak

Mixed Palette

Border made up of a few rows poplar/willow and then shrubs

20 best performing genotypes (10 best willow and 10 best poplar) randomly planted within central block along with standard palette 50/50 (we place poplars and willows and let contractor place the standard palette as per contract.)

Experimental Palette

Border made up of a few rows poplar/willow and then shrubs

20 best performing genotypes (10 best willow and 10 best poplar) randomly planted within central block (we place plants)

Experimental Block

Thank you!

A scenic view of a lake with a forested background and a single tree in the foreground. The lake is calm, reflecting the surrounding greenery. A single, young tree with green leaves stands prominently on the right side of the foreground. The background is a dense forest of trees, partially obscured by a light mist or fog. The overall atmosphere is peaceful and natural.

Acknowledgements

We thank Margie Ewing Costa for the opportunity to speak today.