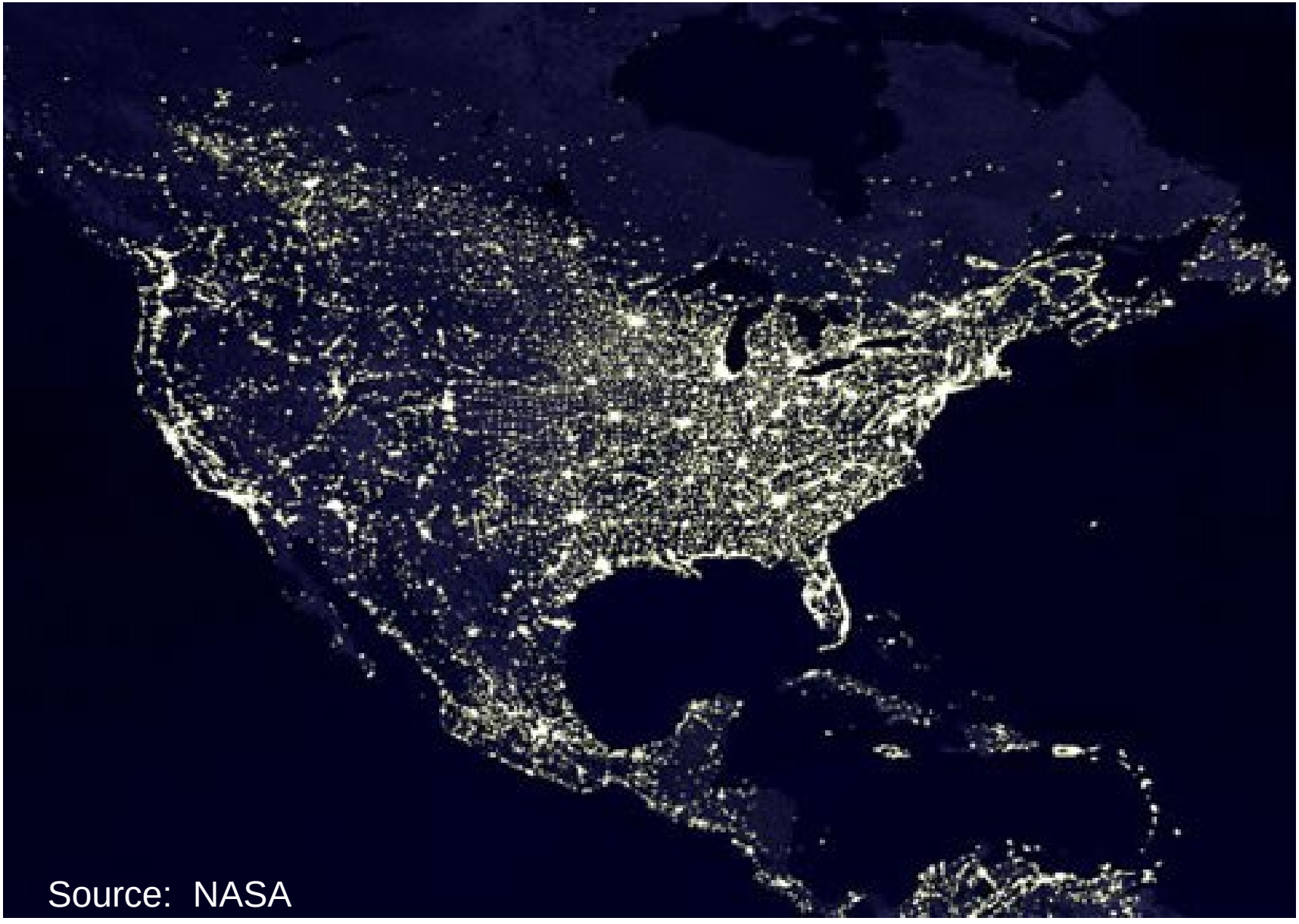
# What city is this:  Phoenix or Boston?


# Where are we now?


# *Lots of urban/suburban/exurban land use in North America . . . . .*



Source: NASA

# The American Residential Macrosystem:

- The large area of residential land use in the U.S. represents a macrosystem, i.e., “a regional to continental-scale system of interacting biological, geophysical, and social components. This perspective treats patterns and processes as dynamic and interactive, both within and across scales of time and space (Heffernan et al. 2014).”
- This macrosystem is driving ecological homogenization of biodiversity, soils, hydrography, microclimate, biogeochemistry and human attitudes, values and behaviors.

# It all looks like this:

## -Why?

## -How does it function ecologically?


# What drives us to all have the same residential land use, and how might we change that?

- Human roots in the savannah or English manor, human domination of nature (psychological)
- The whiffle ball effect . . . (functional)
- It's pretty . . . (aesthetic)
- I enjoy working in the yard , . . (human:nature interactions)
- Laziness . . . (efficiency)
- Irritating the neighbors (social cohesion)
- I'll never sell this dump (property values)
- The lawn industrial complex (political economy)
- There's a law . . . (political economy)
- *"A complex mix of factors!"*

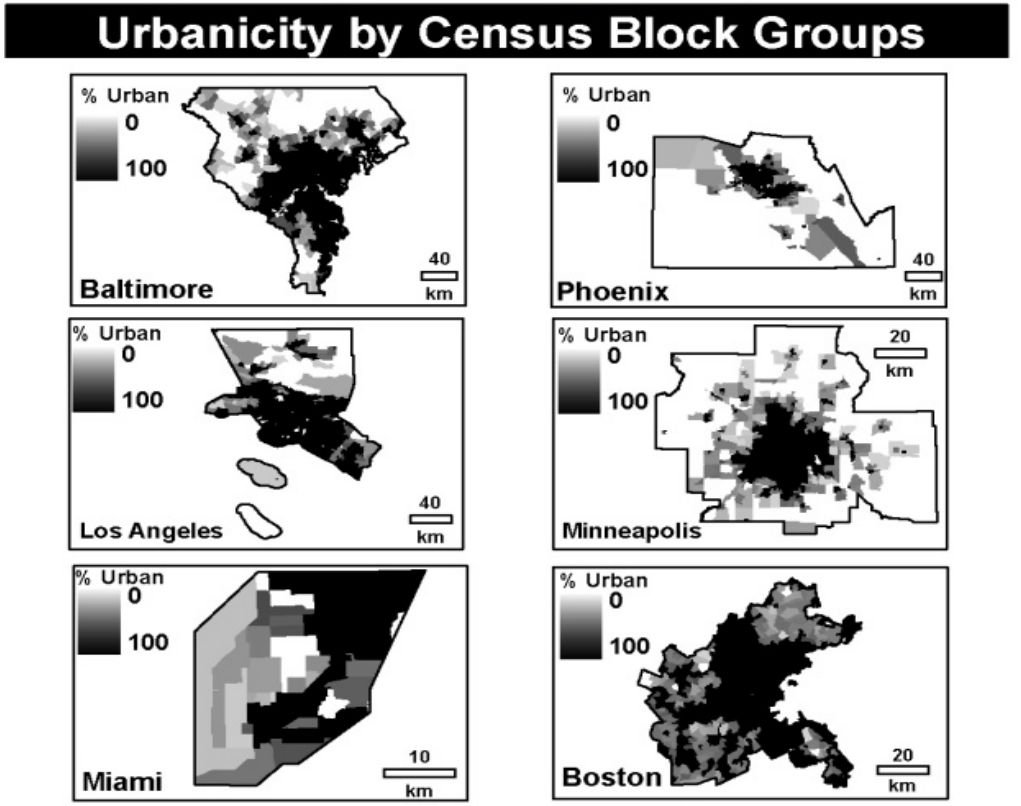
# Ecological Homogenization of Urban America:

- Why do our cities look so similar?
- What are the effects of this urban homogenization on:
  - Biodiversity
  - Soil biogeochemistry (carbon, nitrogen)
  - Hydrography
  - Microclimate
  - Quality of life
- What are the prospects for change?


- Funded by the U.S. National Science Foundation program on "MacroSystems Biology: Research on Biological Systems at Regional to Continental Scales.

# Six study cities, 14 co-pi's, 11 institutions:

- Peter M. Groffman
- J. Morgan Grove
- Sharon Hall
- Kelli Larson
- Colin Polsky
- James Heffernan
- Laura Ogden
- Rinku Roy Chowdhury
- Christopher Neill
- Diane Pataki
- Sarah Hobbie
- Jeanine Cavender-Bares
- Kristin Nelson
- Jarlath O'Neil-Dunne

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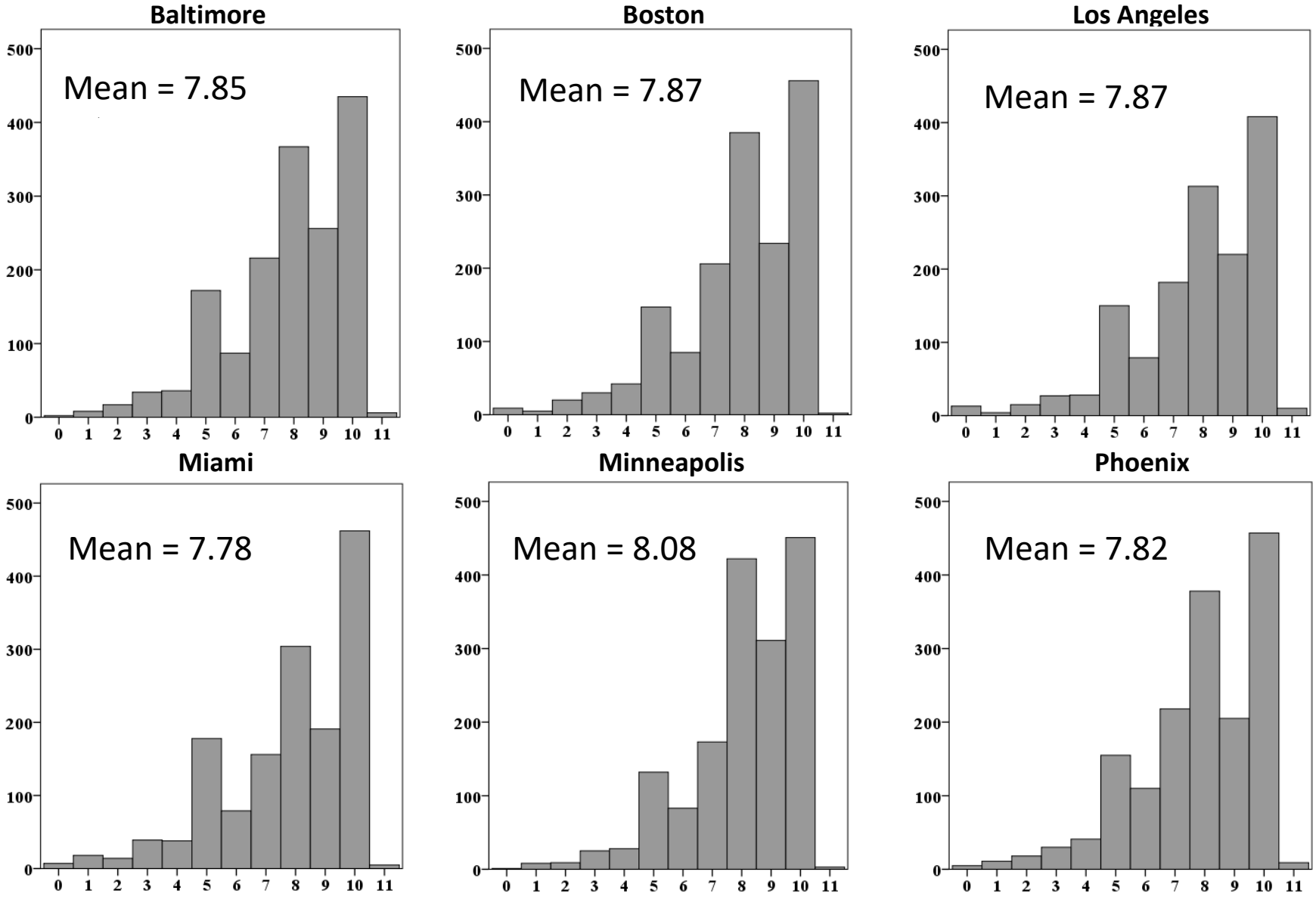
# Satisfied with the natural environment in your neighborhood?



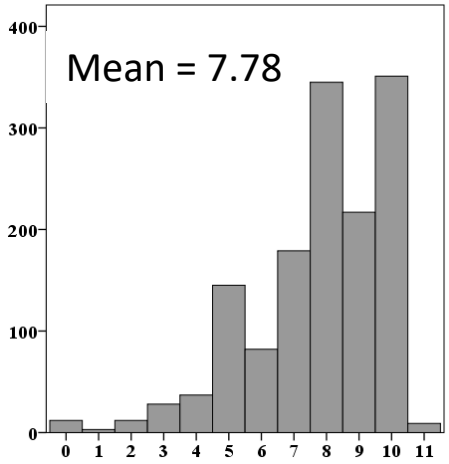

0) Very dissatisfied ------ 10) Very satisfied, 11) Don't know / Refused – Originally coded as 99

**Source: Colin Polsky**

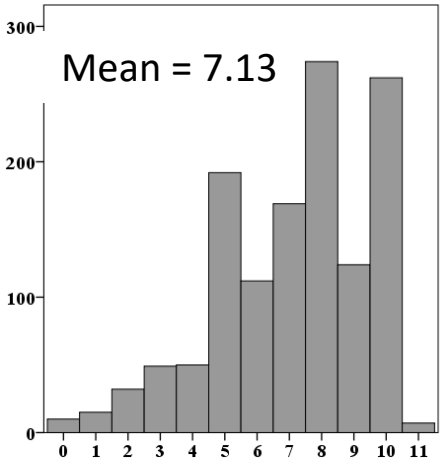
**Scale of 0 - 10**

# Satisfied with the natural environment in your neighborhood?

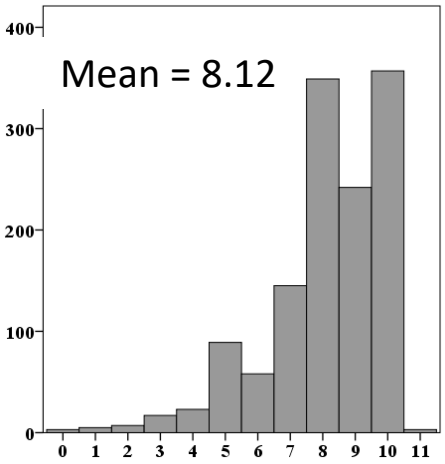
Urban – high SES



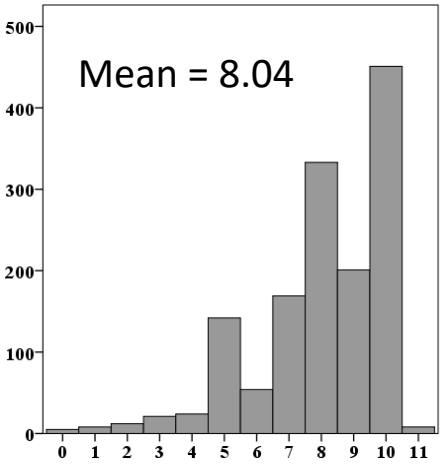

Urban – low SES

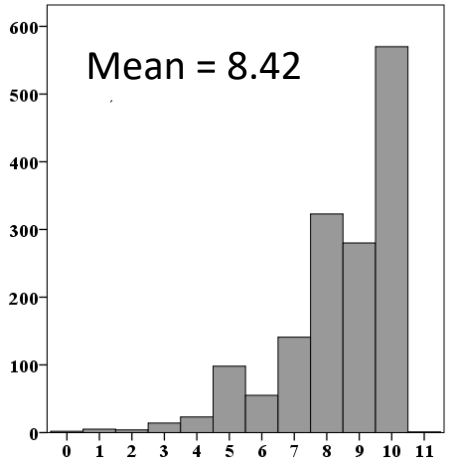



Suburban – high SES

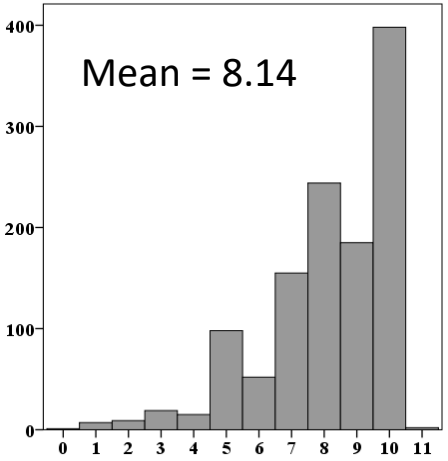



Suburban – low SES

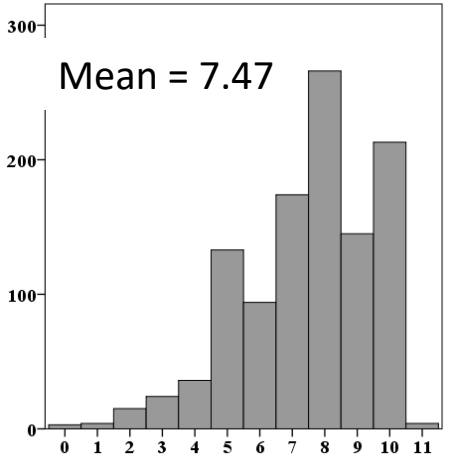


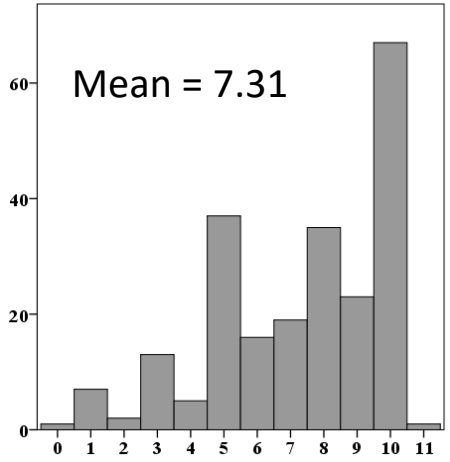

Exuburban – high SES




Exuburban – low SES




Seg.7




Seg.8

0) Very dissatisfied ------ 10) Very satisfied, 11) Don't know / Refused – Originally coded as 99

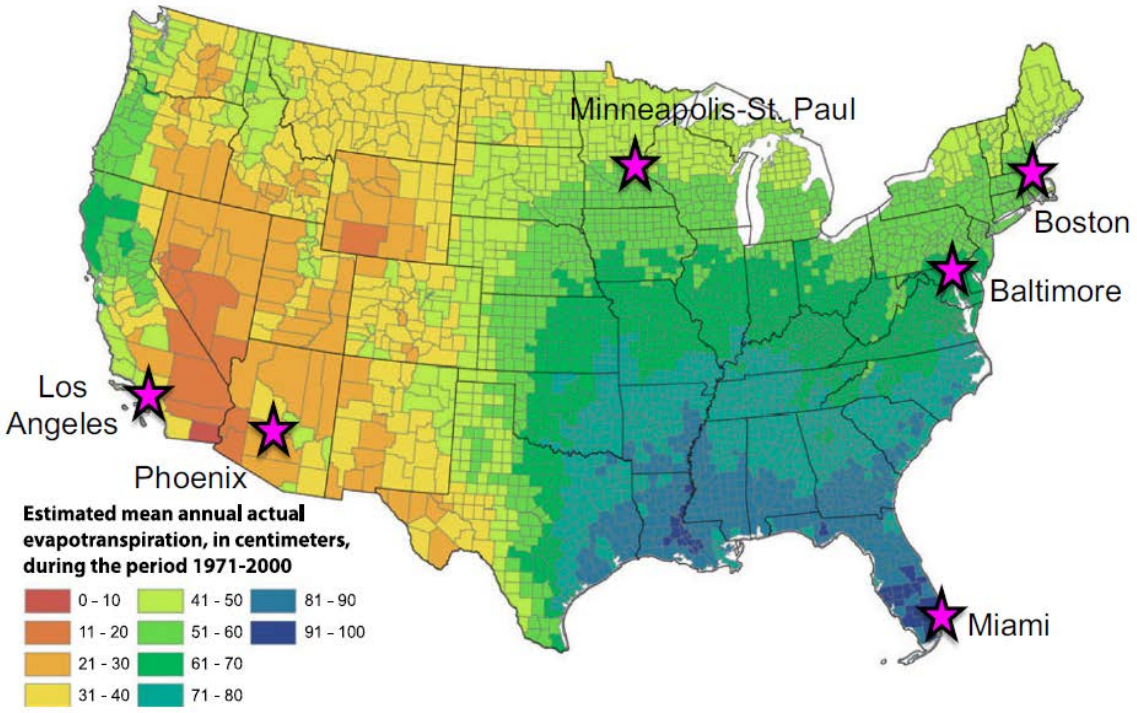
**Full study area (n=9480)** **Scale of 0 - 10**

**Source: Colin Polsky**

# More detailed analyses:

*To what extent do residents prioritize the **same (or different) values across regions** when managing their yards?*

→ As expressed in term of valued ecosystem services!



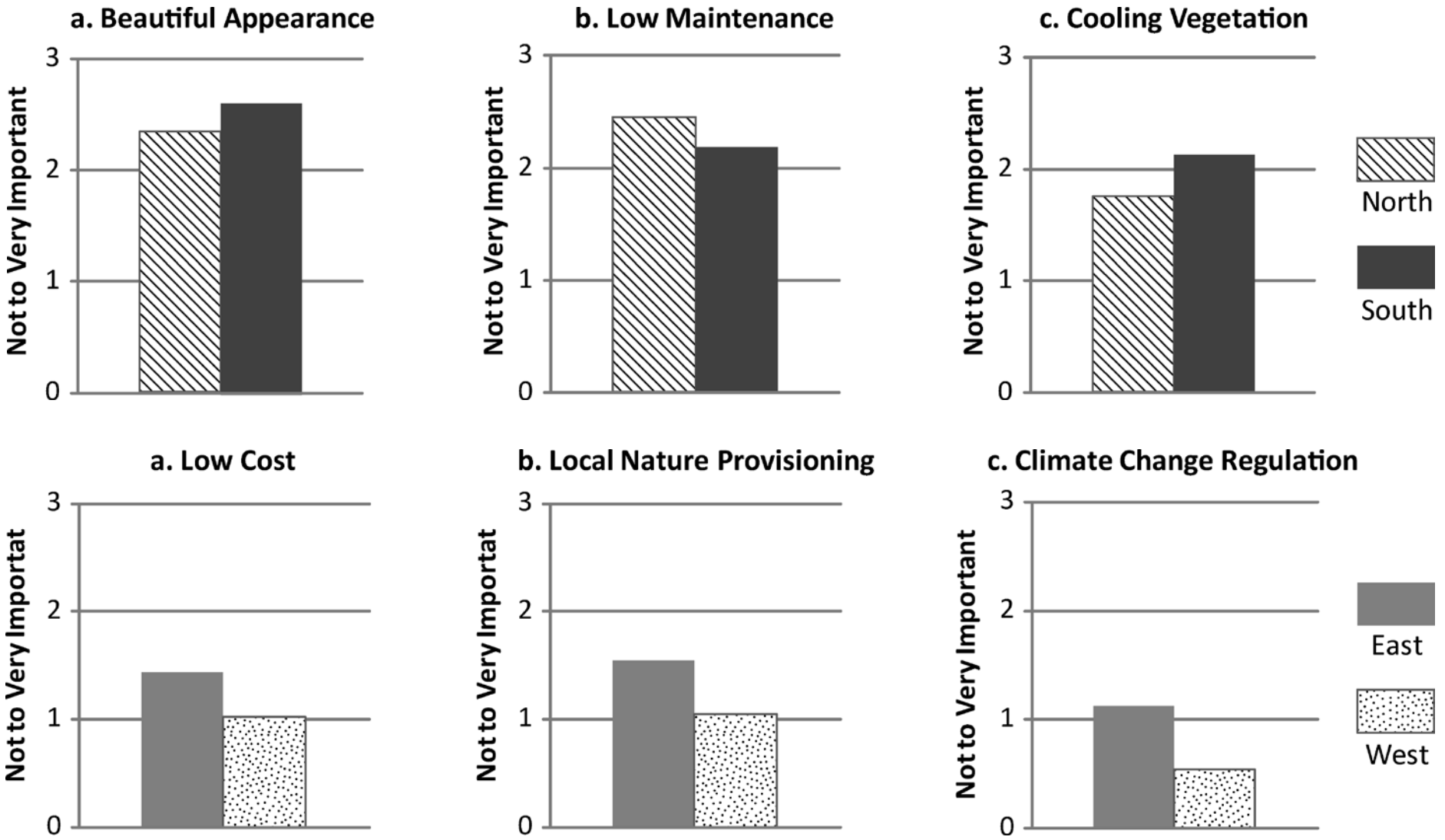

**Regional Comparisons of Survey Respondents:**

*Cool **North** vs. Warm **South***

*Humid **East** vs. Arid **West***

**Larson et al. (2016)**

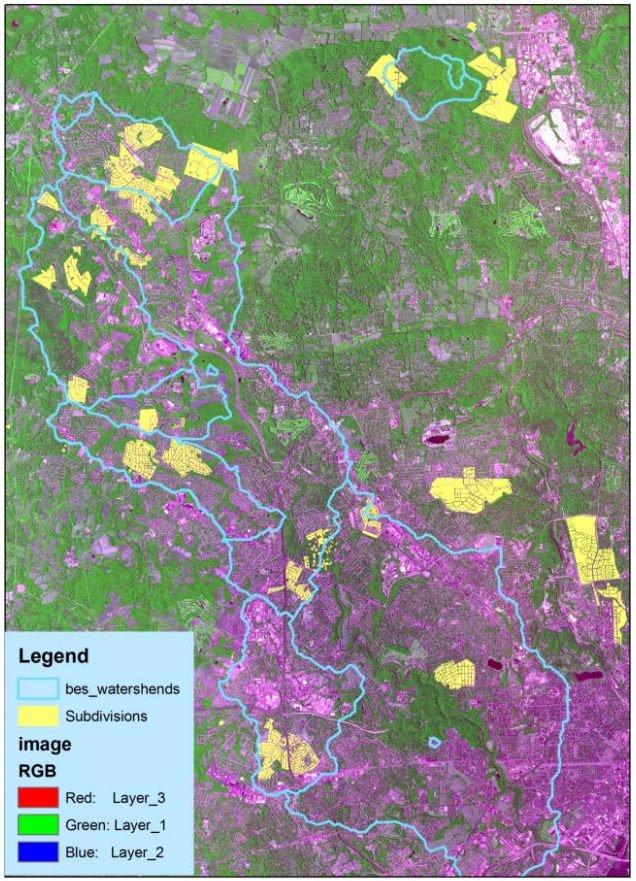
# Heterogeneity in Ecosystem Services Values

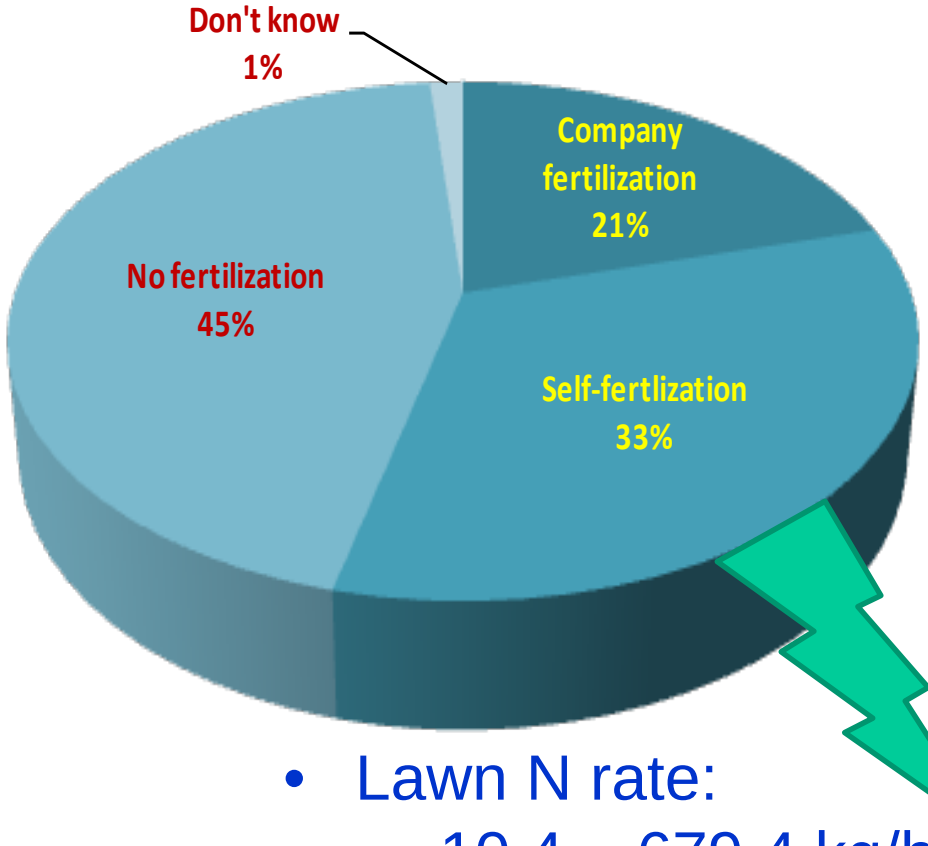



Larson et al. (2016)

# *What are people really doing on their lawns?*

**Survey:** 496 interviews in Baltimore, summer 2008



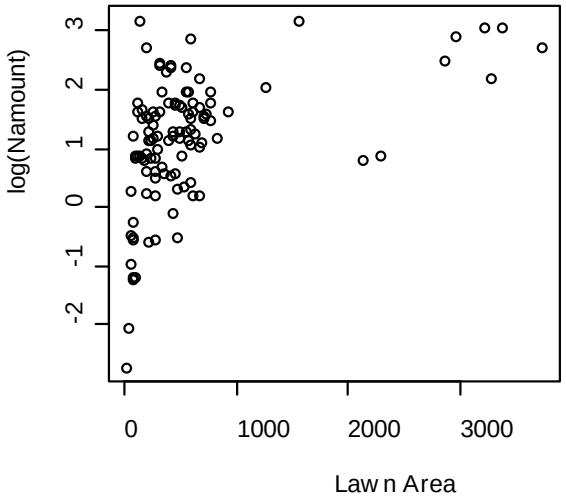



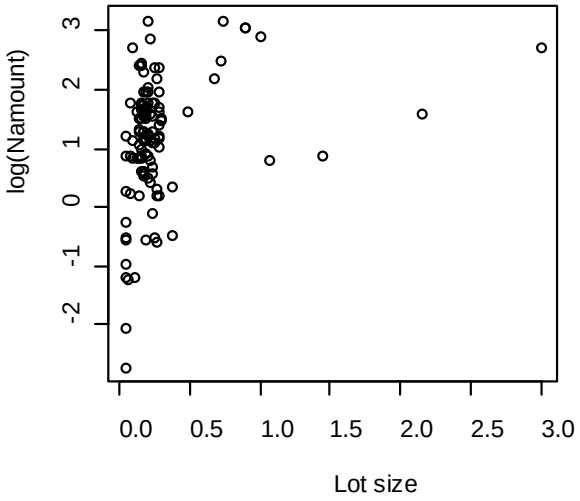

- Lawn N rate:
  - 10.4 ~ 679.4 kg/ha/yr
  - Mean: 115.8 kg/ha/yr

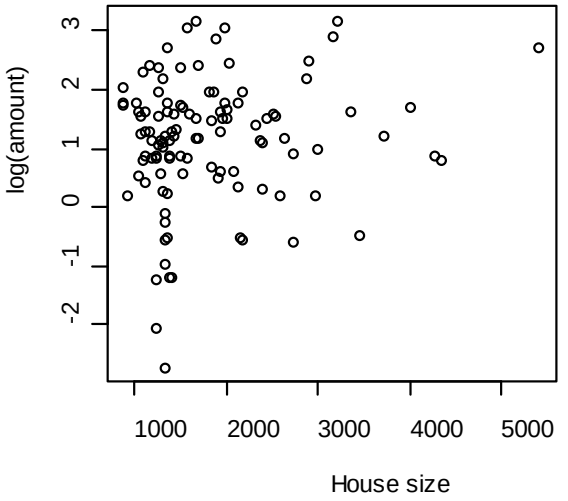
Fraser et al. (2013)

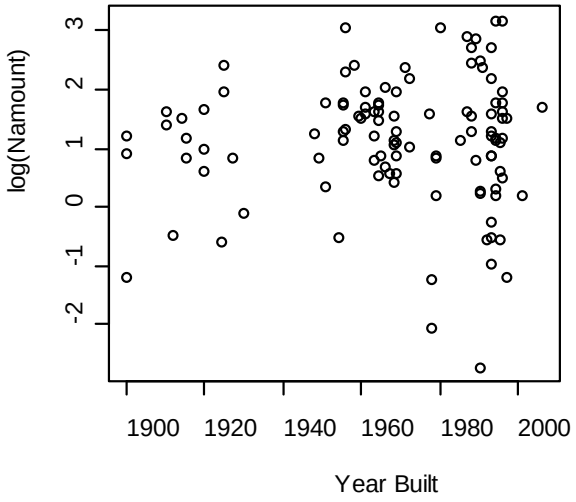
bes_value_Ndescribe.xls

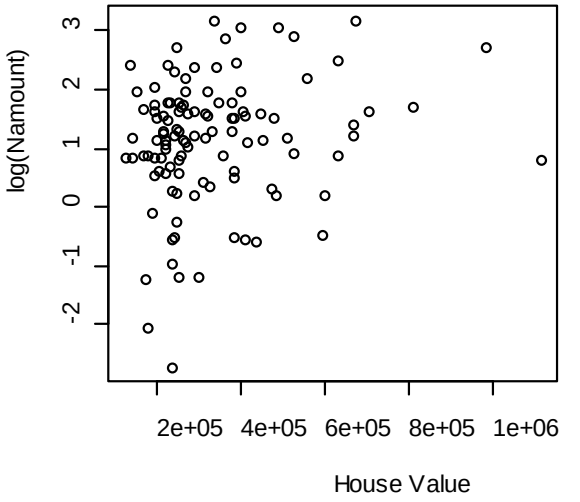
# What are people really doing on their lawns?

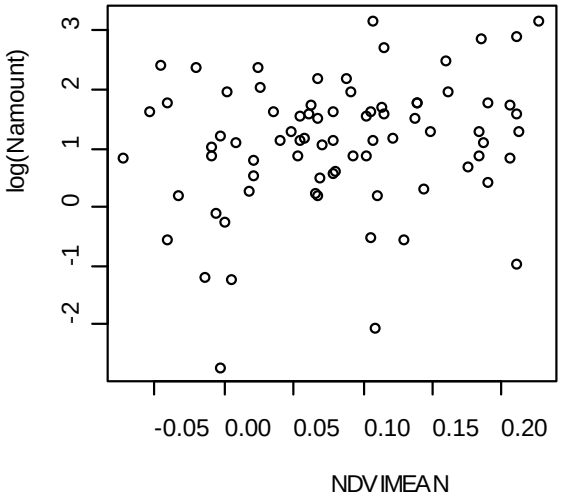



Fraser et al. (2013)

# “Ecology of prestige”:

- “A household’s land management decisions are influenced by its desire to uphold the prestige of its community and outwardly express its membership in a given lifestyle group. From this perspective, housing and yard styles, green grass, and tree and shrub plantings are status symbols, reflecting the different types of neighborhoods to which people belong” (Grove 2006)

- People often use their yard to express their belonging in a certain social group or class.

# “Ecology of prestige”:



# Yard Management and Crime: Case Studies in Baltimore, MD

Ashley Lidman(1), Morgan Grove(2) and Austin Troy(3)

1. Winooski Parks District
2. USDA Forest Service
3. University of Vermont



# Ecological Homogenization of Urban America:

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- What are the effects of this urban homogenization on:
  - Biodiversity
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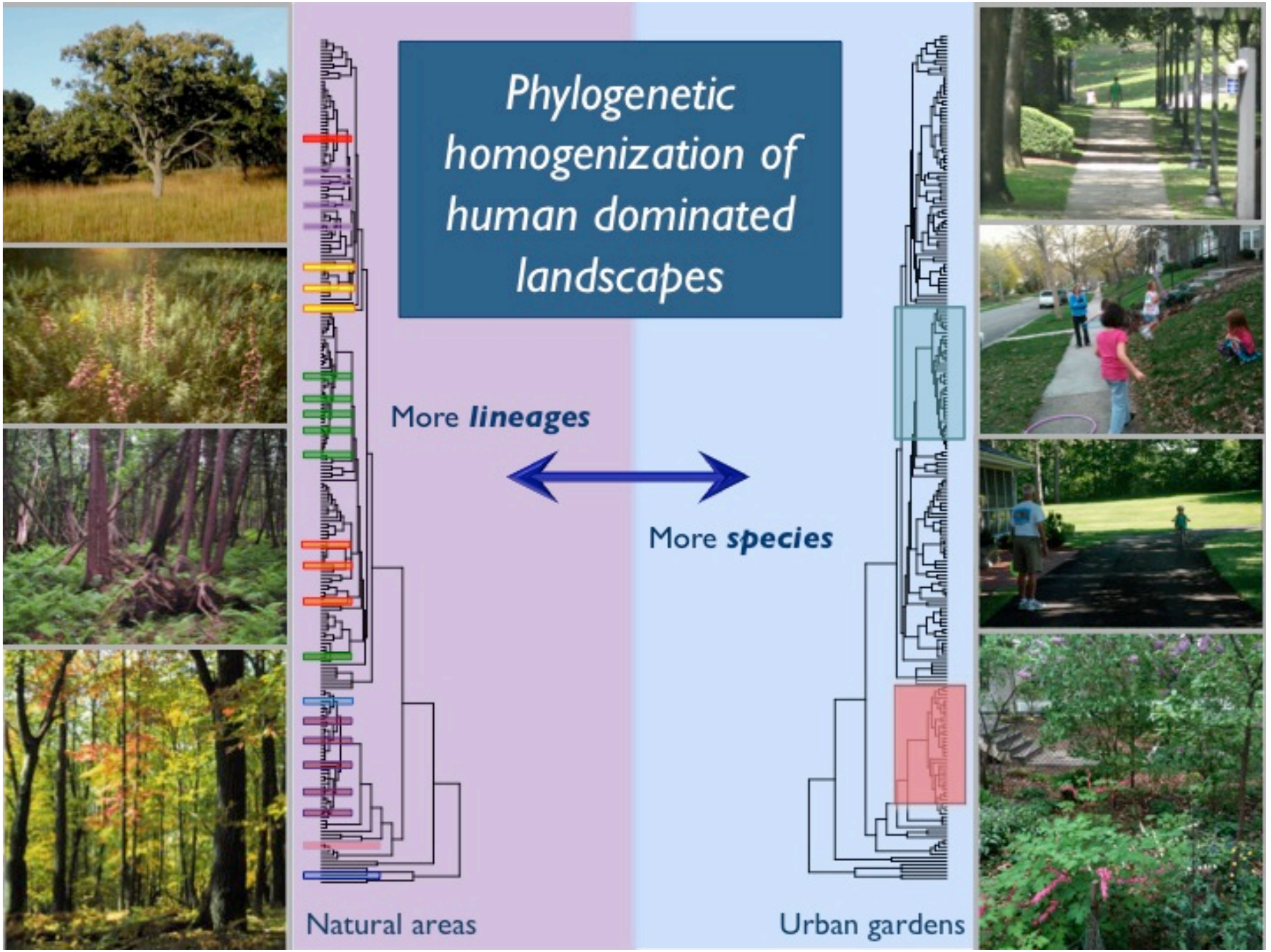
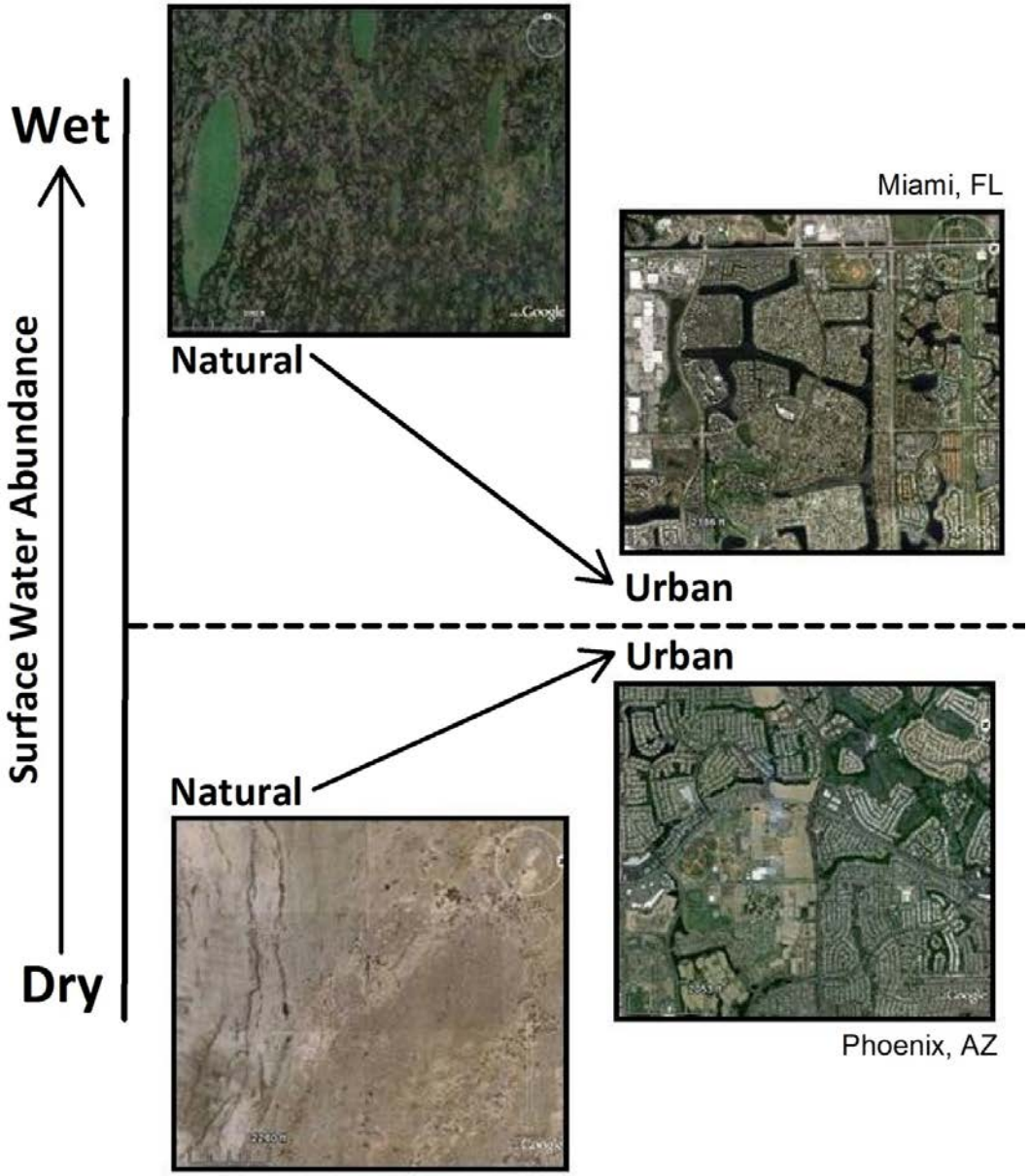
- Funded by the U.S. National Science Foundation program on "MacroSystems Biology: Research on Biological Systems at Regional to Continental Scales.



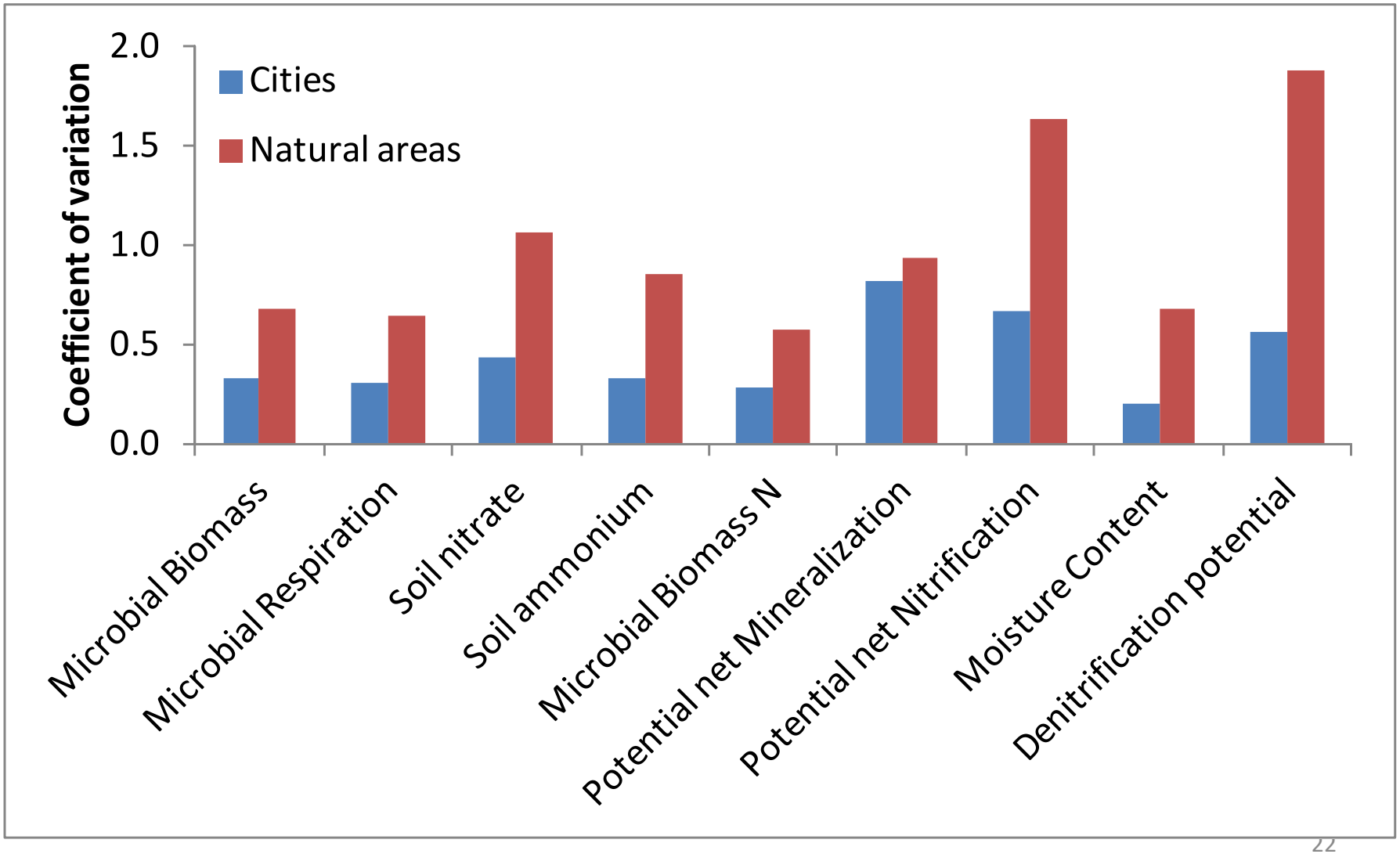

Groffman et al. (2014)

# Hydrographic homogeneity:




Groffman et al. (2014)

# Cities less variable than natural areas: Soil processes



# Urban grasslands:

- Ecosystems dominated by turf-forming species created and maintained by humans for aesthetic and recreational (not grazing) purposes.
- Have coherent patterns of ecosystem processes that can be evaluated with the same approaches used to study other ecosystem types e.g., forests, rangelands, prairies.
- 163,800 $km^2$ - area three times larger than that of any irrigated crop.
- Can be highly fertilized, but tremendous variation in management.
- Complex biogeochemistry, significant potential for nitrogen retention.

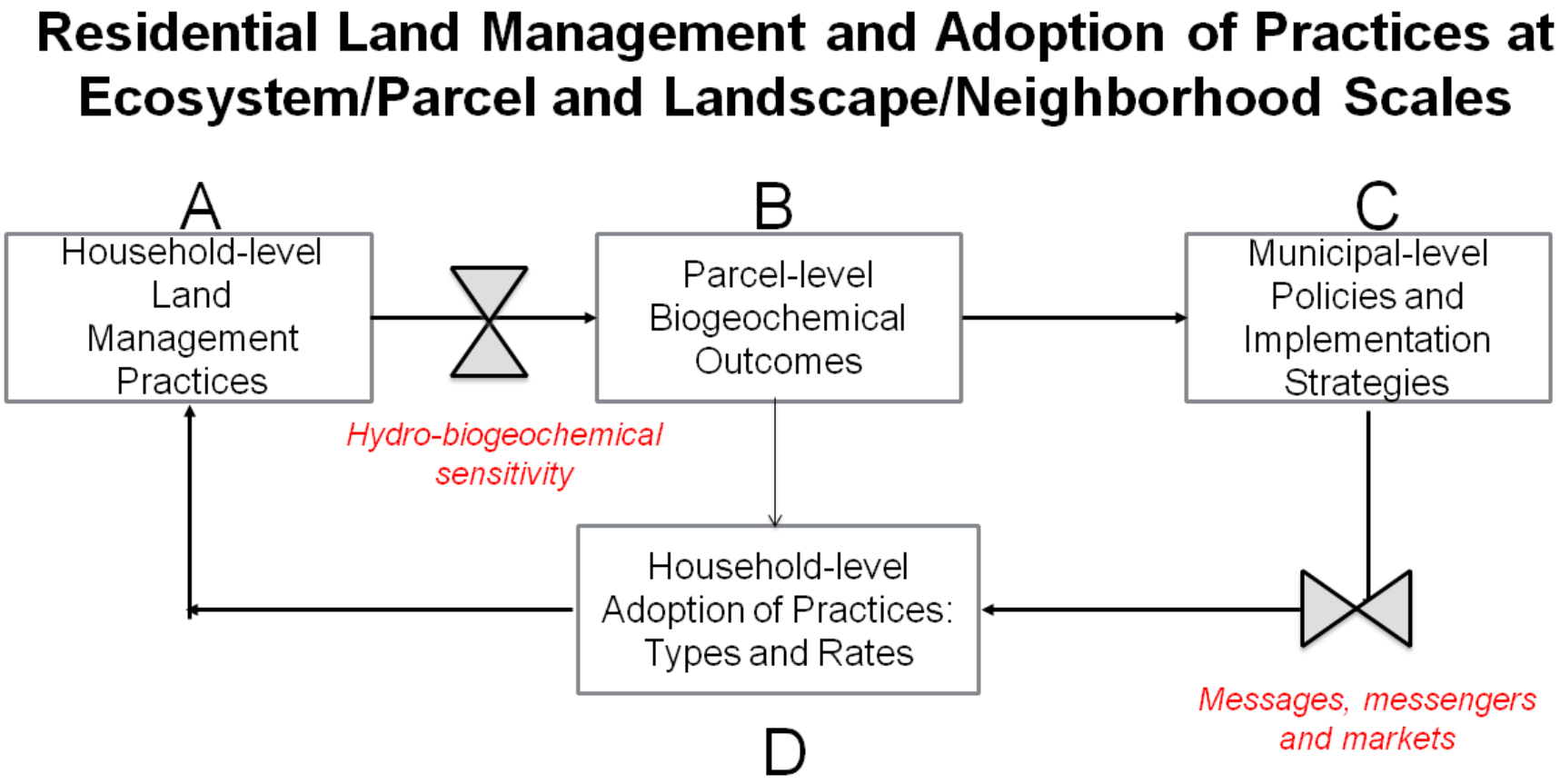
# Long-term studies of urban grasslands:

- Baltimore Ecosystem Study (BES) long-term ecological research (LTER) project.
- BES long-term study plots:
  - Forest, lawns, riparian
  - Lysimeters
  - Trace gas fluxes
  - Soil moisture, temperature
- Studies on real lawns:
  - Production and respiration
  - Soil C and N pools  to 1 m
  - Microbial carbon and nitrogen cycle processes to 1 m
  - $^{15}N$ studies comparing lawns and forests.
- Social science:
  - What are people doing on their lawns?
  - How does this vary along socio-demographic axes?
  - Why?

# Environmental performance of lawns and yards: Not as bad as we thought

- Nitrogen bombs in the landscape?
  - Only 50% are fertilized.
  - Water pollution and greenhouse gases higher than forest but much lower than agriculture.
- Biodiversity:
  - Species diversity, even in lawns, higher than expected, higher than native ecosystems – not a monoculture, not a desert.
- An active carbon cycle:
  - Productivity is high, i.e., grass grows a lot.
  - Soil organic matter is high.
  - Active carbon tightens up the nitrogen cycle.
- An active water cycle:
  - Infiltration: Is it like pavement or like forest?
  - Evapotranspiration, cooling, leaching and flooding

# Effecting change: Messages, messengers and markets . . .



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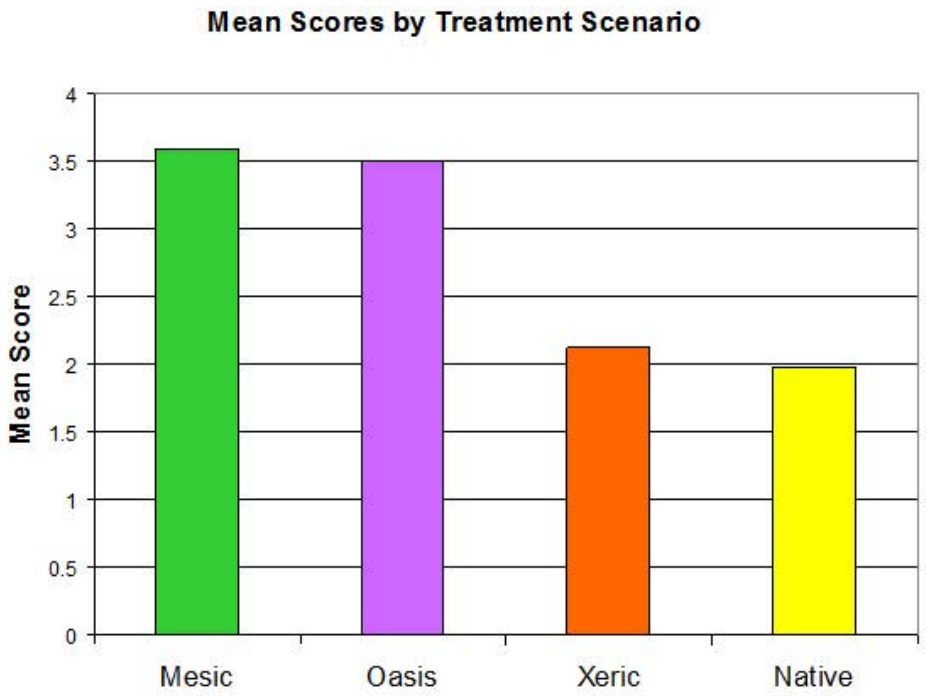
# Alternative futures for the American residential macrosystem:

- What are the factors motivating change and stability:
  - Change: Shifts in human demographics, desires for biodiversity and water conservation, regulations governing water use and quality, dispersal of organisms
  - Stability: Social norms, property values, neighborhood and city covenants and laws, commercial interests.
- Ecological implications within and beyond cities.

# Interest in water conservation in the west:





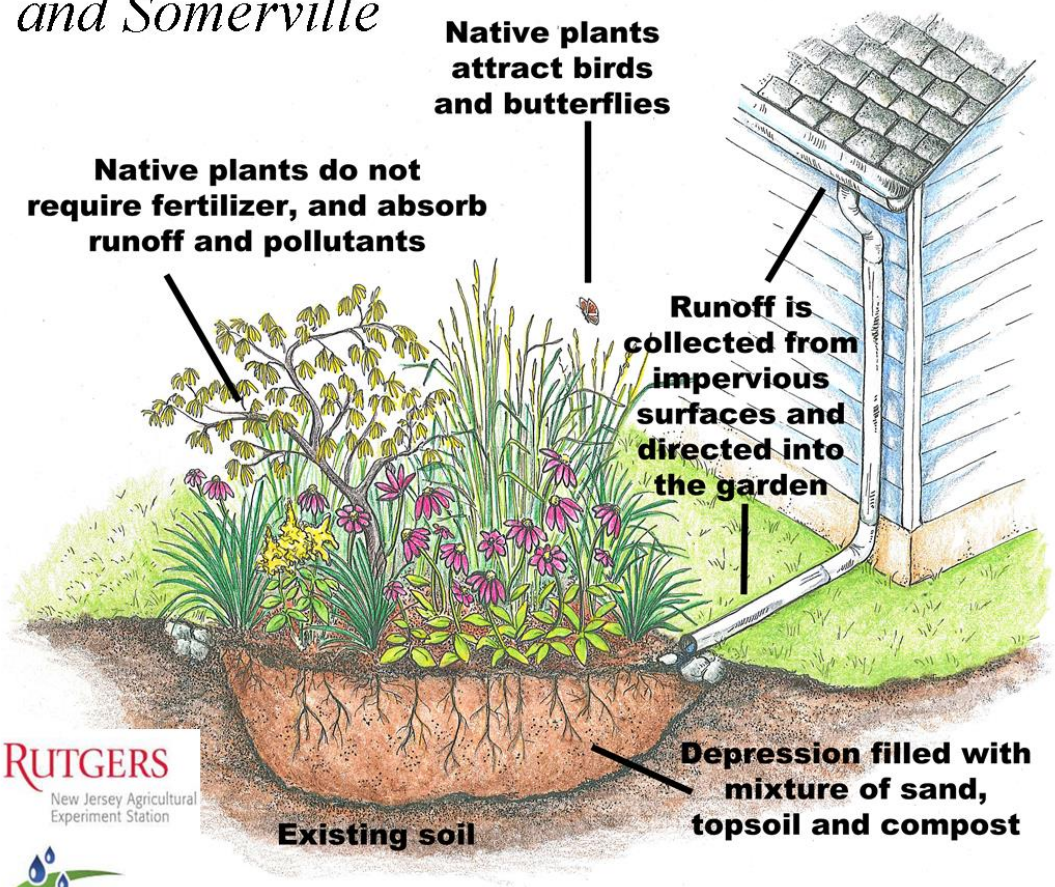



(Casagrande et al. 2006, Larson et al. 2009)

# Interest in water retention in the east:

## Rain Garden Rebate Program

*For residents of Hillsborough, Raritan, Bridgewater and Somerville*





Rebates of up to $450 for Rain Gardens!

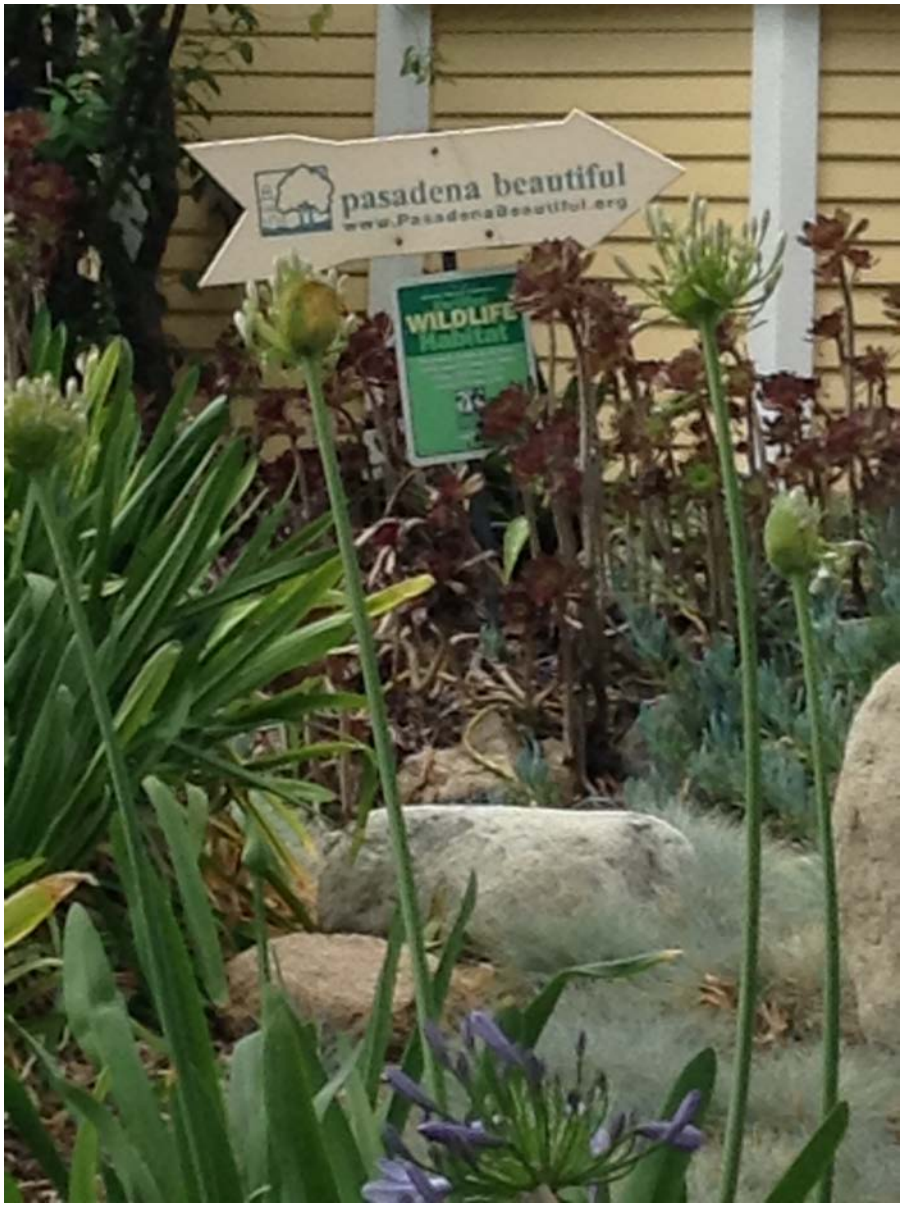
*Protect our water and make a difference!*

RUTGERS New Jersey Agricultural Experiment Station

Water Resources Program

NEW JERSEY EST. 1981 WATER SUPPLY AUTHORITY

# Interest in wildlife/biodiversity:



# Get the lawn your neighbors expect.


## Get started with a FREE lawn analysis.

Name

House Number

Street Name

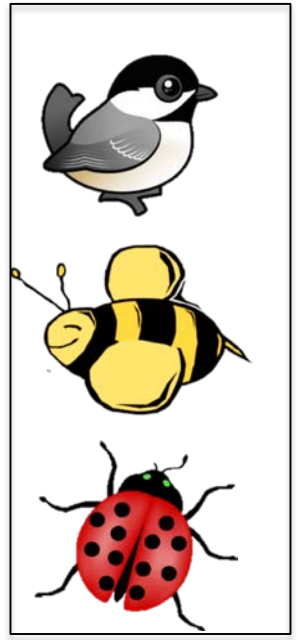
## Neighbors talk.

And, whether you like it or not, they talk about your lawn. You shouldn't have to worry about that. Let us help give you the lawn that will meet your (and your neighbors') expectations.

# Yard Futures

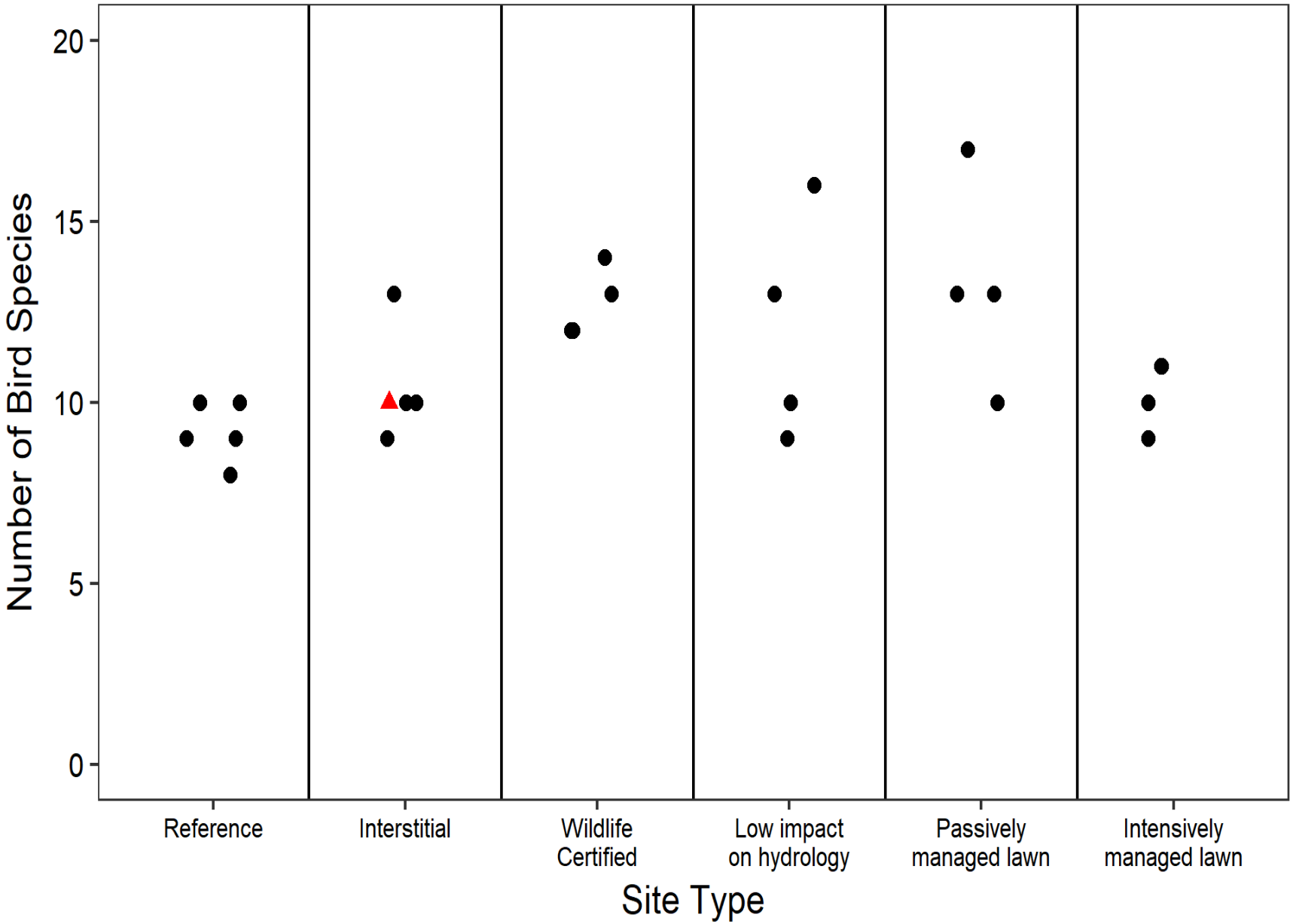


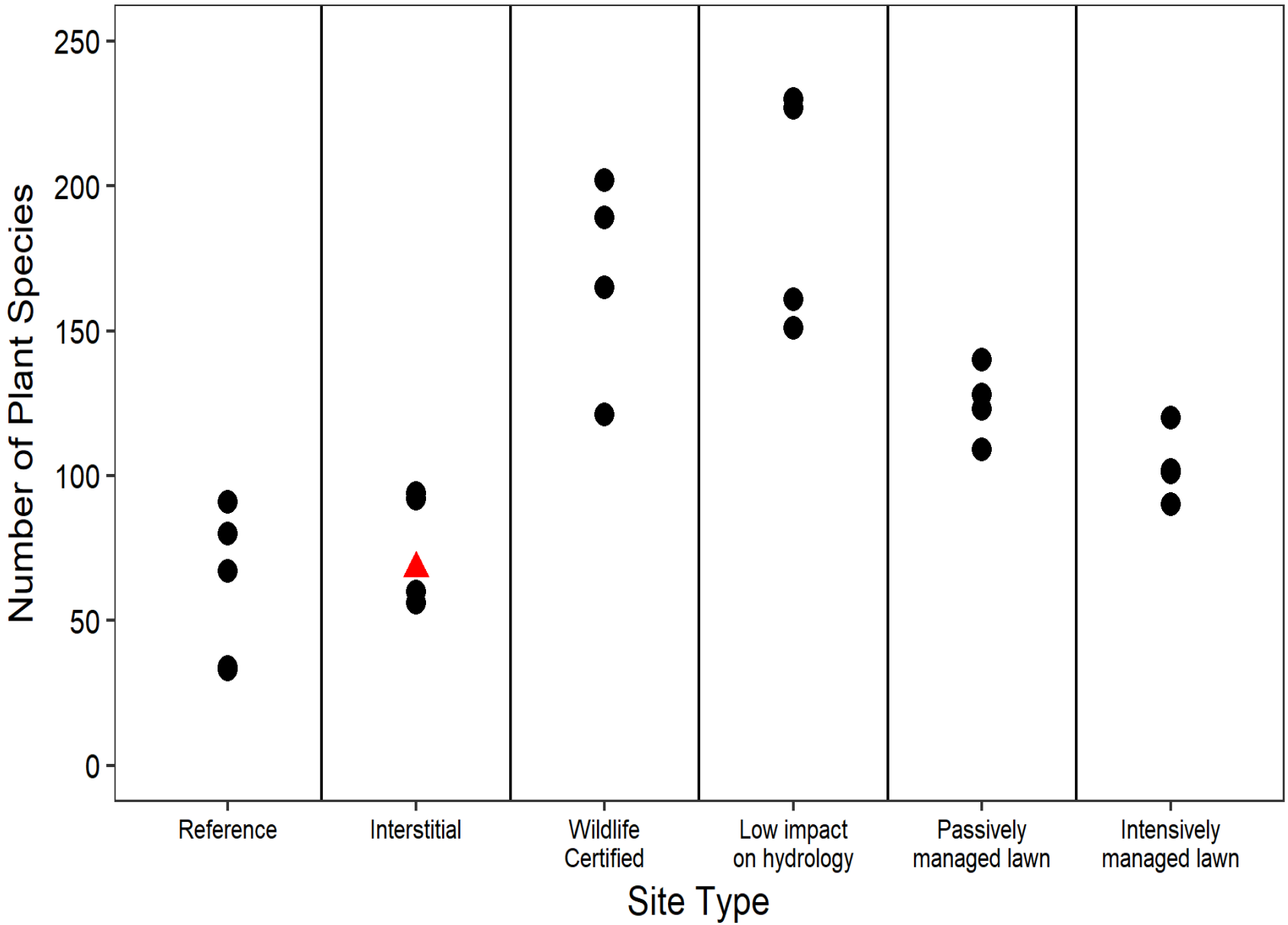


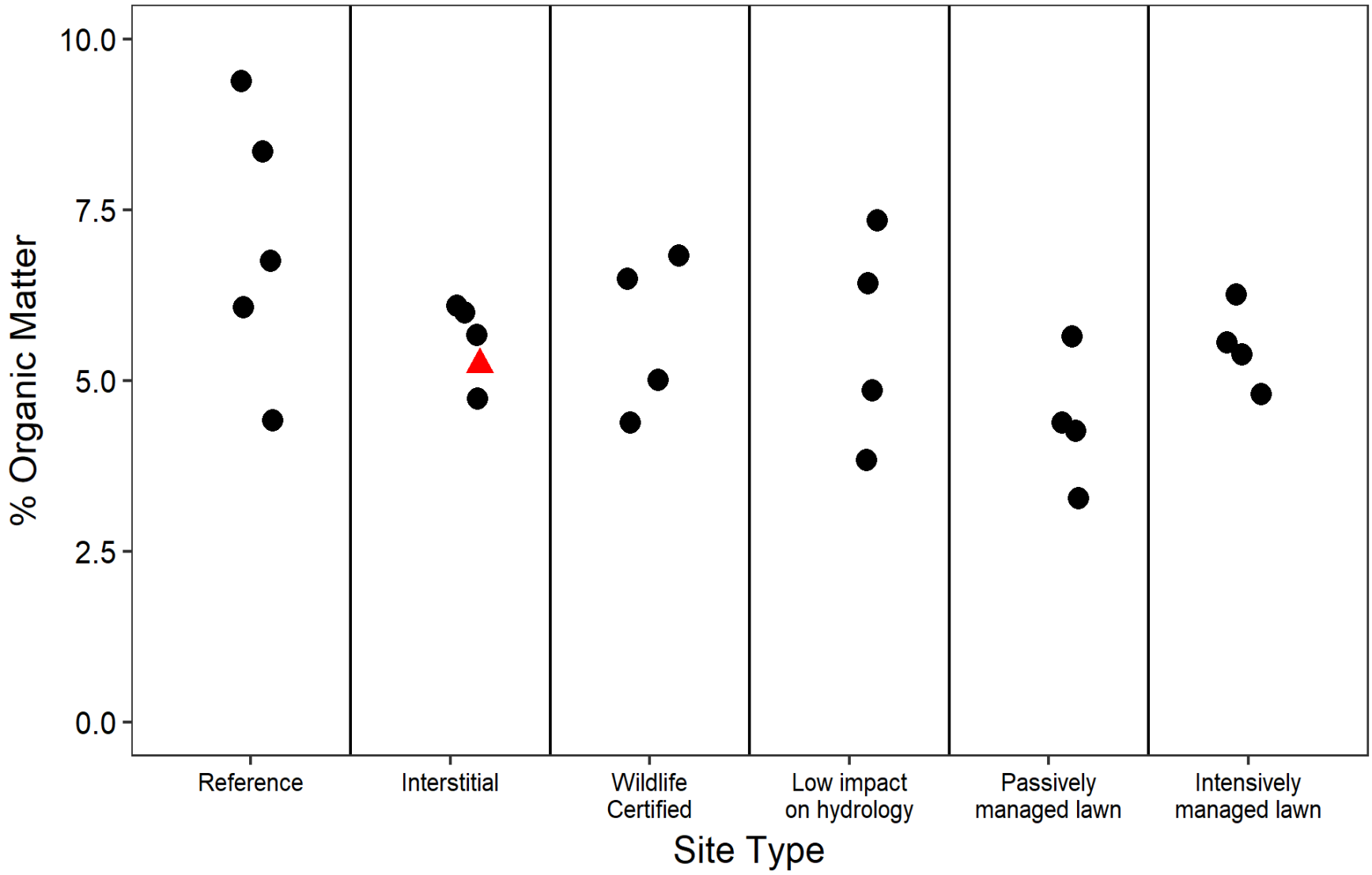


1. Boston
2. Baltimore
3. Miami
4. Minneapolis
5. Phoenix
6. Los Angeles

- *Plants*
- *Nutrient retention*
- *Water-use efficiency*
- *Soil C and N storage*
- *Governance*


Number of Bird Species
20
15
10
5
0
Reference
Interstitial
Wildlife Certified
Low impact on hydrology
Passively managed lawn
Intensively managed lawn
Site Type


Number of Plant Species
250
200
150
100
50
0
Reference
Interstitial
Wildlife Certified
Low impact on hydrology
Passively managed lawn
Intensively managed lawn
Site Type


10.0
7.5
5.0
2.5
0.0
% Organic Matter
Reference
Interstitial
Wildlife Certified
Low impact on hydrology
Passively managed lawn
Intensively managed lawn
Site Type

# Conclusions:

- The ecological homogenization of urban America is real, and has continental scale effects on fluxes of carbon, nitrogen and water and on human well being.
- Thoughts about the future of urban ecology:
  - There is basic science to be done in cities; e.g., the biogeochemistry of interactions between plants, microbes, riparian zones, wetlands, streams.
  - The new frontier in bio-geo-socio-chemistry:
    - The vast majority of human:environment interactions take place in residential areas.
    - Understanding human environmental perceptions, values and behaviors should result in improvements in environmental quality, more successful ecological restorations, and improvements in human health and well being.

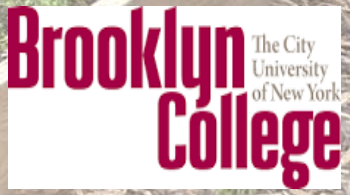
# The New York City Clean Soil Bank Pilot Study: Manufacturing Topsoil from Terrestrial Sediments and Compost

**Sara Perl Egendorf, Zhongqi Cheng, Anna Paltseva**

The Graduate Center and Brooklyn College of the City University of New York
Department of Earth and Environmental Sciences
NYC Urban Soils Institute



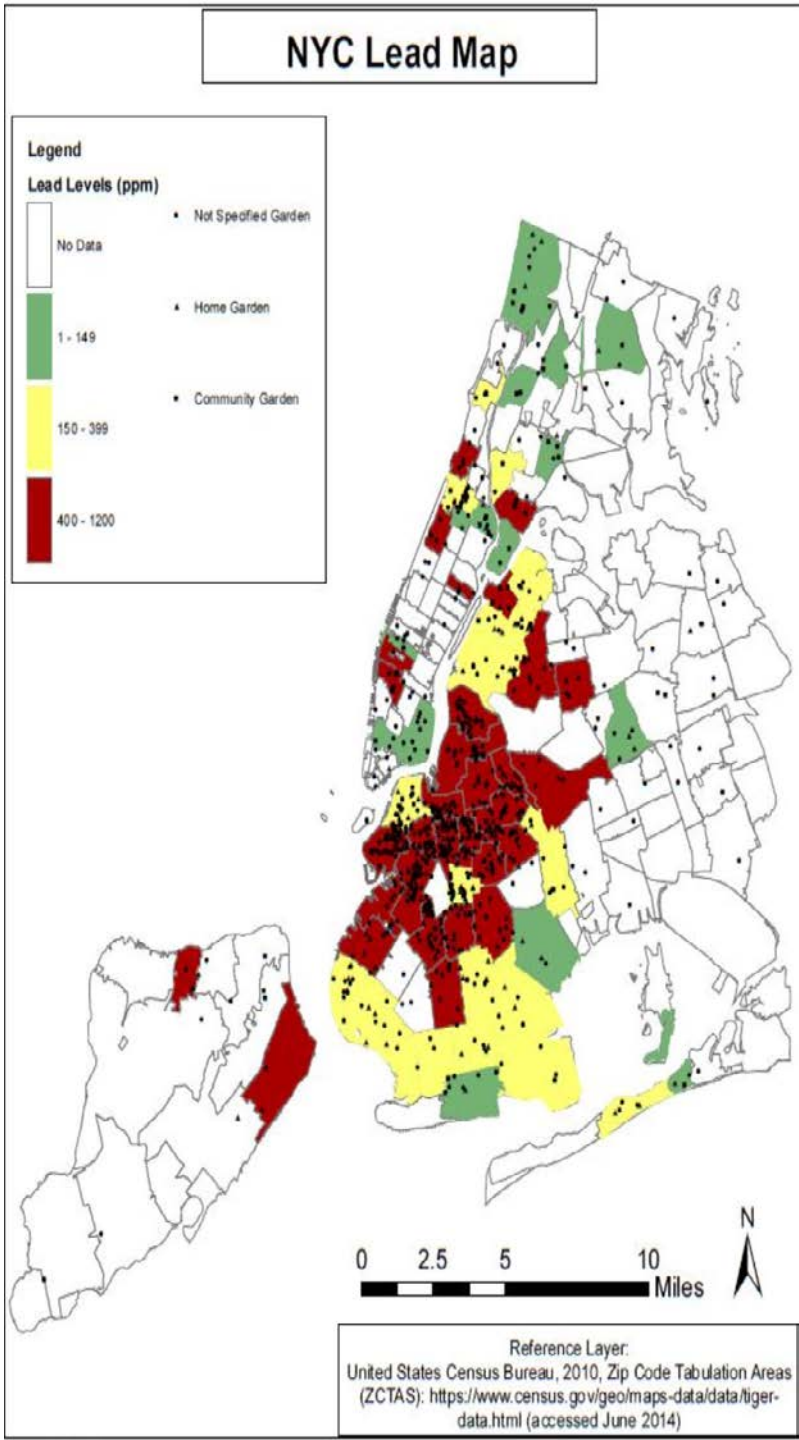




# Urban Soils are Highly Contaminated with Lead (Pb)

- Community gardens and backyards have Pb levels above EPA standards (400 ppm)
- Pb cannot be broken down or leached from soil
- Community gardeners and all urban residents are at risk for exposure

(Cheng et al., 2015)



# Remediation Options for Pb-Contaminated Soil

## Excavation


**Pro**:

- Effective

**Con**:

- Expensive
- Placement in landfill
- Requires new soil

## Cap and Cover

**Pro**:

- Effective
- Less expensive

**Con**:

- Requires new soil

*Can we construct new soil*
*to remediate contamination and promote community gardening?*

http://www.northjersey.com

# The NYC Mayor's Office of Environmental Remediation (OER) Clean Soil Bank (CSB)

Since 2013, MOER has exchanged 255,000 cubic yards of pristine, tested glacial outwash sediments from NYC for development projects

Historically, excavated sediments were deposited in landfills

CSB Sediments used for study

CSB has eliminated 985,000 miles of truck travel, 245,000 gallons of diesel combustion, and 2,750 tons of $CO_2$ emissions

***But can they be used for gardening?***

# Need to mix CSB sediments with clean compost:

1st mulch / manure compost sampled 5/13/15:
230 mg/kg Pb

2nd mulch / manure / yard waste compost sampled 6/3/15:
200 mg/kg Pb

3rd mulch / food waste compost sampled 5/5/15:
40 mg/kg Pb

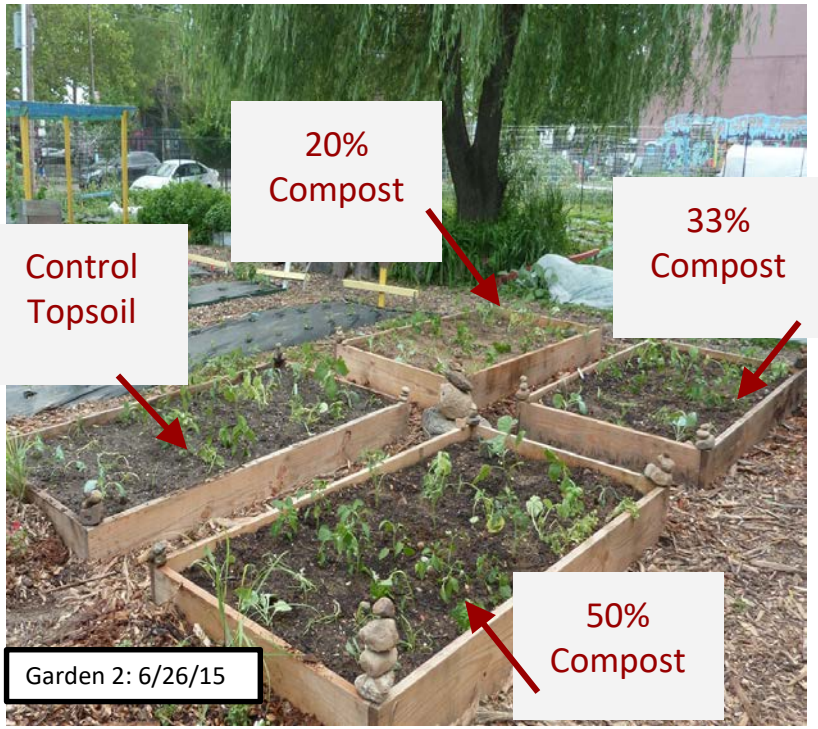
# Field Methods: Construct Raised Beds

1. Built 4 raised beds in 2 community gardens; 1 bed in 3rd garden; placed landscape fabric between garden and raised bed soil

2. Mixed sediments with compost at three ratios (50%, 33%, 20%) and established control topsoil bed (soil used by GreenThumb for other garden beds)

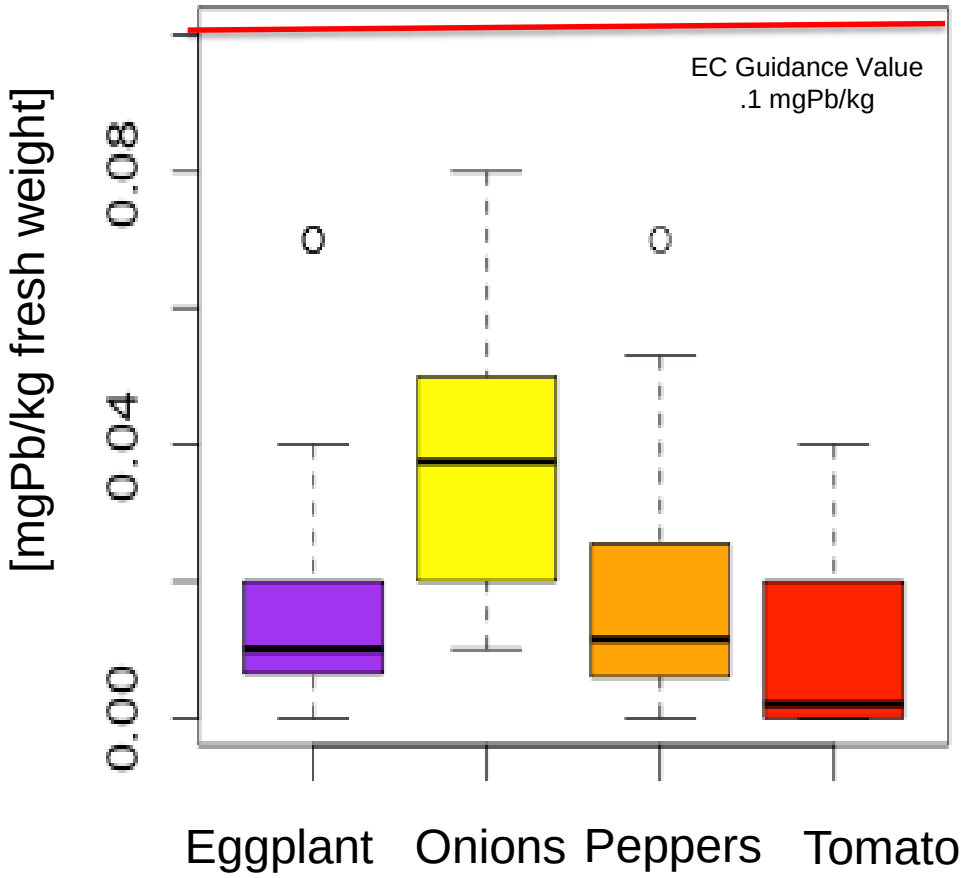
3. Planted consistent number and variety of crops in each bed, watered and tended to crops





# Results: Fruit / root crop tissue metals

Lead Concentrations in fruit / root crop tissues are low!



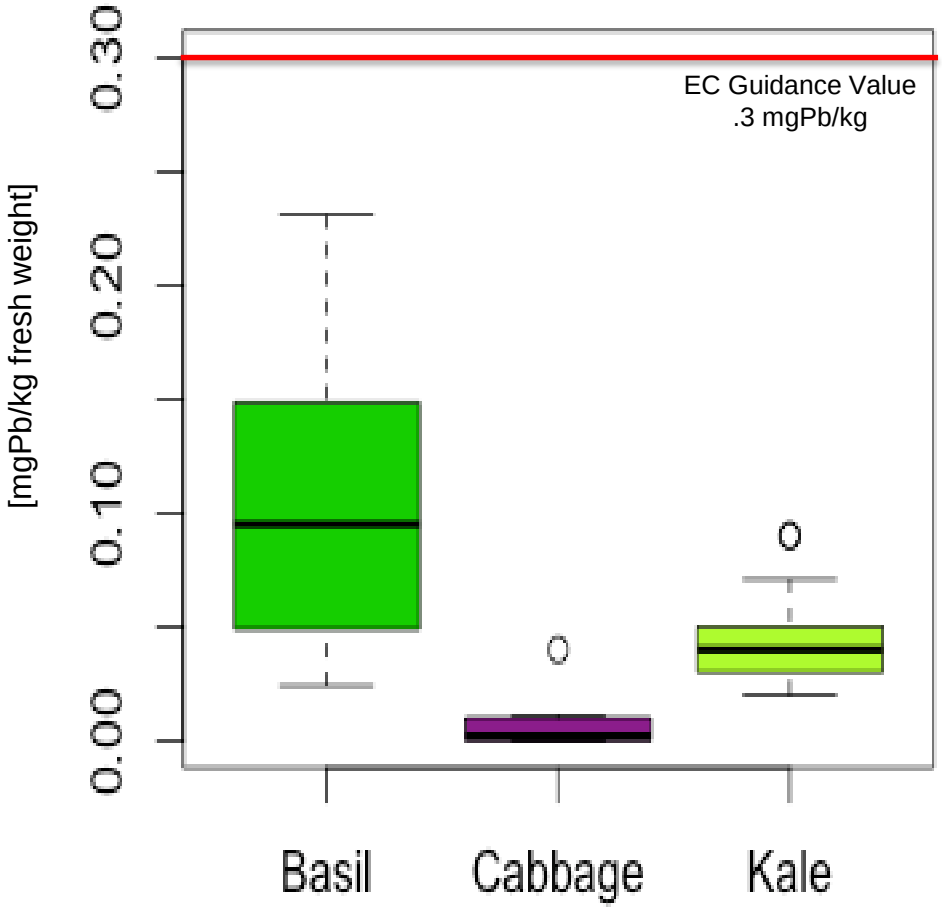
# Results: Leafy crop metals

Guidance Value set by European Commission:

.3 mg Pb /kg for leafy vegetables

All tissue samples are well below this standard

## Lead Concentrations in leafy crop tissues are low!



# Benefits and Next Steps:

- The Clean Soil Bank is a viable way to cap and cover contaminated soils, minimize associated risks, support edible plant growth, and enhance the many benefits of community gardening.
- This program is being expanded. 66% of new buildings in NYC generate ~6,500 tons of clean soil on average.
- There are sufficient clean native sediments to remediate ALL gardens in less than 1 year – with the correct logistics in place.
- These sediments can be mixed with other organic residuals.
- More research is needed on CSB / organic residual blends.