

Soils In Context, Soils In Cities

Peter M. Groffman

City University of New York Advanced Science
Research Center

and

The Scientists of the NSF funded Baltimore (BES)
and Phoenix (CAP) Long-Term Ecological
Research Projects



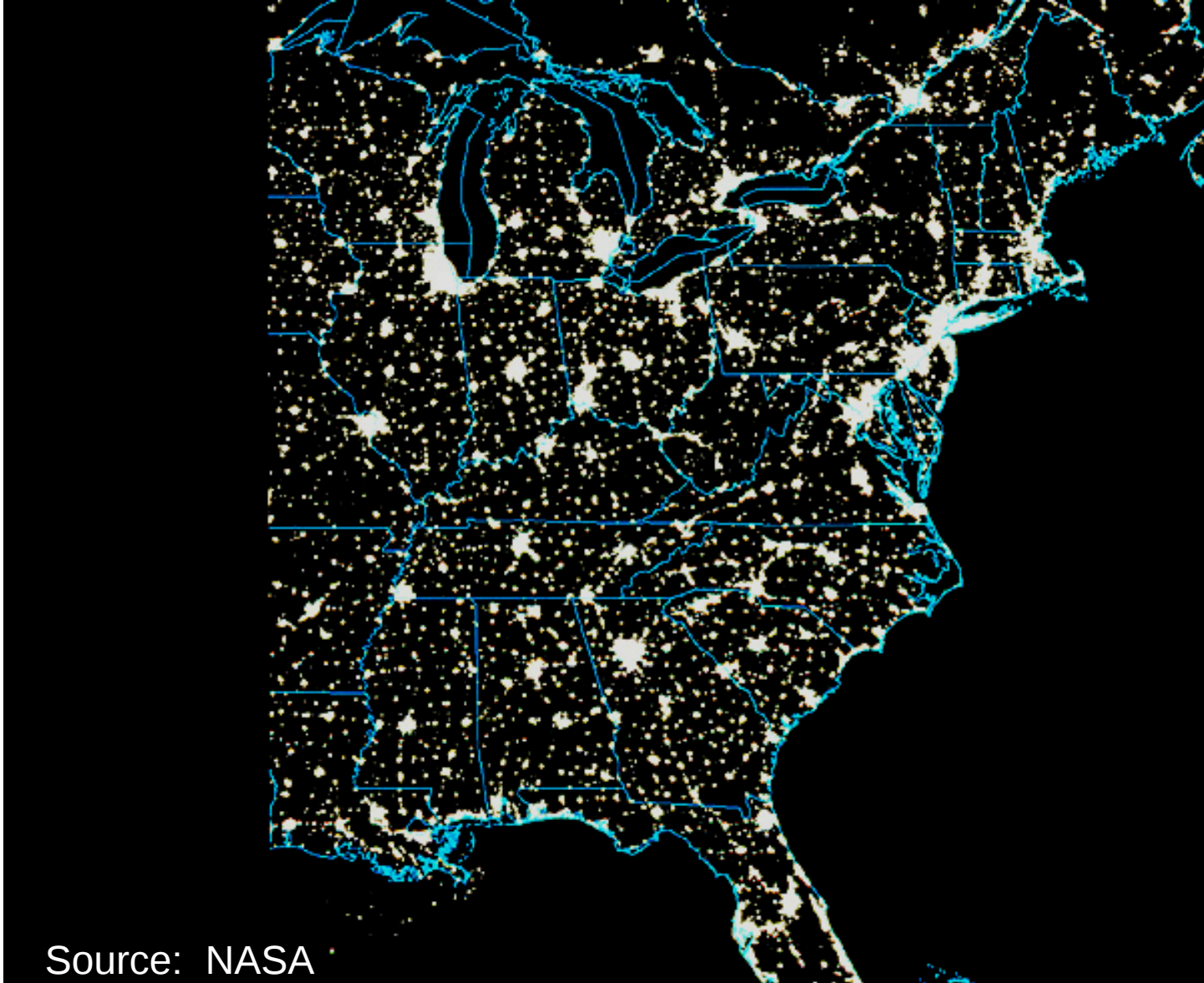
Soils in context, soils in cities:

- Soils in context:
 - Soils research, as a component of Environmental Science, is more important and dynamic than ever!
 - However:
 - No one really inherently cares about soils except for us.
 - Why do I keep getting hired as a Soil Scientist?
- Urban systems science:
 - Novel ecosystems, novel conditions, continental scales.
 - Humans as components of ecosystems:
 - Most human:environment interactions occur in their yards.
 - These interactions are key to human health and well being.
 - These interactions depend on soils: contamination, fertility.
- Ecological homogenization of Urban America

Urban Systems Science: The importance of soil

- Novel ecosystems:
 - Urban, suburban and exurban areas are where the ecosystems of tomorrow are being assembled.
 - Fundamental questions about community assembly, evolution, response to environmental change.
 - Soils (natural and altered) and fundamental controllers of these dynamics.
- Humans as components of ecosystems:
 - Requires a grand merger of ecology, economics, engineering, social science.
 - Critical component of Sustainability Science.
 - Human:soil interactions for landscaping, gardening, food production are fundamental here:
 - Soil contamination, soil sources and urban agriculture, earthworms.

Lots of urban/suburban/exurban land use in the U.S.



Source: NASA

Lots of urban/suburban/exurban land use in the U.S.



Source: NASA

What city is this: Phoenix or Boston?



Source: Chris Neill

Where
are we
now?



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.
- The ecological communities of tomorrow are being assembled within this macrosystem.

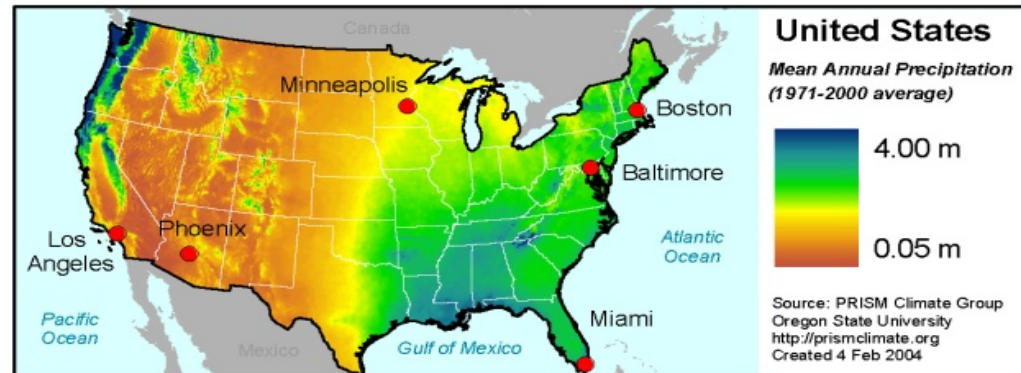
Ecological Homogenization of Urban America:

- 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
- Is this likely to change
- Funded by the U.S. National Science Foundation program on “MacroSystems Biology: Research on Biological Systems at Regional to Continental Scales.

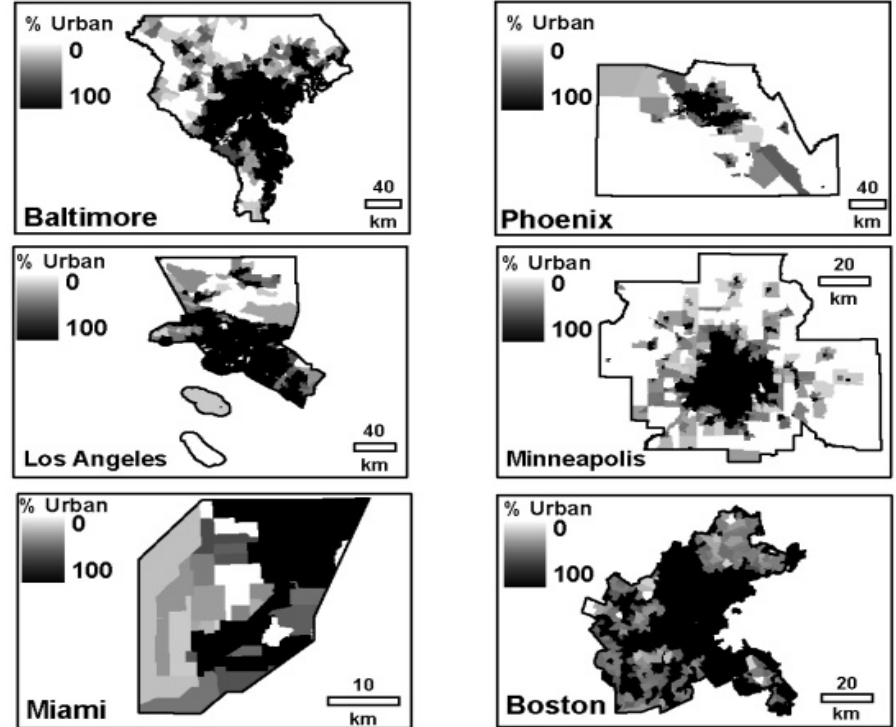


Six study cities, 14 co-pi's, 11 institutions:

- 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



Urbanicity by Census Block Groups



Source: US Census Bureau, 2000

Phylogenetic homogenization of human dominated landscapes

More *lineages*

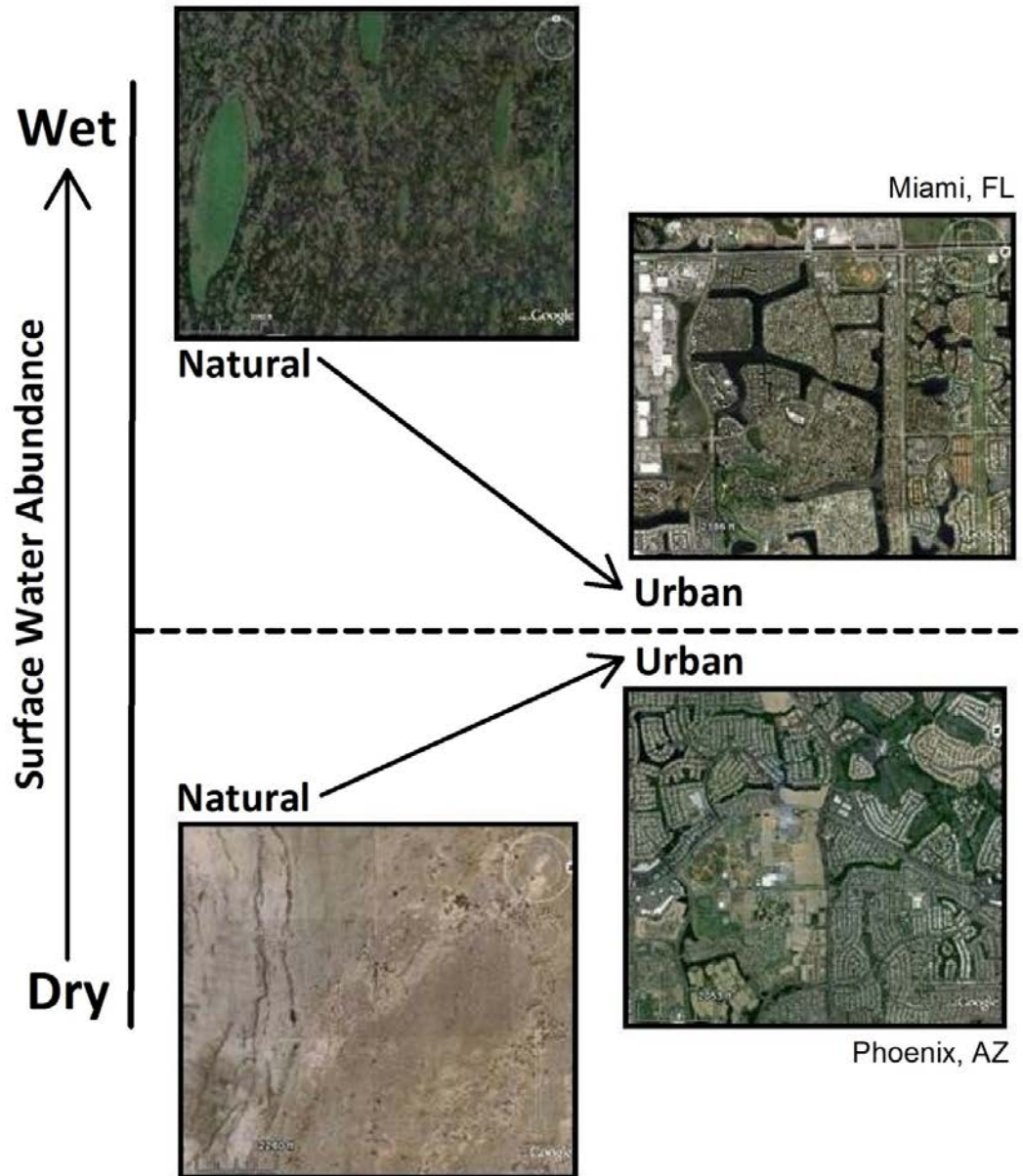
More *species*

Natural areas

Urban gardens

(Groffman et al. 2014, Pearse et al. 2016)

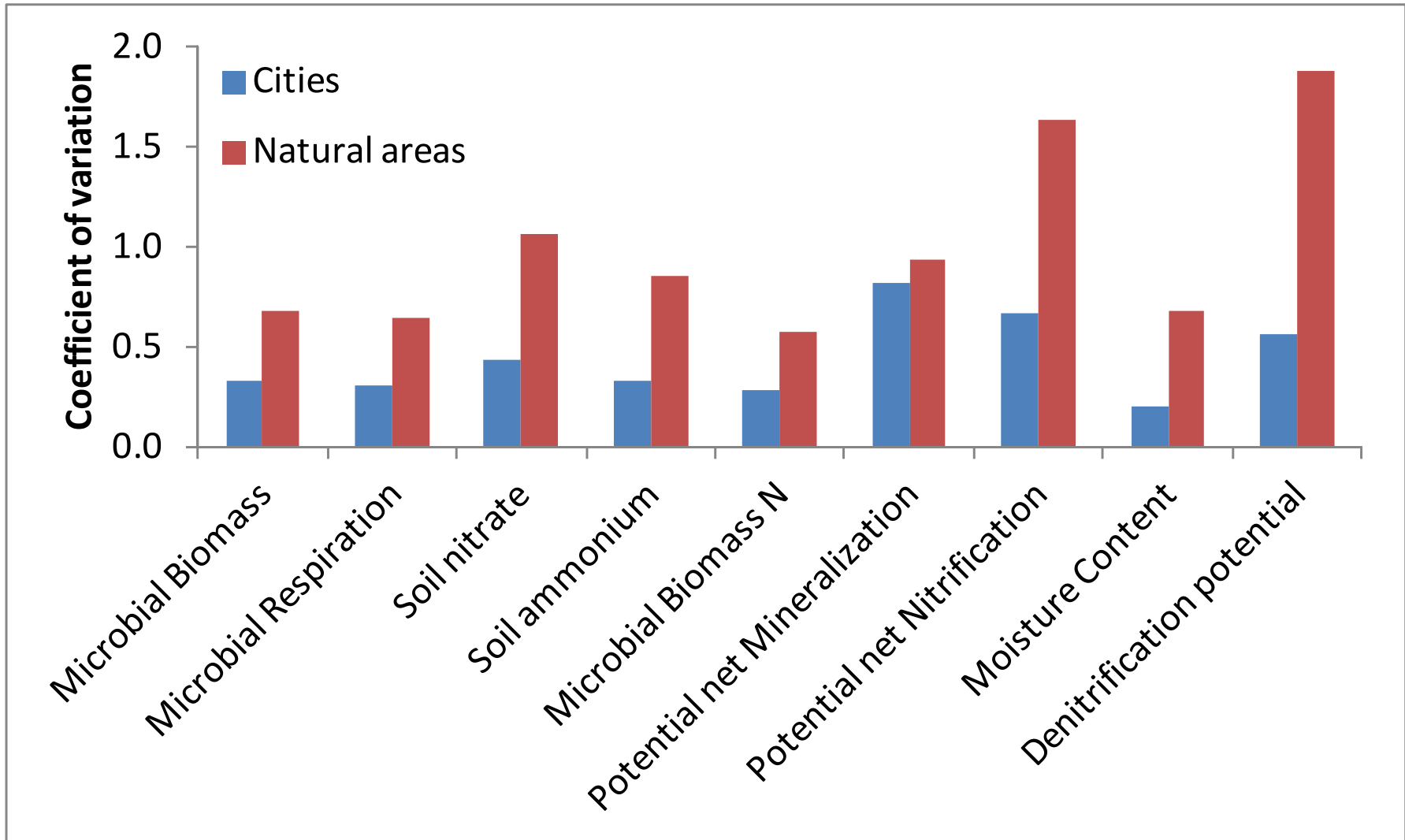
Hydrographic homogeneity:



(Groffman et al. 2014, Steele et al. 2014)

Cities less variable than natural areas:

Soil processes



It all looks like this:

-Why?

-How does it function ecologically?

-Where is it going?

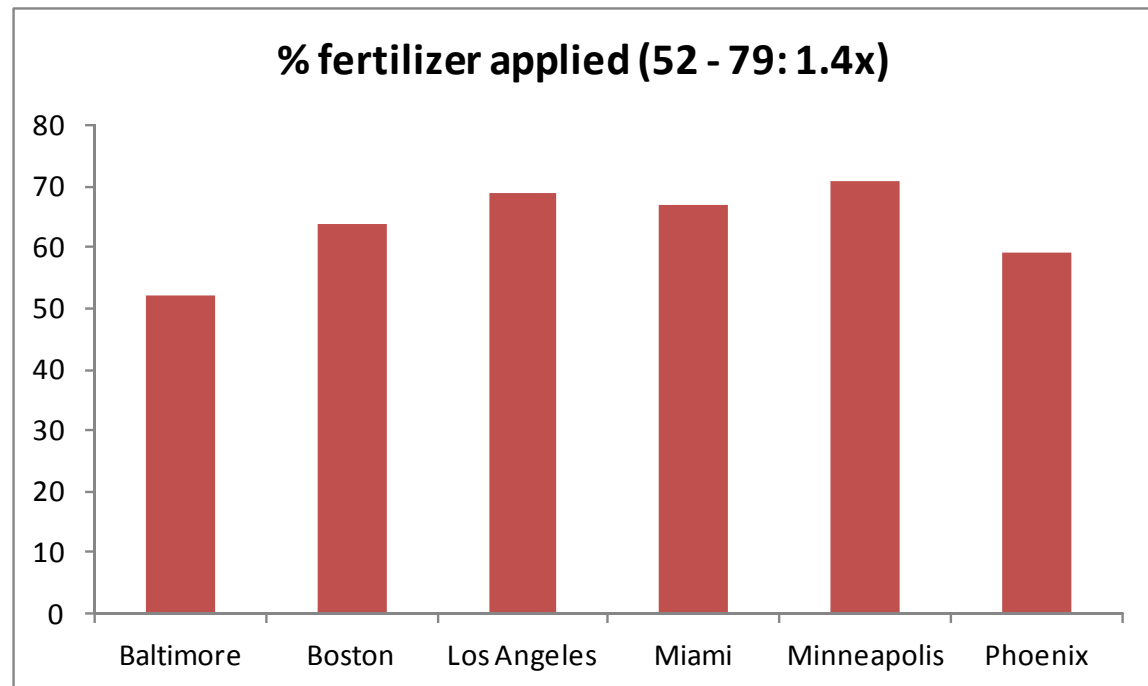
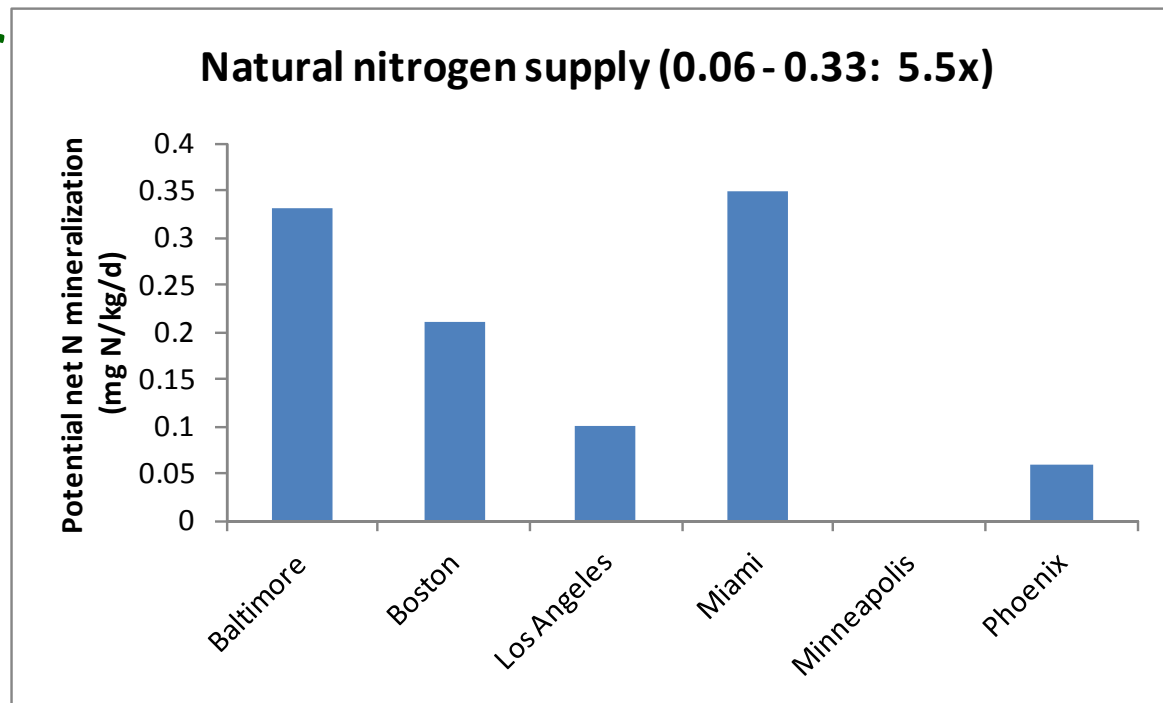


What drives us to all have the same residential land use, and how might we change that?

- 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)
- *“Landscapes of satisfaction versus landscapes of “fear”*

Homogenization of human behavior: Fertilization varies much less than nitrogen mineralization cross the U.S.

**(Polsky et al. 2014,
Groffman et al. 2016)**



It all looks like this:

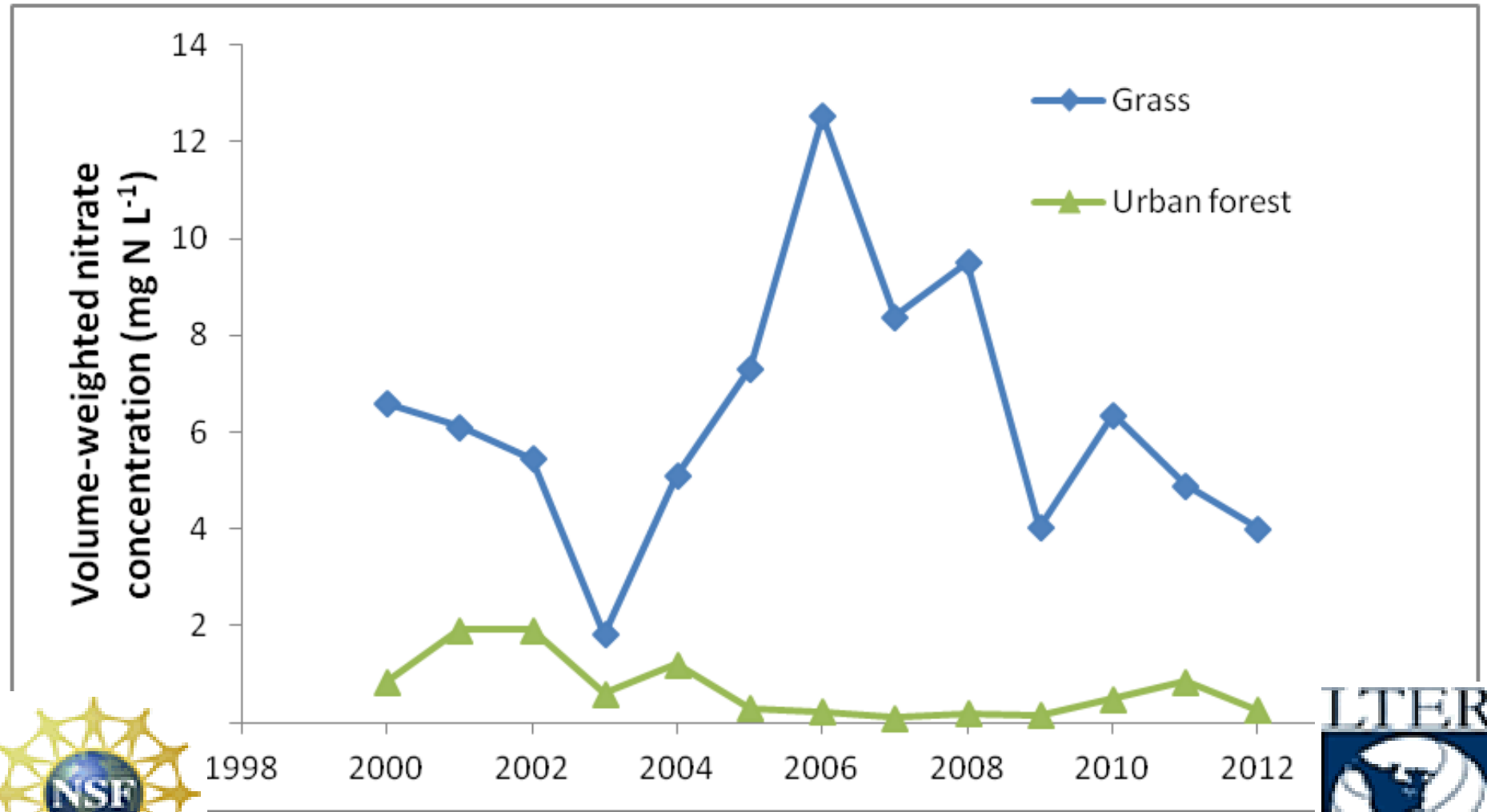
-Why?

-How does it function ecologically?

-Where is it going?



***Effects of residential land use on water quality:
Nitrate concentrations higher in drainage water
from lawns than the forests they replace:***

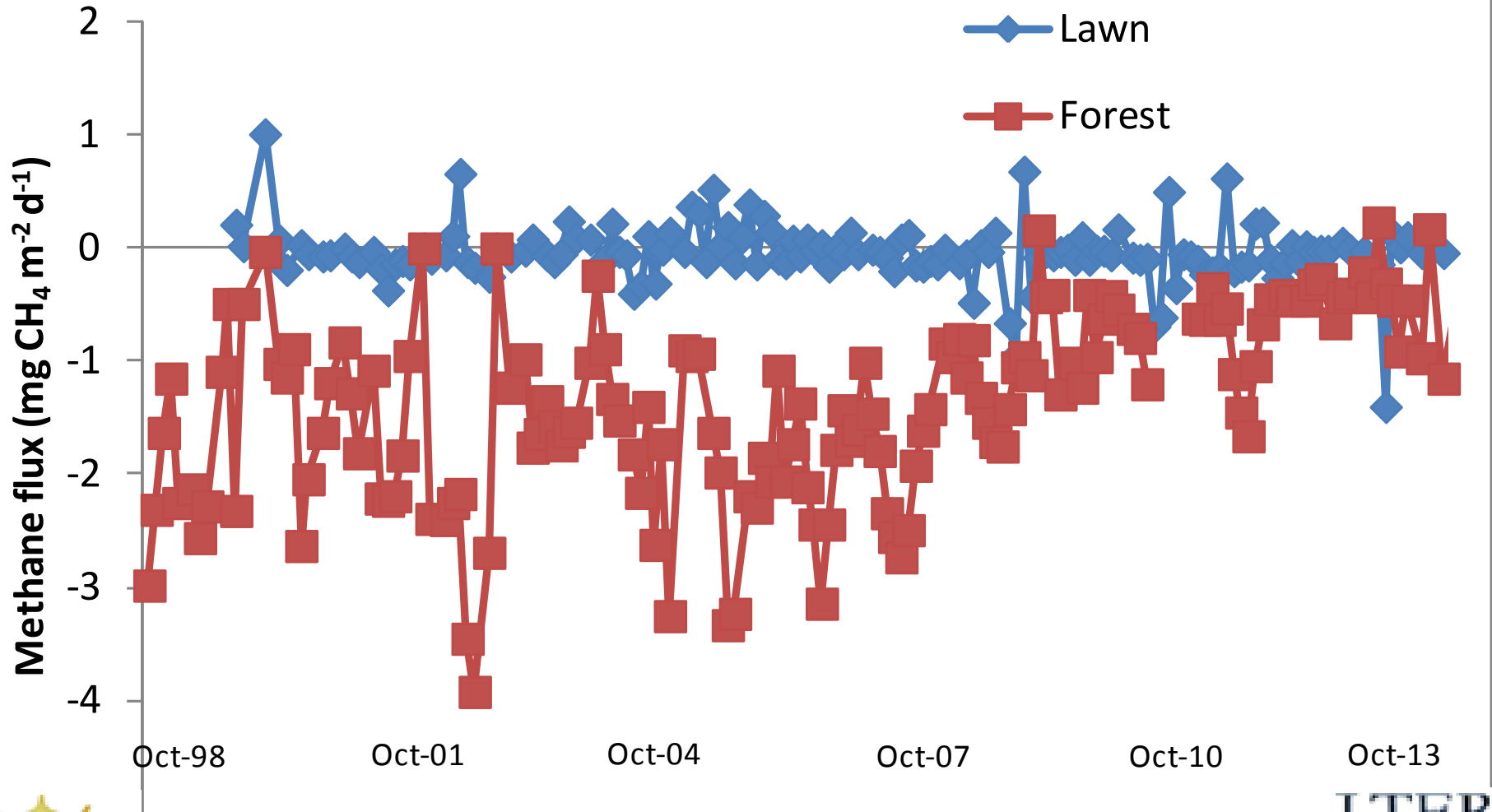


(Groffman et al. 2009 and unpublished)



Lawns and greenhouse gases: No CH_4 uptake in lawns:

uptake in lawns:



(Groffman and Pouyat 2011 and unpublished)



It all looks like this:

-Why?

-How does it function ecologically?

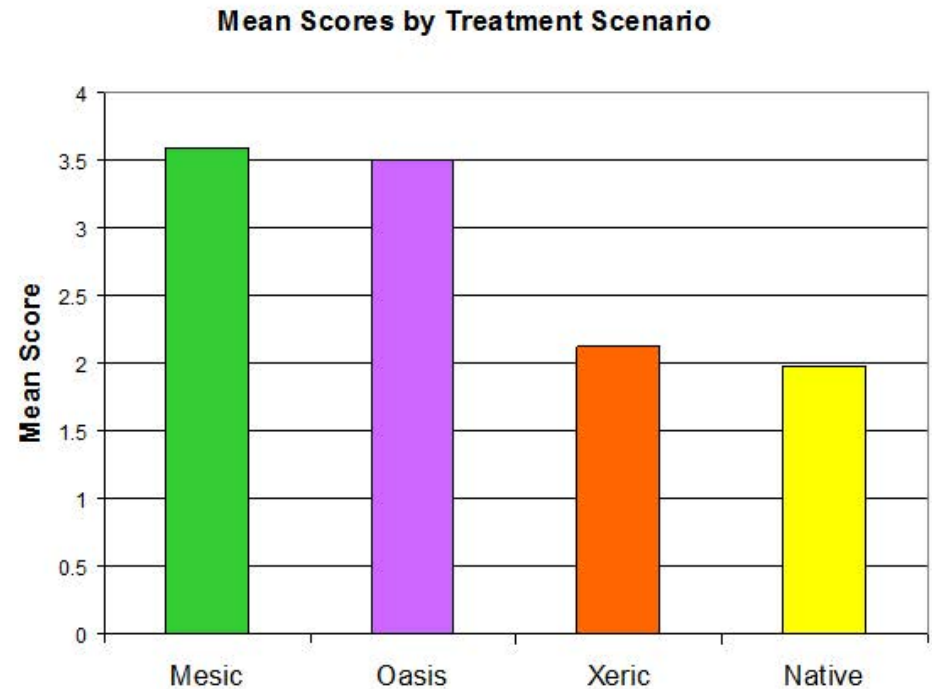
-Where is it going?



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:

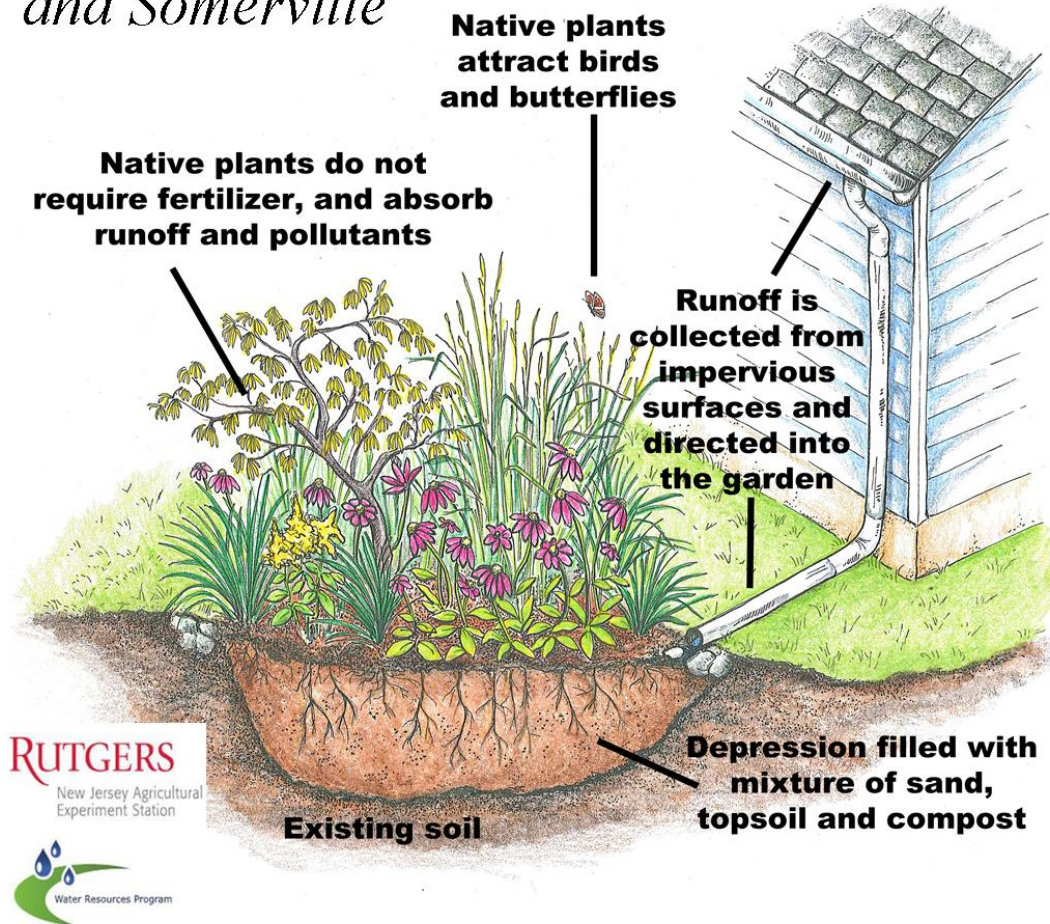


(Casagrande et al. 2006, Larson et al. 2009)

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!**



Interest in wildlife/biodiversity:

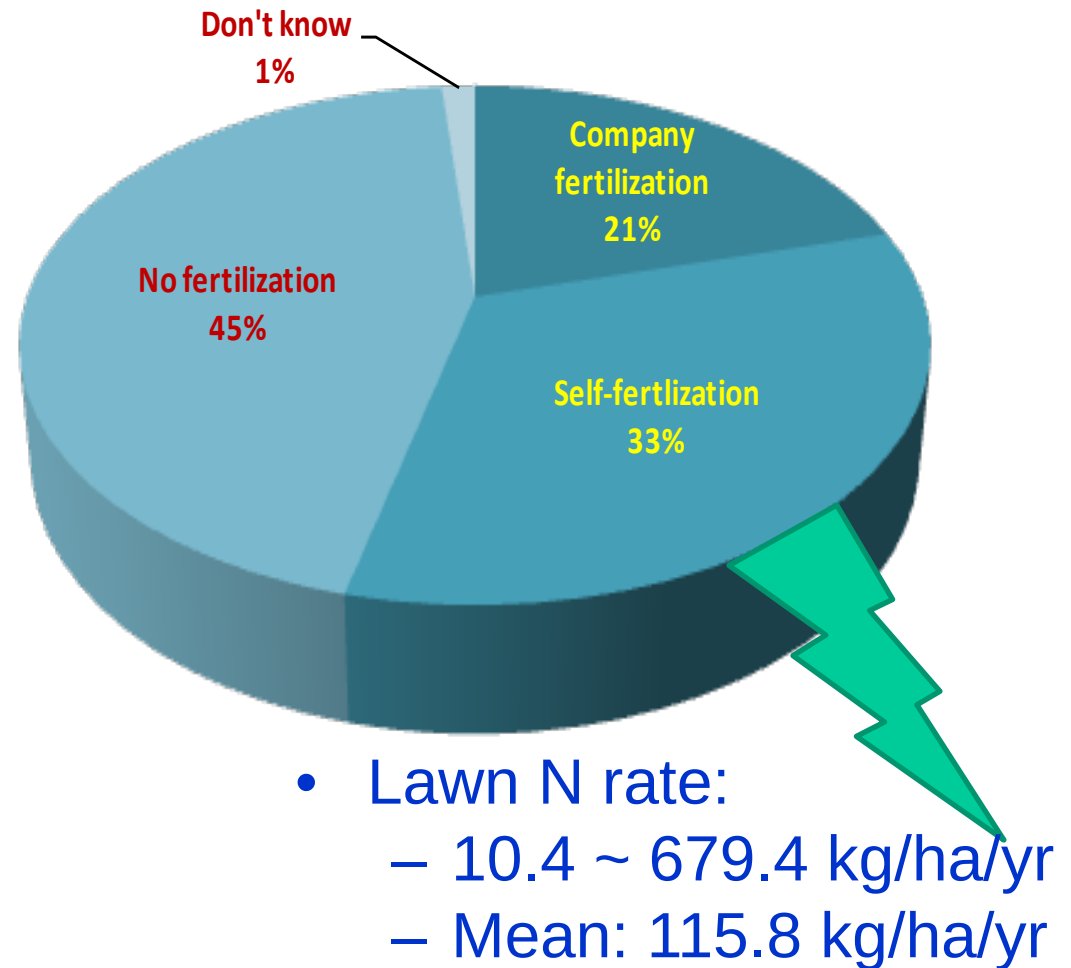
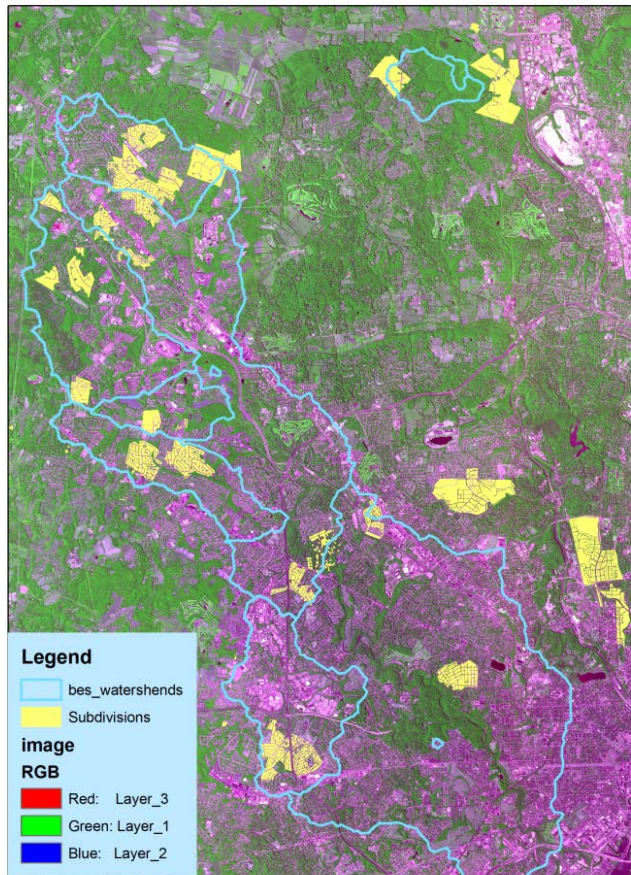


Conclusions: Soils in context, soils in cities

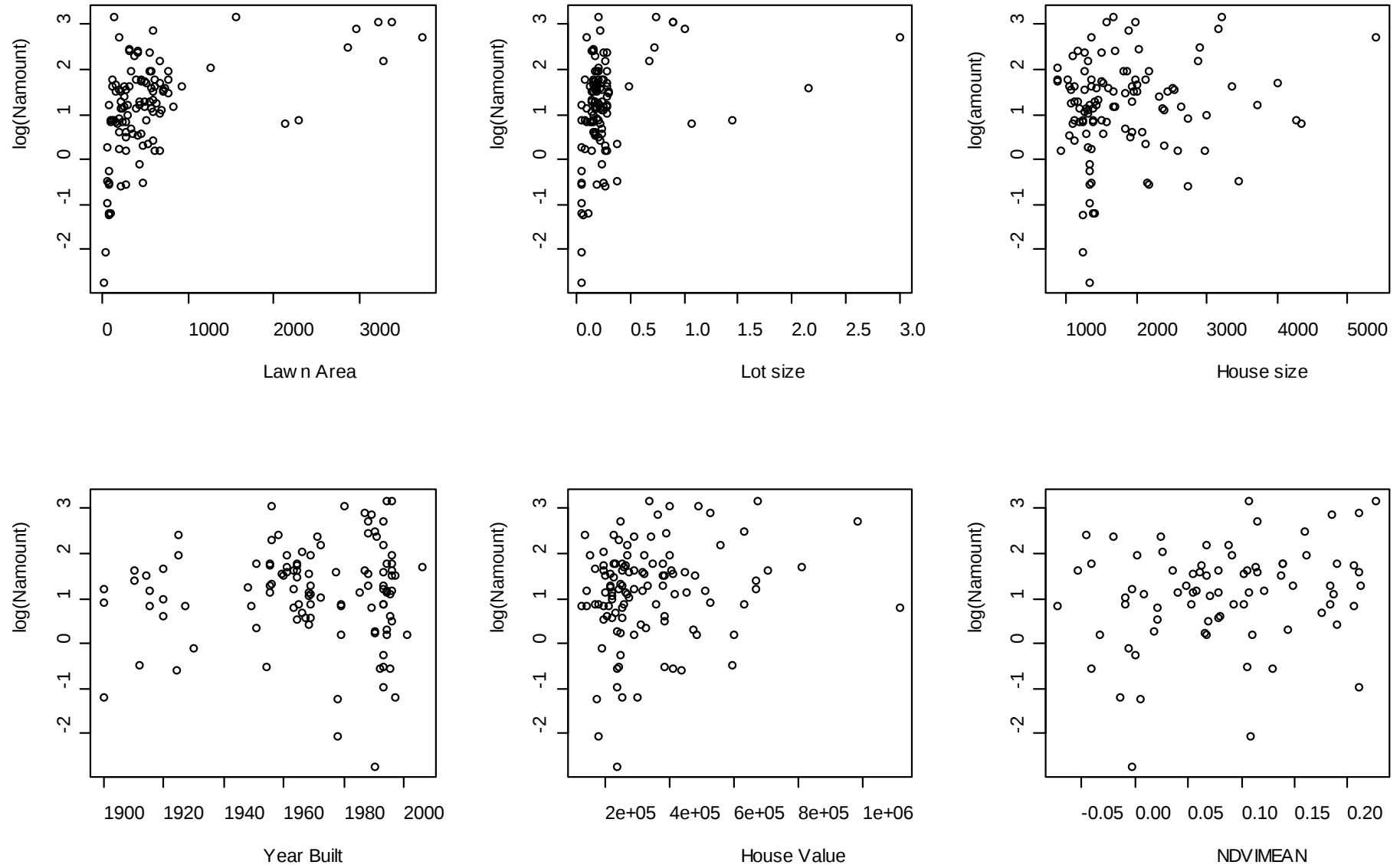
- Soils are critical to the function of urban ecosystems and landscapes.
- The ecological homogenization of urban America has continental scale effects on carbon, nitrogen and water.
- Urban ecosystems provide great opportunities for addressing the structure and function of the “novel” ecosystems that are coming to dominate our continent under novel environmental conditions.
- Human:environment interactions, many involving soil, are fundamental to human health and well-being.

What are people really doing on their lawns?

Survey: 496 interviews in Baltimore, summer 2008



What are people really doing on their lawns?



“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.



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

