Katalin Szlavecz

Johns Hopkins University

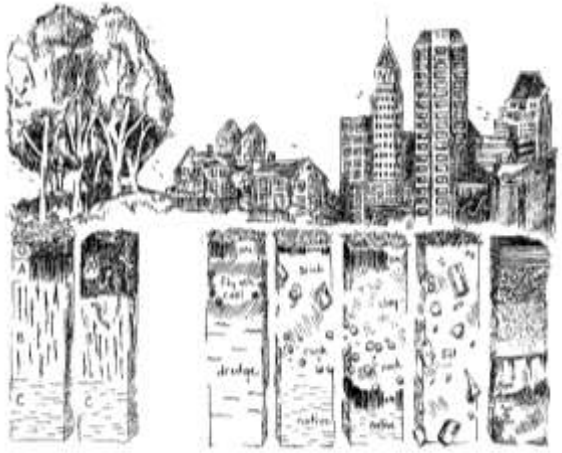
GLOBAL SYMPOSIUM ON SOIL BIODIVERSITY | 19-22 April 021

Urban Soil Biodiversity: A Multi-City Comparison

Collaborators

Csaba Csuzdi, Dietrich J. Epp Schmidt, Erzsébet Hornung, Heikki Setäla, Ian D. Yesilonis, D. Johan Kotze, Miklós Dombos, Richard Pouyat, Saket Mishra, Sarel Cilliers, Stephanie Yarwood, Yumei Huang, Zsolt Tóth

Why Study the Urban Environment?



- The majority of world population lives in cities
- Cities are built on soils
- Urban soils and their biota perform essential ecosystem services
- Green spaces connect citizens to nature

Global Urban Soil Ecology & Education Network

Motivation

- Soils are often neglected in urban ecology research
- Soil is everywhere and forms a continuum of human effects
- Opportunity to reconnect people with nature

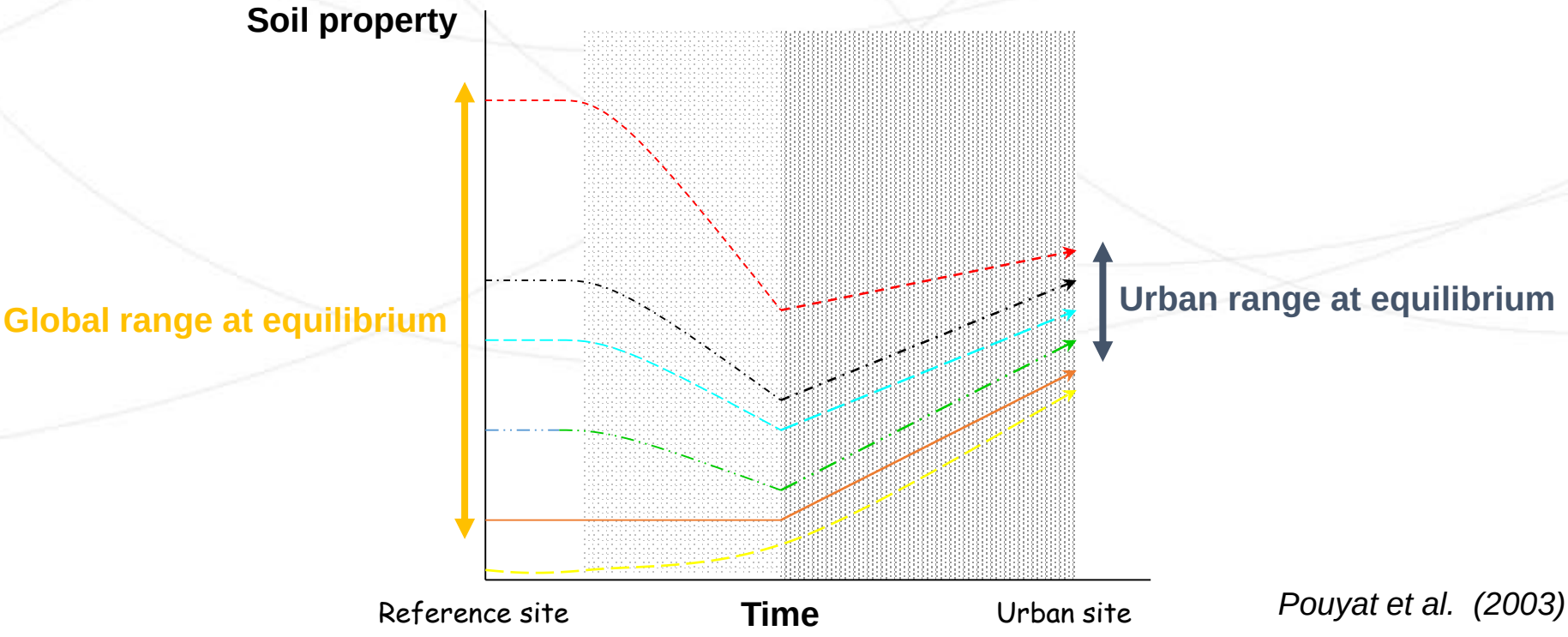
Objectives

- Address scientific and applied questions on urban soils
- Study design and experimental protocols simple to adopt es in urban areas across the world.
- Two-tier approach: scientists, community scientists

Science Questions

- Does urbanization create novel soil ecosystems?
- What is the relative importance of *native* (climate, parent material) vs. *anthropogenic* (management, disturbance) soil forming factors?
- How do urban soil communities assemble?
- Do soil ecosystem attributes “converge” and do soil biota “homogenize” on global and regional scales?

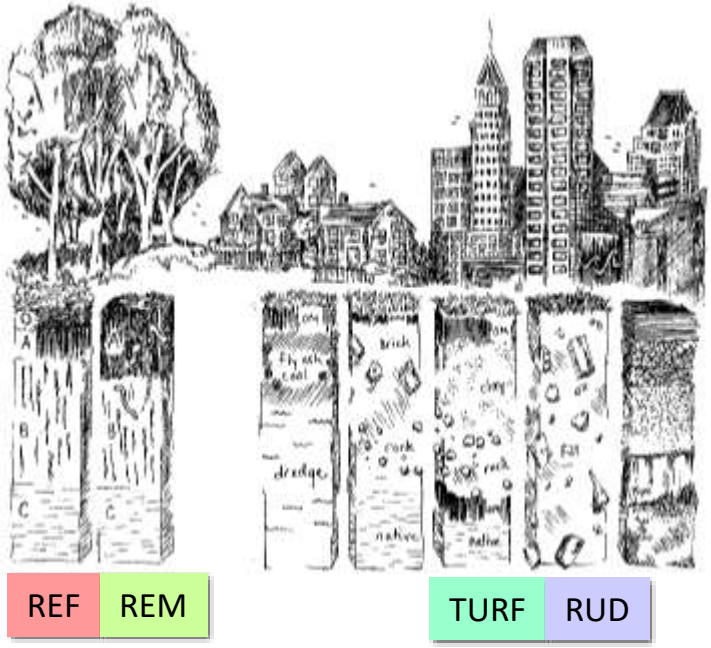
Urban Ecosystem Convergence Hypothesis

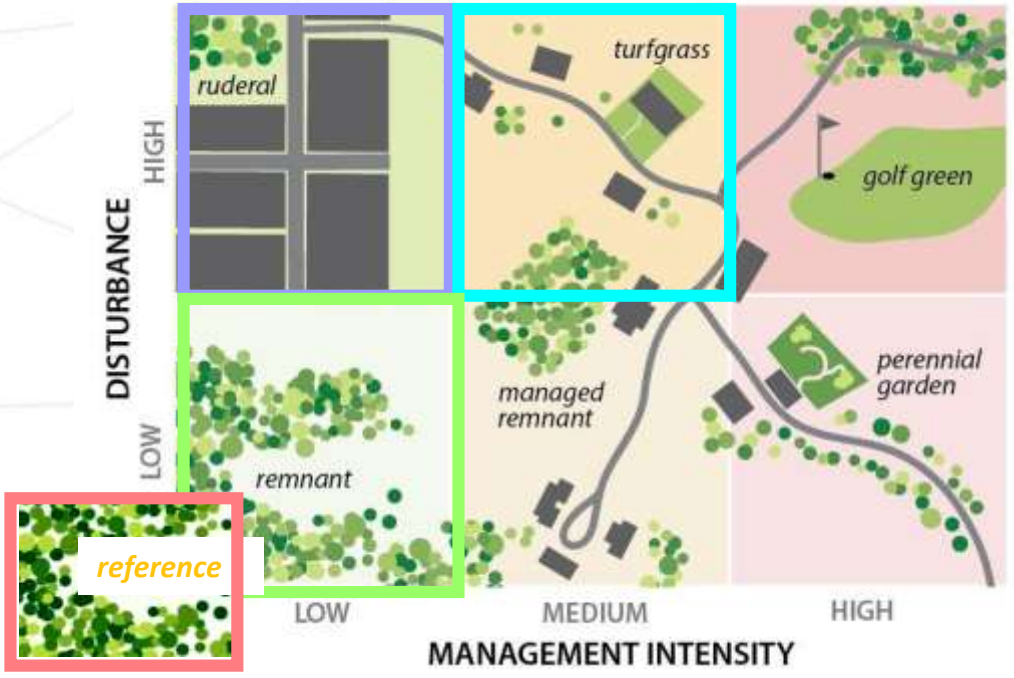


Pouyat et al. (2003)

Study Design: Urban Habitat Matrix

Based upon disturbance and management intensity



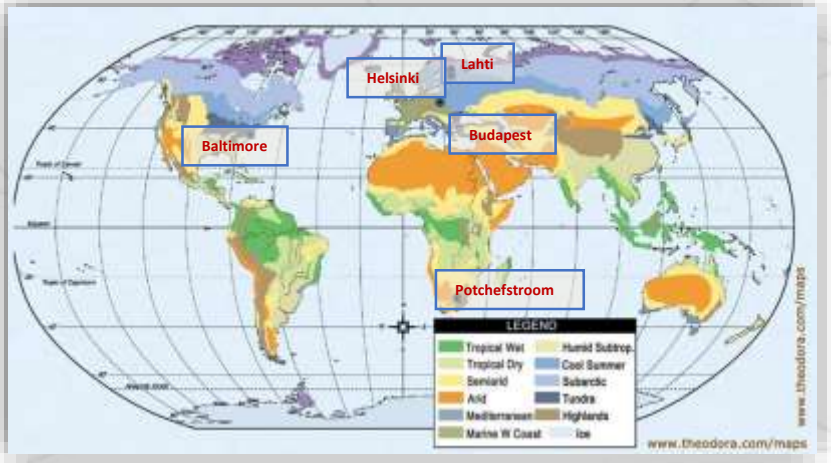


Each habitat replicated 5 times: 20 locations per city

Pouyat et et al. 2017

Pilot Study in Five Cities

Baltimore



Helsinki

Lahti

Budapest

Potchefstroom

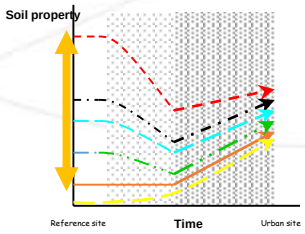
Observations and Measurements

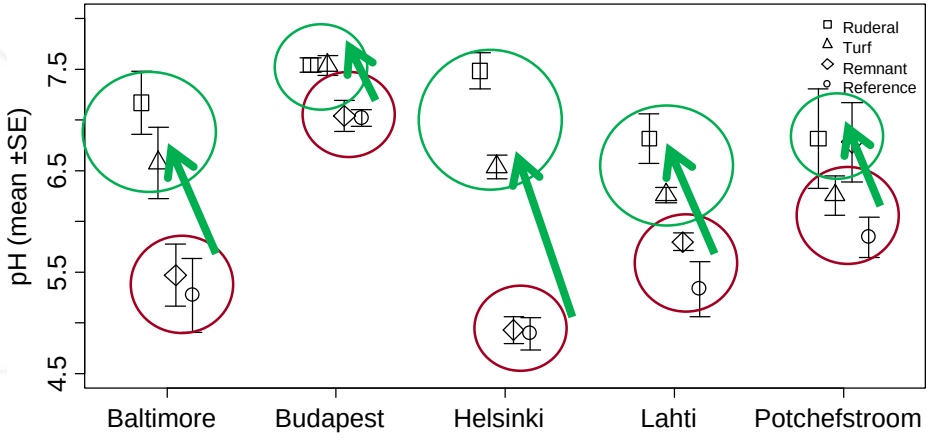
- Soil analysis: pH, C, N, nutrients, metals
  - Central lab: Inst. Soil Science, Hungary
- Soil microbial community
  - Central lab: University of Maryland
- Earthworm sampling
  - Adapted from EU protocol
- Decomposition: testing universally available pyramid teabags in place of litterbags (Keuskamp et al 2013)

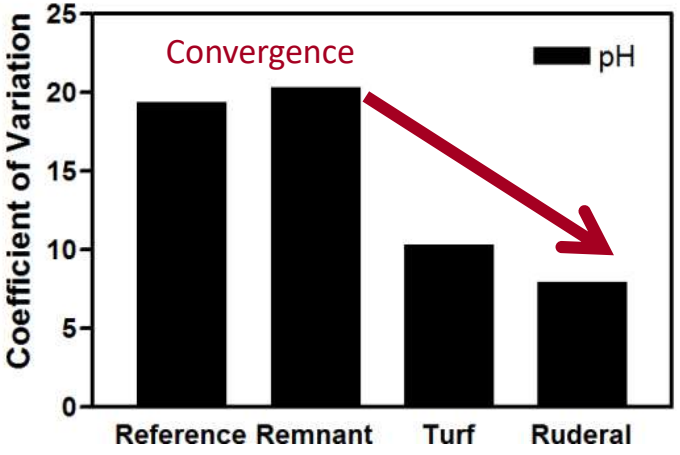




Global Comparison: Soil pH Increased

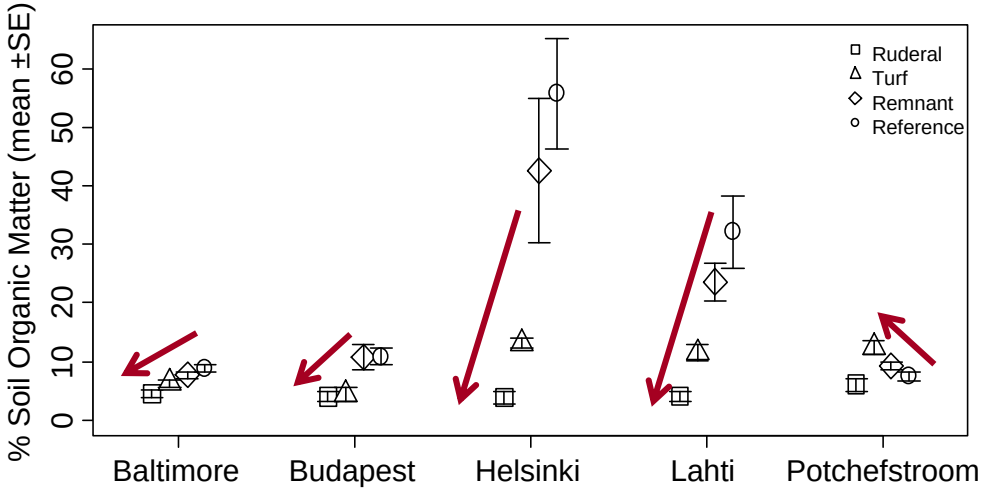


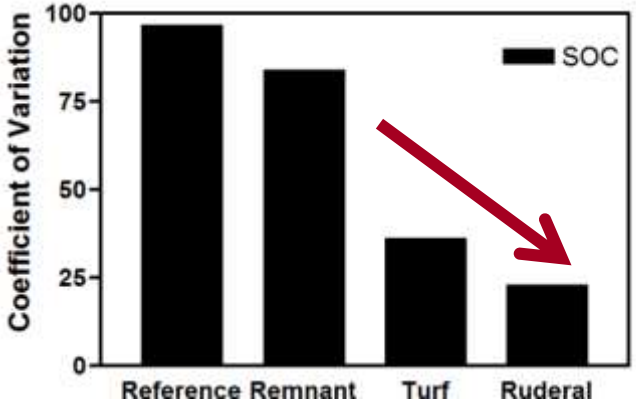




Pouyat et al. 2015

Global Comparison: Soil Organic Matter Decreased

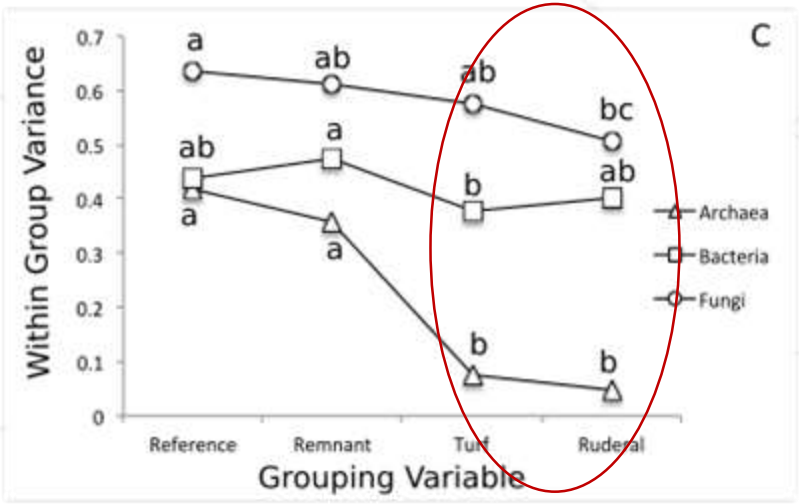




Pouyat et al. 2015

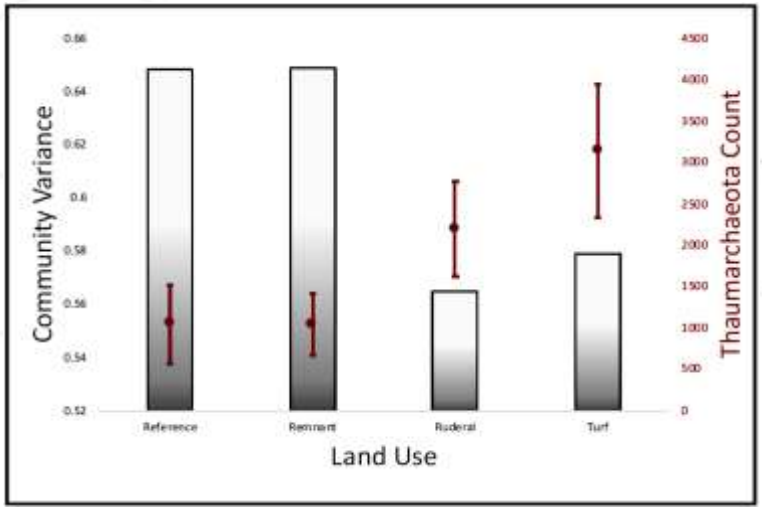
Global comparison: Microbial Communities

Archeal and fungal communities converge



Epp Schmidt et al. 2017

Archea: ammonia oxidizers increase in open habitats



Epp Schmidt et al. 2019

Earthworms: Keystone Soil Group

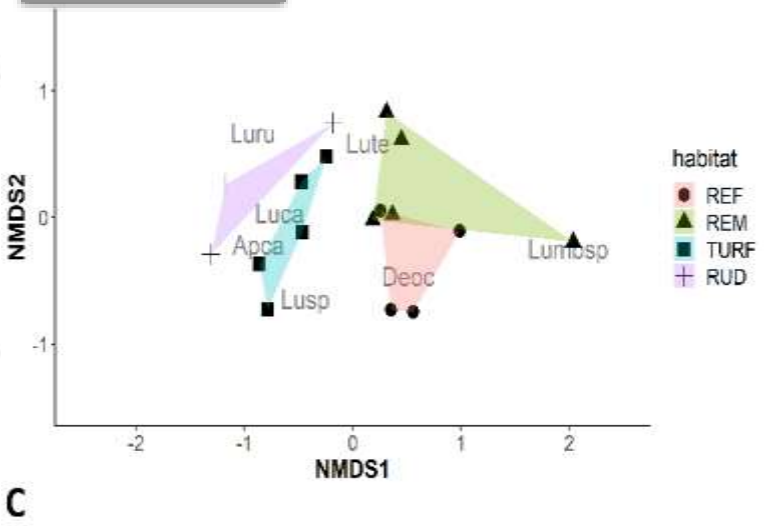
Photo credit: Chih-Han Chang; scienceblogs.com/zooillogix/2008/05/22/giant-blue-earthworms-and-frie/

- Ecosystem engineers: 'beneficial' or 'bad'
- Successful and common in urban settings (few animals can potentially move under sealed surface
- ~3500 species have been described
- ~ 80 species are *peregrine:* live close to and move with humans

Do Different Habitats have Different Earthworm Communities?

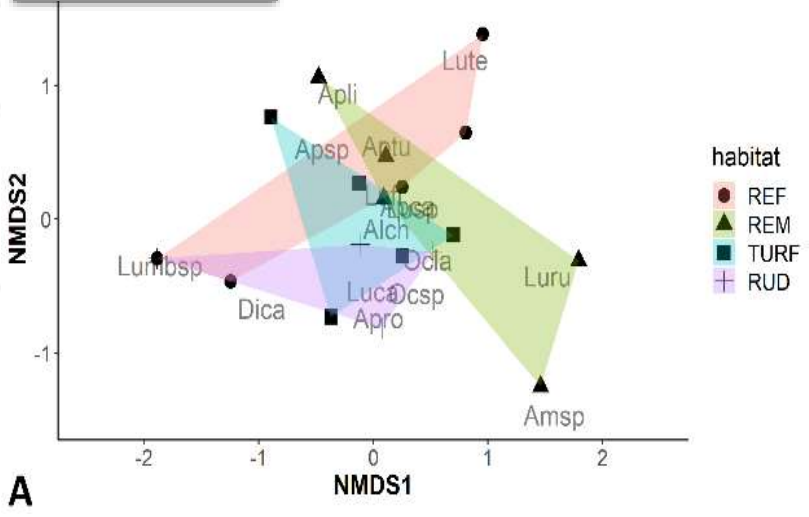
YES!

HELSINKI



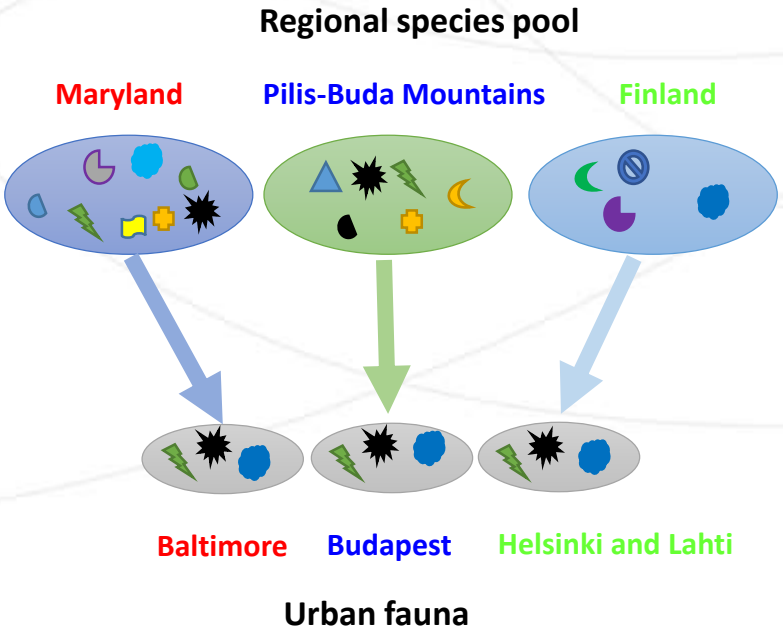
No!

BALTIMORE

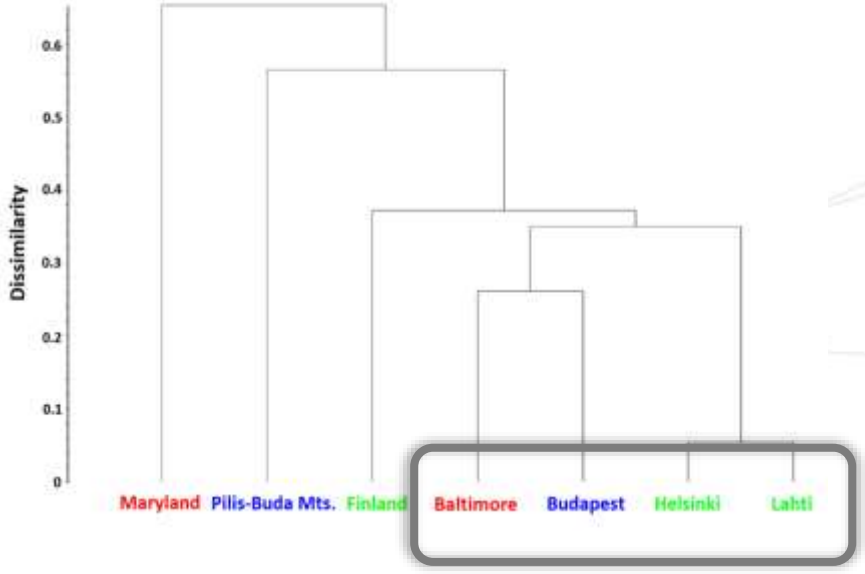


Toth et al. 2020

Are Earthworm Communities Similar Across Regions?



Yes: Biotic Homogenization



Toth et al. 2020

Microarthropod Fauna Differs by Habitat Type

Density of springtails in different urban habitats

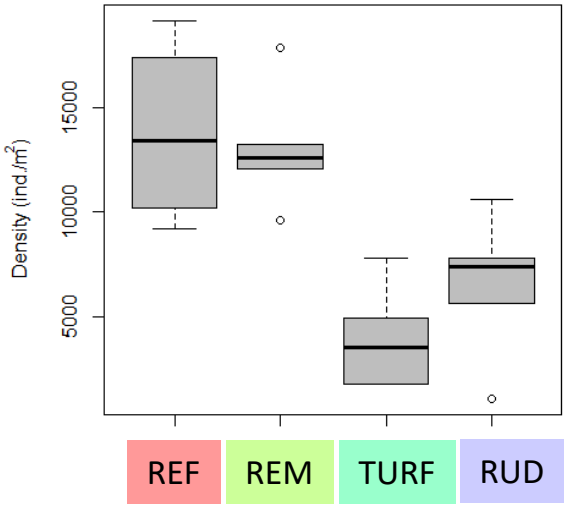
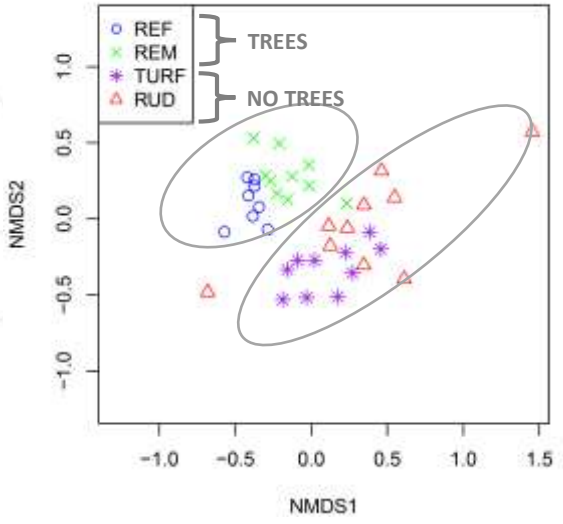


Photo cr: Zsolt Ujvari

Microarthropod community composition



Huang, Yesilonis & Szlavecz 2020

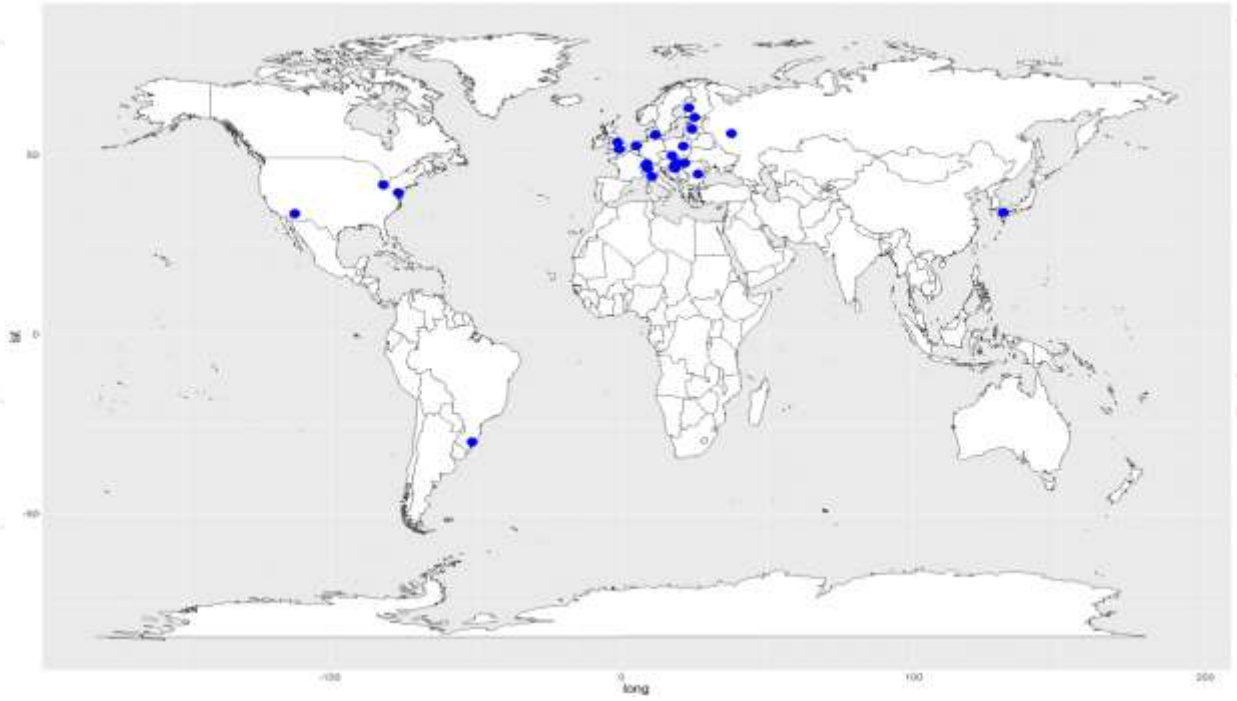
Isopods: Another Successful Group in Cities

Location	Land use type	Isopoda in pitfall traps	Reference
Yorkshire, UK	Urban agriculture	51%	Turnbull 2012
Sheffield, UK	Gardens (BUGS)	45%	Smith et al. 2006
Toledo, OH	Various	59%	Philpott et al. 2014
San Diego, CA	Various suburban	48%	Bolger et al. 2000
Baltimore, MD	Vacant lots	52%	Szlavecz unpubl.

Can dominate the epigeic arthropod fauna, but……*they can become pests!*

Szlavecz et al. 2019

…but: Limited geographical coverage



Szlavecz et al. 2019

Summary and Conclusions

- Urban soils are alive!
- Urban soil biodiversity research and current urban land conversion do not overlap
- Urban soils have tremendous potential to inform the public about the importance of soil biodiversity and the ecosystem function.
- This knowledge is essential for restoration, management and sustaining long-term soil health in the urban landscape


Vancouver


Durban


Paris


Any city


Shanghai


Melbourne


Sydney

Photos: A. Ossola, A. Vergnes

Thank you for your attention