The Vertical Structure of Urban Soils and Their Convergence Across Cities

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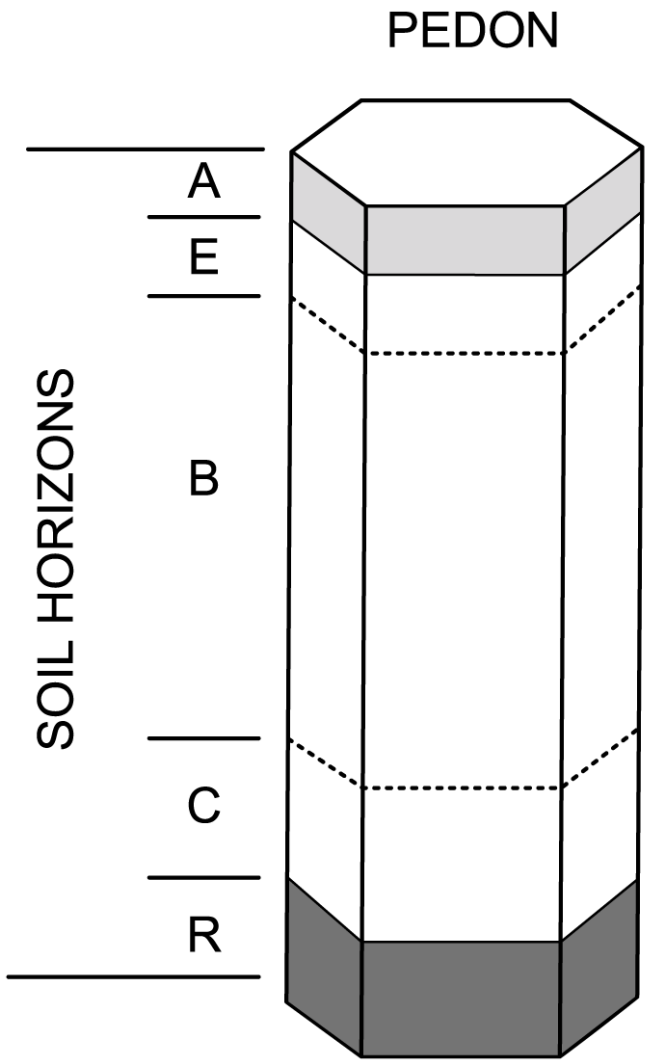
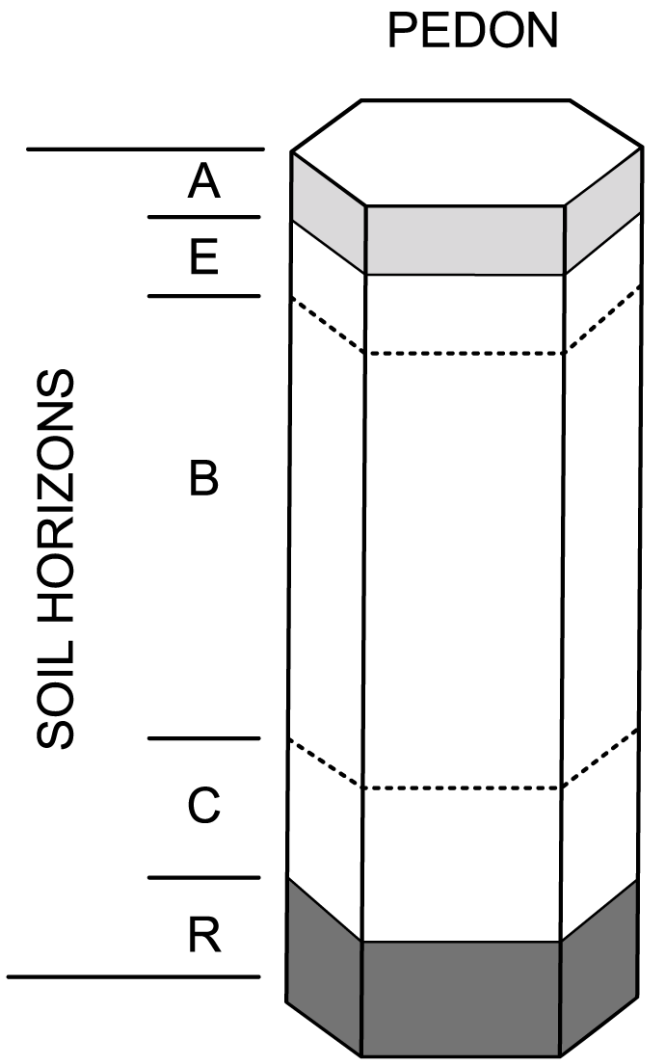


Soils [are] arranged in a relatively predictable vertical structure

Chapin et al. 2002. Principles of Terrestrial Ecosystem Ecology

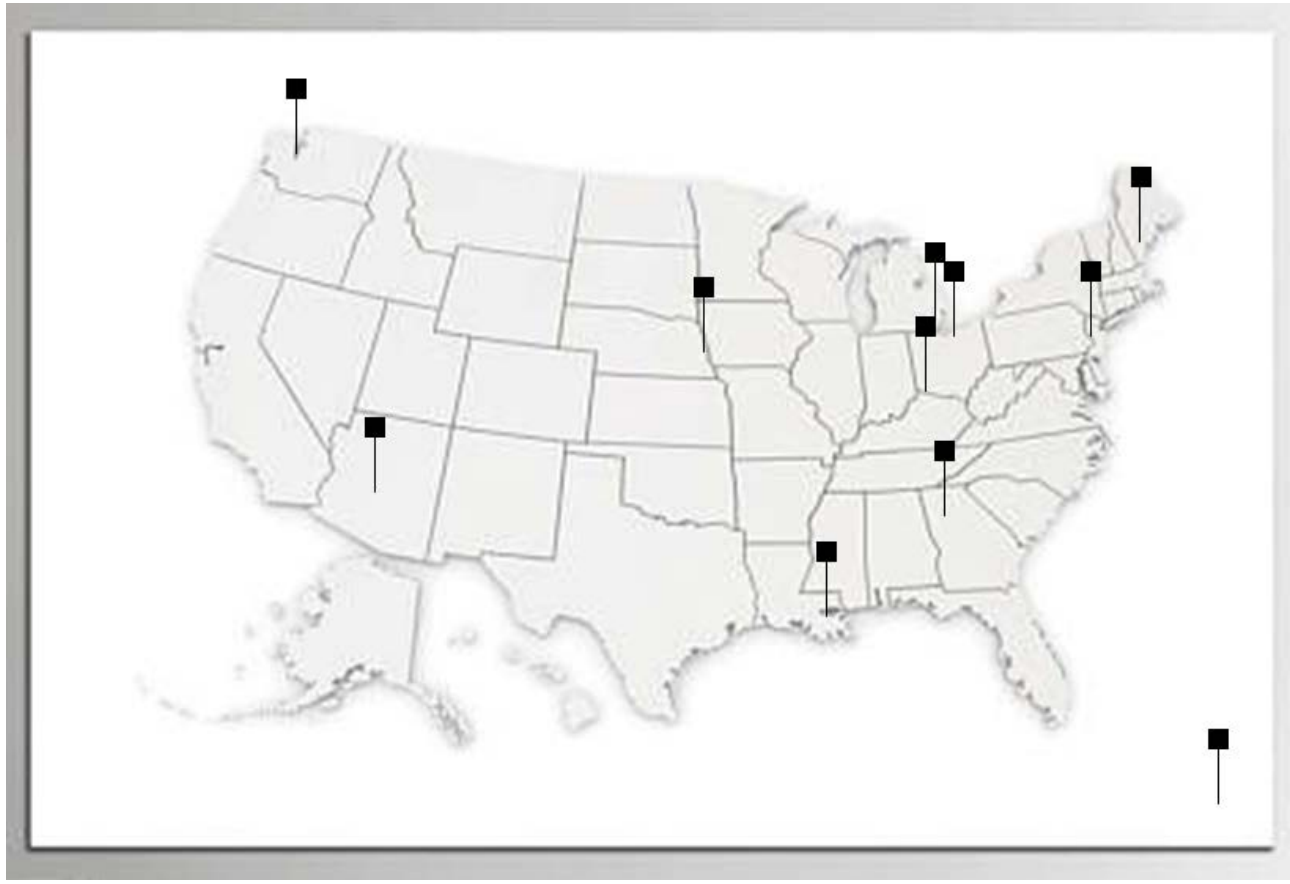


Soils [are] arranged in a relatively predictable vertical structure

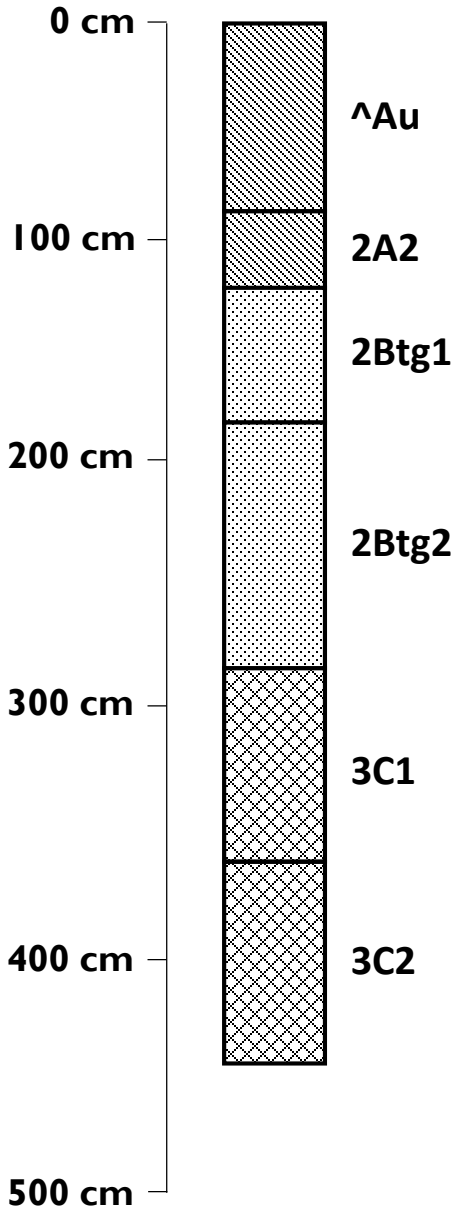
Chapin et al. 2002. Principles of Terrestrial Ecosystem Ecology

Most urban soils have been transported or displaced…at least partially destroying their…horizon arrangement

Craul 1999. Urban Soils in Landscape Design



Atlanta Camden Cleveland Cincinnati
Detroit New Orleans Omaha Phoenix
Portland San Juan Tacoma



Urban Soil

Pedons we characterized in the urban landscape

Identified likely pre-urban soil series

Reference Soil

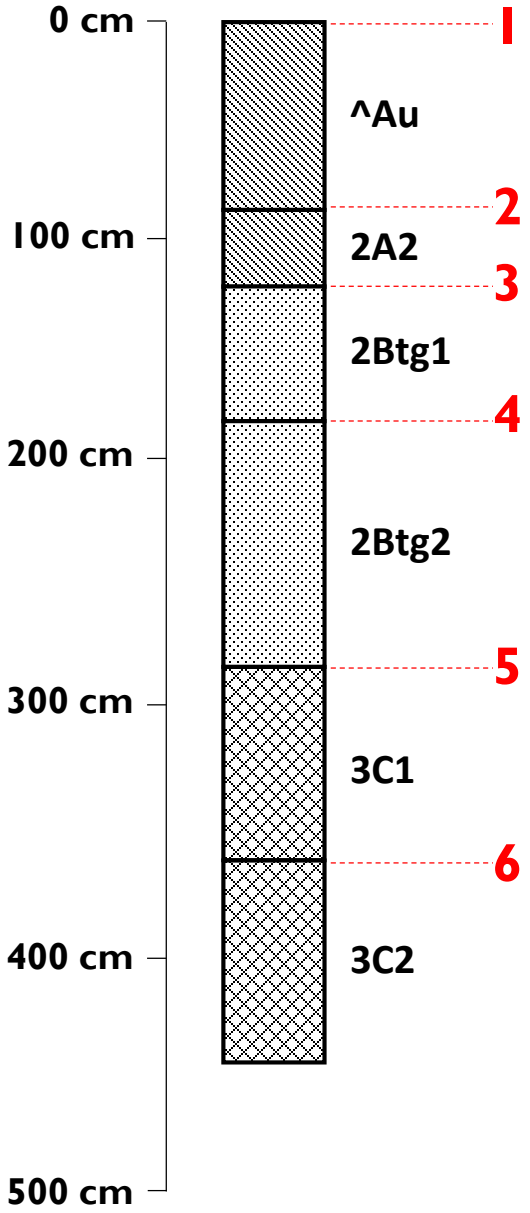
Non-urban pedons from the NASIS database

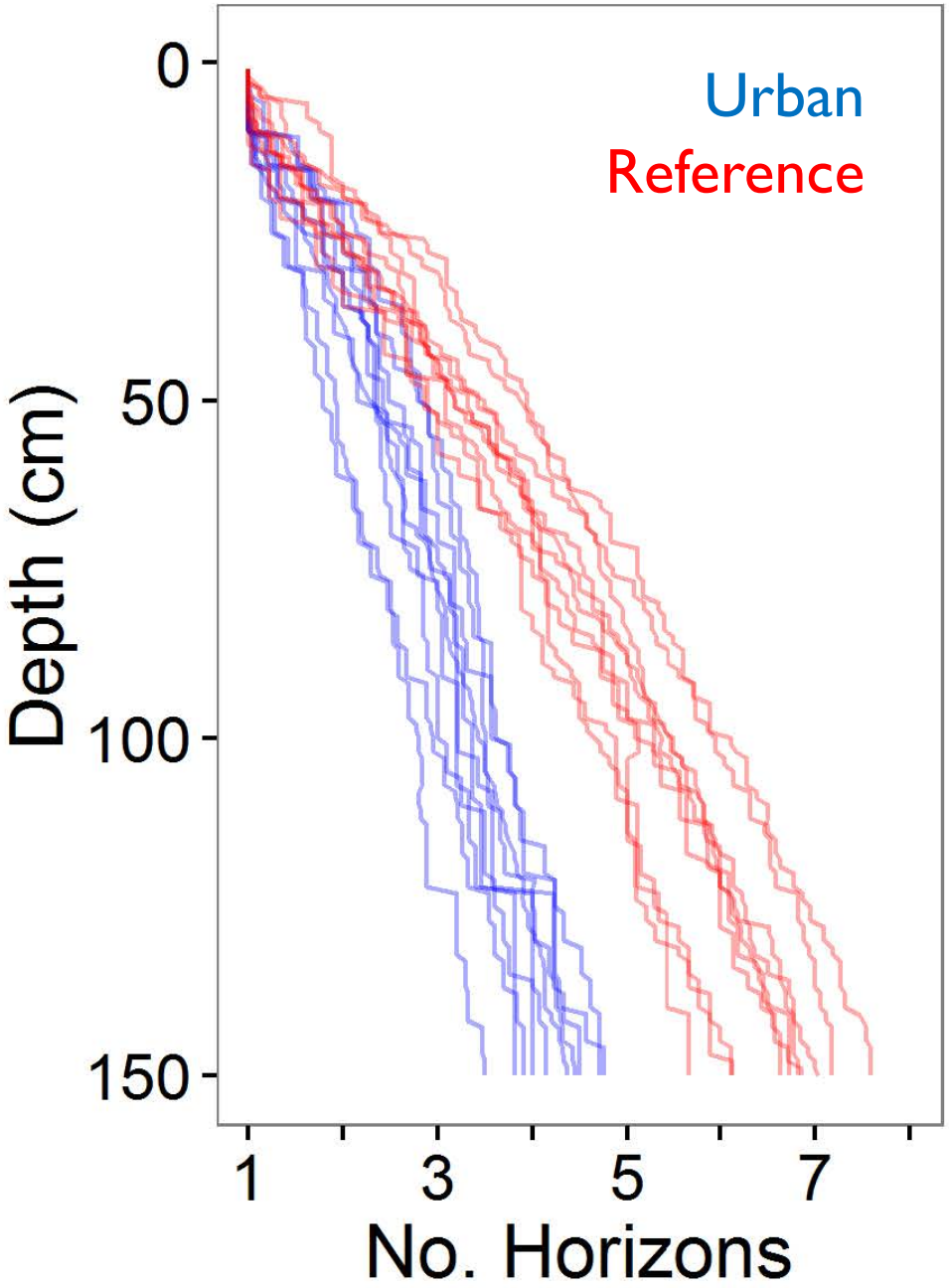
From same soil series as the urban soil

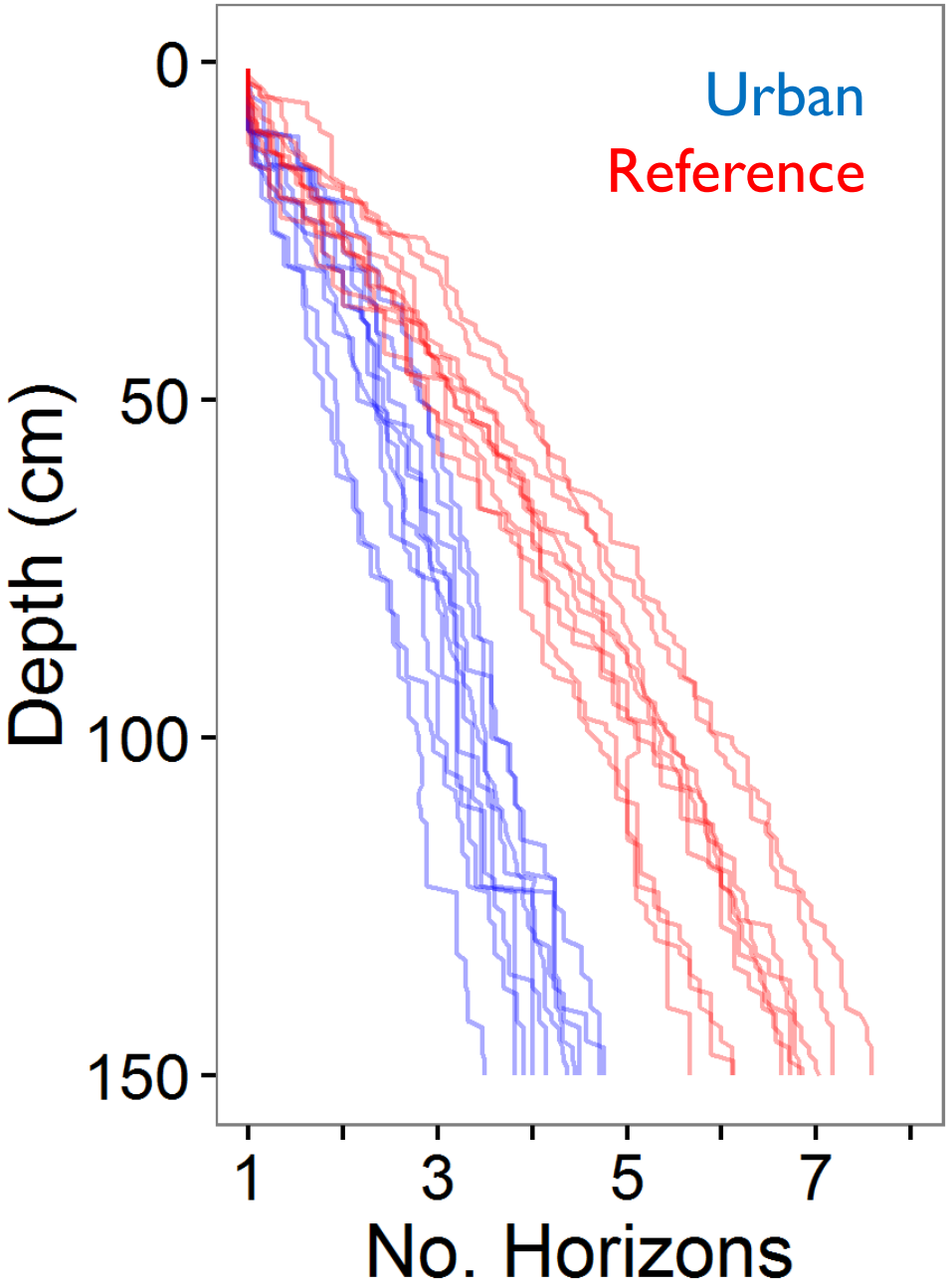
City	Urban pedons	Soil series	Reference pedons
Atlanta	14	7	12
Camden	23	4	7
Cincinnati	43	5	22
Cleveland	72	9	28
Detroit	57	13	28
New Orleans	20	6	11
Omaha	36	6	24
Phoenix	11	4	9
Portland, Maine	20	9	20
San Juan	21	8	12
Tacoma	15	4	8
Total	332	75	181

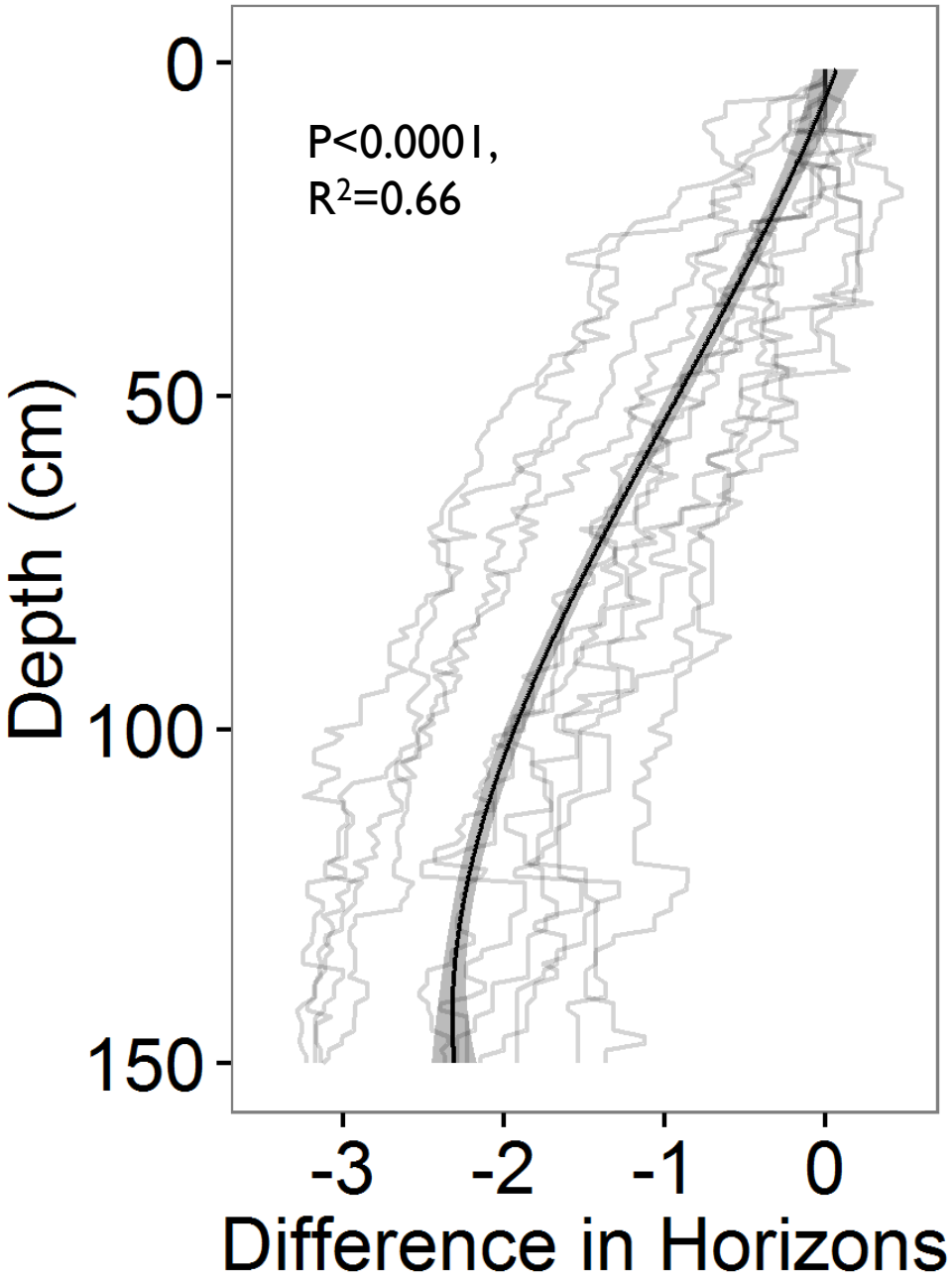
Cumulative horizonation

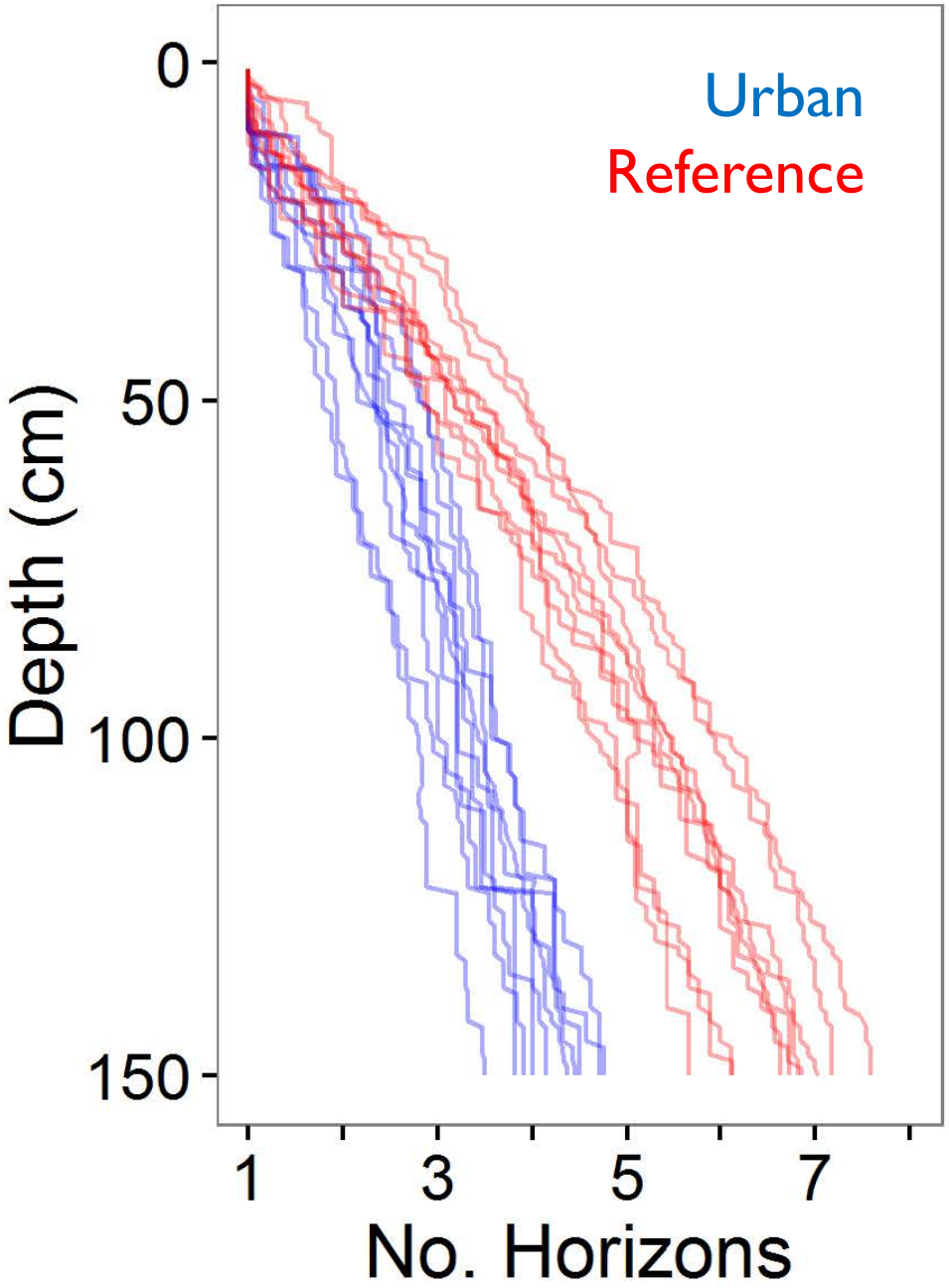
Number of horizons encountered as you move down the soil profile

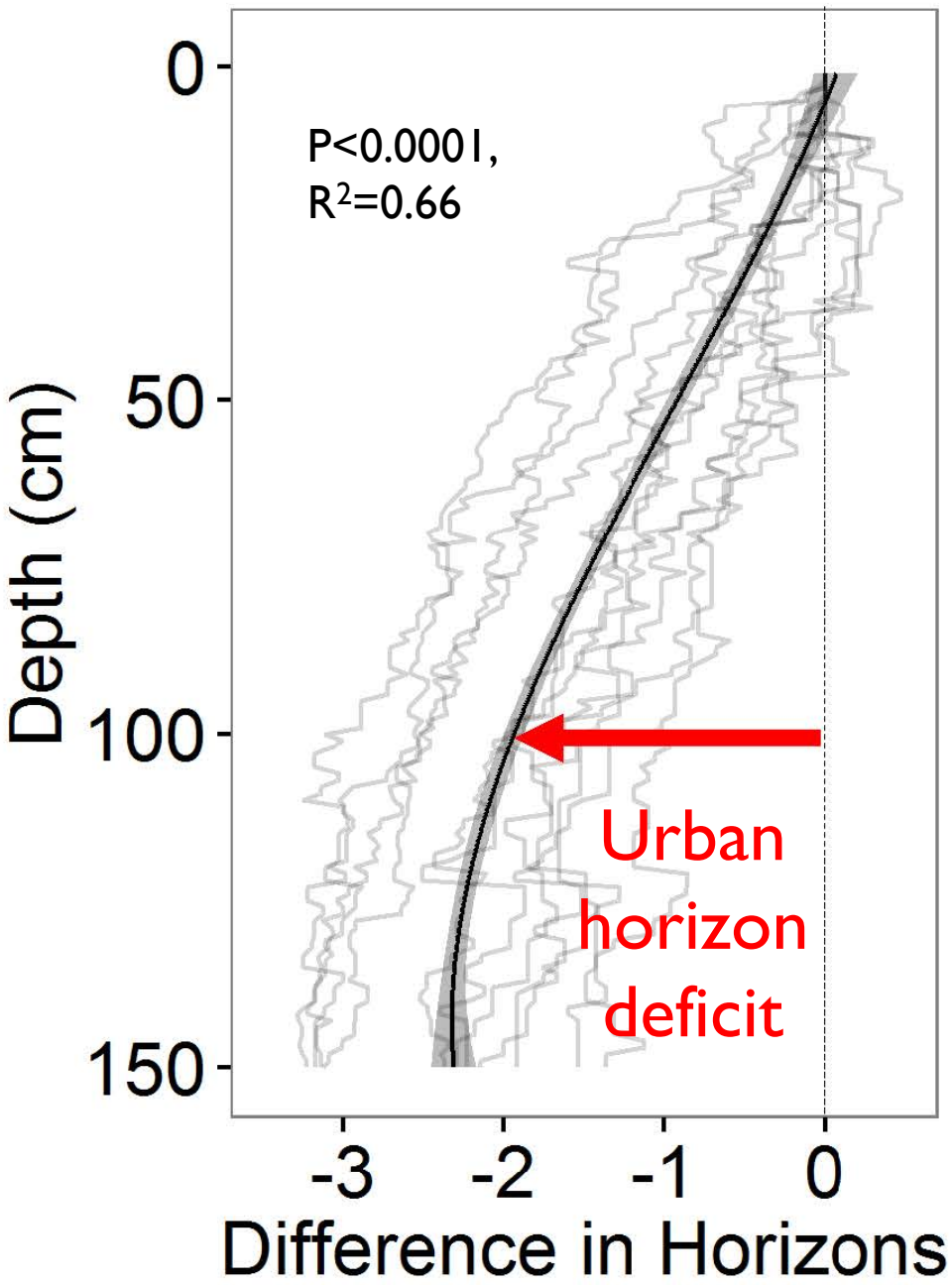



Urban
Reference
Depth (cm)
0
50
100
150
1
3
5
7
No. Horizons


Urban
Reference
Depth (cm)
0
50
100
150
1
3
5
7
No. Horizons

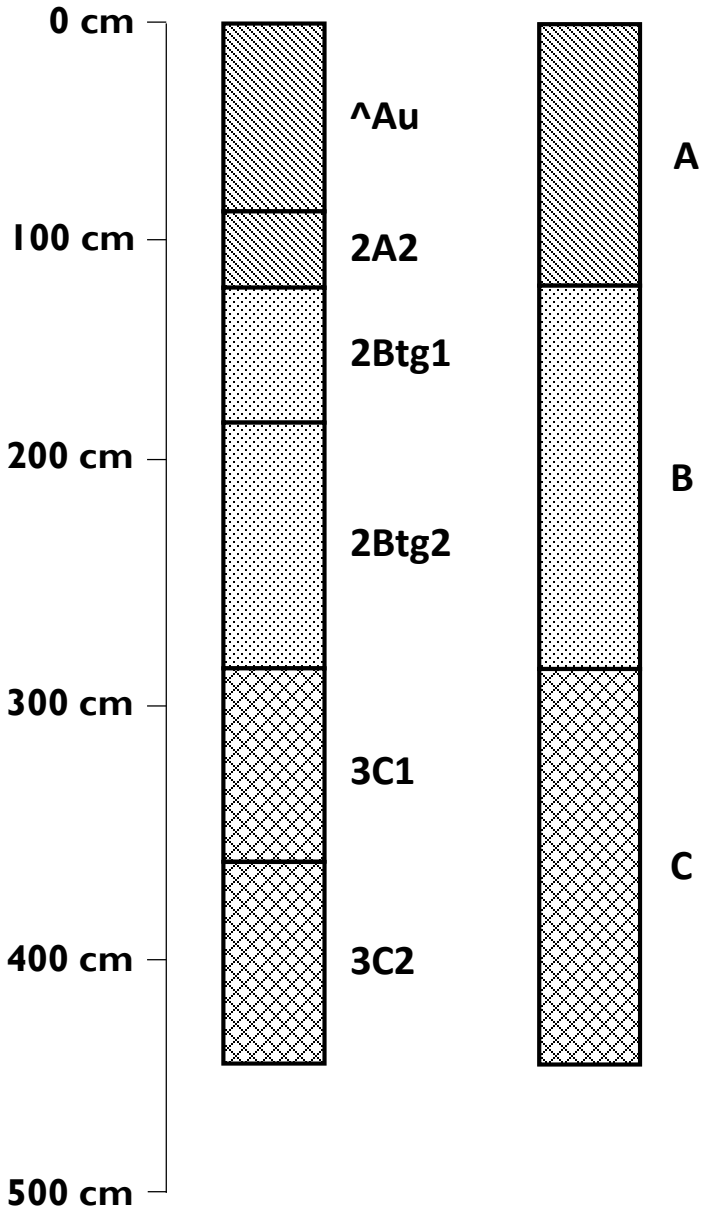

P<0.0001,
R2=0.66
Depth (cm)
0
50
100
150
-3
-2
-1
0
Difference in Horizons

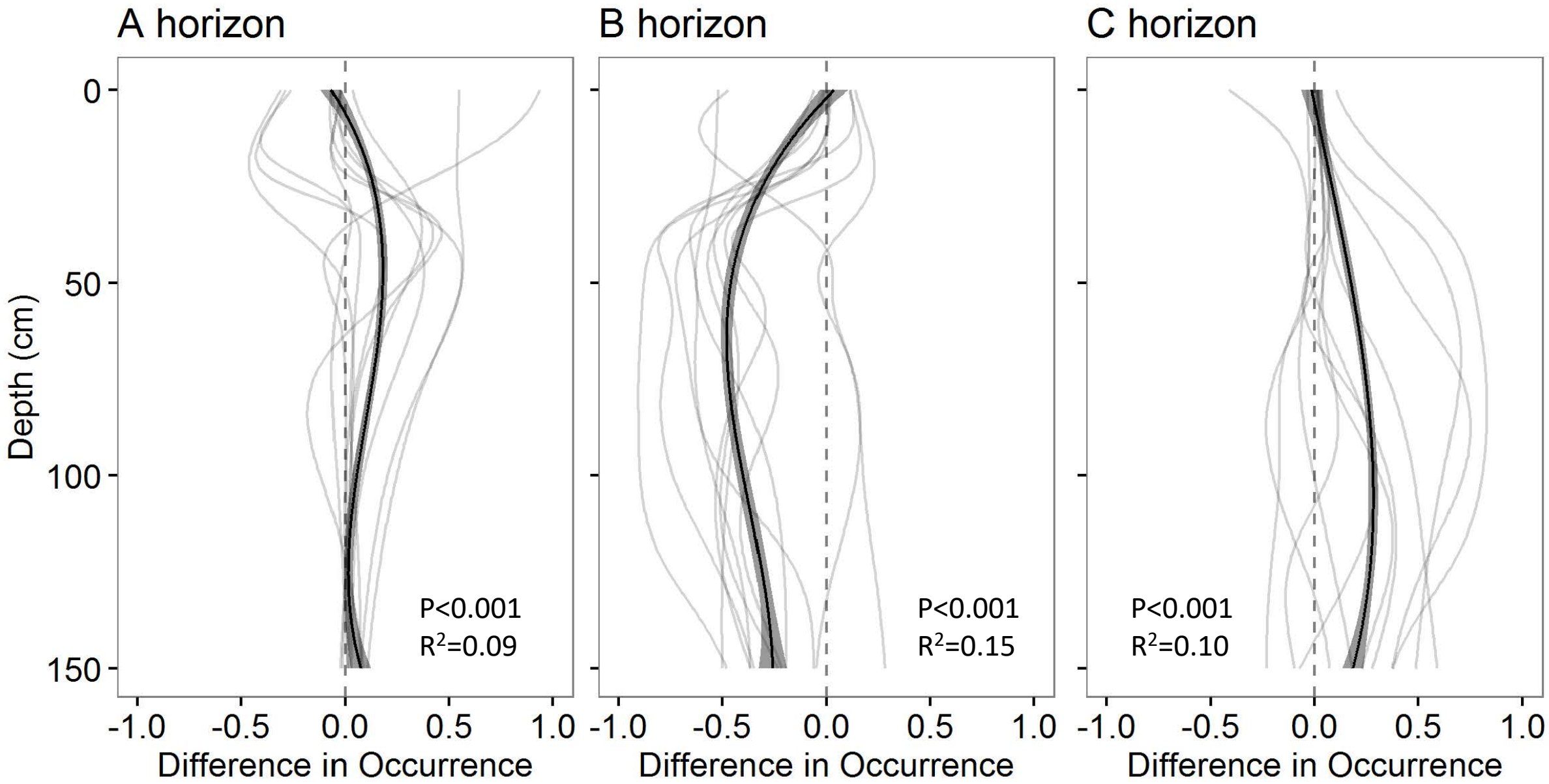

Urban
Reference
Depth (cm)
0
50
100
150
1
3
5
7
No. Horizons

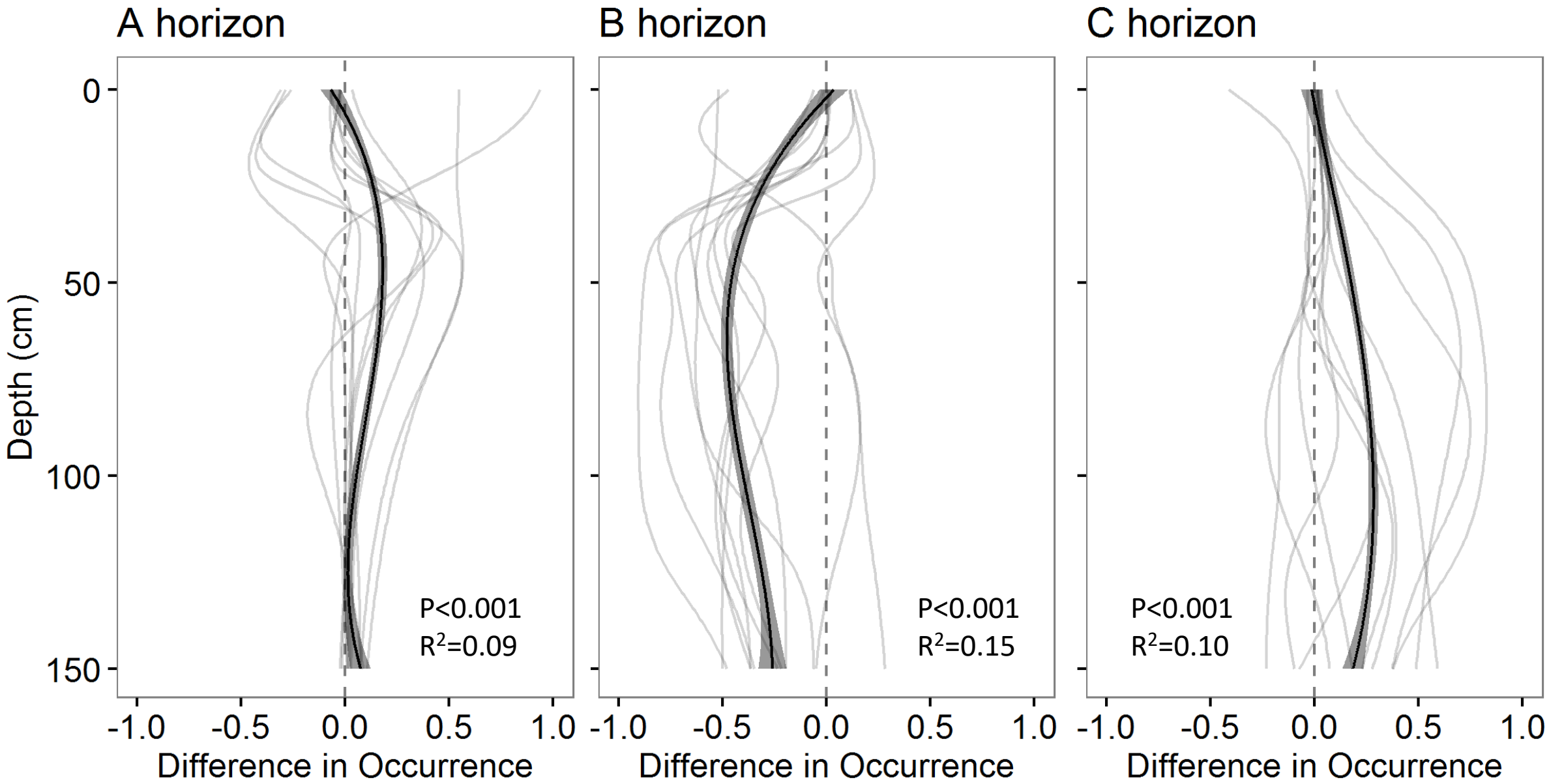

P<0.0001,
R2=0.66
Urban
horizon
deficit
Depth (cm)
0
50
100
150
-3
-2
-1
0
Difference in Horizons

Horizon occurrence

Proportion occurrence of master horizons



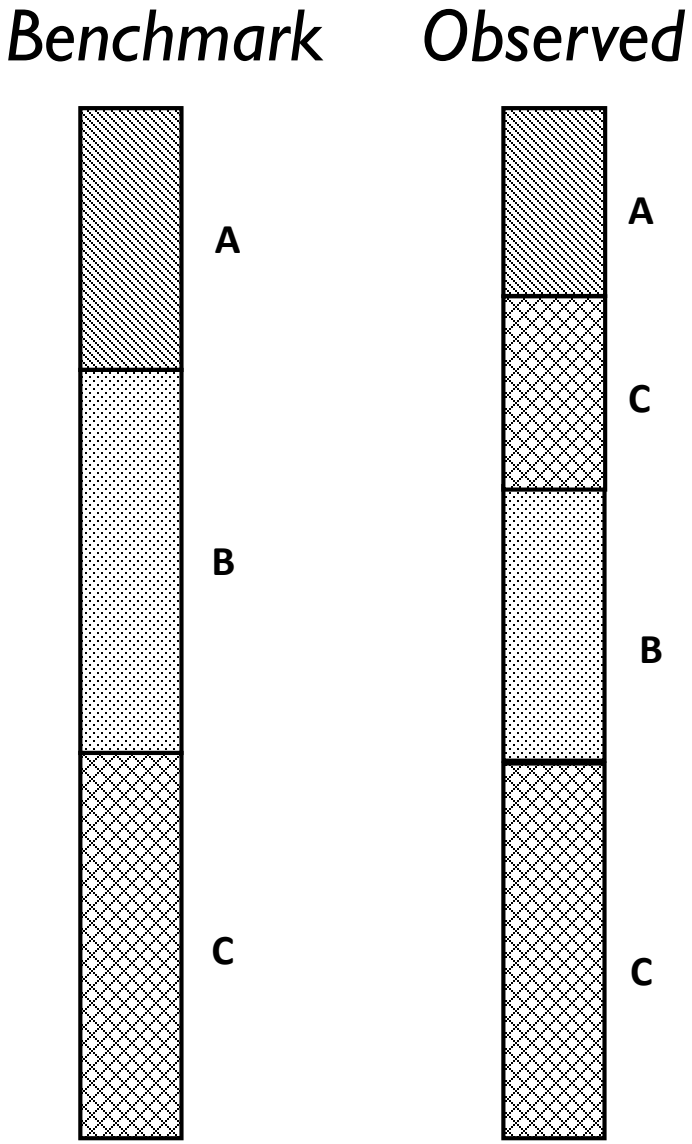

A horizon
B horizon
C horizon
Depth (cm)
0
50
100
150
P<0.001
R2=0.09
P<0.001
R2=0.15
P<0.001
R2=0.10
-1.0
-0.5
0.0
0.5
1.0
Difference in Occurrence



Deepening

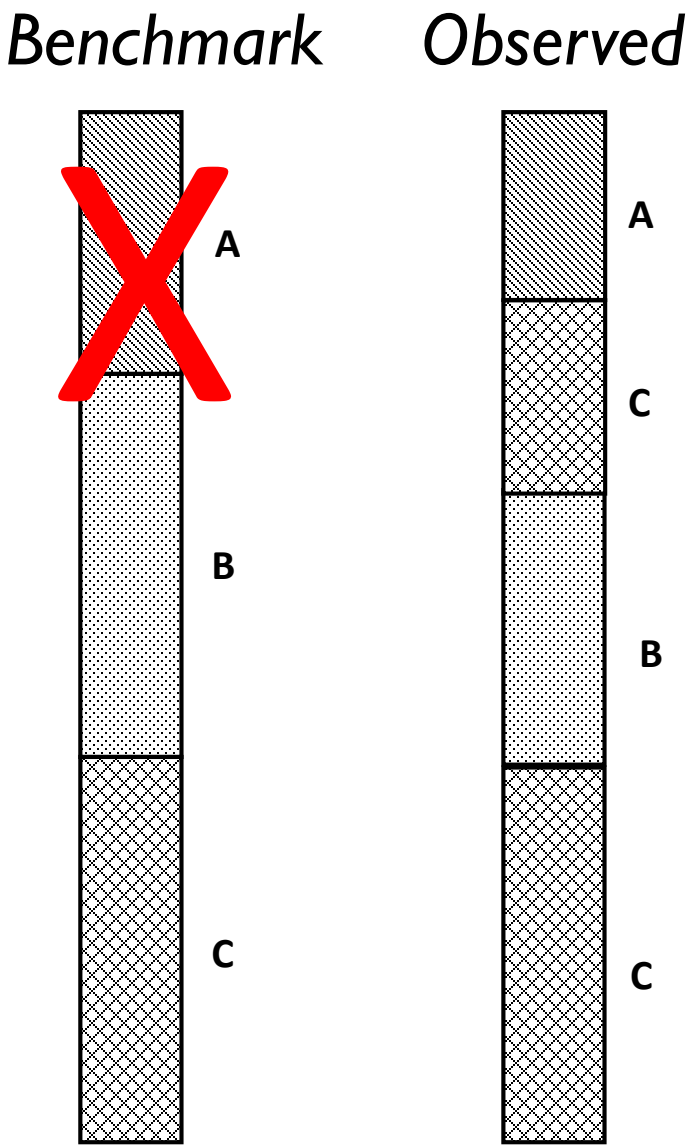
Being lost

Shallowing



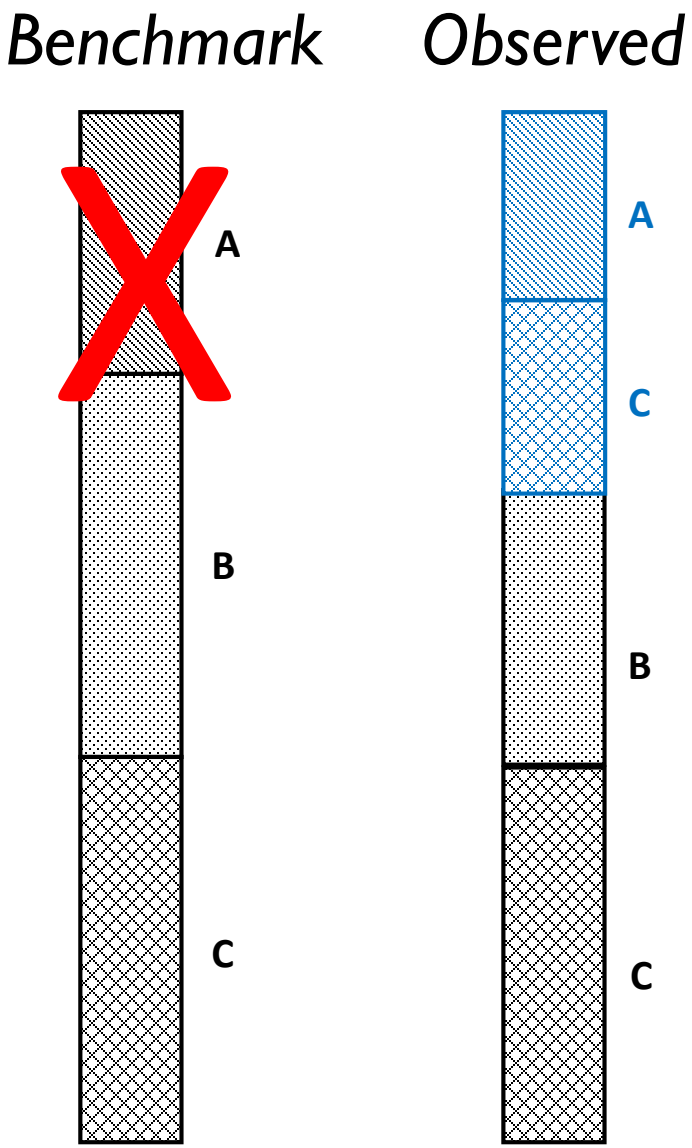
Horizon order:
Distance from A-B-C

Benchmark	A-B-C
Observed	A-C-B-C



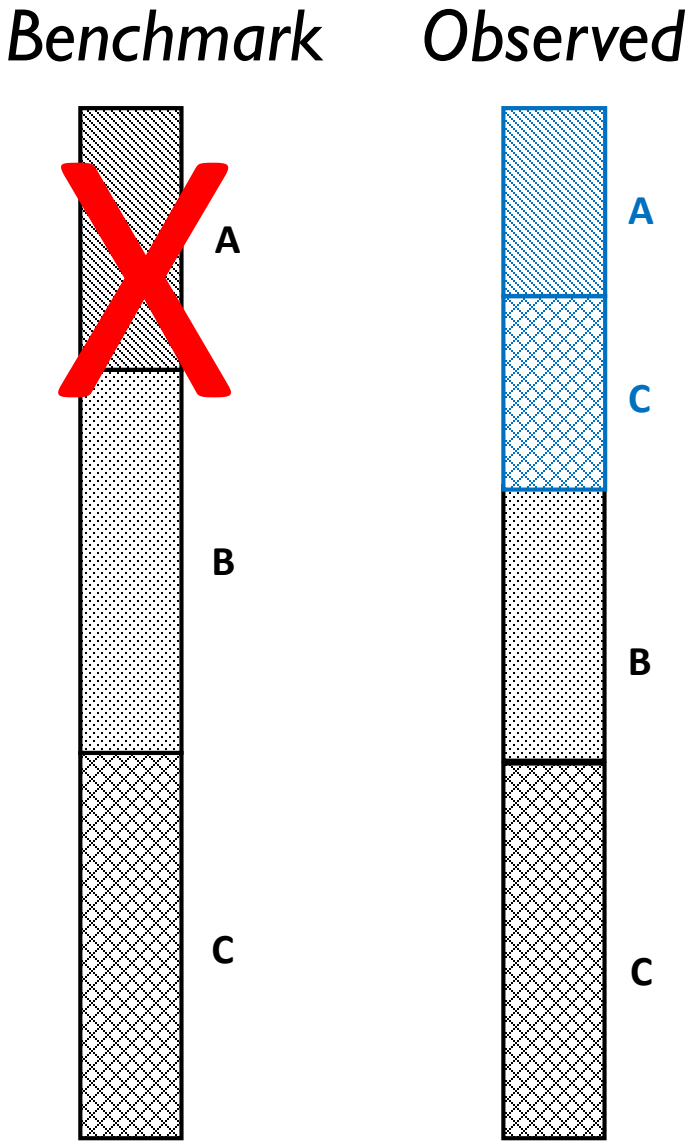
Horizon order:
Distance from A-B-C

Benchmark	A-B-C
One deletion	~~A~~-B-C
Observed	A-C-B-C



Horizon order:
Distance from A-B-C

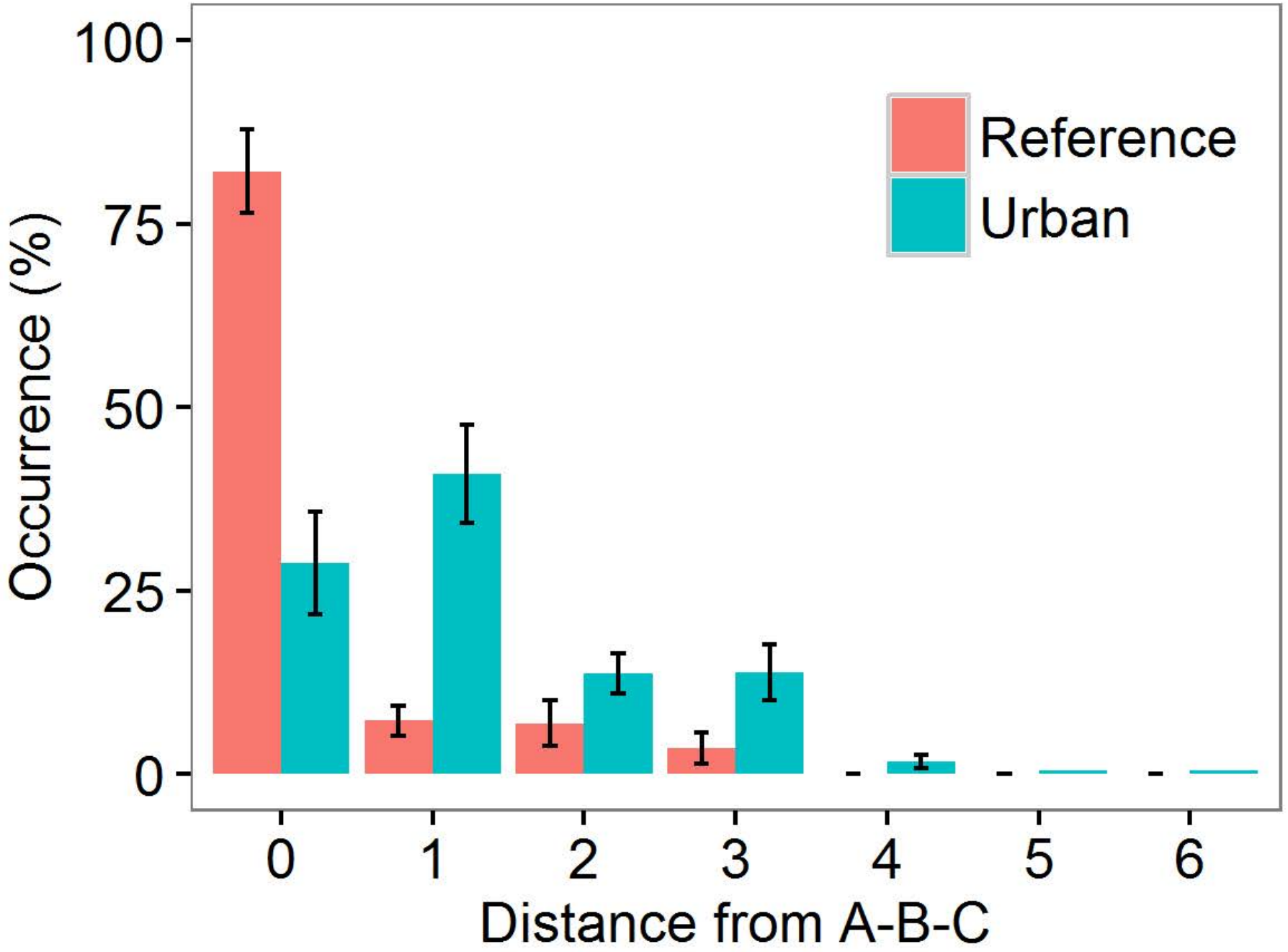
Benchmark	A-B-C
One deletion	~~A~~-B-C
Two insertions	A-C-B-C
Observed	A-C-B-C



Horizon order:
Distance from A-B-C

Benchmark	A-B-C
One deletion	~~A~~-B-C
Two insertions	A-C-B-C
Observed	A-C-B-C

One deletion + two insertions
= Distance of 3


Reference
Urban
Occurrence (%)
100
75
50
25
0
0
1
2
3
4
5
6
Distance from A-B-C

Discussion:
Parallels to aboveground urban ecosystems

Simplification of structure

Sharp boundaries

Novelty

Discussion:
Informing our research approach

Basis for analyzing existing data and shaping experimental design going forward

Research on the consequences of changes identified needed

Identify horizon geography when establishing sampling protocol

Questions?

Big, big thanks to our consulting USDA-NRCS Soil Scientists

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