

Opportunities and challenges to using BCG in an urbanizing setting



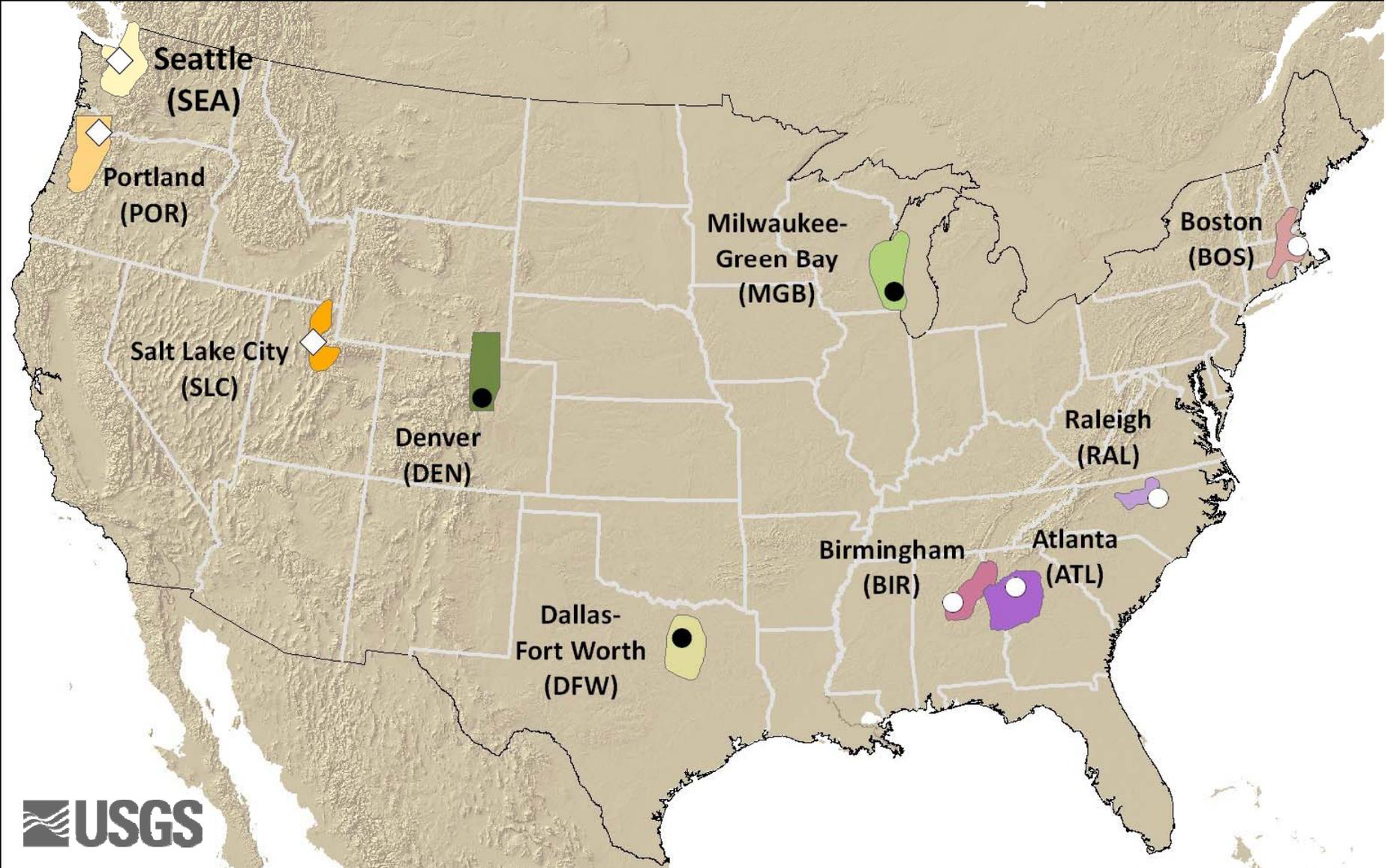
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National Water Quality Assessment Program
U.S. Geological Survey

Maine Department of Environmental Protection



USGS National Water Quality Assessment Program: Effects of Urbanization on Stream Ecosystems (EUSE)



The Biological Condition Gradient: Standardized Biological Response to Increasing Levels of Stress

Levels of Biological Condition

Natural structural, functional, and taxonomic integrity is preserved.

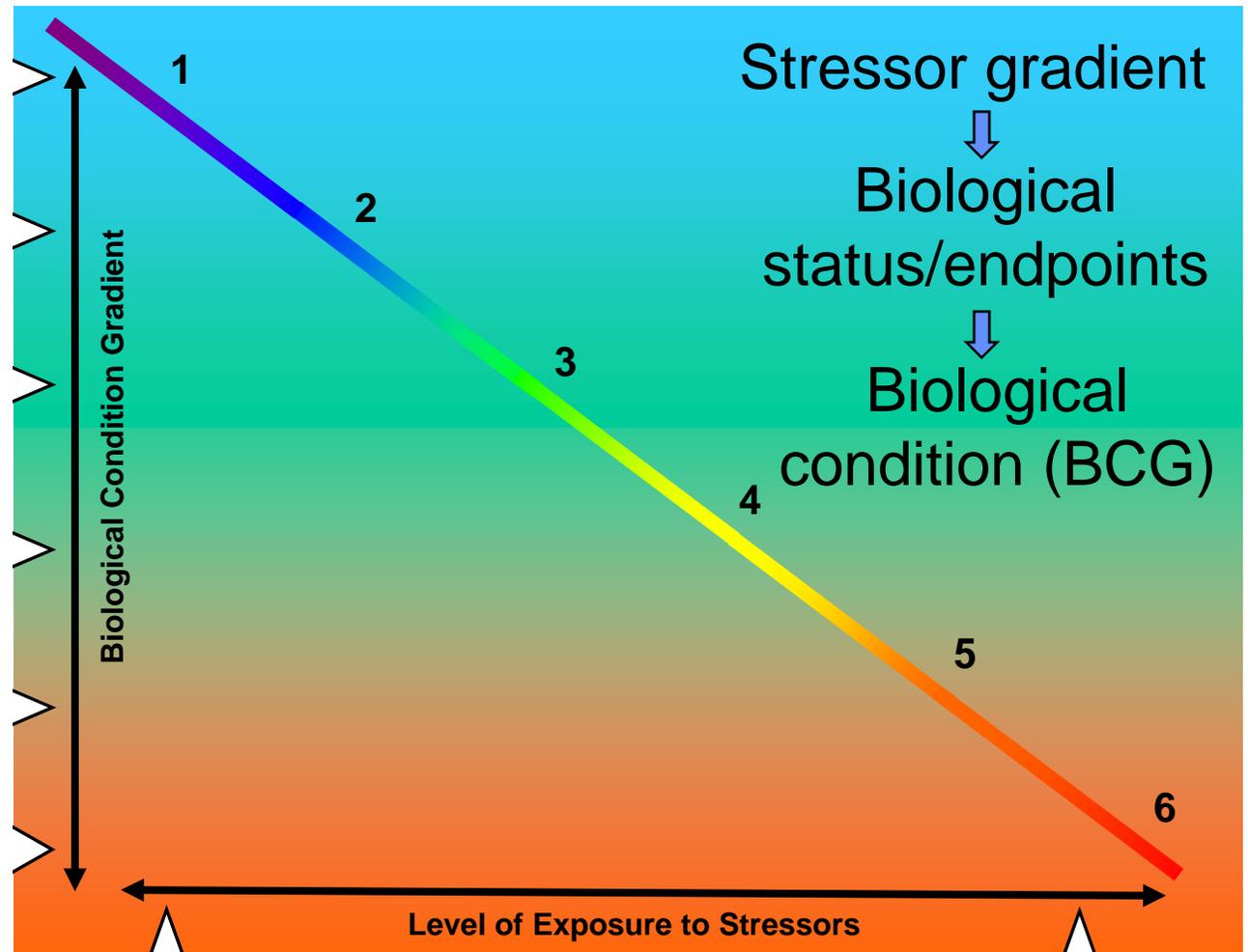
Structure & function similar to natural community with some additional taxa & biomass; ecosystem level functions are fully maintained.

Evident changes in structure due to loss of some rare native taxa; shifts in relative abundance; ecosystem level functions fully maintained.

Moderate changes in structure due to replacement of some sensitive ubiquitous taxa by more tolerant taxa; ecosystem functions largely maintained.

Sensitive taxa markedly diminished; conspicuously unbalanced distribution of major taxonomic groups; ecosystem function shows reduced complexity & redundancy.

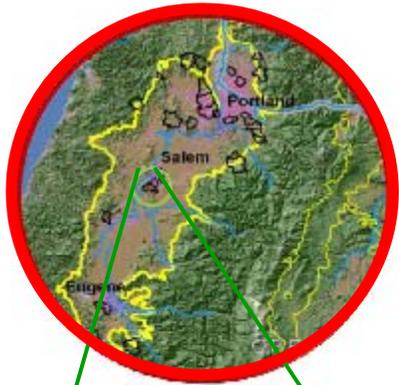
Extreme changes in structure and ecosystem function; wholesale changes in taxonomic composition; extreme alterations from normal densities.



Low end of urban gradient:
Habitat, flow, and stream chemistry as naturally occurs.

High end of urban gradient:
Habitat, flow, and stream chemistry severely altered from natural conditions.

Ecosystems respond to multi-scale processes



Regional Scale

Natural setting: geology, climate, natural resources, ecoregions
Human setting: historical land use and transportation patterns

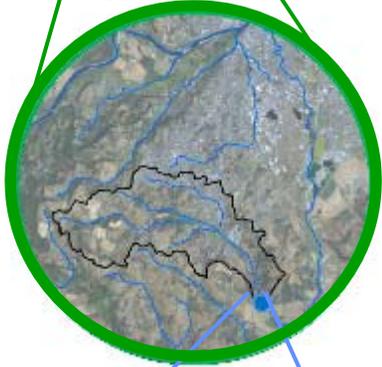
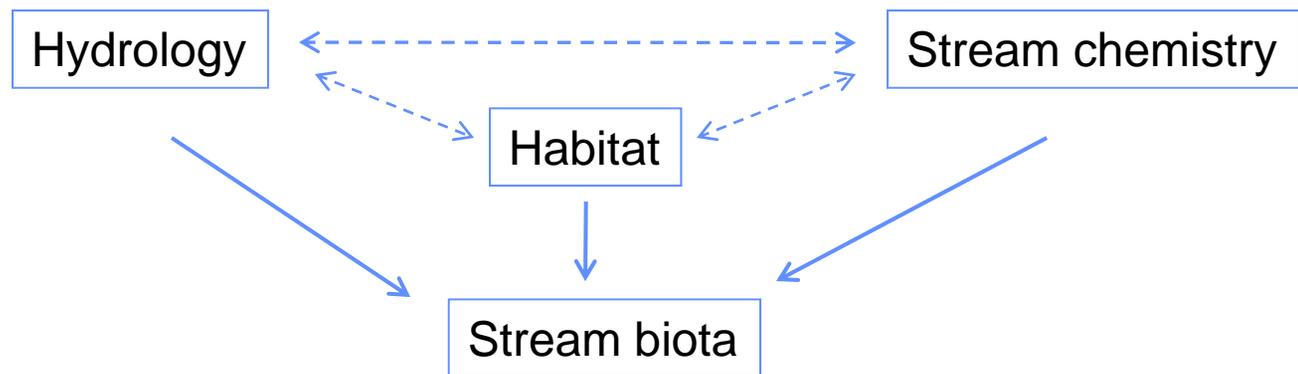


Watershed Scale

Natural setting: rainfall, soil permeability
Human setting: impervious cover, housing, roads, population

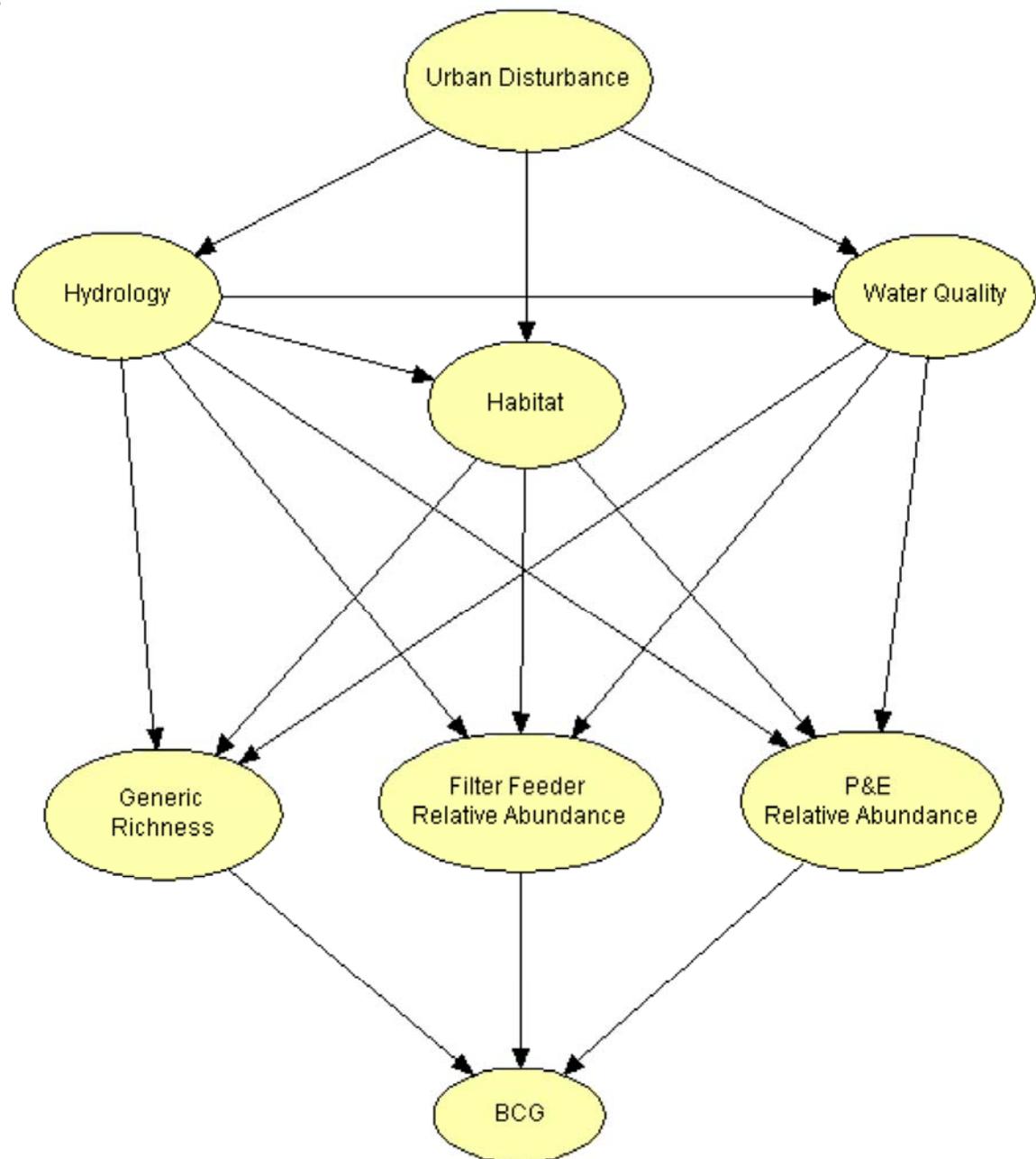


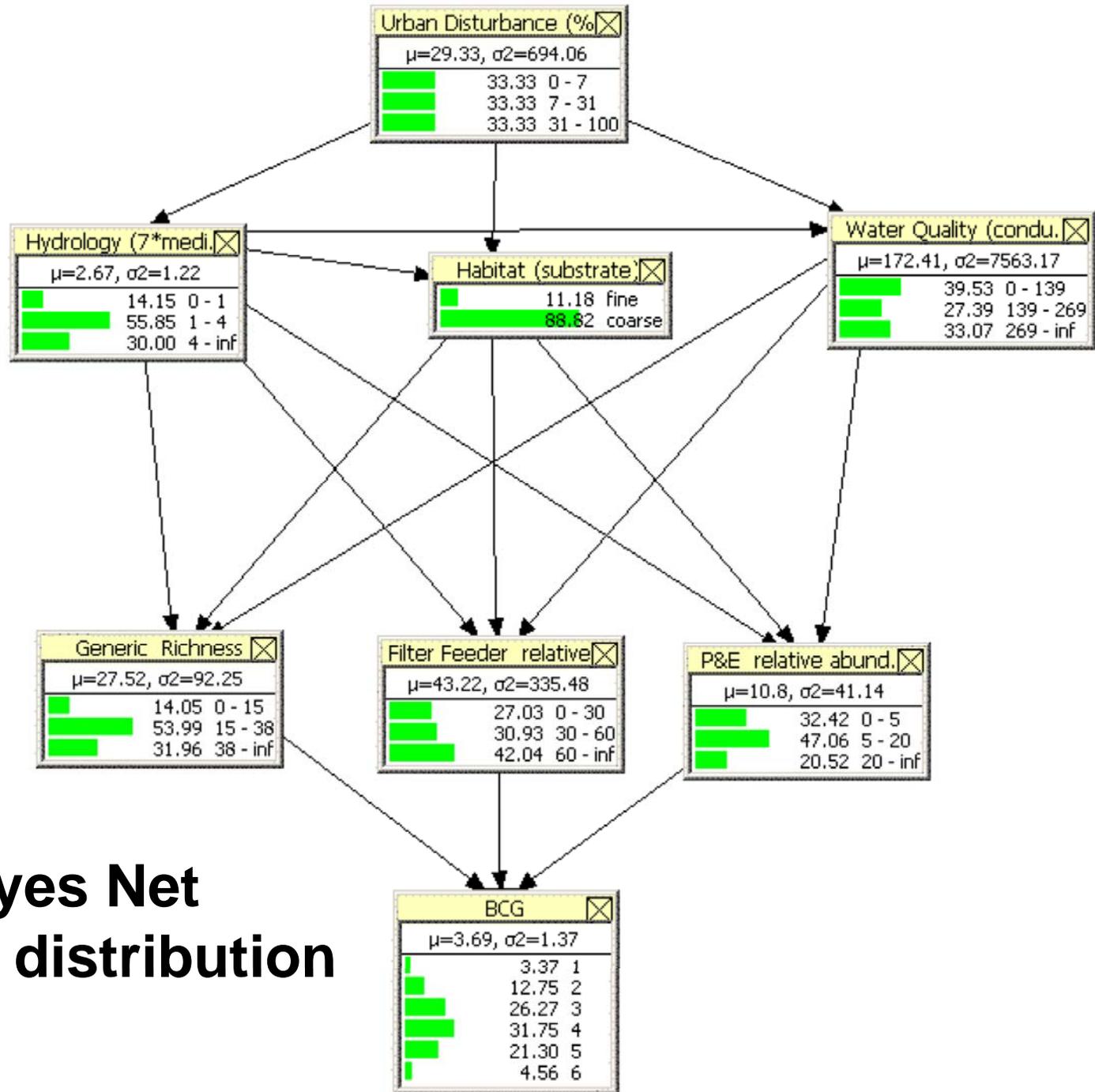
Stream Reach Scale



EUSE Bayes Net Pilot study

Model specification





EUSE Bayes Net

Posterior distribution

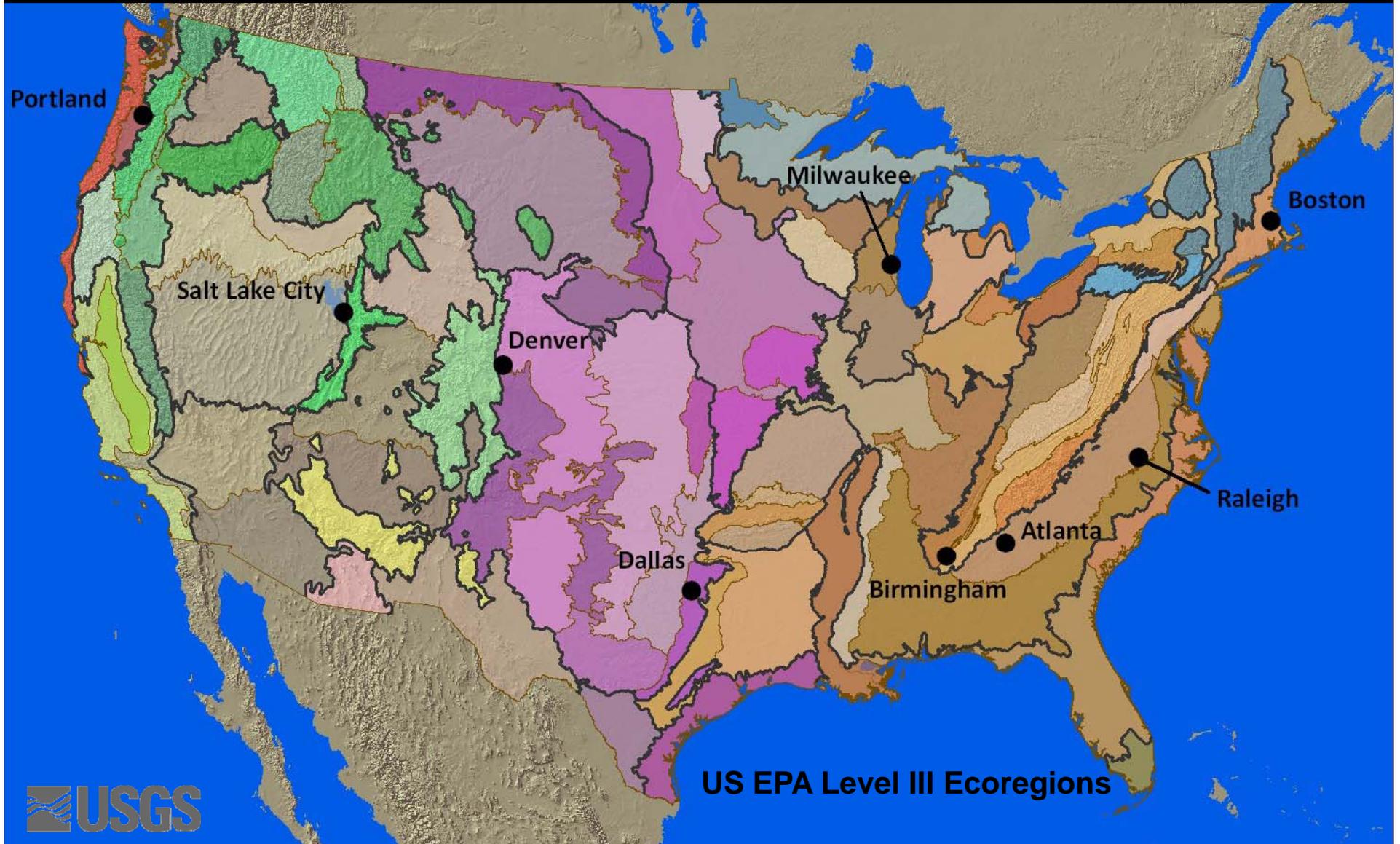
Healthy Stream Ecosystems



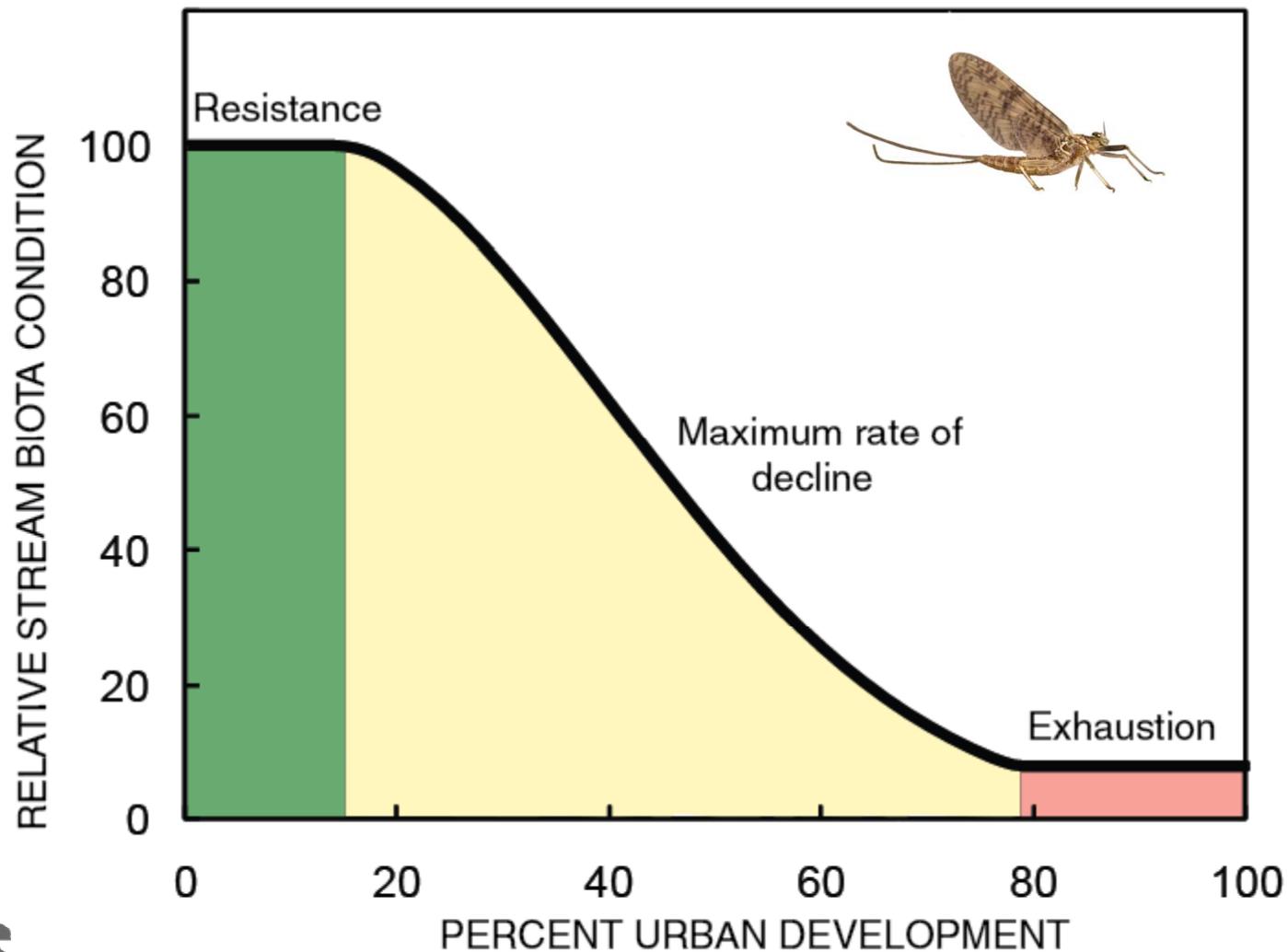
Signs of Stream Degradation in Urban Areas



Limiting the variability of natural setting



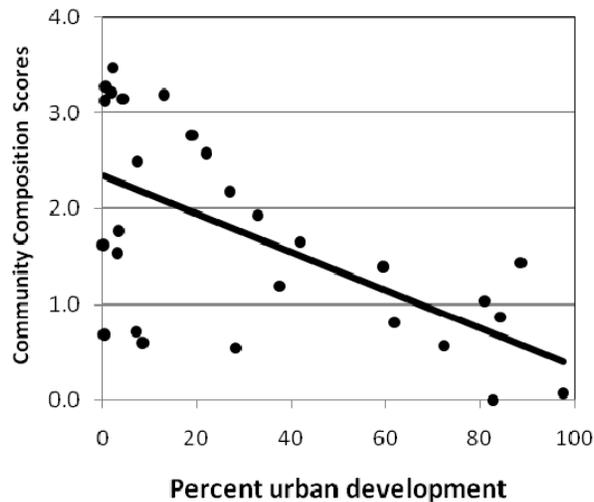
Hypothesized Stream Biota Response to Urbanization



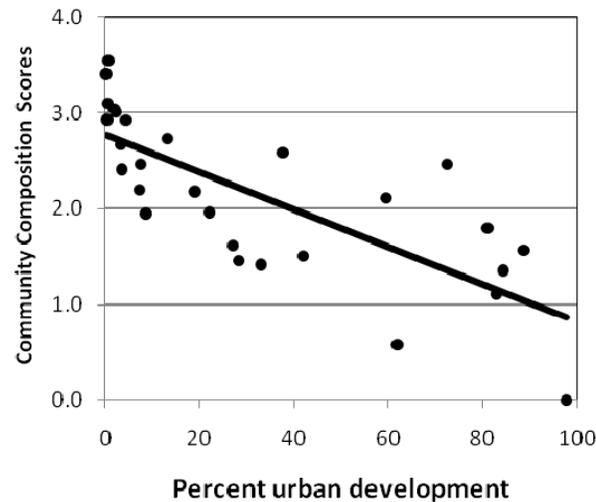
All Biological Communities Showed Signs of Negative Impacts to Urban Development



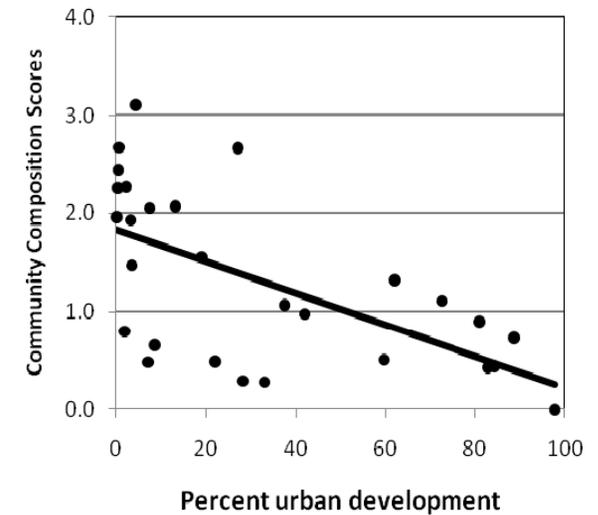
Algal Communities



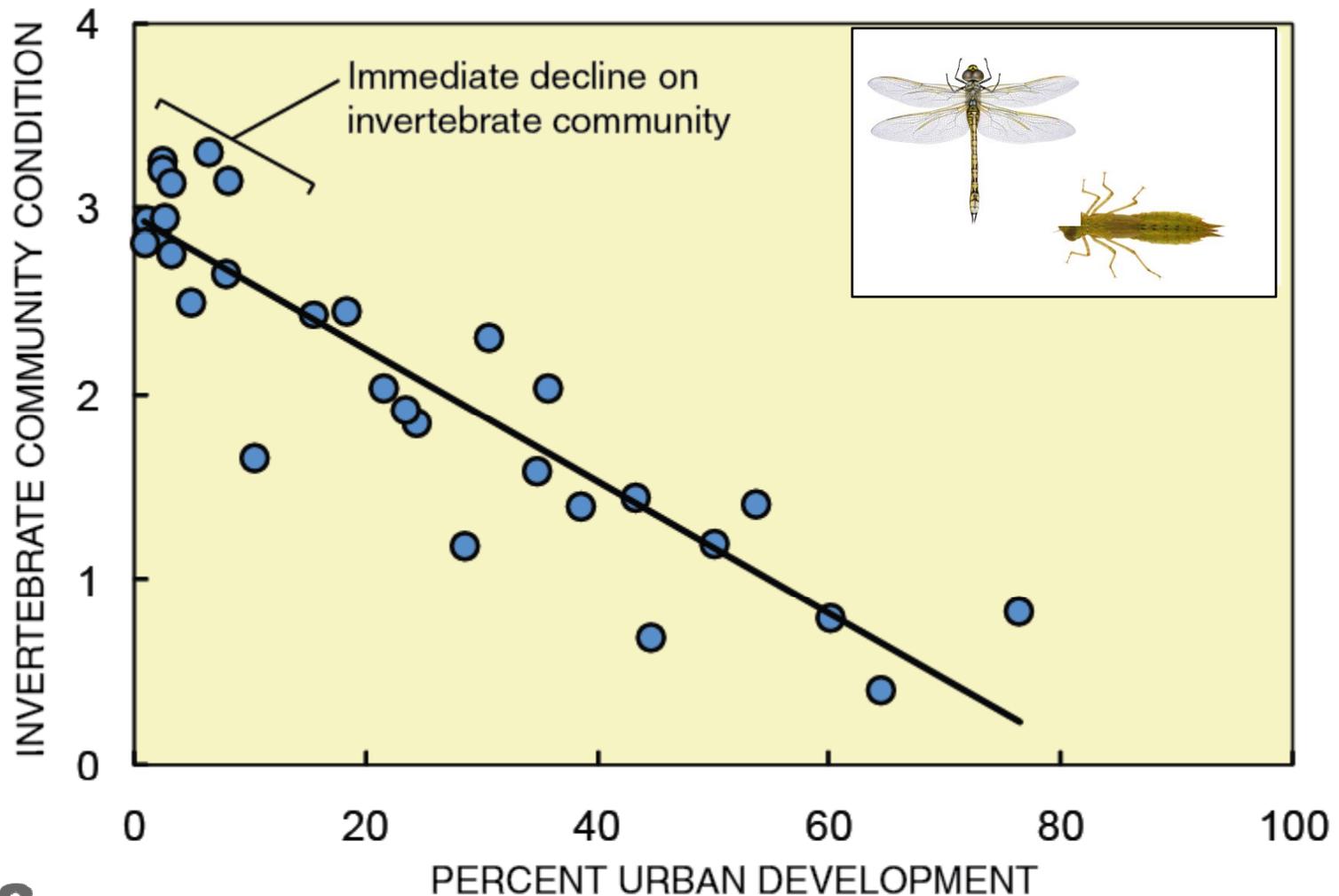
Aquatic Insect Communities



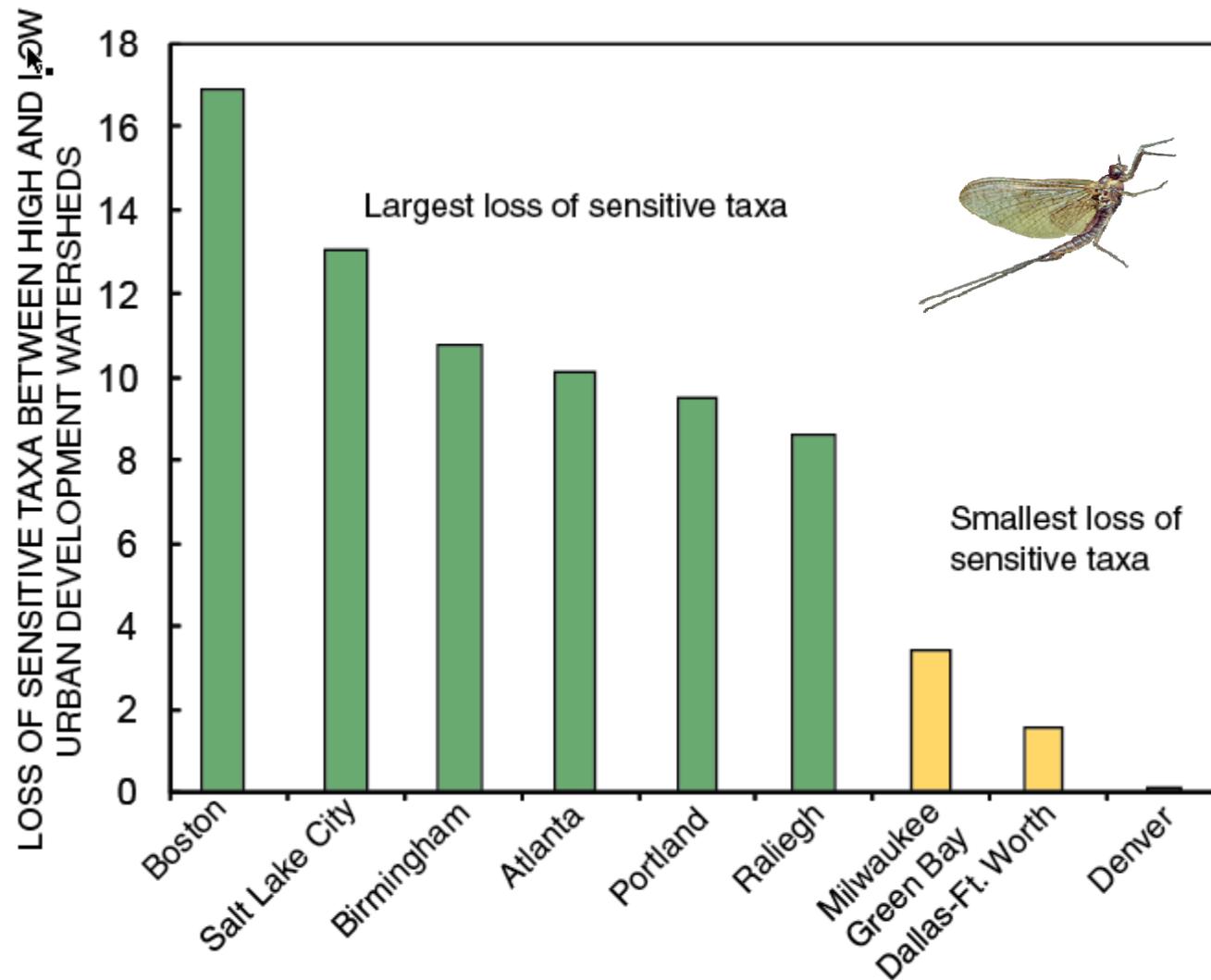
Fish Communities



Immediate decline in aquatic insect communities as urban development increases

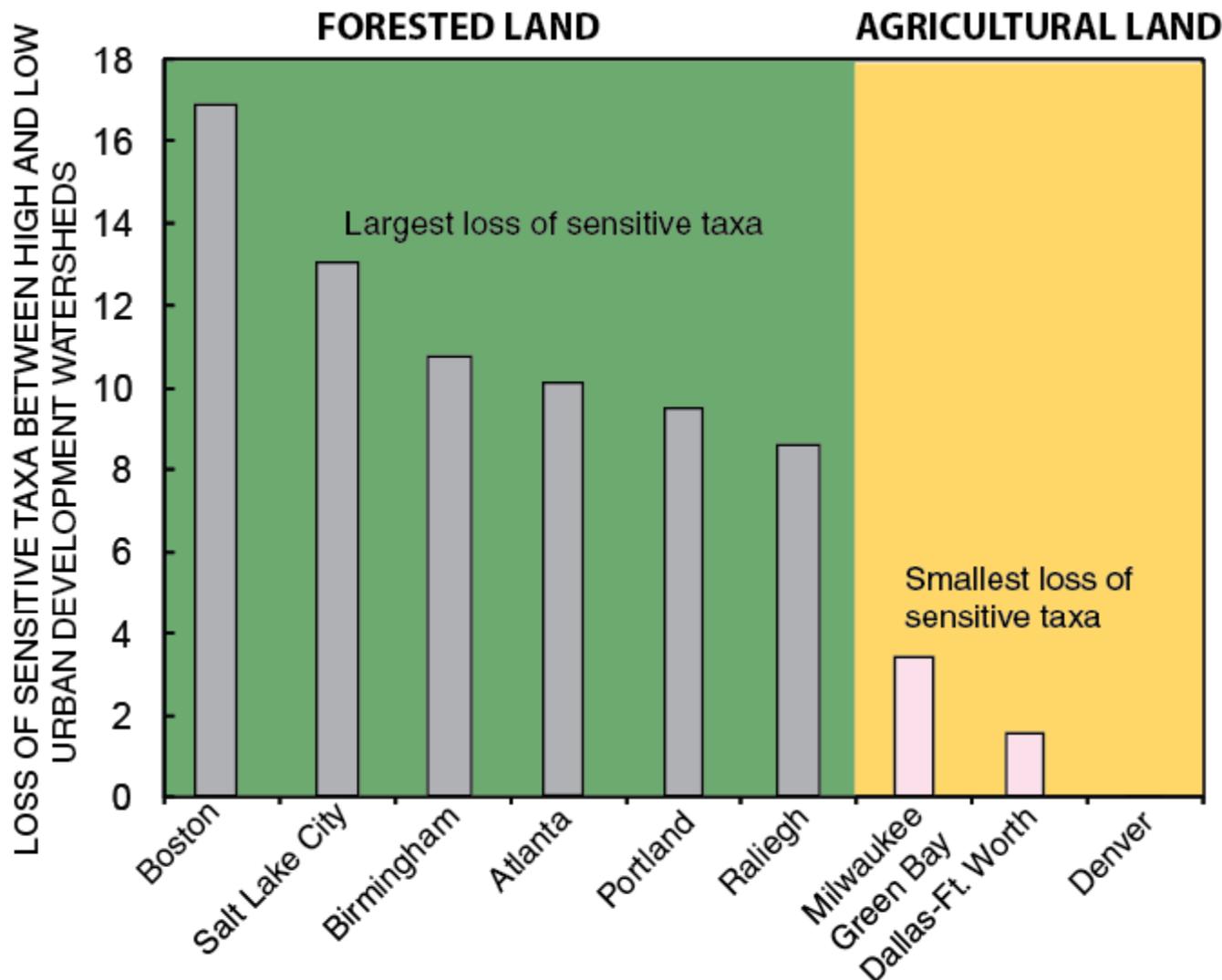


Urban Development Leads to a Loss of Sensitive Species



Historical Land Uses Can Mask Effects of Urban Development on Aquatic Life

MAJOR TYPE OF LAND THAT EXISTED PRIOR TO URBAN DEVELOPEMNT



How can this information be used by water resource managers and planners?



“How we develop and maintain land within our watersheds affects both the quality and quantity of water in our streams, river, and lakes. As the watershed develops, that natural ecology can be greatly altered.” *Milwaukee Metropolitan Sewerage District, 2004*