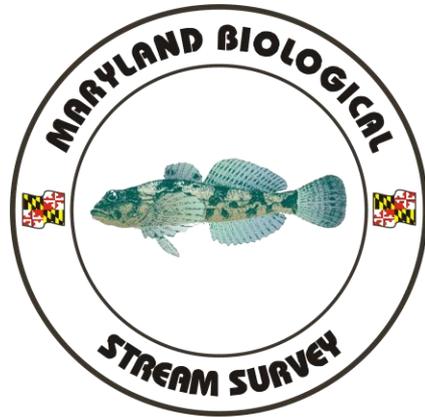


Comparing the Biology of Restored Urban Streams to Non-Urban Streams



**Scott Stranko,
Robert Hilderbrand,
and
Margaret Palmer**



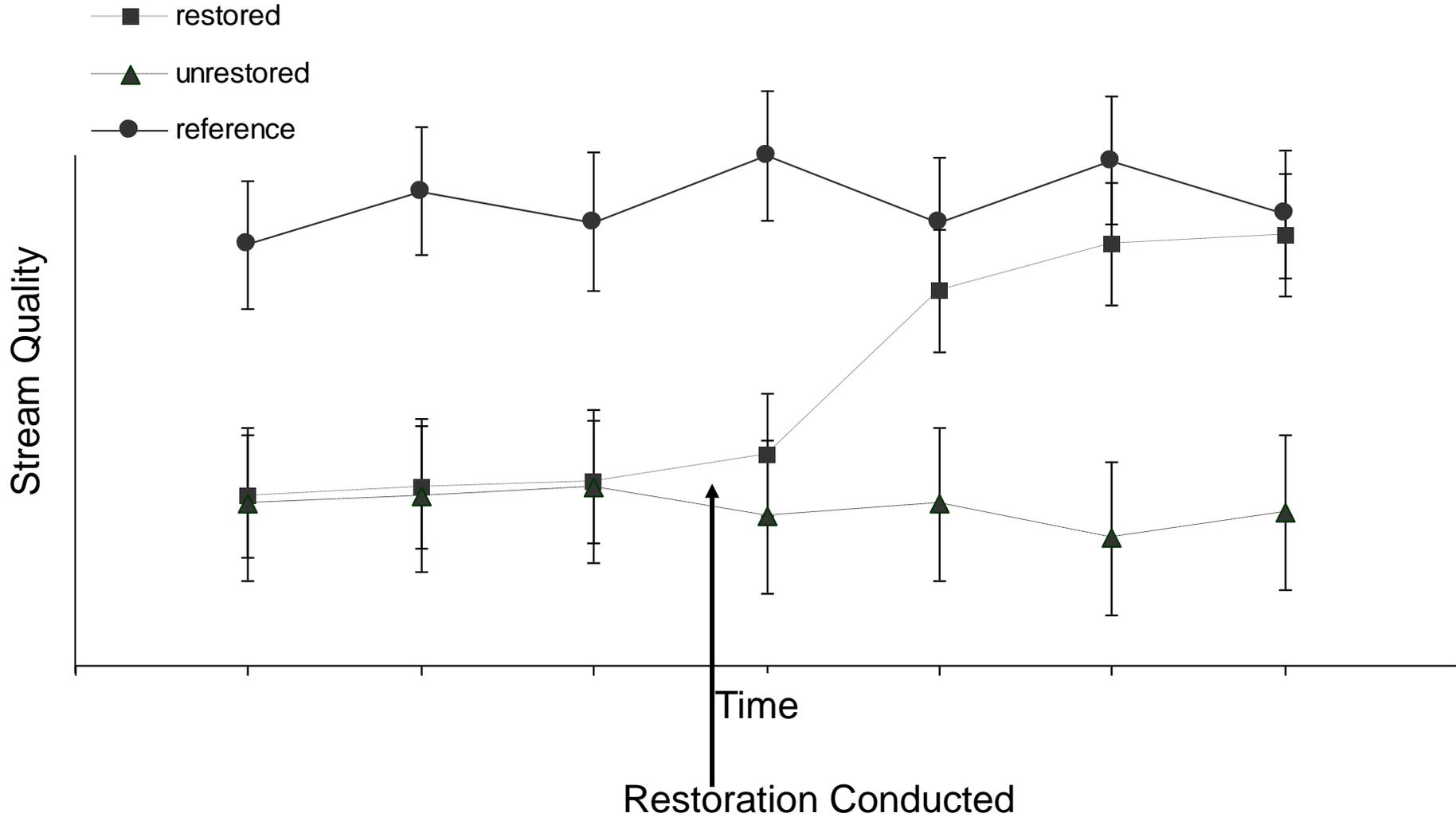
Analytical and Editorial Support:

Michael Kashiwagi, Rebecca Bourquin, Ron Klauda, Andy Becker; Jay Kilian

County Support and Data Providers:

Rachel Gauza, Dennis Genito, Keith VanNess, Jim Cummins

Hypothetical Graph of Restoration Expectation



Urban Restored Streams

All > 60% Urban (NLCD 2001)

Substantial Restoration Conducted



Sligo Creek

Stormwater Retrofits (8)
Created Wetland (1)
Channel Recon (2,670 ft)
Tree Planting
Fish Stocked (23 spp, 6 events)
Completed ~2001
About \$2.6 Million

Minebank Run

Remove Concrete (500 ft)
Channel Recon (3.5mi)
Tree Planting

Completed 2005
About \$4.0 Million

Longwell Branch

Stormwater Ponds Added (2)
Fortify Banks (~400 ft)
Tree Planting

Completed 1998
About \$600,000

Reference Streams

All less than 5% Urban and > 60% Forest (NLCD 2001)



Baisman Run

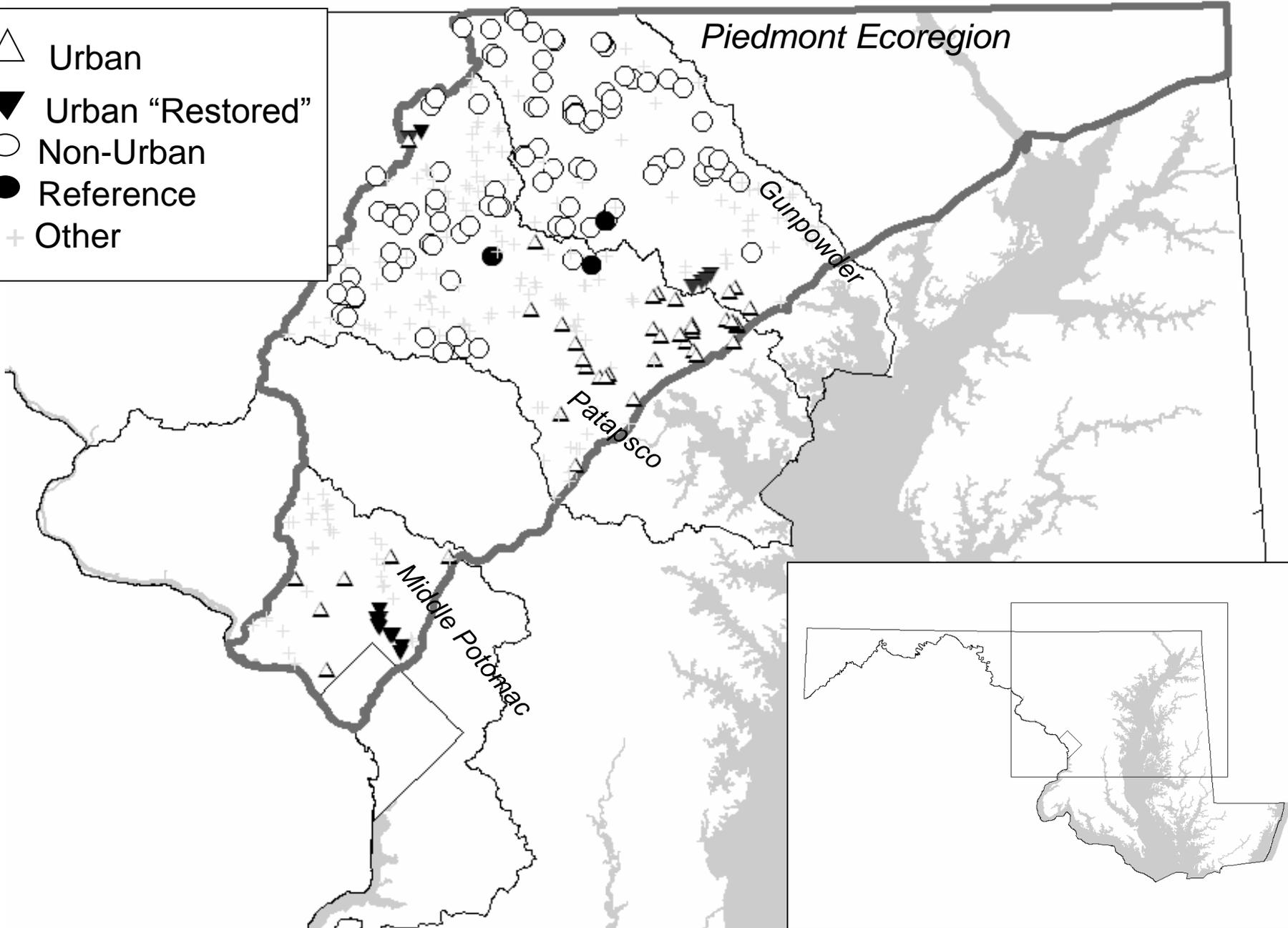
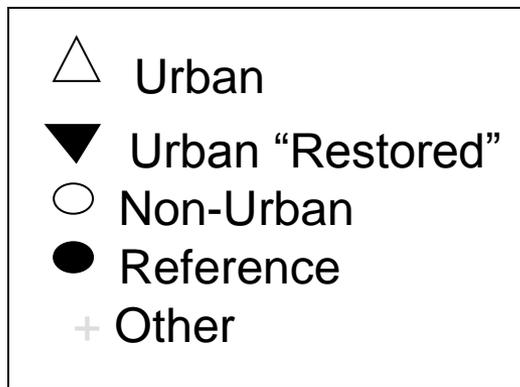


NB Jones Falls



Timber Run

Sites



Analyses

Ordination (NMS)

Multi-Resolution Permutation Procedure (MRPP)

ANOVA

CIPS (Control Impact Paired Series)

Biological Data

Benthic Macroinvertebrate

- IBI

Spatial Differences?

Change Over Time?

Fish

- IBI
- Number of Species (adj. stream size)
- Number of Intolerant Species
- Trout Density
- Sculpin/Darter Density



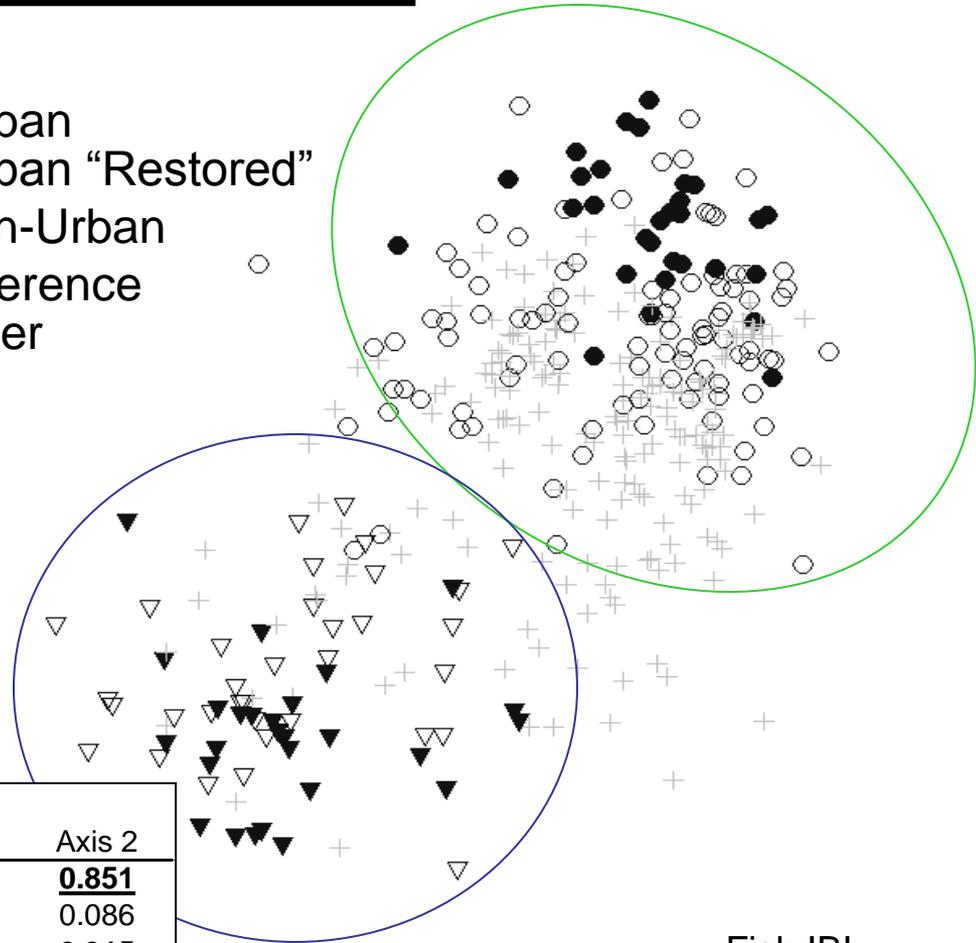
Ordination Results

Benthic IBI
 Intolerant Benthic Taxa
 Total Benthic Taxa
 Mayfly Taxa
 Stonefly Taxa
 Trout Density



Axis 2

- ▽ Urban
- ▼ Urban "Restored"
- Non-Urban
- Reference
- + Other



NMS Correlation Coefficients

	Axis 1	Axis 2
Benthic Macroinvertebrate IBI	<u>0.661</u>	<u>0.851</u>
Number of Benthic Genera	<u>0.603</u>	0.086
Intolerant Benthic Genera	<u>0.643</u>	<u>0.915</u>
Stonefly Genera	0.408	<u>0.669</u>
Mayfly Genera	<u>0.645</u>	<u>0.766</u>
Fish IBI	<u>0.769</u>	0.449
Number of Fish Species	<u>0.674</u>	0.157
Intolerant Fish Species	<u>0.77</u>	0.223
Trout Density	0.248	<u>0.5</u>
Darter/Sculpin Density	0.394	0.289

Bold r>0.5

Axis 1



Fish IBI
 Intolerant Fish Species
 Total Fish Species
 Benthic IBI
 Intolerant Benthic Taxa
 Total Benthic Taxa
 Mayfly Taxa

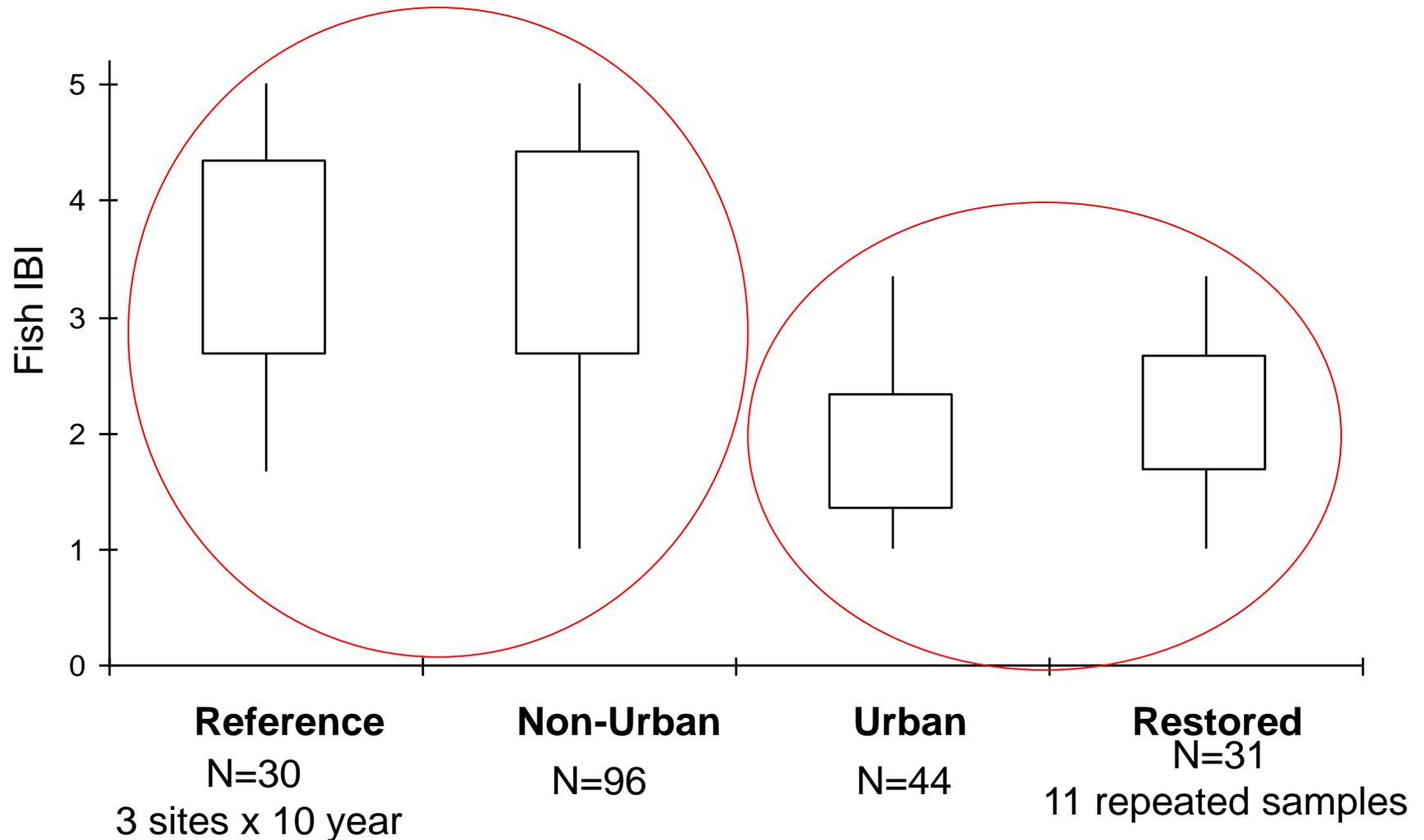
Multi-Resolution Permutation Procedure (MRPP)

$p < 0.001$

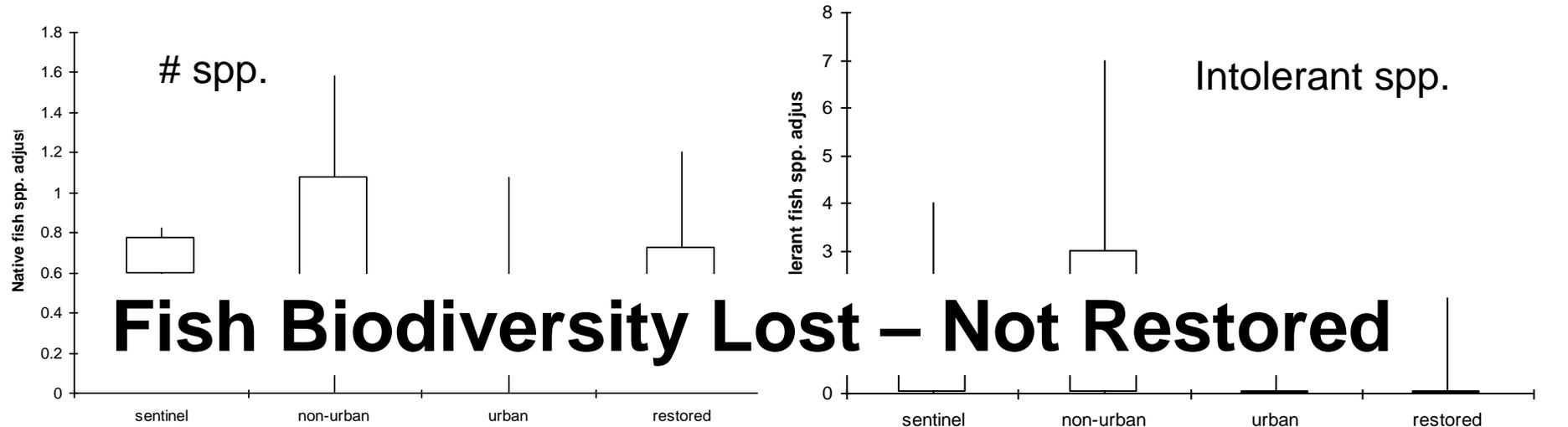
MRPP Pairwise Results

	<u>P</u>
Urban vs. Restored	0.013
Urban vs. Non-Urban	<0.000001
Urban vs. Sentinel	<0.000001
Restored vs. Non-Urban	<0.000001
Restored vs. Sentinel	<0.000001
Sentinel vs. Non-Urban	<0.000001

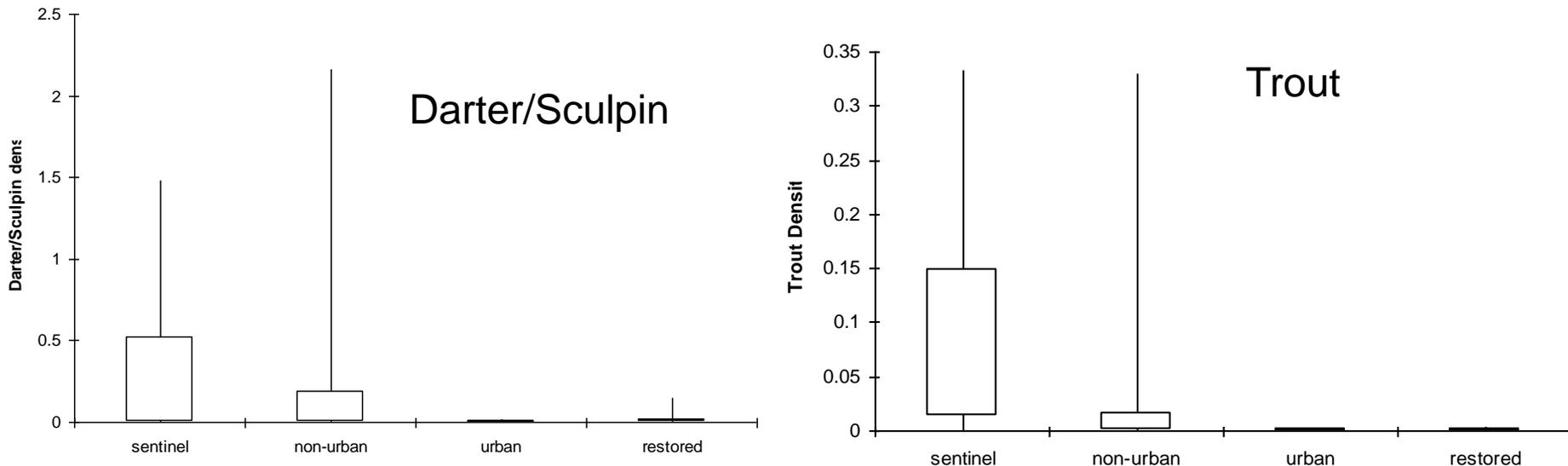
Fish Variables



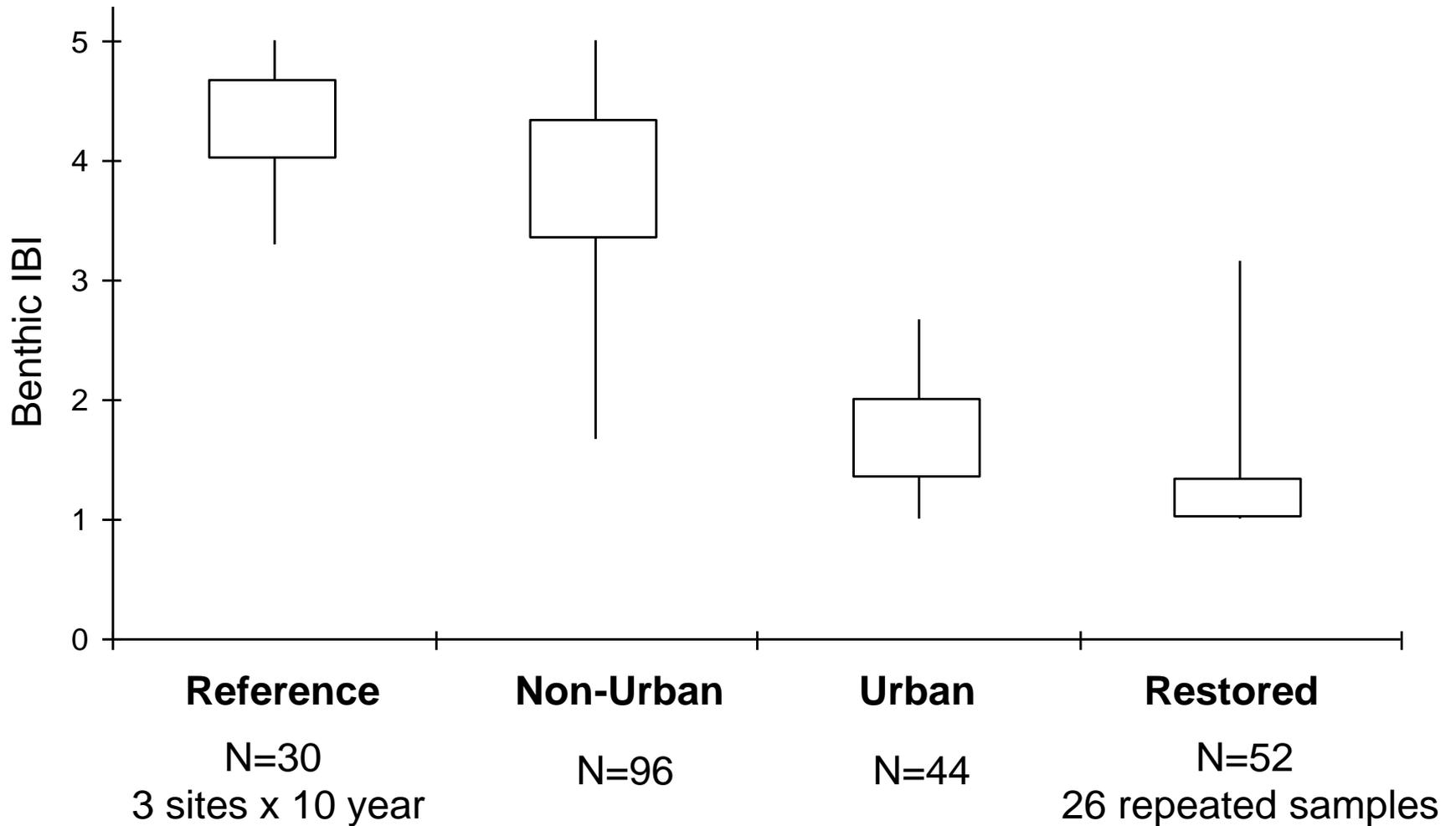
Fish Variables Continued...



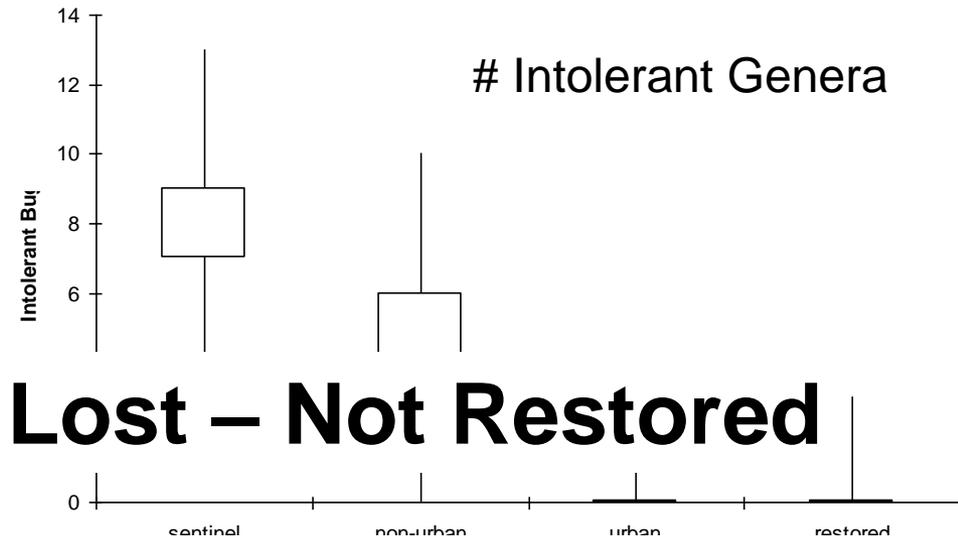
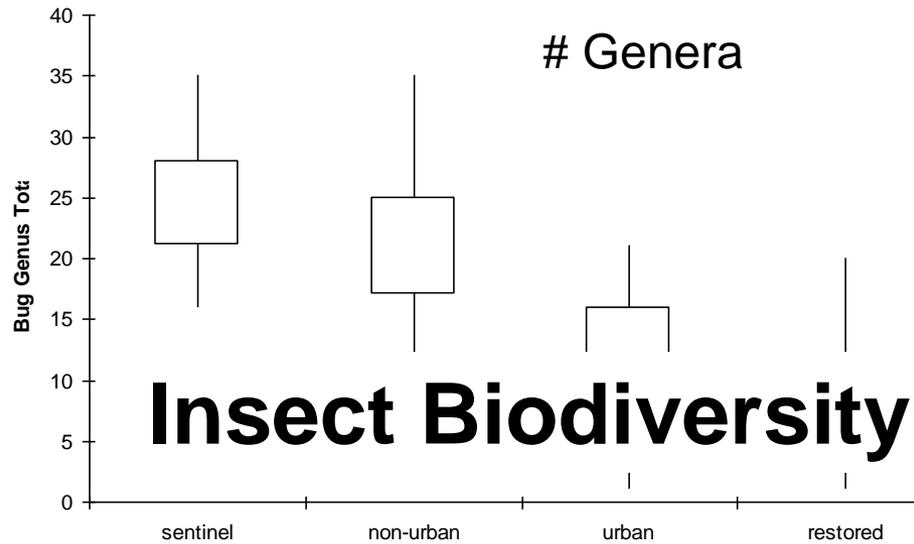
Fish Biodiversity Lost – Not Restored



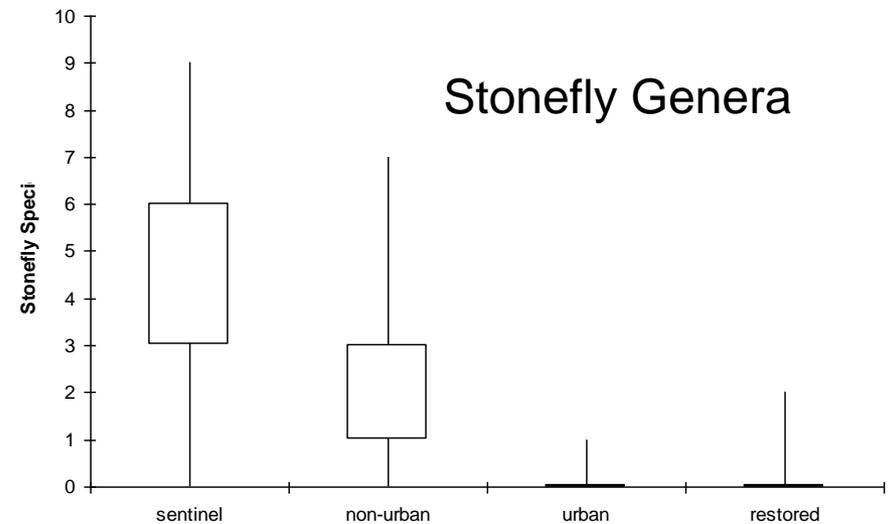
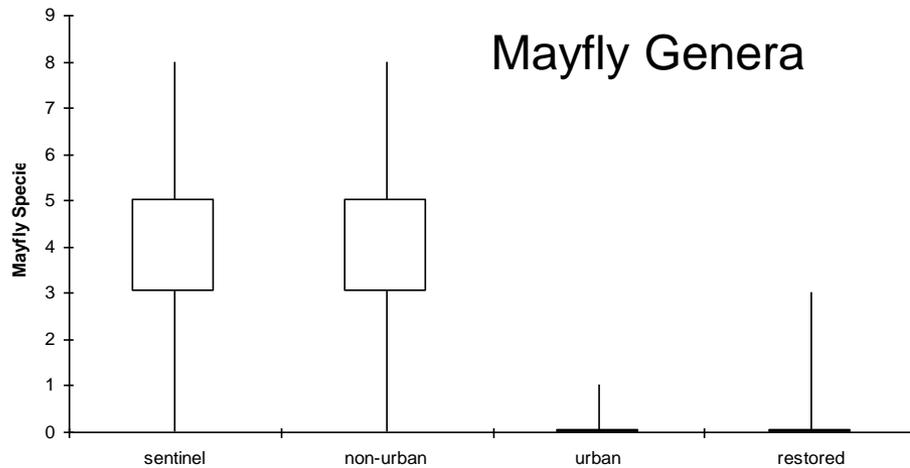
Benthic Macroinvertebrate Variables



Benthic Macroinvert Variables Continued...



Insect Biodiversity Lost – Not Restored



Change Over Time?

Benthic Macroinvertebrate

- IBI
- Number of Genera
- Number of Intolerant Genera
- Number of Mayfly Genera
- Number of Stonefly Genera



Fish

- IBI
- Number of Species (adj. stream size)
- Number of Intolerant Species
- Trout Density
- Sculpin/Darter Density



Are Restored Streams Getting Better with Time?

Restoration Streams Sig. Correlation

Mine Bank Run (n=7)

Longwell Branch (n=1)

Sligo Creek (n=1)

Number of Fish Spp. (+.89)

Number of Intolerant Fish Spp. (+.95)

Sligo Creek More Fish Species and Intolerant Fish spp. with Time

Based on Spearman Correlation

Why More Fish Species At Sligo?



- Longest Time Since Restoration Began
- The Most Restoration Work Done
- Friends of Sligo Creek
- Many Fish were Stocked

Stormwater Retrofits (8)

Created Wetland (1)

Channel Recon (2,670 ft)

Tree Planting

Fish Stocked (23 spp, 6 events)

Completed ~2001

About \$2.6 Million

Reference Streams Getting Worse with Time?

Reference Streams

Sig. Correlation

Baisman Run

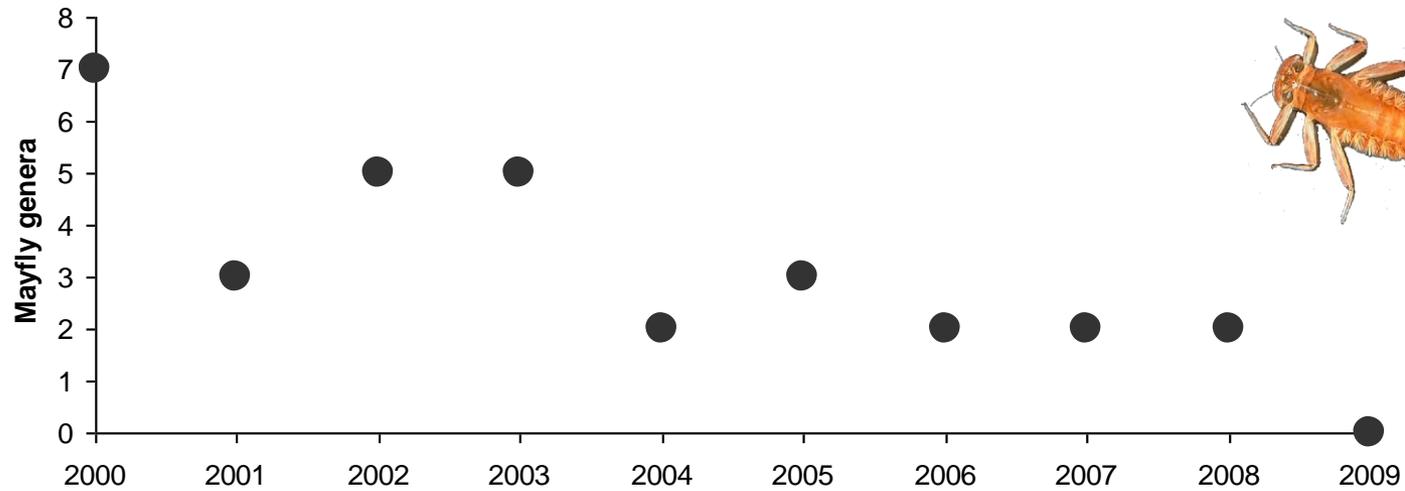
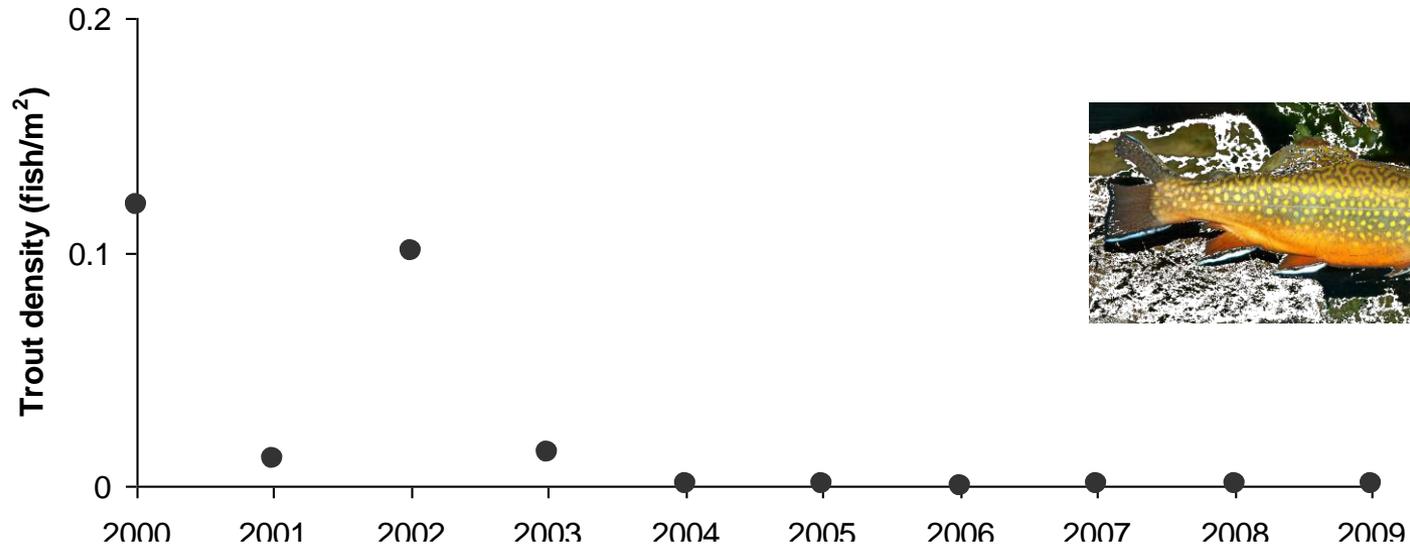
Timber Run

FIBI (-.64) + Trout Density (-.82)

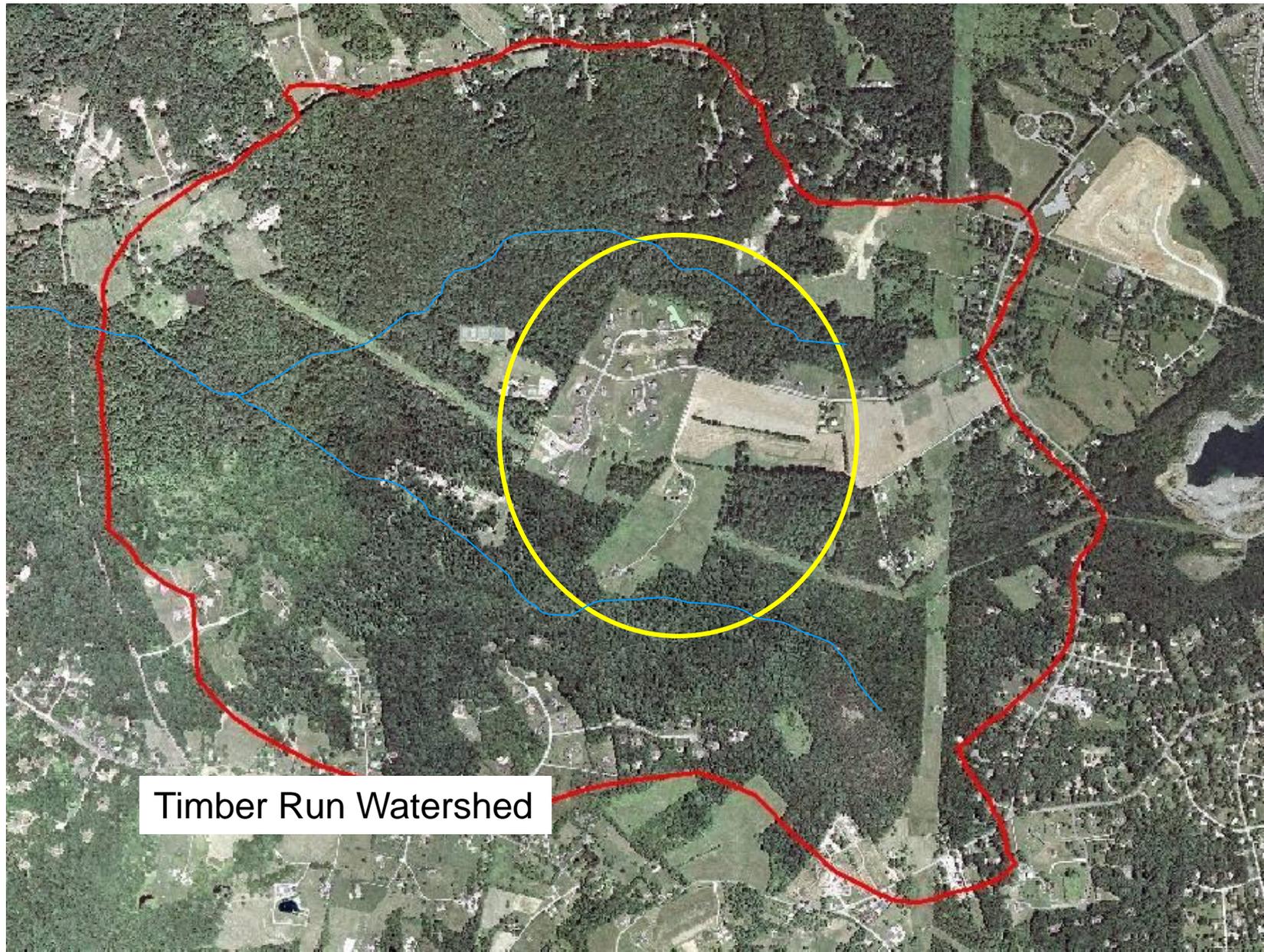
NB Jones Falls

BIBI (-.76) + Mayfly Genera (-.72)

Reference Site Declines



Reference Site Land Use Change



Timber Run Watershed

Conclusions:

- We are Losing Biological Diversity From Our Best Streams with Little to No Improvement to the Worst Streams
- Restored Urban Streams are Similar to Urban Streams
- Restored Streams are Not as Good as Non-Urban or Reference Streams
- Reference Stream Conditions are Declining

Restoration Must Continue, But Protection From Urbanization Is Drastically Needed, is More Cost Efficient, And More Effective

We Must Be Honest and Realistic About the Expectations of Urban Restoration

