Quantifying the Ecological uplift and effectiveness of differing stream restoration approaches in Maryland

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Introduction

- Billions spent in Restoration (Palmer et al. 2014)
- Many studies focus on only a few streams (Violin et al. 2011, Filoso et al. 2015,…)
- Inconsistencies between projects labelled successful and scientific literature

Introduction

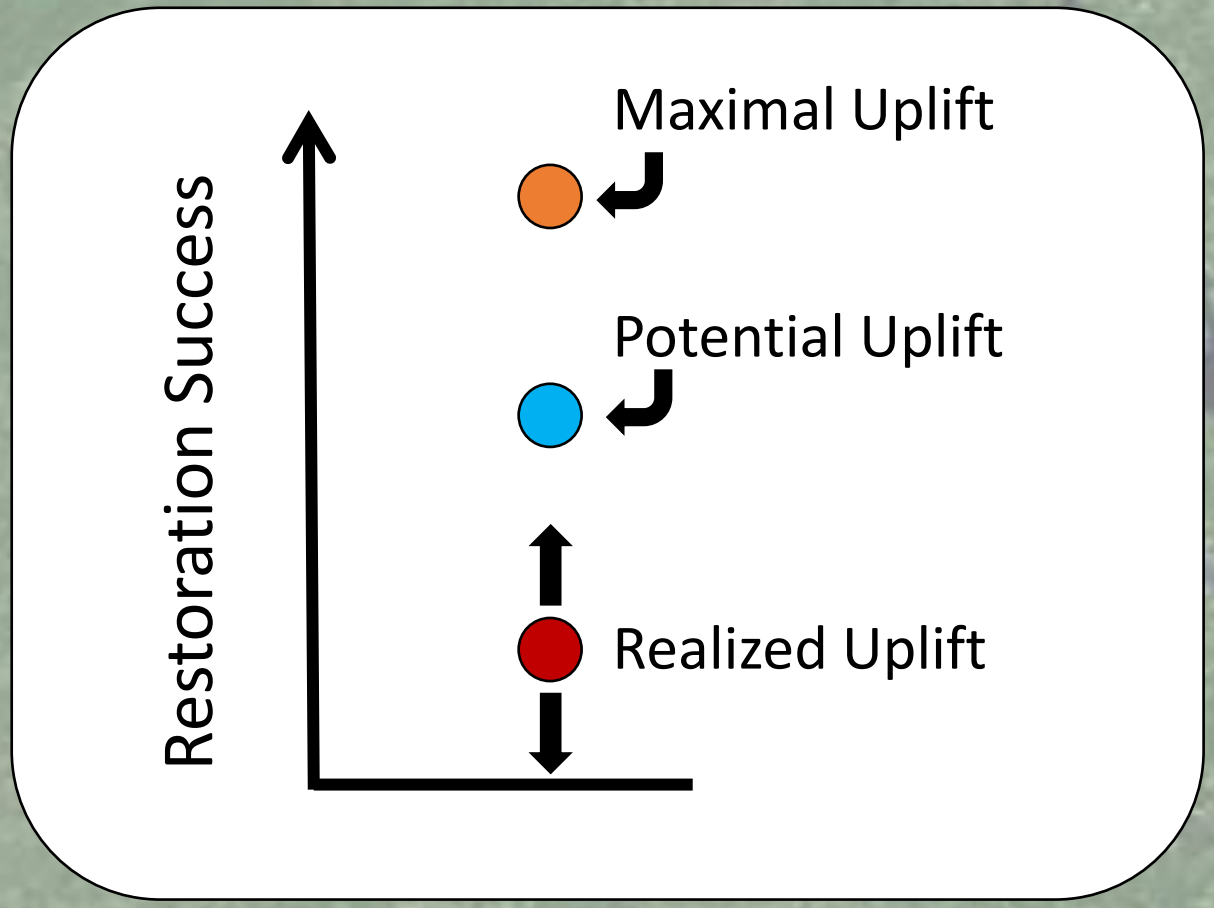
- Ecosystem health of larger water bodies (Chesapeake Bay) is inherently linked to health of it’s tributaries
- A healthy ecosystem is an important consideration for restorations

Photo by USGS

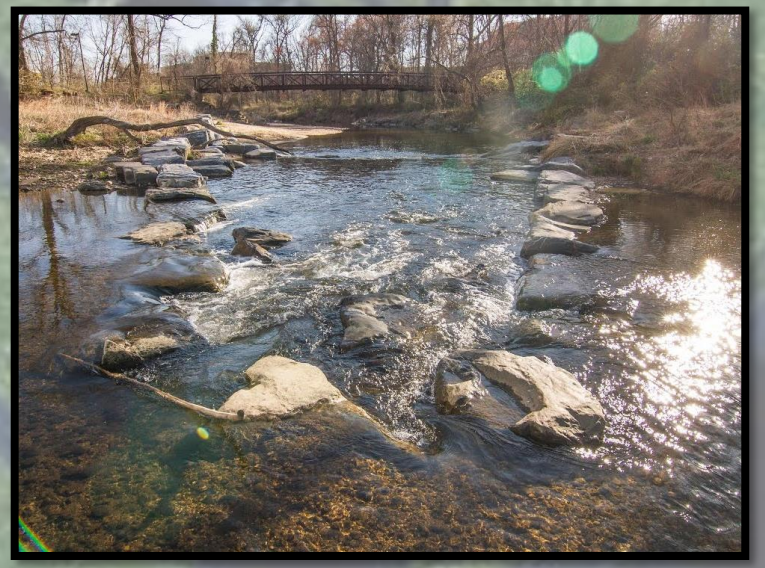
Objectives

- Assess how restoration induced changes in a stream's physical attributes change its biological structure
- Define maximal, potential, and realized uplift amongst different restoration types
- Quantify in-stream structures used in restoration and compare to biological structure

What is Uplift?



Minimally disturbed reference



Paint Branch Restoration

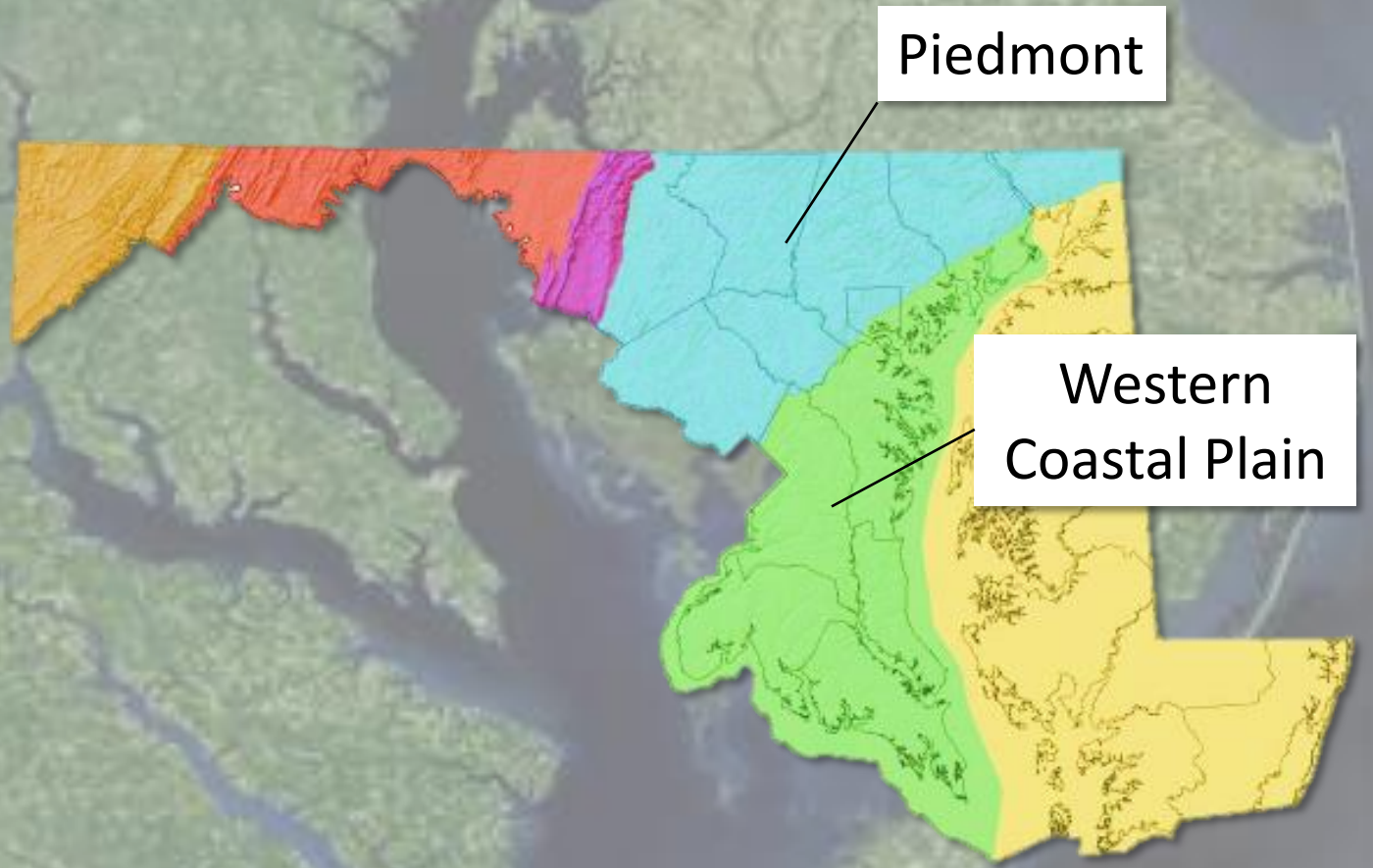
Restoration types

Natural Channel Design

Regenerative Stormwater Conveyance

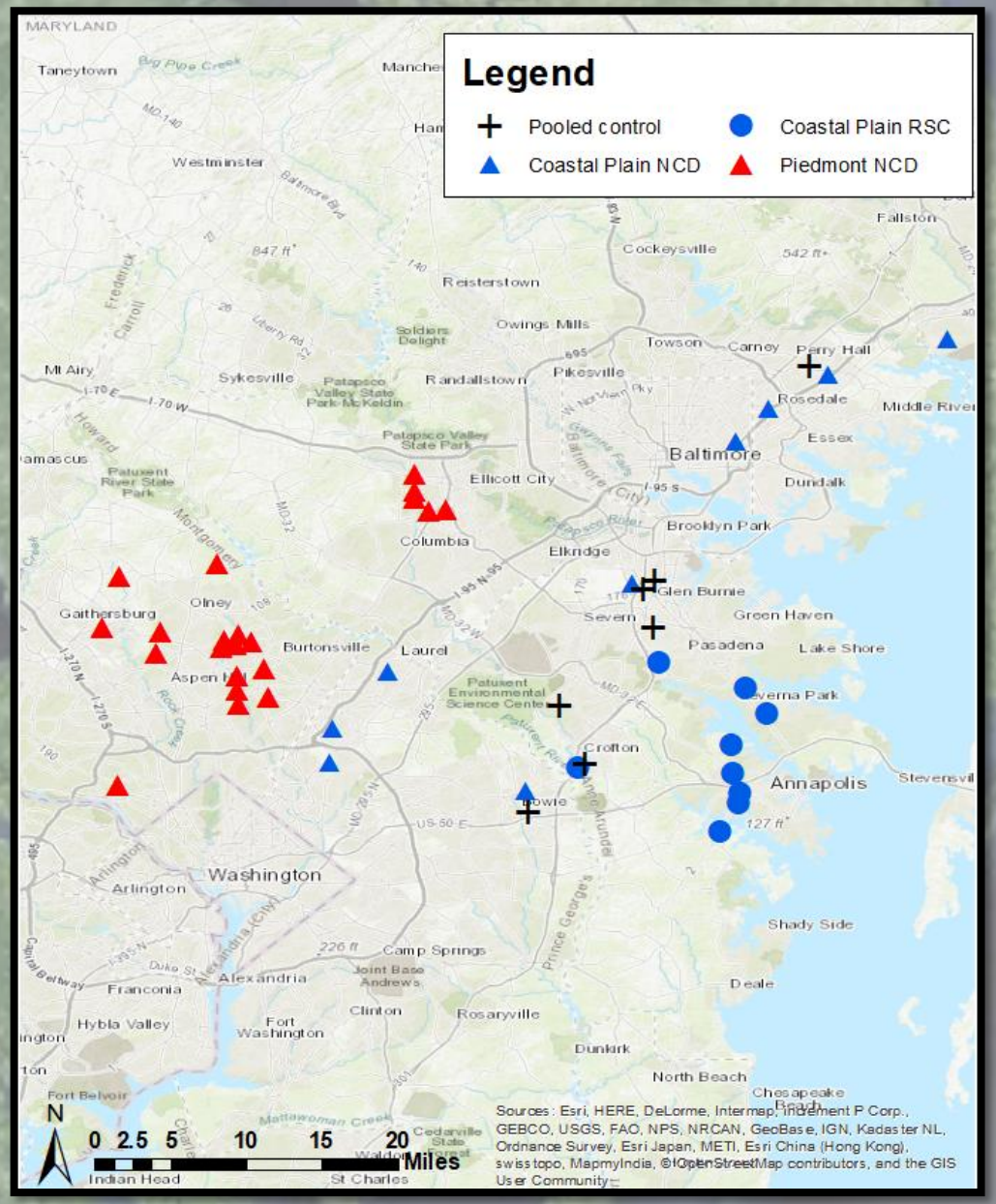
Where in MD?

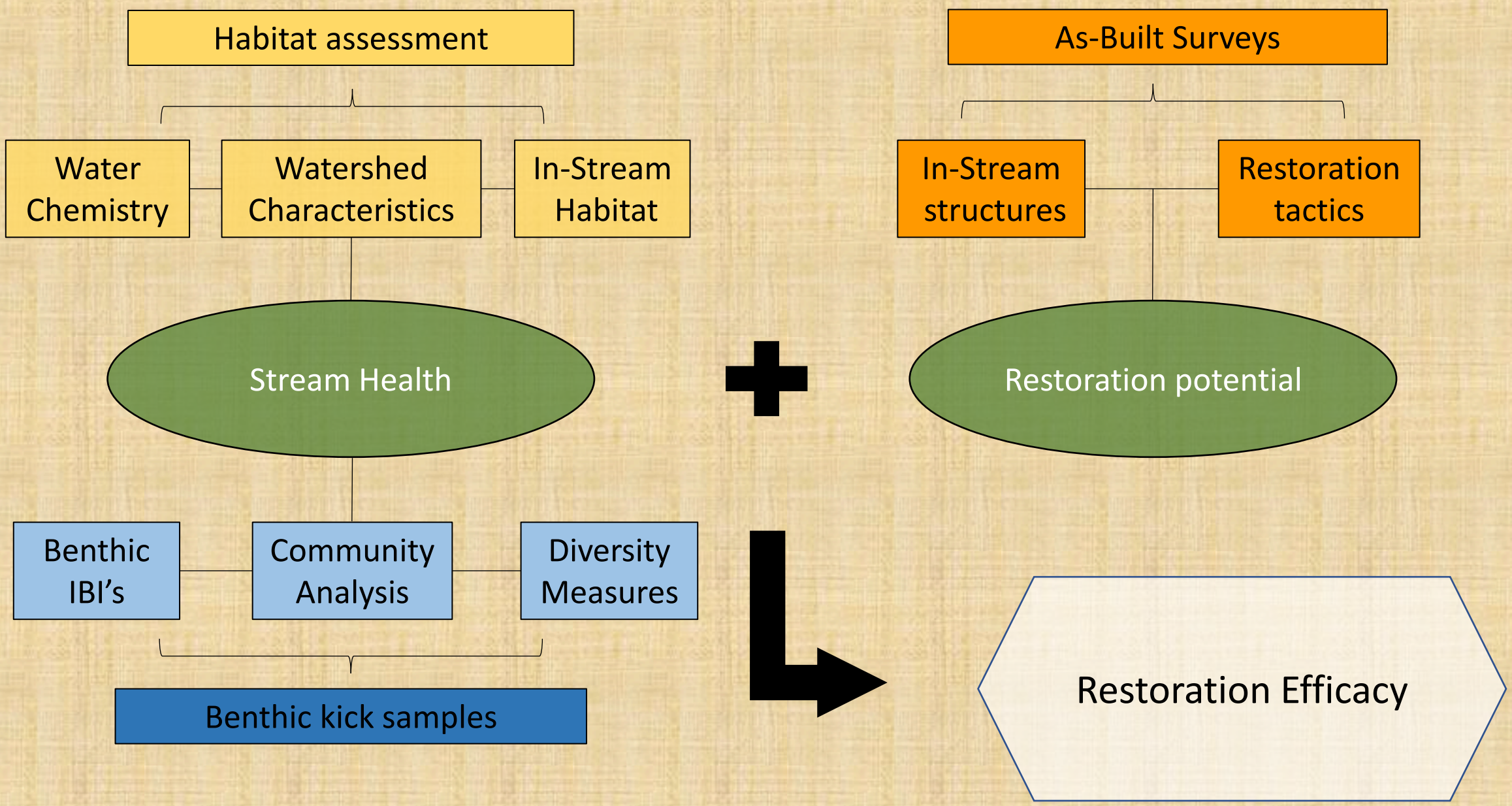
- Restorations were selected from Piedmont and Coastal Plain provinces
- 41 restorations: 19 Coastal Plain, 22 Piedmont



Site Selection

- Spread restoration types between Natural channel design (NCD) and regenerative stormwater conveyance (RSC)
- Excluded sites with major tributaries occurring anywhere between possible sample sites
- Final sites were selected based on permission



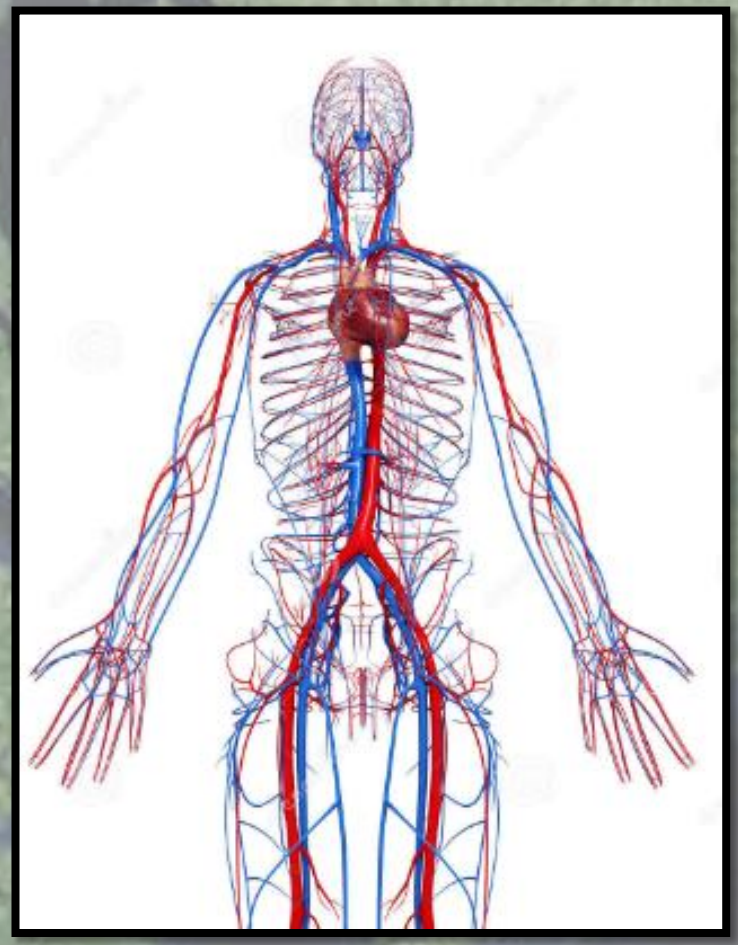

Habitat assessment
Water Chemistry
Watershed Characteristics
In-Stream Habitat
Stream Health
Benthic IBI's
Community Analysis
Diversity Measures
Benthic kick samples
As-Built Surveys
In-Stream structures
Restoration tactics
Restoration potential
Restoration Efficacy

Benthic Invertebrates

- Why did we choose invertebrates?
- Invertebrate community structure is important in understanding stream health

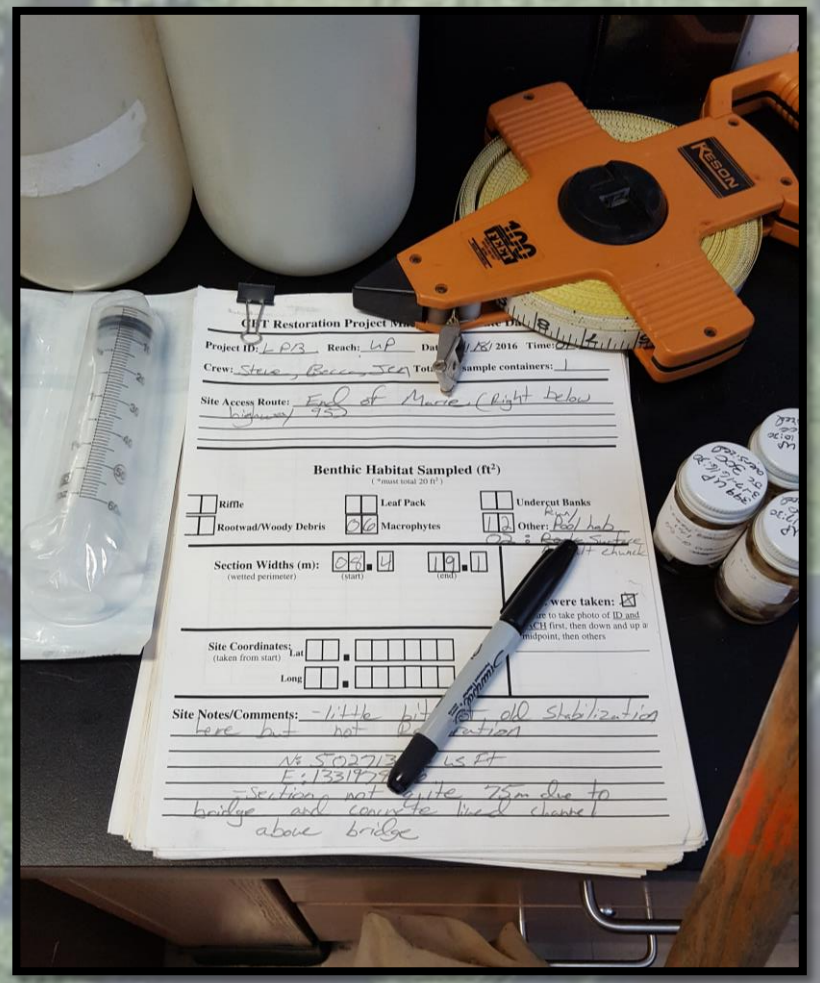
Stream Health

- Our assessments are like a blood panel for the stream
- Quick and easy way to assess stream health



Study Design

- Investigated a combination of physical in-stream habitat, watershed characteristics, and biological (invertebrate) data
- Utilized triplet design approach on streams of interest.




Upstream
Restoration
Downstream

Data Collected

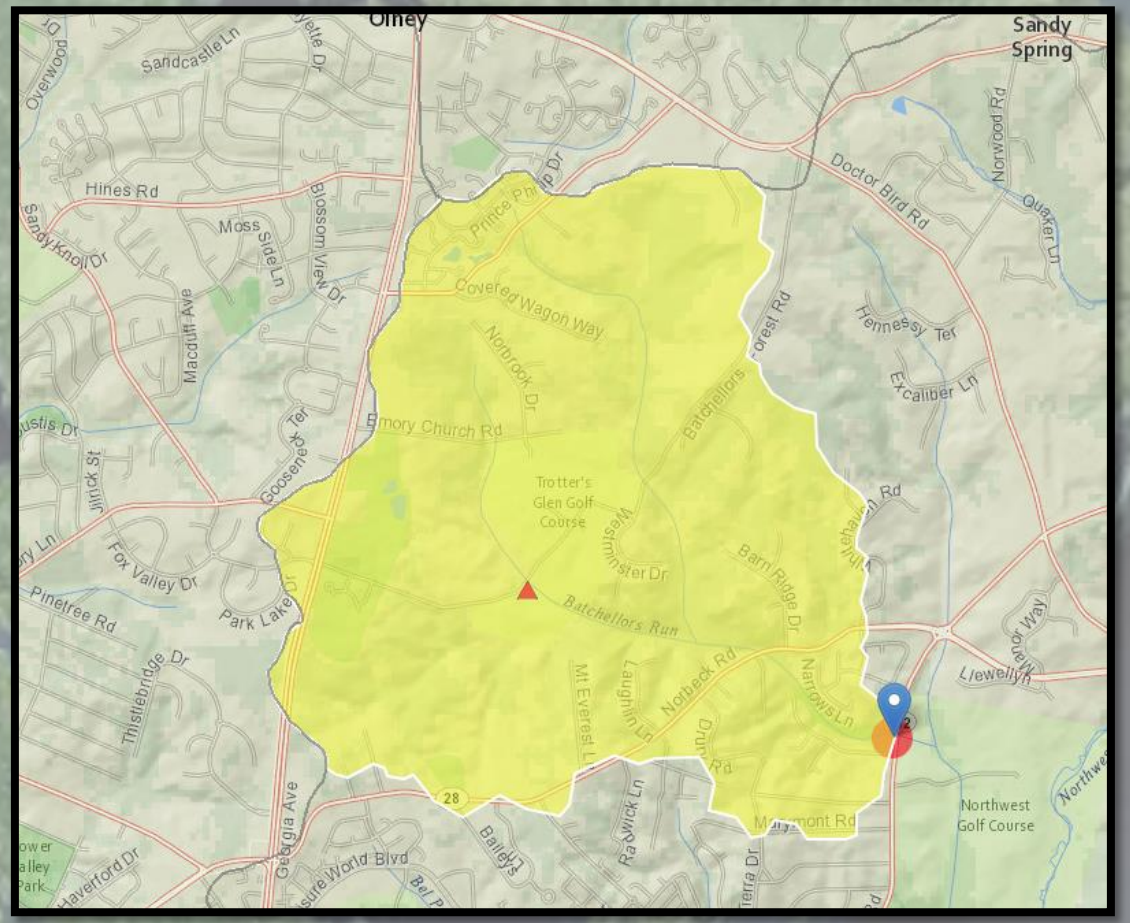
- Each site was designed to be comparable to Maryland Biological Stream Survey (MBSS) data.
- All personnel are MBSS certified
- Consulted MBSS data sheets to complete assessments

Data Collected

- Benthic Macroinvertebrate samples collected with MBSS protocol
- Picked one 300 organism sample per site.
- Organisms were identified to genus

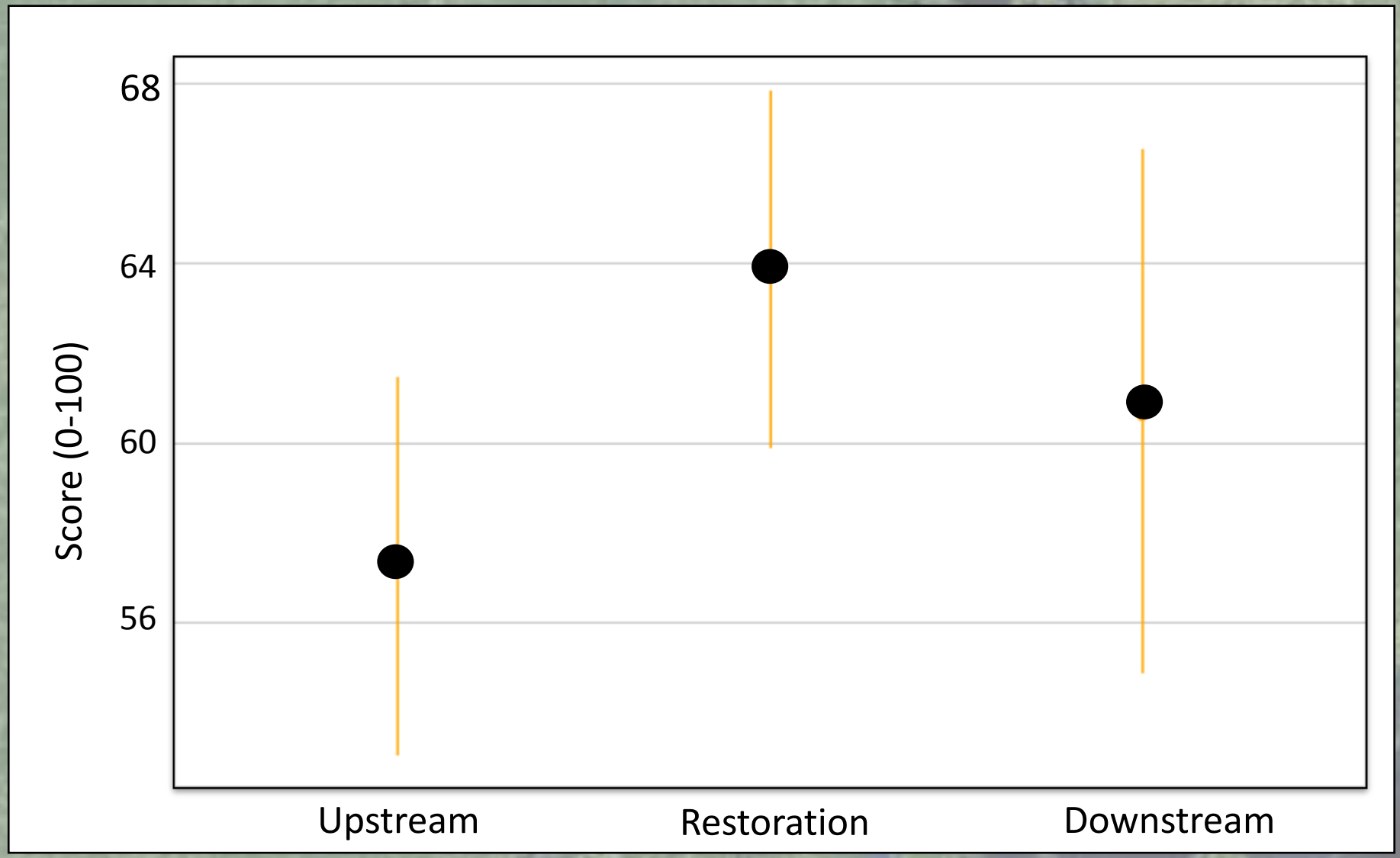
Data Collected

- Used USGS StreamStats program to acquire watershed characteristics of all sites
- Gathered Engineer as-built plans for all restorations (still in progress) to quantify in-stream structures

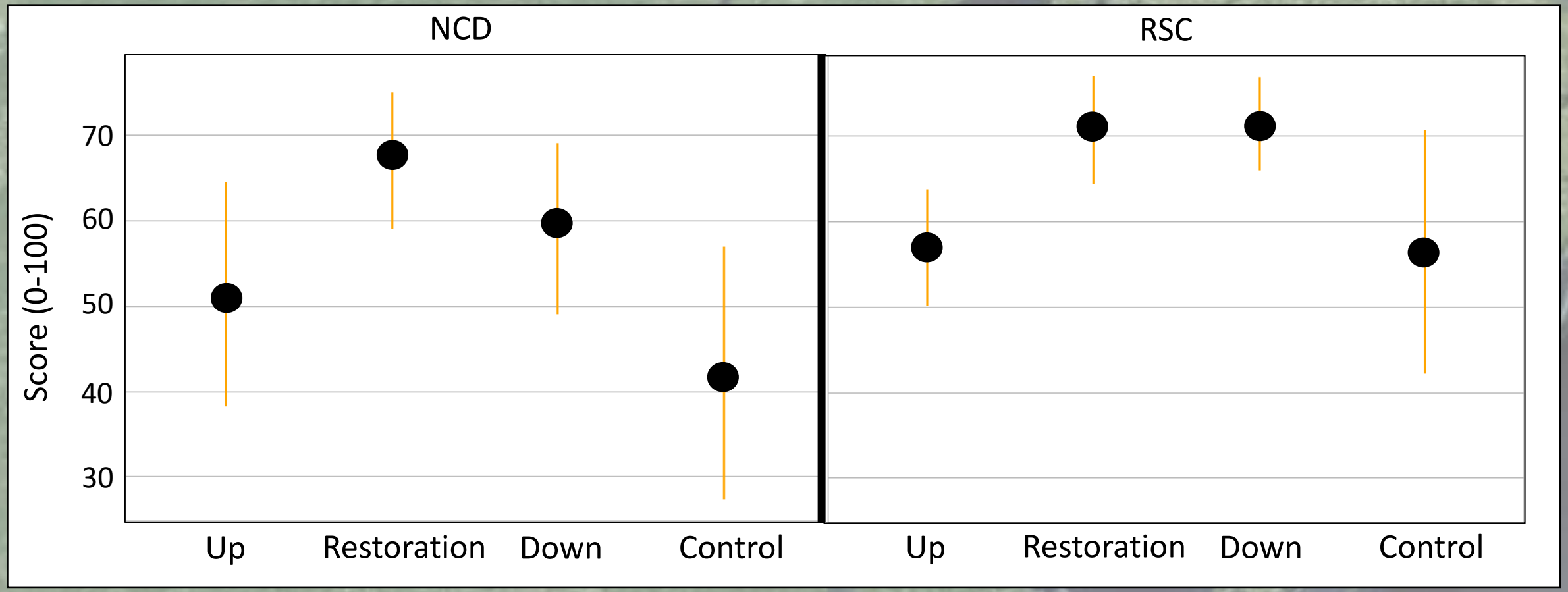


Results

Piedmont Physical Habitat Index

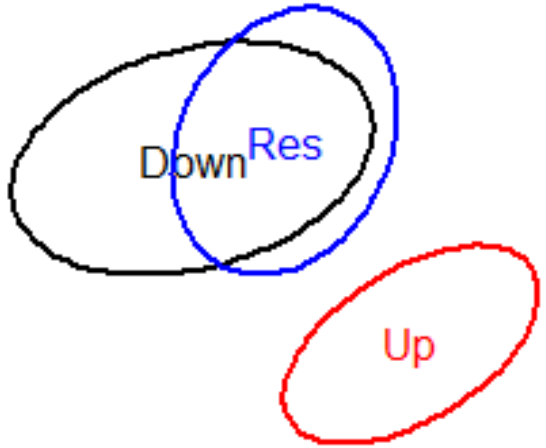


Coastal Plain Physical Habitat Index



Benthic Communities are Largely Similar

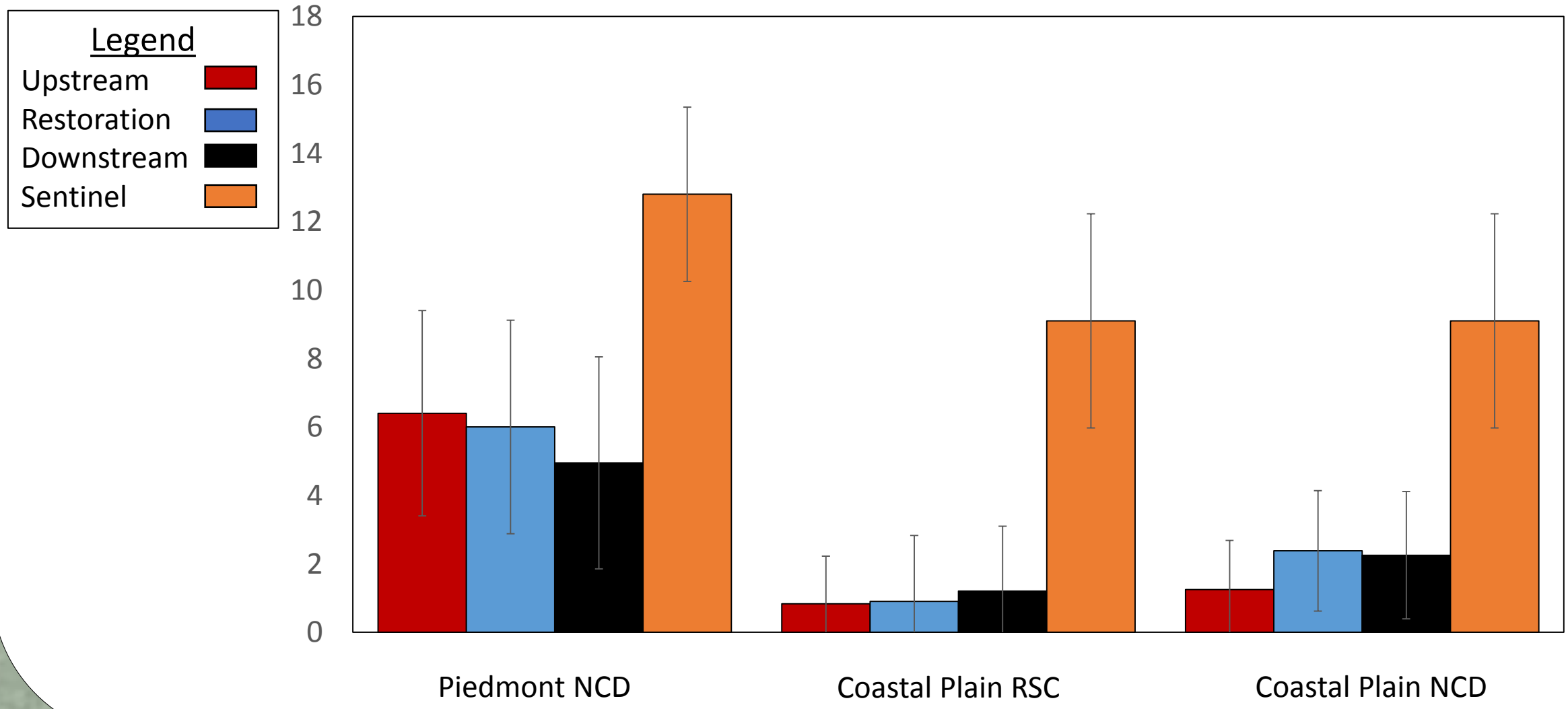
Piedmont NCD



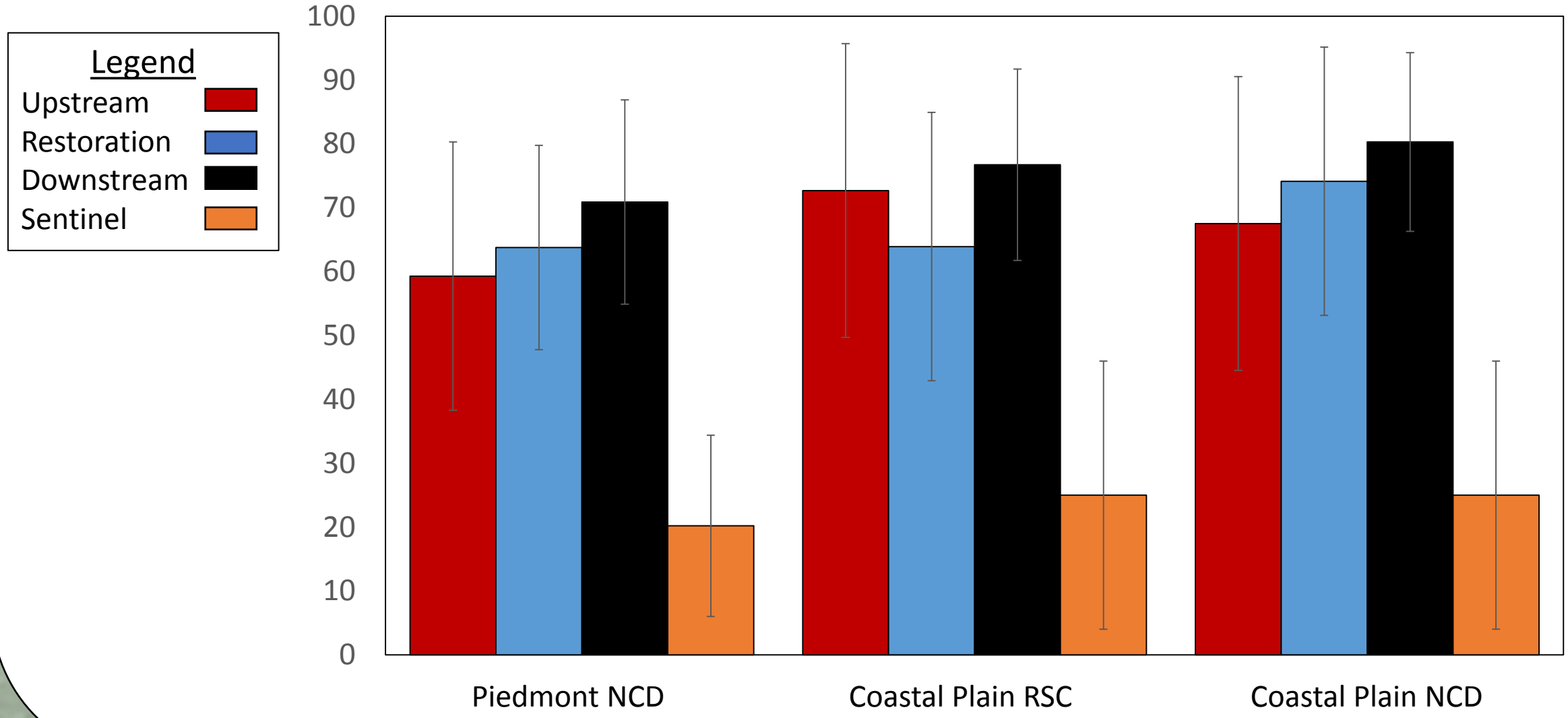
Coastal Plain RSC

Coastal Plain NCD

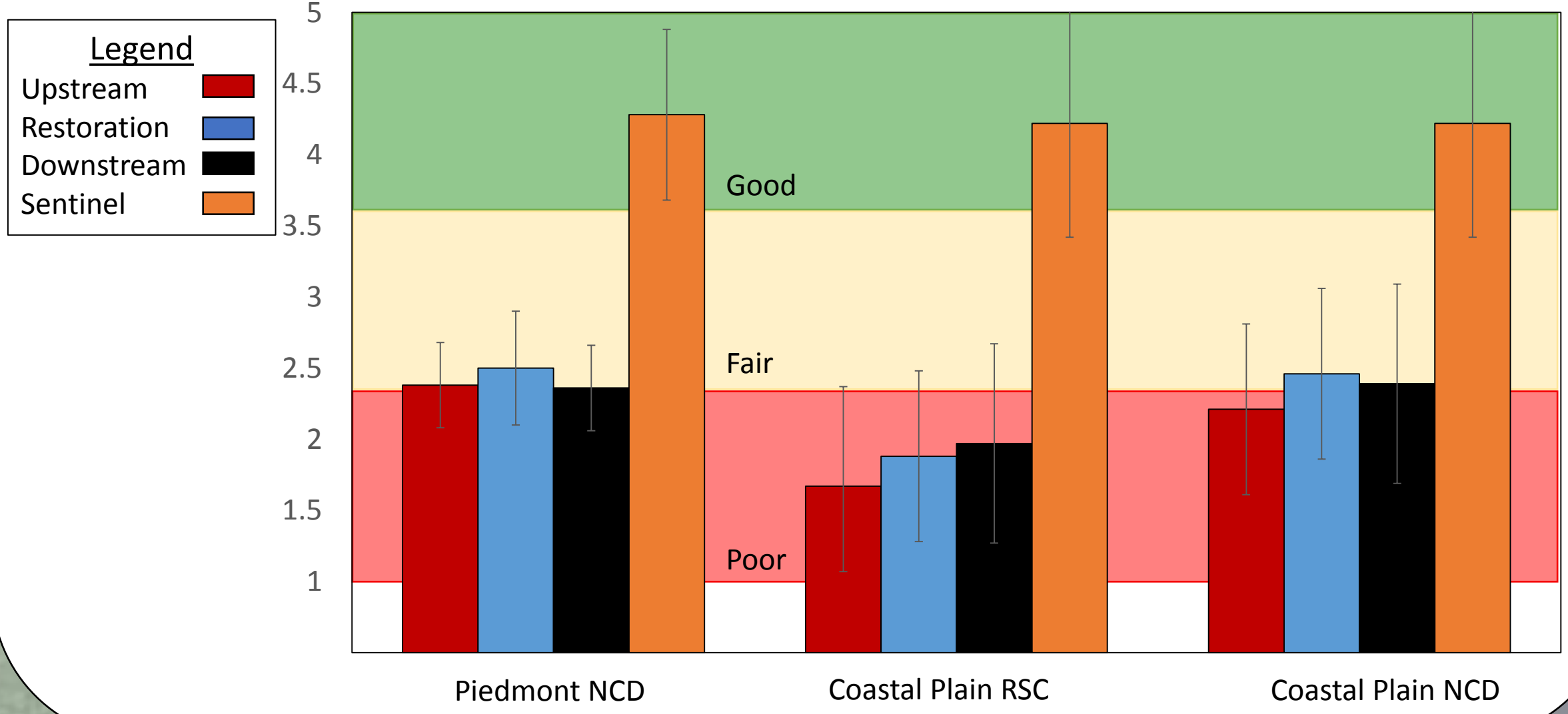
of Different Sensitive Taxa (EPT Richness)



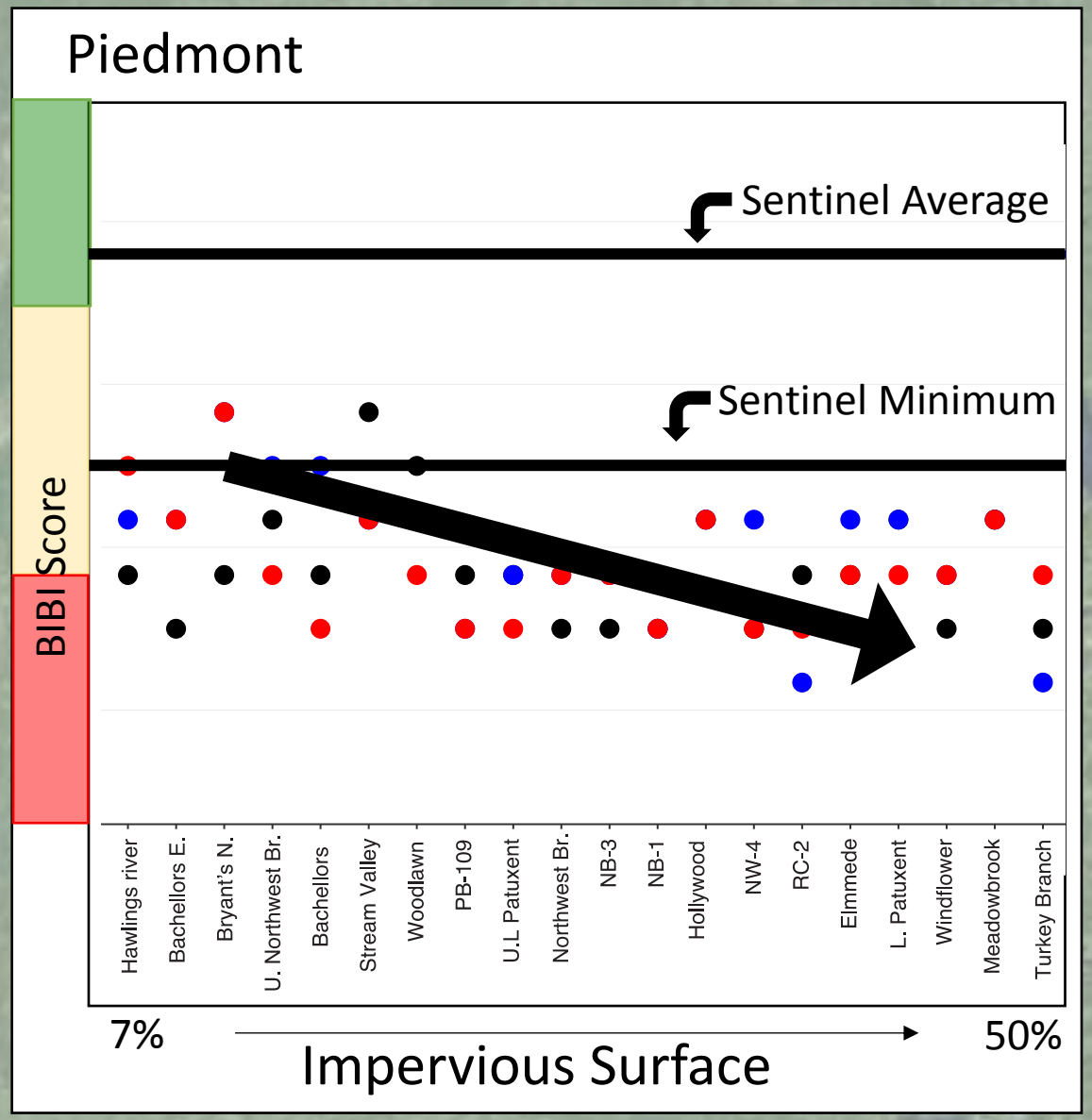
% Urban-Tolerant Taxa (Chironomid)

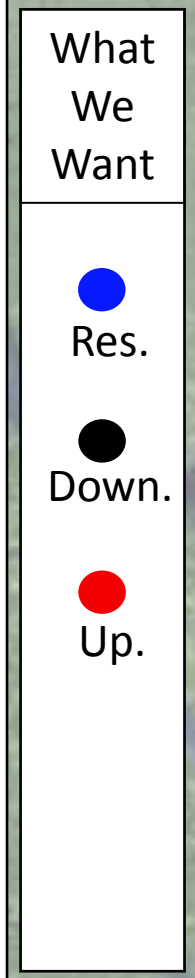


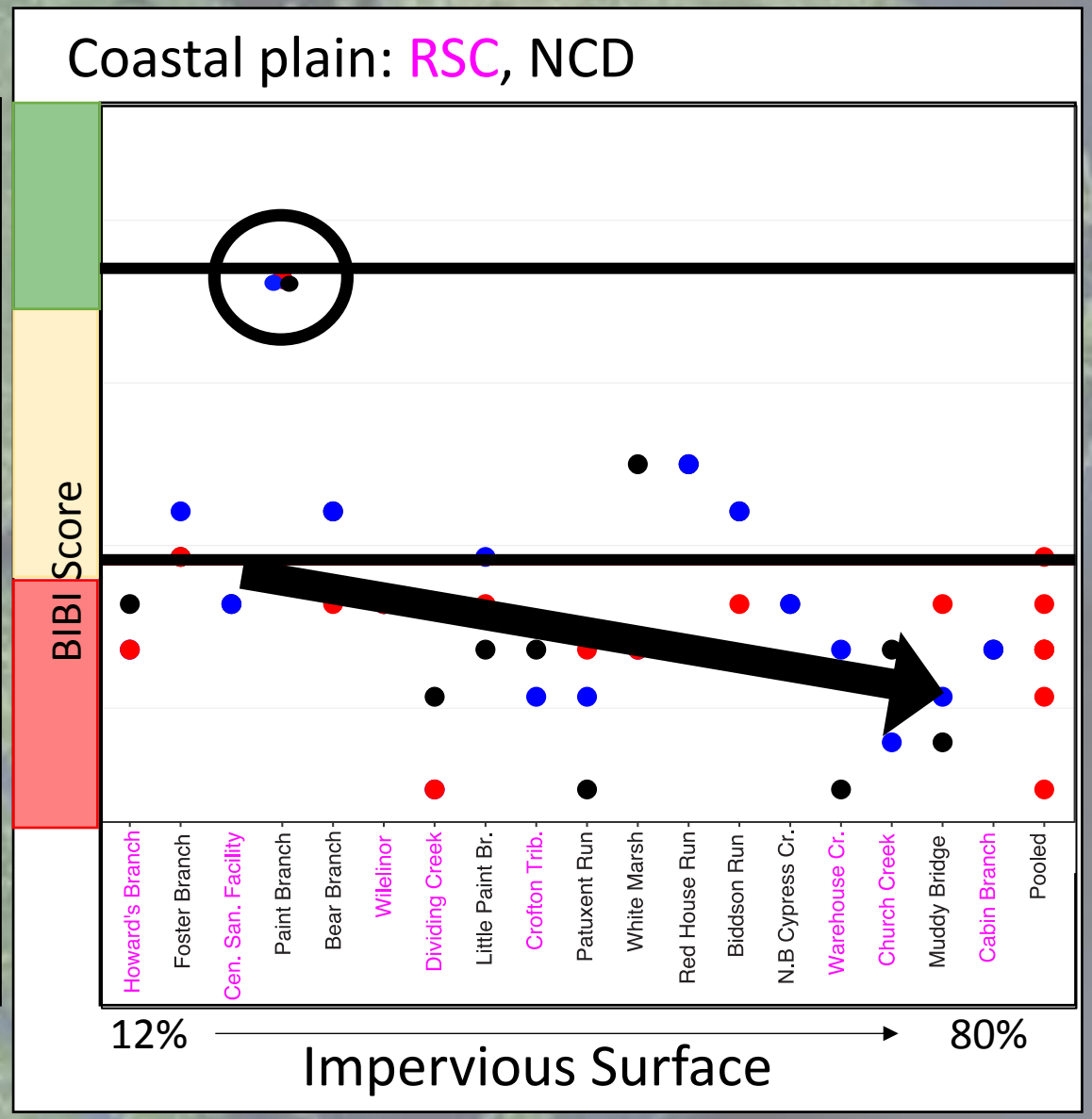
Benthic IBI Scores (1-5)



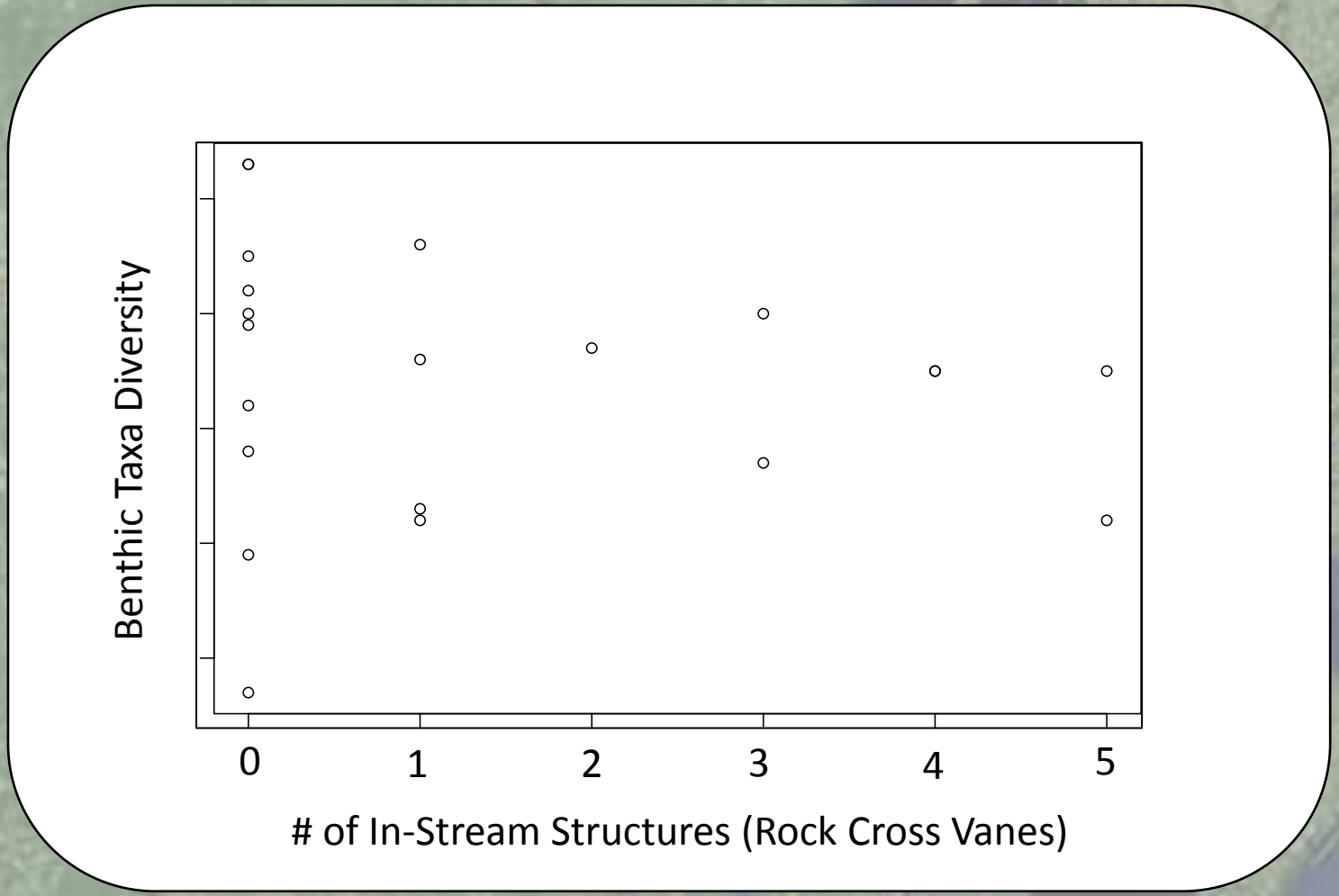
Watershed Characteristics Likely Limiting







of In-stream Structures Inconclusive



Conclusions

- Despite areas of uplift within physical habitat parameters, biological data did not respond quite the same way
- Piedmont NCD sites had some individual restoration successes but several cases with negligible success
- Coastal Plain NCD had more successes than not, however, minimal improvement

- Coastal Plain RSC had uplift in downstream and restoration sections, but success still minimal
- As-built surveys (although preliminary) has not shown strong conclusions toward in-stream structures and ecological uplift

Thank You!

-Stream physical habitat improved after restoration

-Benthic macroinvertebrates also showed slight improvement in restored reaches where Natural Channel Design restoration was used and downstream from Regenerative Stormwater Conveyance

-There is more work to be done comparing specific restoration structures with benthic macroinvertebrates

- Considerations regarding stream benthic macroinvertebrates
    - Time since restoration
    - Recolonization potential
    - Watershed condition
    - Factors that may be difficult to address with stream restoration alone, but that could be limiting.

UMCES
Translation Slides

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