# The Importance Of Data Collection And Research in the Delaware River Watershed Initiative

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The Academy of Natural Sciences
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# Presentation Outline

1. DRWI: A coordinated approach to protecting water quality
2. Monitoring & Assessment, Data Collection
3. Communication and Research

# Delaware River Watershed Initiative

***To ensure sufficient clean water through healthy watersheds***


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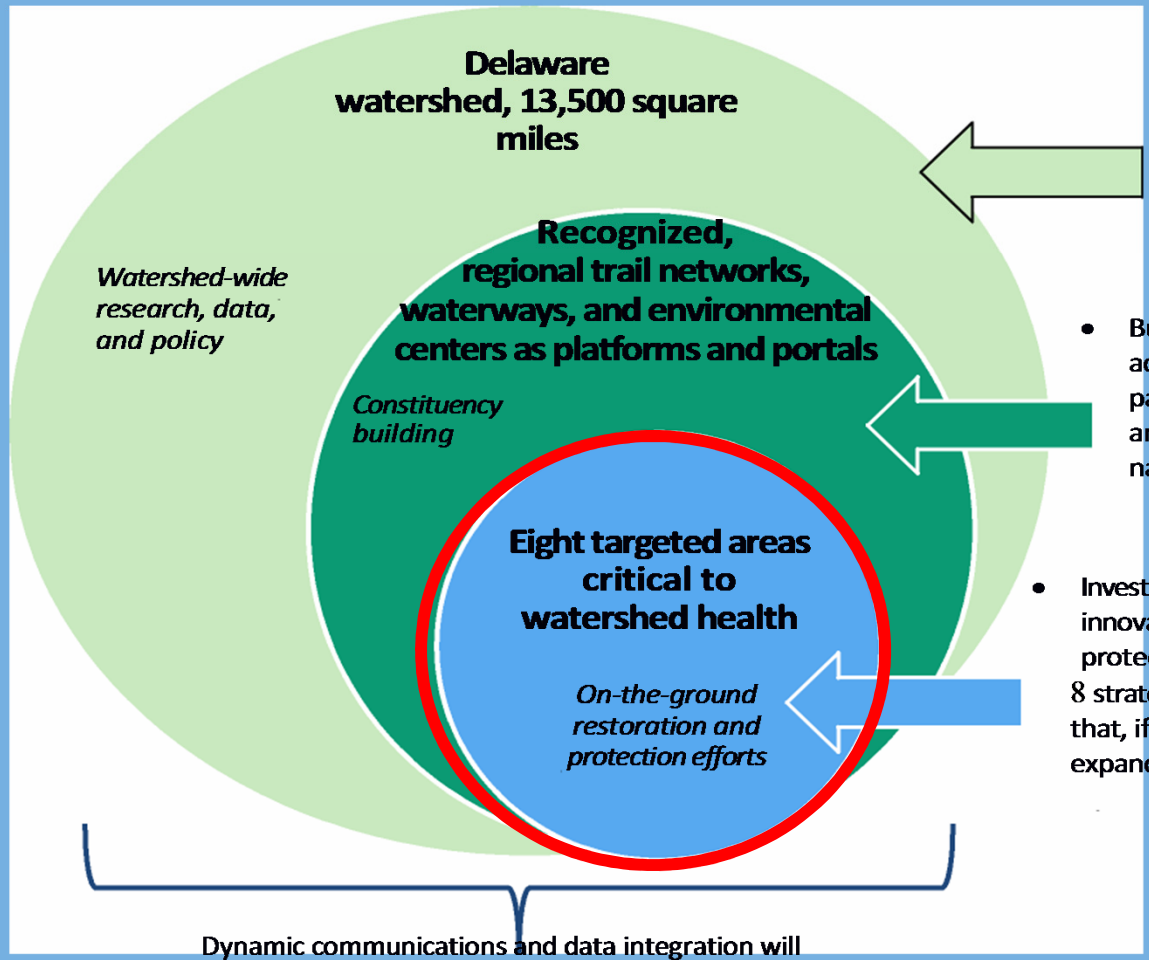
# William Penn Foundation Watershed Protection Program

**Goal: By 2023, drive measurable improvement in the quality of the Delaware watershed so there is a sustainable supply of clean water for ecological health and human consumption, enjoyment, and economic opportunity.**




- Drive strong, science-based policies and practices that protect water quality and supply by supporting research and analysis.
- Track changes in watershed-wide stressors and indicators to drive informed watershed protection and restoration.

- Build a movement to advance watershed protection by actively engaging thousands of people in our region who participate in outdoor activity on rivers and trails, in parks and forests that depend on abundant clean water and natural lands.

- Invest in efforts, using scientific data and innovative conservation approaches, to protect and restore water quality in 8 strategically located sub-watersheds that, if successful, can be replicated to expand the impact.

Dynamic communications and data integration will highlight the targeted work, linking local restoration and protection with watershed-wide policies and outdoor recreation.

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# Unique Features

- Strong Scientific Backbone
- Working Through "Grasstops" Organizations
  - Not top down, 50+ organizations
  - Many Partners
- Targeted Programs and Funding
  - Restoration and Preservation
- Continual Evaluation of Program Value and Transferability (lessons learned)

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NATIONAL FISH AND WILDLIFE FOUNDATION
NFWF

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INSTITUTE FOR CONSERVATION LEADERSHIP

OPEN SPACE INSTITUTE

# The DRWI

## Specific Stressors

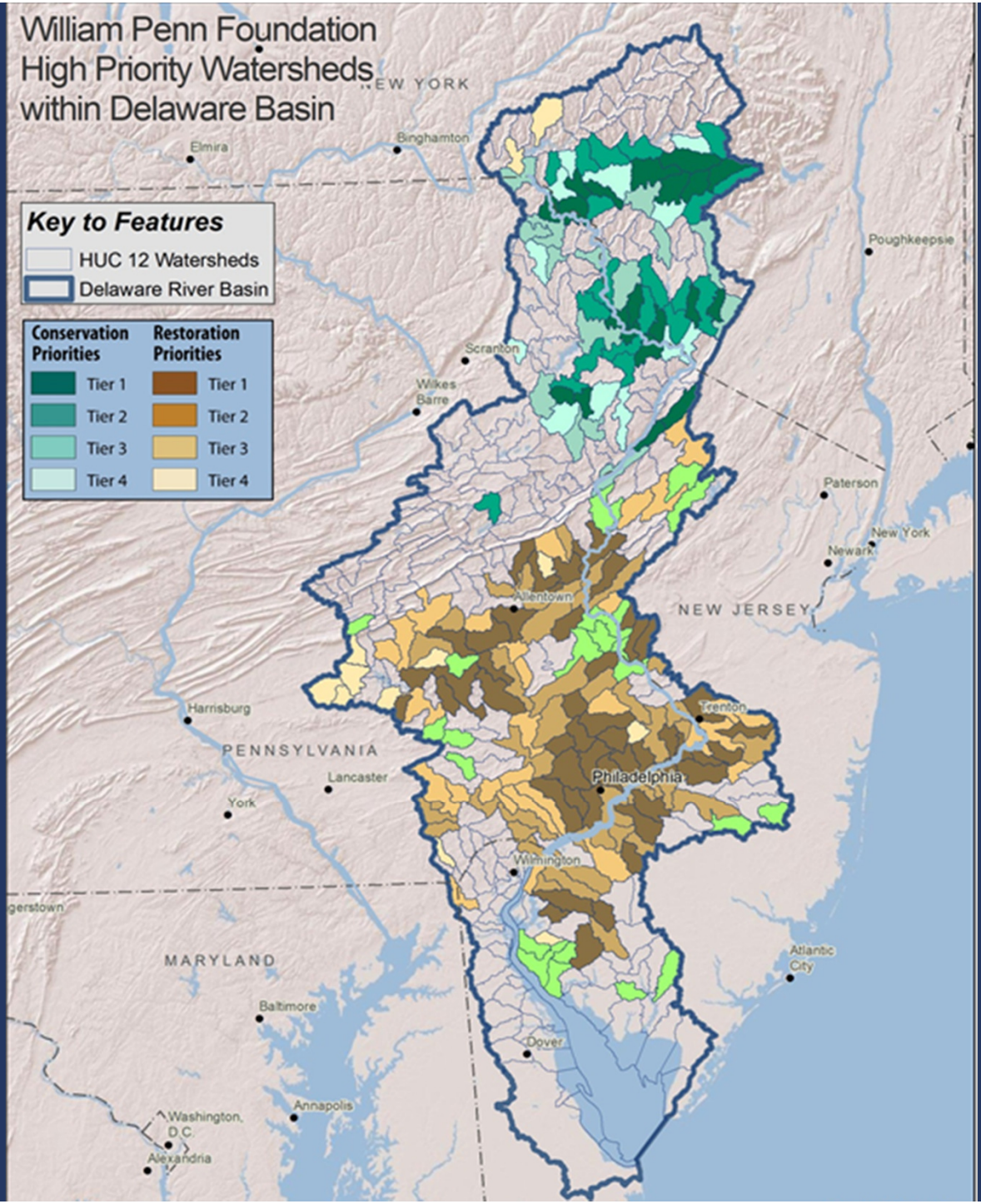
- Forest fragmentation and loss in headwaters
- Agricultural run-off
- Stormwater run-off
- Aquifer depletion


(source: DRN)


(source: BCC)


(source: PEC)


(source: PPA)


William Penn Foundation
High Priority Watersheds
within Delaware Basin
Key to Features
HUC 12 Watersheds
Delaware River Basin
Conservation Priorities
Tier 1
Tier 2
Tier 3
Tier 4
Restoration Priorities
Tier 1
Tier 2
Tier 3
Tier 4
NEW YORK
Elmira
Binghamton
Poughkeepsie
Scranton
Wilkes Barre
Paterson
New York
Newark
Allentown
NEW JERSEY
Harrisburg
PENNSYLVANIA
Lancaster
York
Trenton
Philadelphia
Wilmington
MARYLAND
Baltimore
Dover
Atlantic City
Annapolis
Washington, D.C.
Alexandria

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# Criteria for Investment in Watersheds

- Potential for Significant Impact
- Urgency to Act
- Organization Capacity
- Cost Efficiency
- Ability to Measure Impact

Delaware Water Gap National Recreation Area

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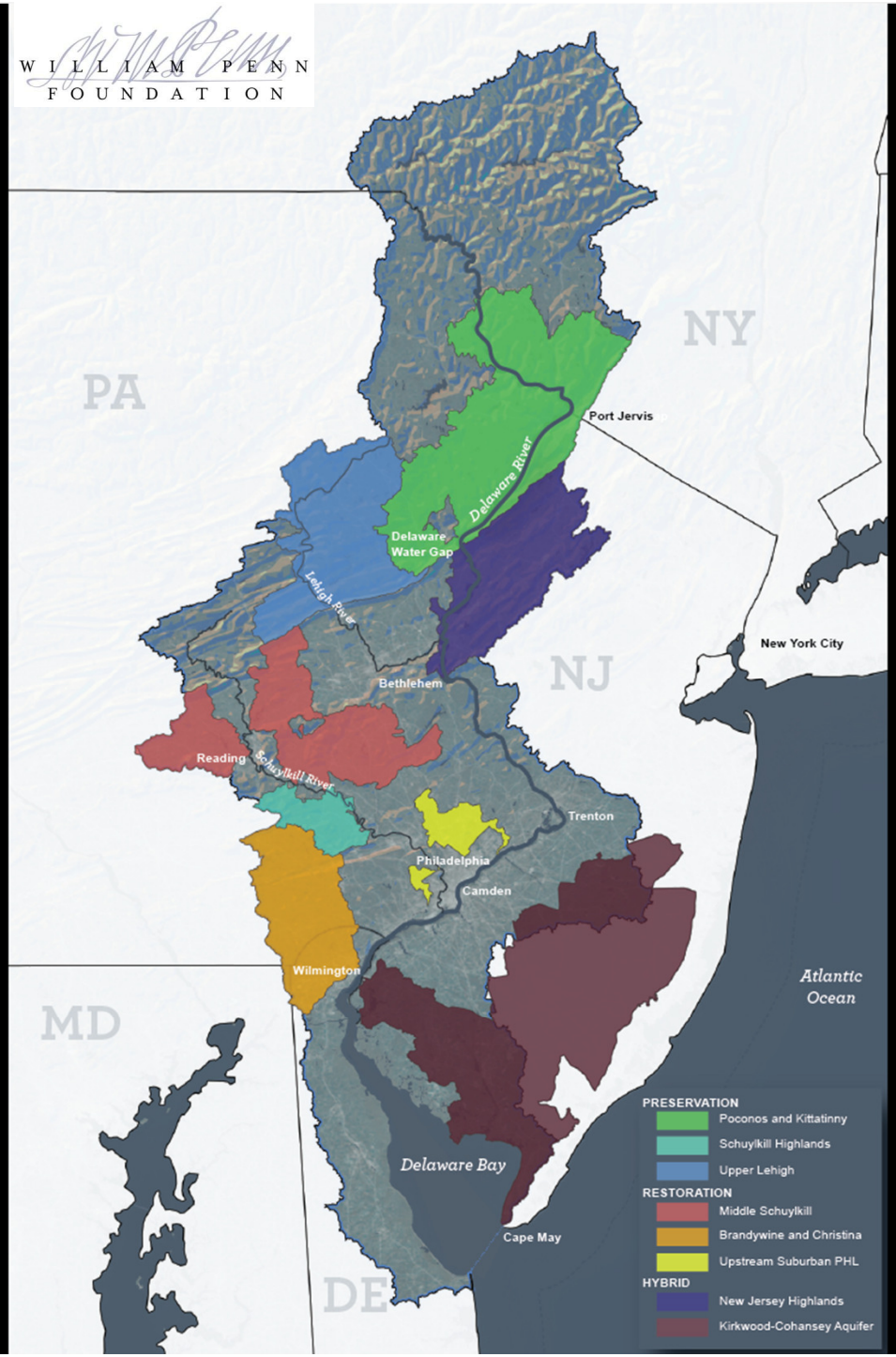


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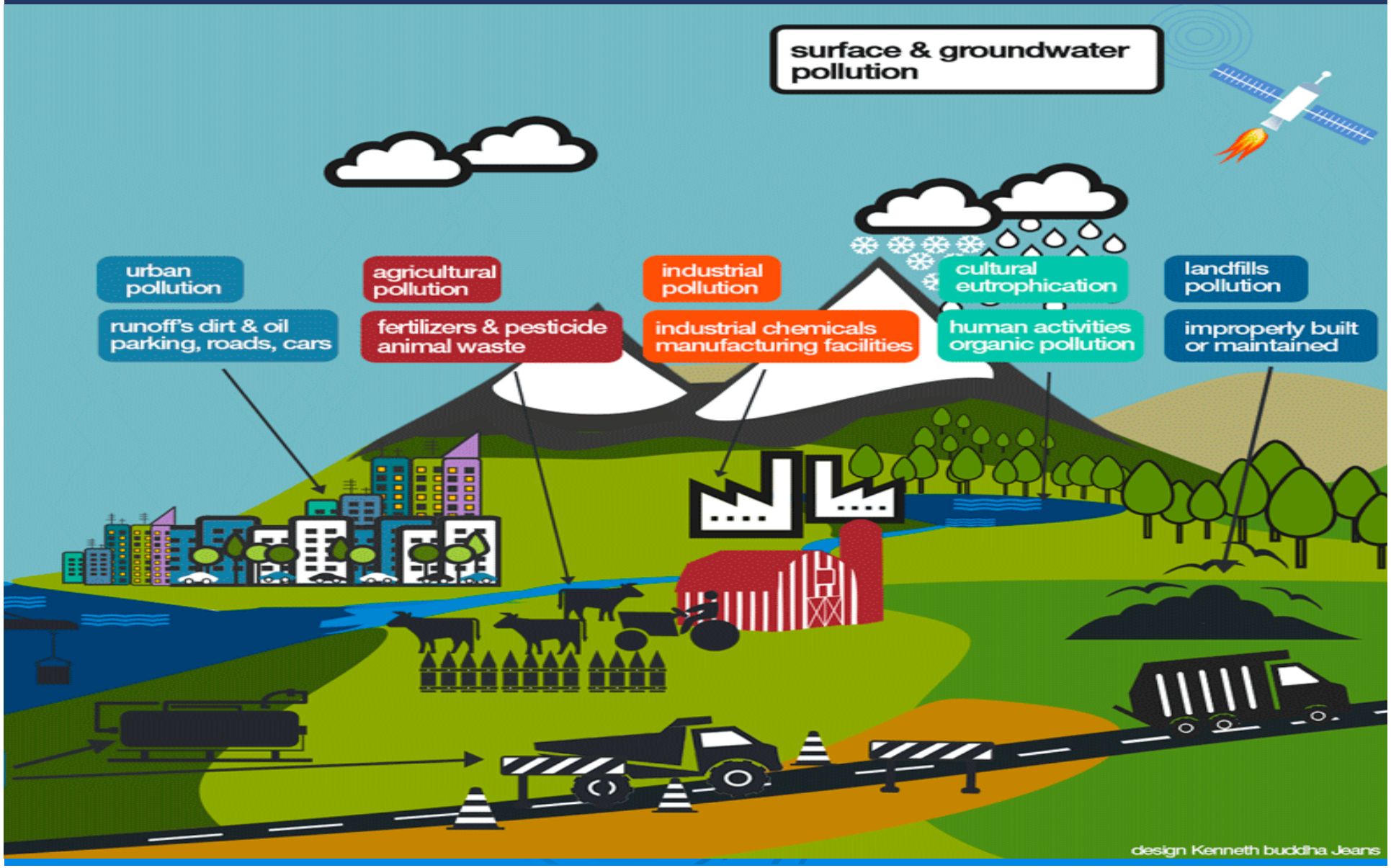
# On-the Ground Projects

- William Penn Foundation: $40M/ 3 yrs – for on-the-ground projects
- Preservation/Protection
  - Open Space Institute: $5.77 million for 14,000 acres and $37 million in matching funds!
- Restoration
  - Nat'l Fish and Wildlife Foundation (NFWF): $4.5 million, with $9 million in matching funds!
- $3M/3 yrs – Monitoring and Assessment
  - Re-Grant monitoring program
  - $6M Research Re-Granting Program

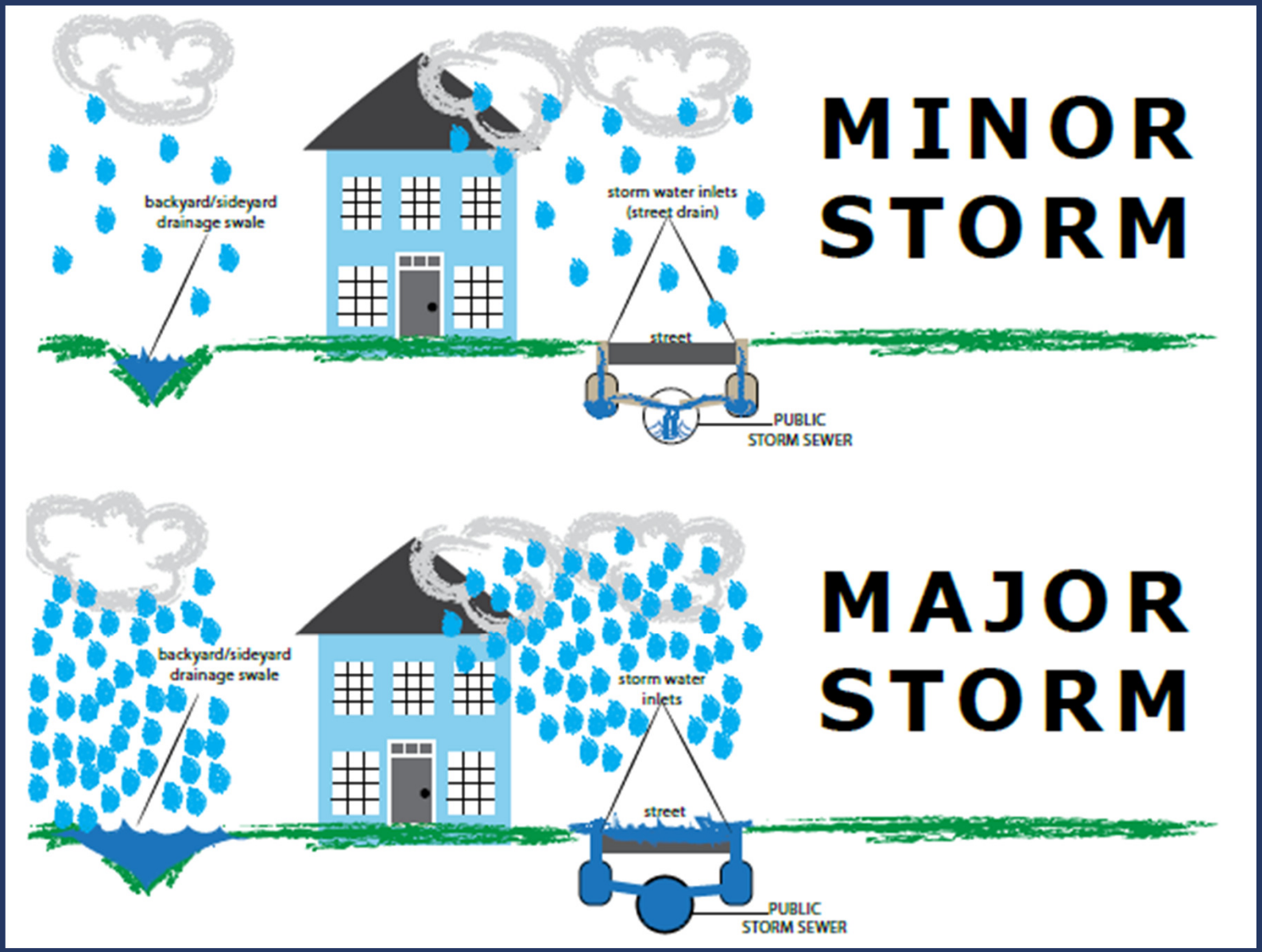
# Objectives of the DRWI

- Bringing together
  - NGOs, agencies,
- Pooling informatic
- Sharing resources
  instead of compet
- Working with rese
  - Identifying threats
  - Targeting restoration and preservation aligned with specific goals
  - Designing efforts with a goal of improving water quality
- Overall getting groups to look holistically and act collectively to protect the watershed
- Engaging watershed groups and the public

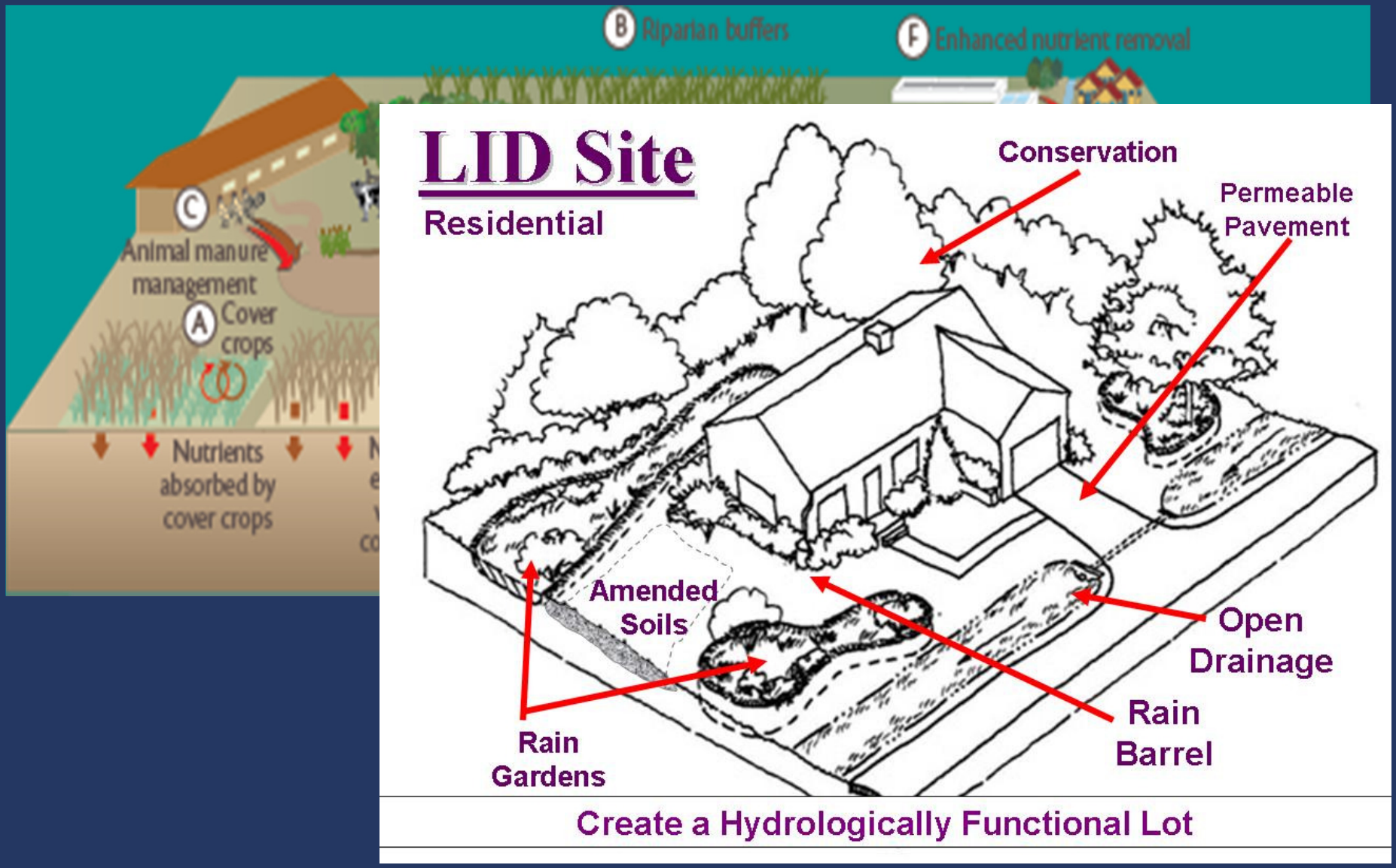
# Pollution & Best Management Practices



# Pollution & Best Management Practices



# Pollution & Best Management Practices



# UNDERLYING QUESTIONS ADDRESSED BY IN-STREAM MONITORING

**How are in-stream ecosystems responding to on-the-ground actions?**

Which indicators best respond to current stressors and conditions, as well as changes in water (and ecosystem) quality over time?

**How can monitoring results inform the DRWI and similar work in the future?**

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# ANS' Role

## DRWI Goals

- Targeted Investment, Place-based
- Apply Consistent Scientific Metrics Across Time and Space

- Build a Suite of Collaborations

- Test Strategies and Hypotheses, Assess Impacts
- Adapt Program Over Long Time Horizon
- Demonstrate Scalability and Transferability

## ANS support

- Site Selection and Review
- Data Collection

- Cluster Monitoring Outreach & Quality Assurance (QA)
- Research Regrant Programs

- Spatial Analysis, Development of Indicator Response Models
- Data Analysis, ANS Research Questions
- Growing Greener Past Project Inventory Research
- Data Sharing and Archiving
- Reports for a broad audience

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# Monitoring partners

## *Non-profits, Local Government, Universities*

### Upper Lehigh

Wildlands Conservancy
Moravian University

### Poconos-Kittatinny

TNC (PA)
North Pocono CARE
Brodhead W.A.
East Stroudsburg Univ.

### NJ Highlands

TNC (NJ)
Musconetcong W.A.
Wallkill River W'shed Mgmt. Group

### Middle Schuylkill

Schuylkill Action Network
Miller Environmental
Stroud Water Research Center
Berks County Conservancy

### Citizen Scientists

Students
Volunteers

### Philadelphia

Tookany-Tacony Frankford W'shed Partnership
Wissahickon Valley W.A.
Lower Merion Conservancy
Pennypack Ecological Restoration Trust
Friends of the Poquessing
Villanova Univ. & Temple Univ.

### Schuylkill Highlands

Green Valleys Association
French & Pickering Creeks Cons. Trust
Hay Creek W.A.
Berks County Conservancy
Chester County Water Resources Auth.
Stroud Water Research Center

### Kirkwood-Cohansey

Association of NJ Env. Commissions
NJ Audubon
Pinelands Preservation Alliance

### Brandywine-Christina

Stroud Water Research Center


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# Summary of Three Tiers

| Tier | Chemistry | Chemistry Lab | Macroinver-tebrate Sampling, ID level | Fish Sampling | Habitat Assessment | Algae |
|---|---|---|---|---|---|---|
| I | ANS or other designated lab, YSI sonde | Low detection levels | Surber sampler<br><br>Genus/ species | Quantitative, multiple pass depletion sampling | EPA WSA, Habitat Index, Riparian Index | Multi-habitat (SWAMP Protocol) |
| 2 | Hach kit or other kit; non-designated lab | Higher detection levels | Kick nets; Family | Single-pass, presence/ | Habitat Index | None |
| 3 | Hach kit or other chemistry kit | No laboratory analysis | Kick nets Family, order | None | None | None |

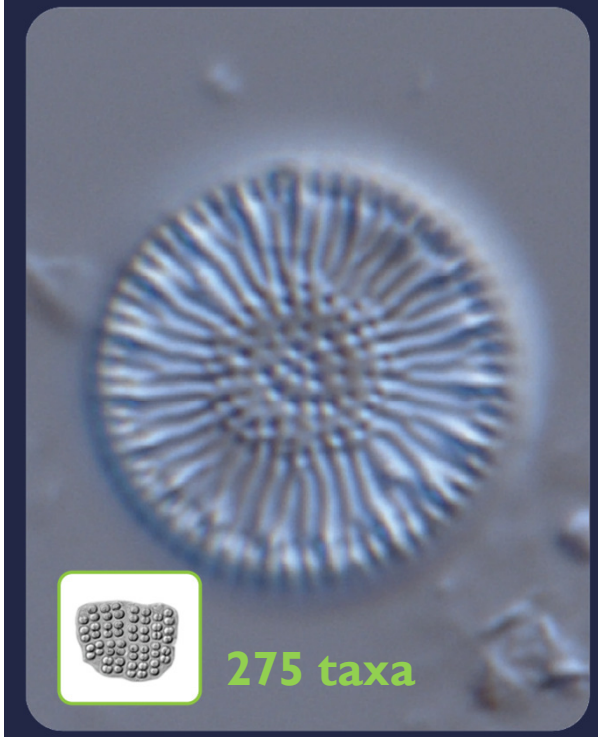
Outreach and Data Quality

TRAINED VOLUNTEERS, QA/QC

Numerous, Enthusiastic

ANY VOLUNTEERS, NO QA/QC

# Overview of ANS & Stroud 2013-2015 monitoring






## Monitoring Site Stats

- ✓ 35 Integrative Sites: **fish, algae, macroinvertebrates, habitat**, **salamanders, water chemistry** (4x/yr)
- ✓ 77 Project Sites (algae, macroinvertebrates, habitat & water)
- ✓ 24 Fish Project Sites
- ✓ 15 Lentic macroinvertebrate sites
- ✓ 15 Salamander Sites
- ✓ 4 Stormwater Sites

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# 2013-2014 Results

## *ANS & Stroud data*

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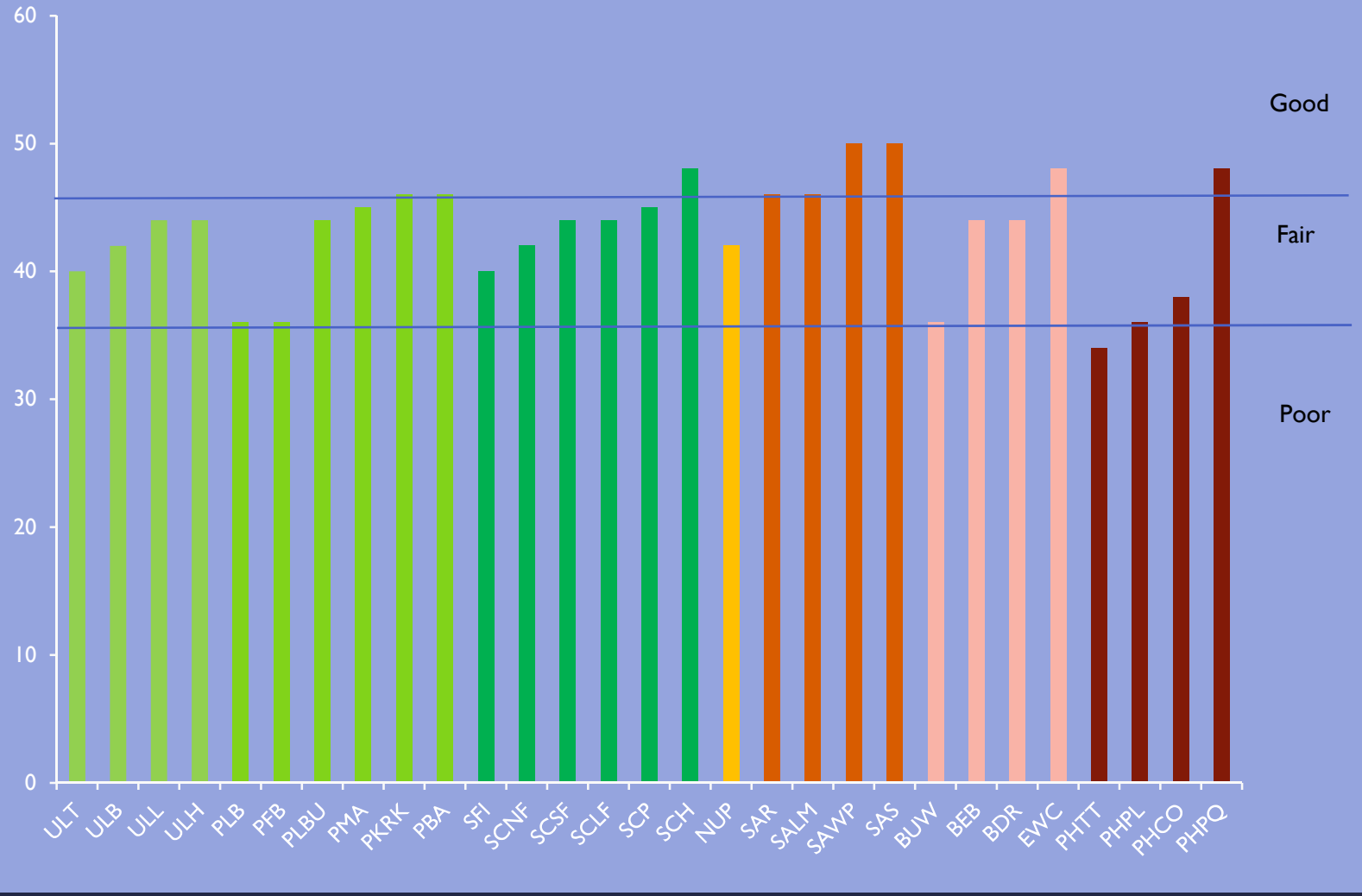
# 2013 Fish IBI scores: Daniels IBI

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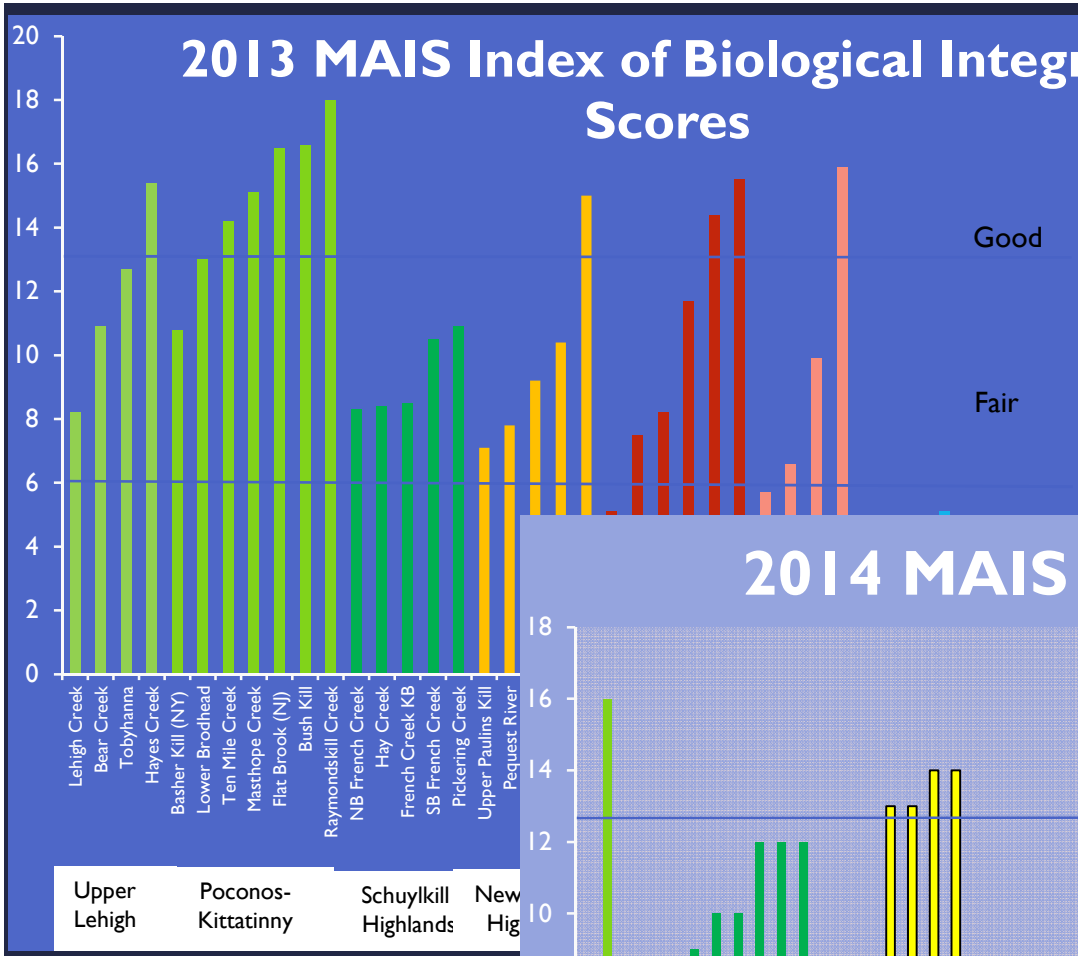
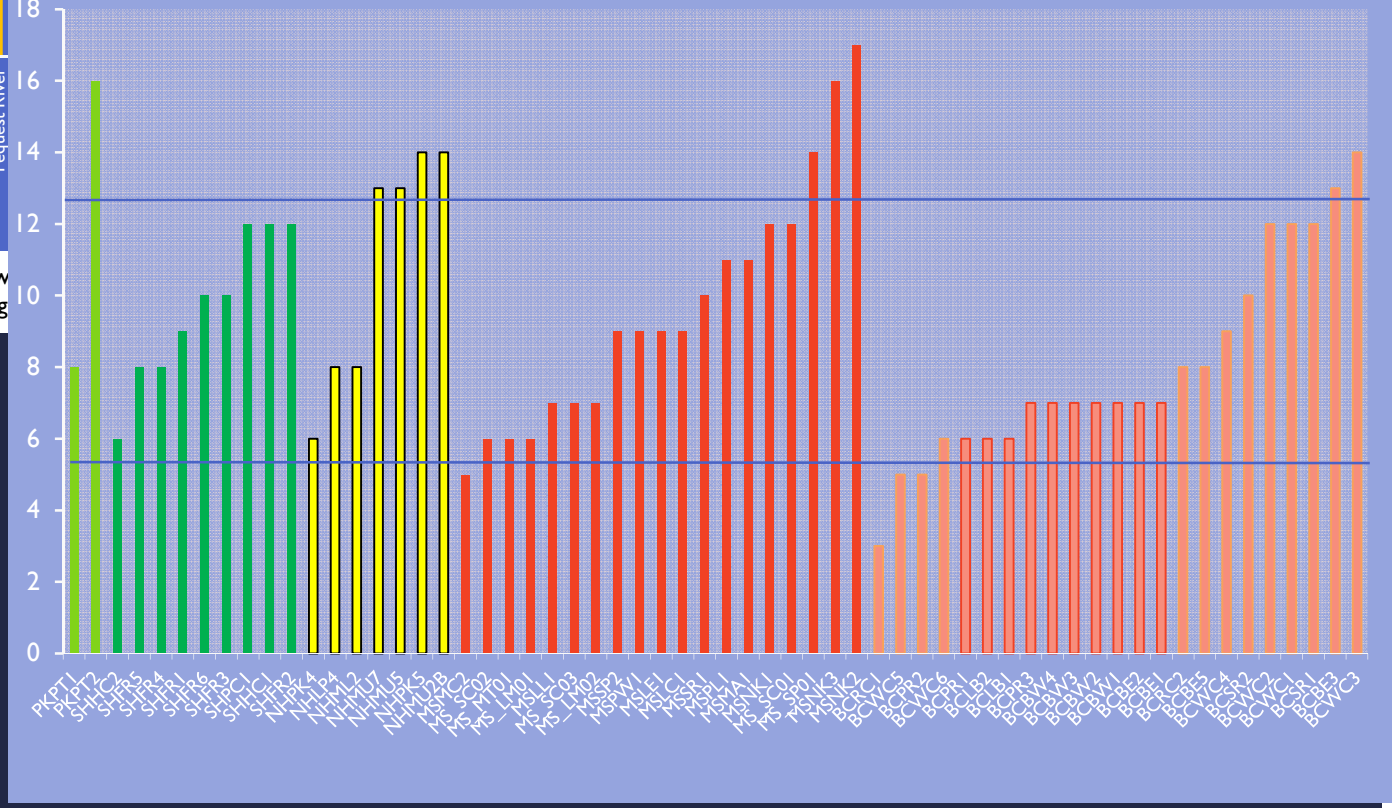
# 2013 MAIS Index of Biological Integrity Scores




# 2014 MAIS Scores: Project sites

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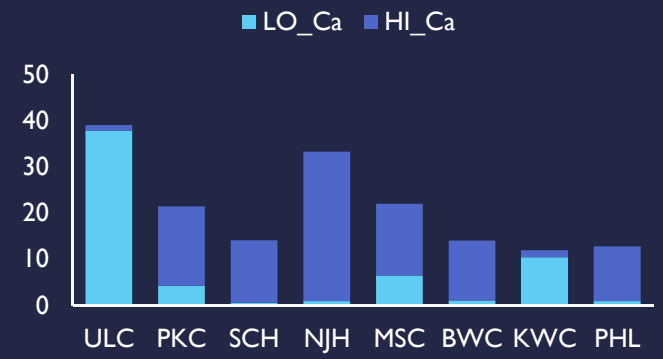
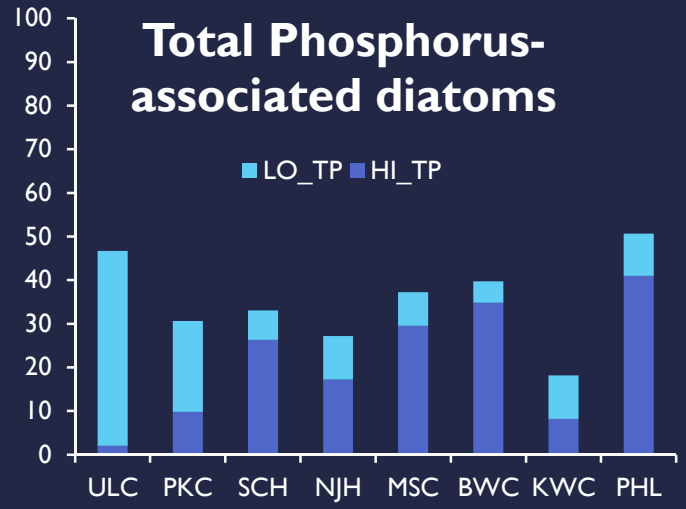
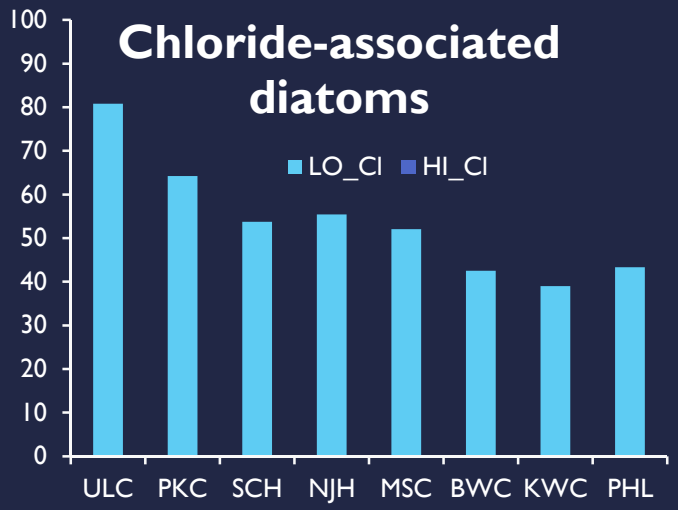
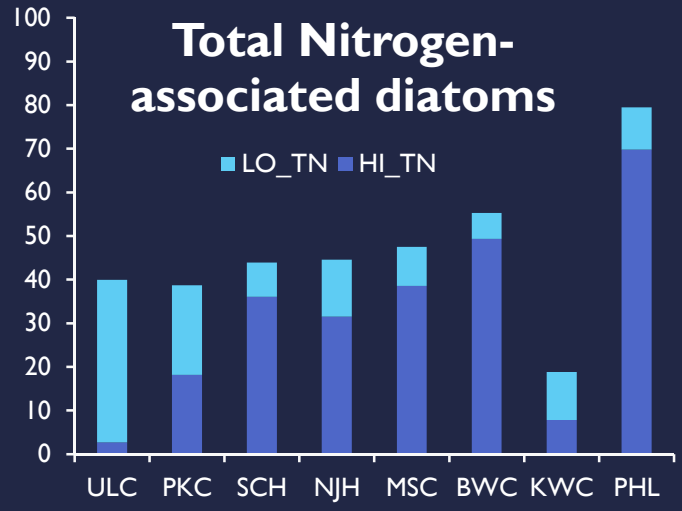
# DIATOMS: INDICATOR TAXA

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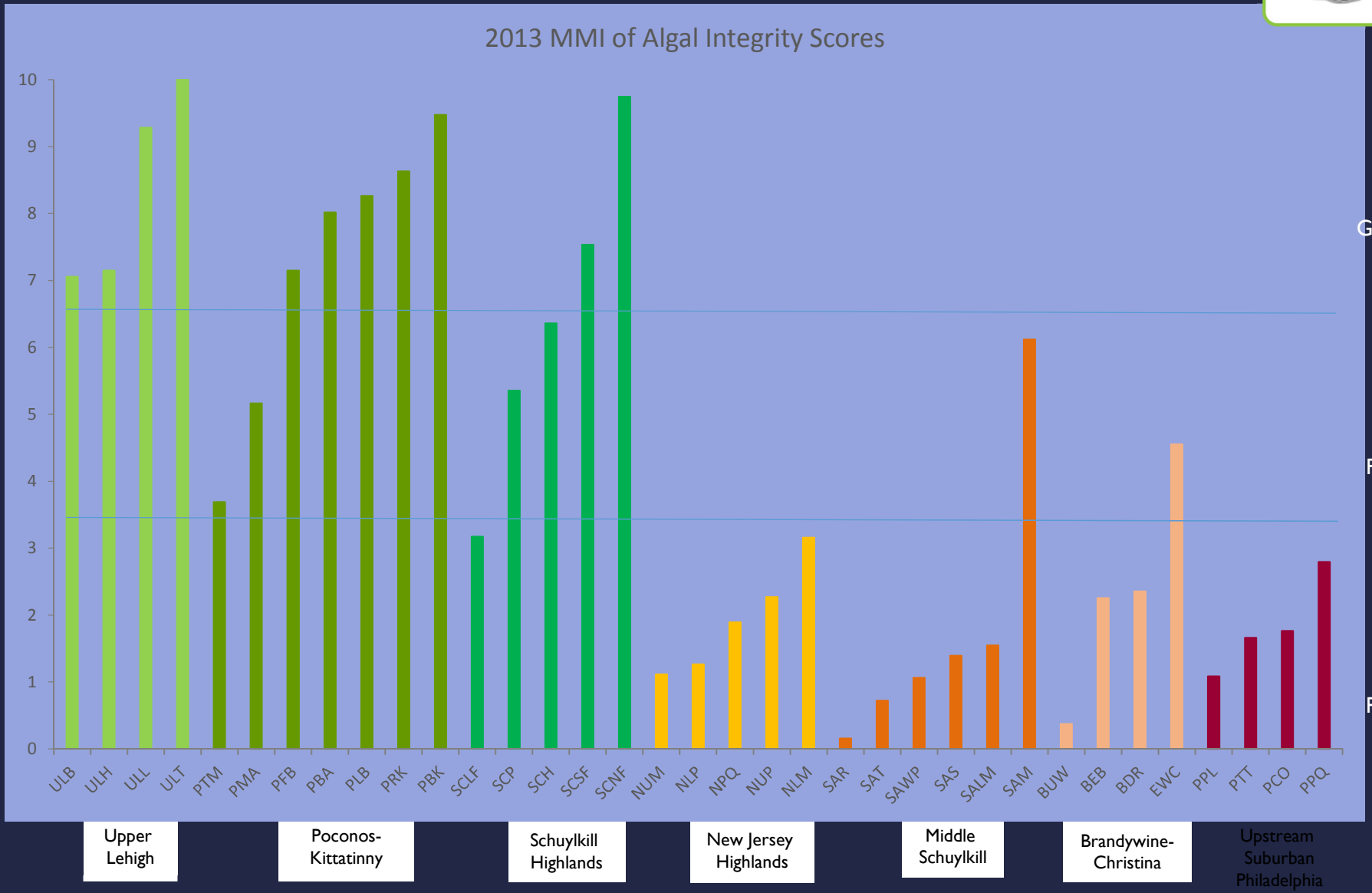
Potapova and Charles (2006)

# DIATOM IBI SCORES

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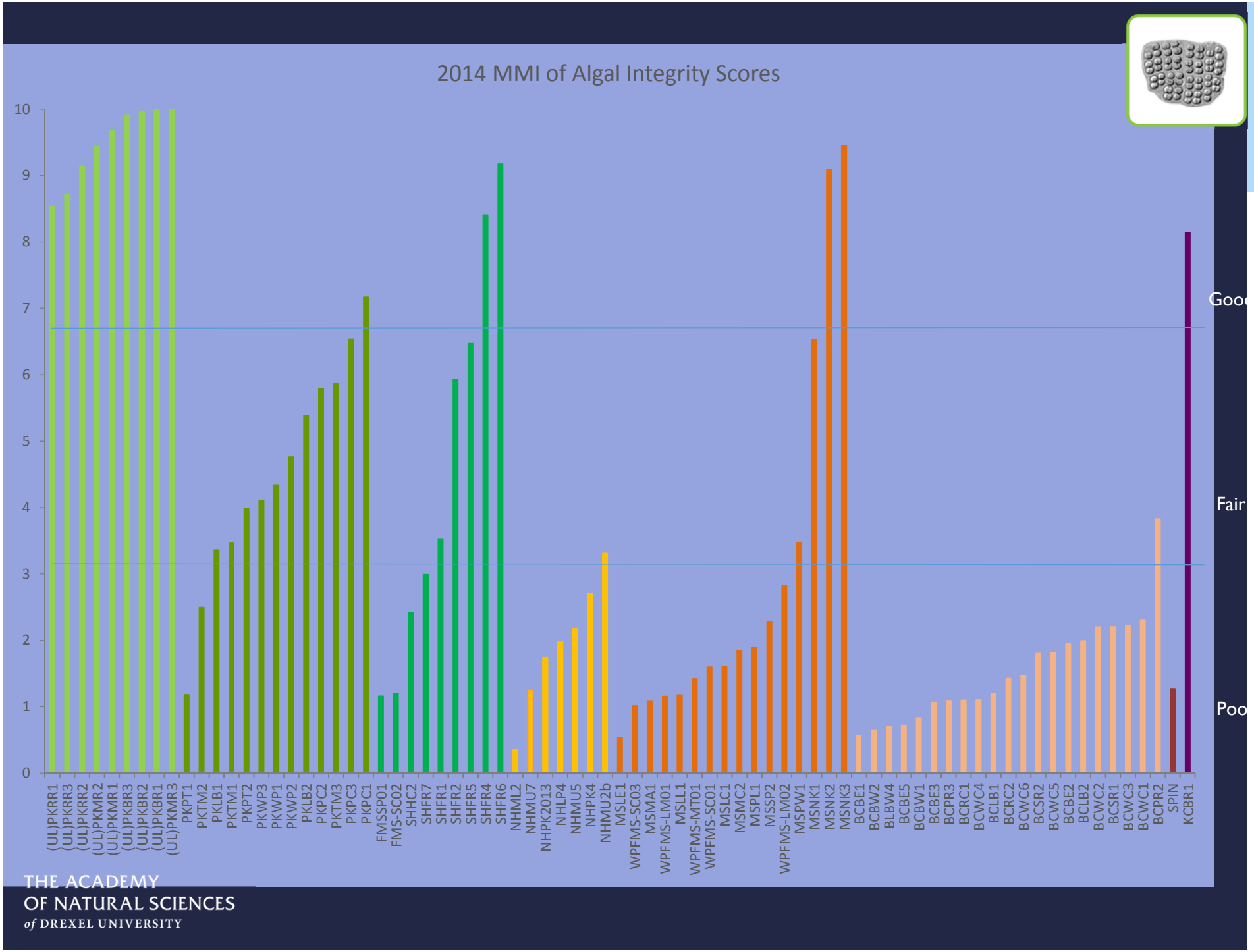


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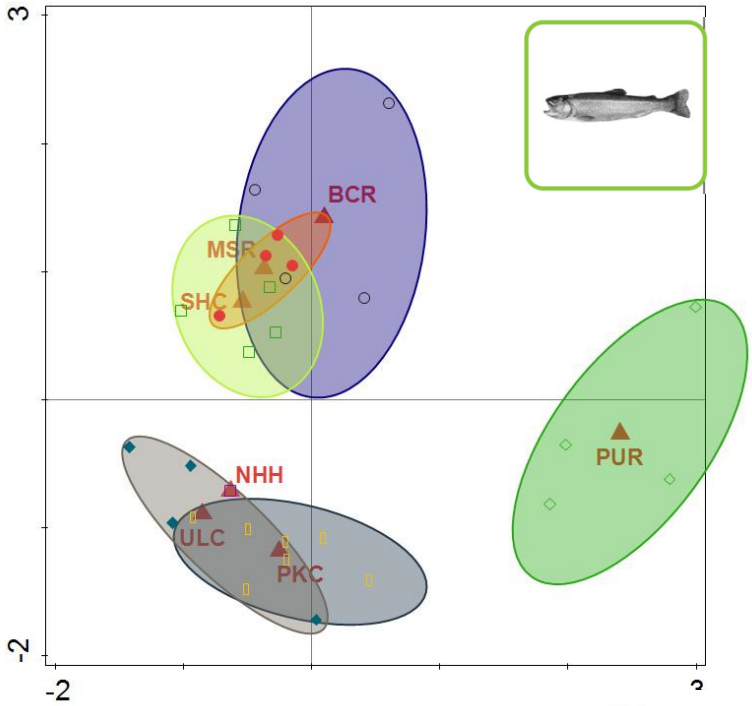


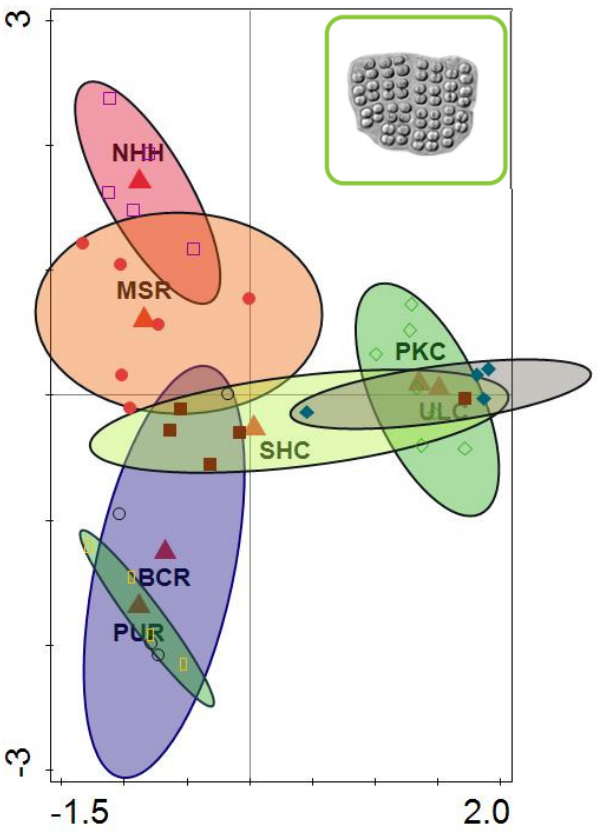


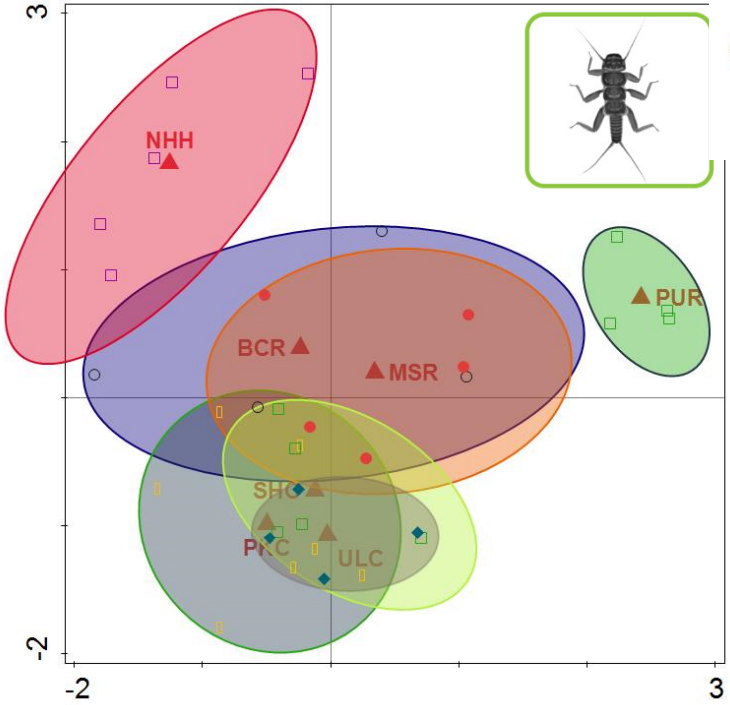


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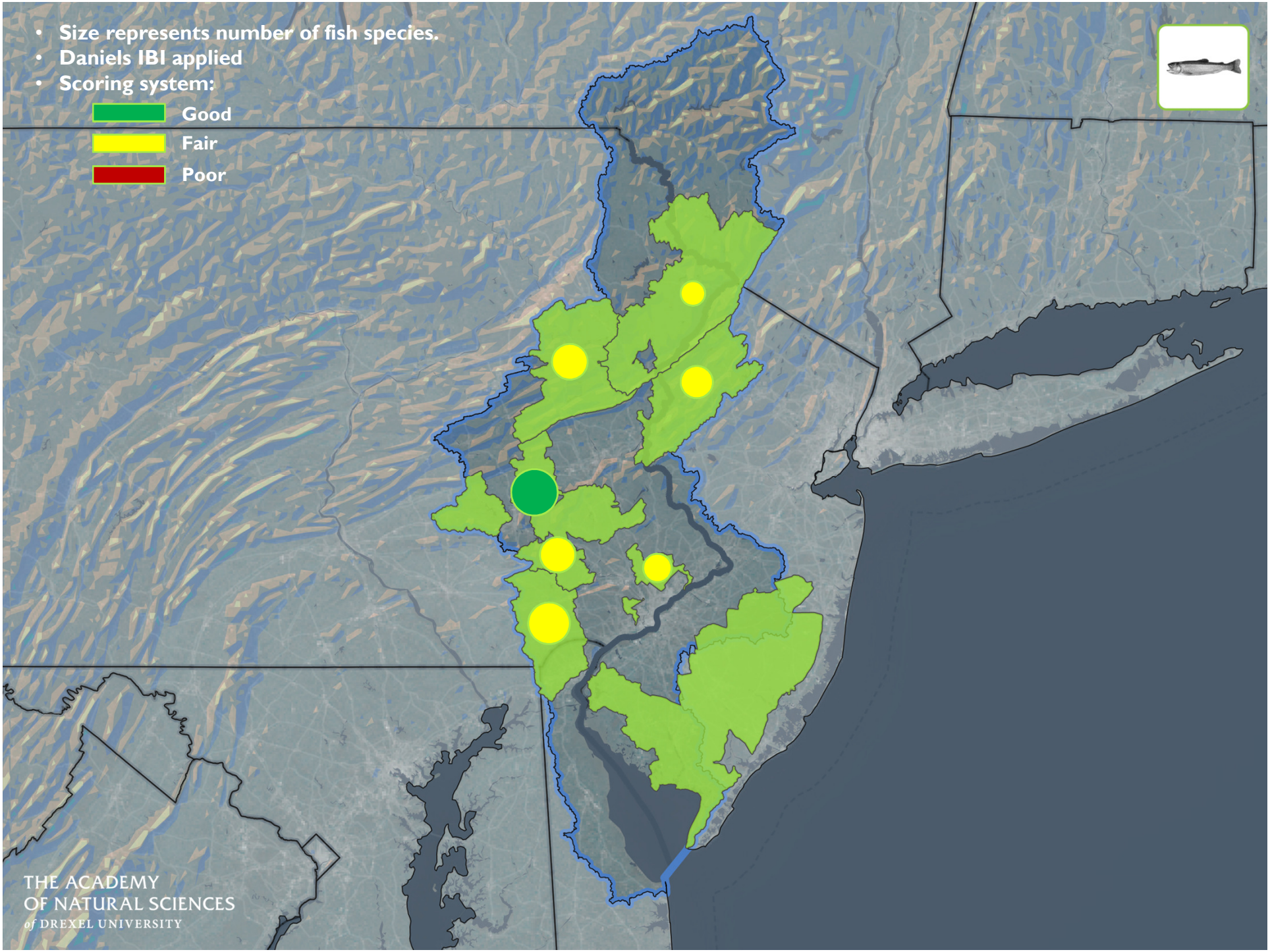
• Size represents number of fish species.
• Daniels IBI applied
• Scoring system:
Good
Fair
Poor
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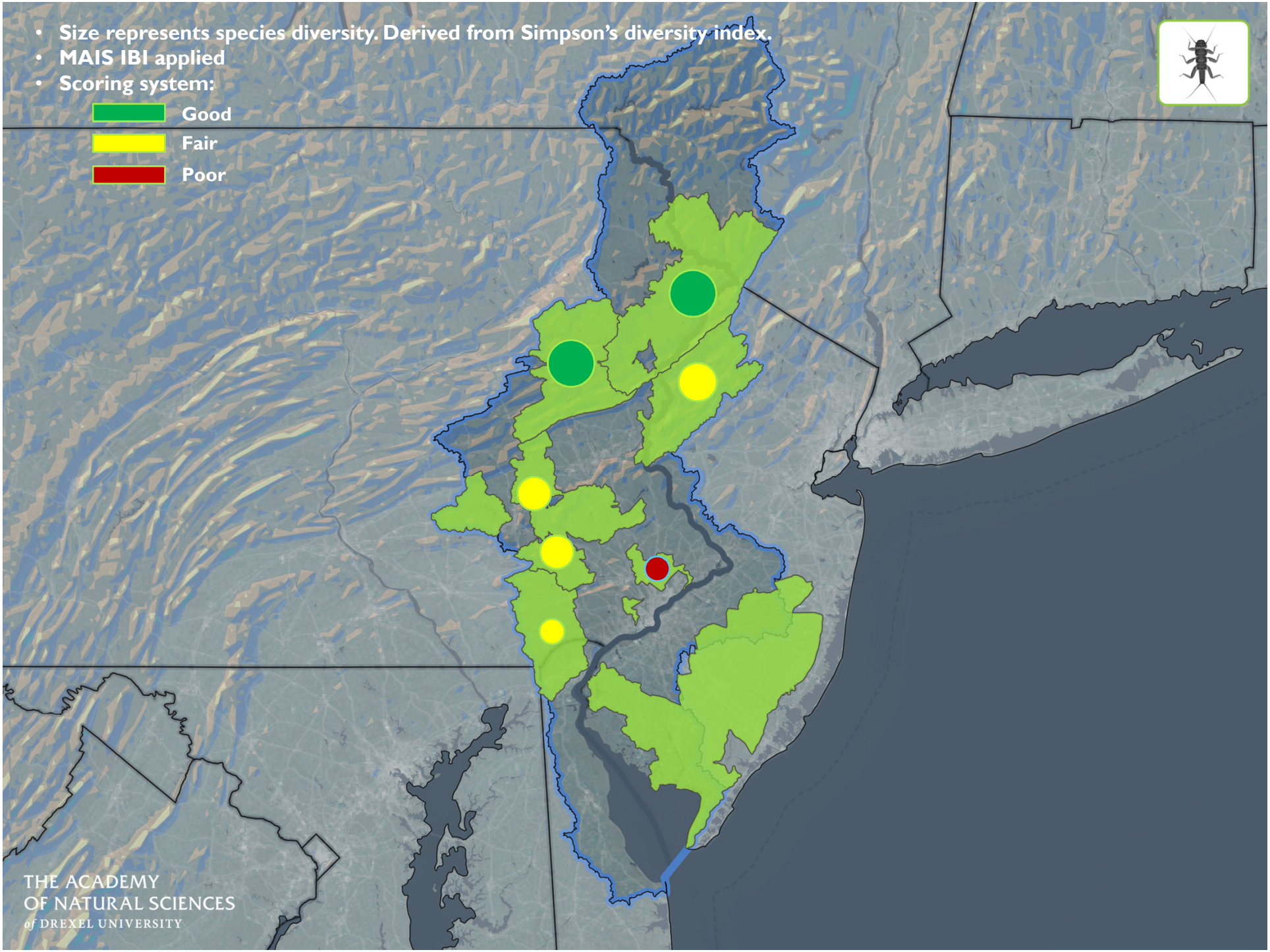
• Size represents species diversity. Derived from Simpson's diversity index.
• MAIS IBI applied
• Scoring system:
Good
Fair
Poor
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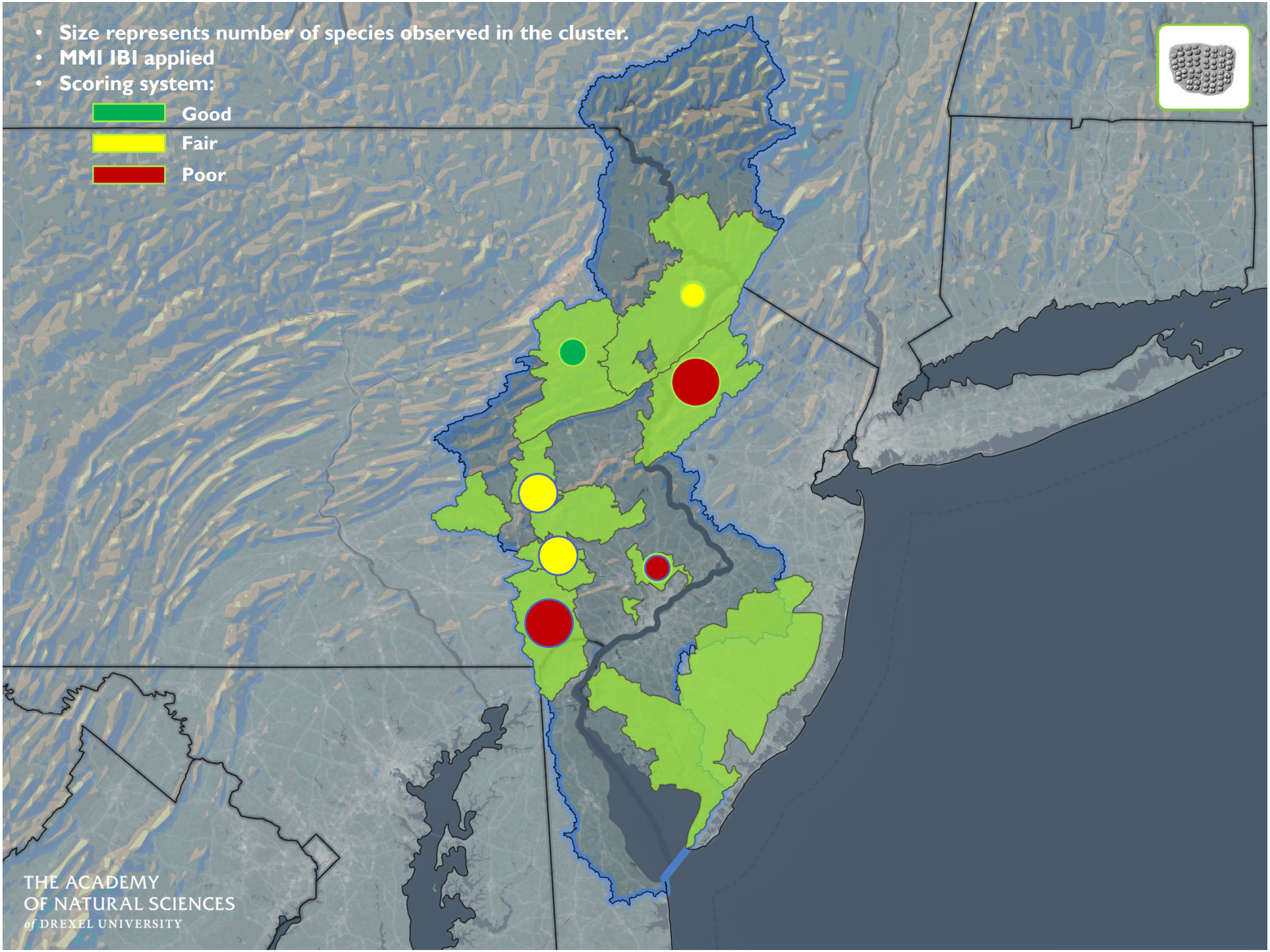
• Size represents number of species observed in the cluster.
• MMI IBI applied
• Scoring system:
Good
Fair
Poor
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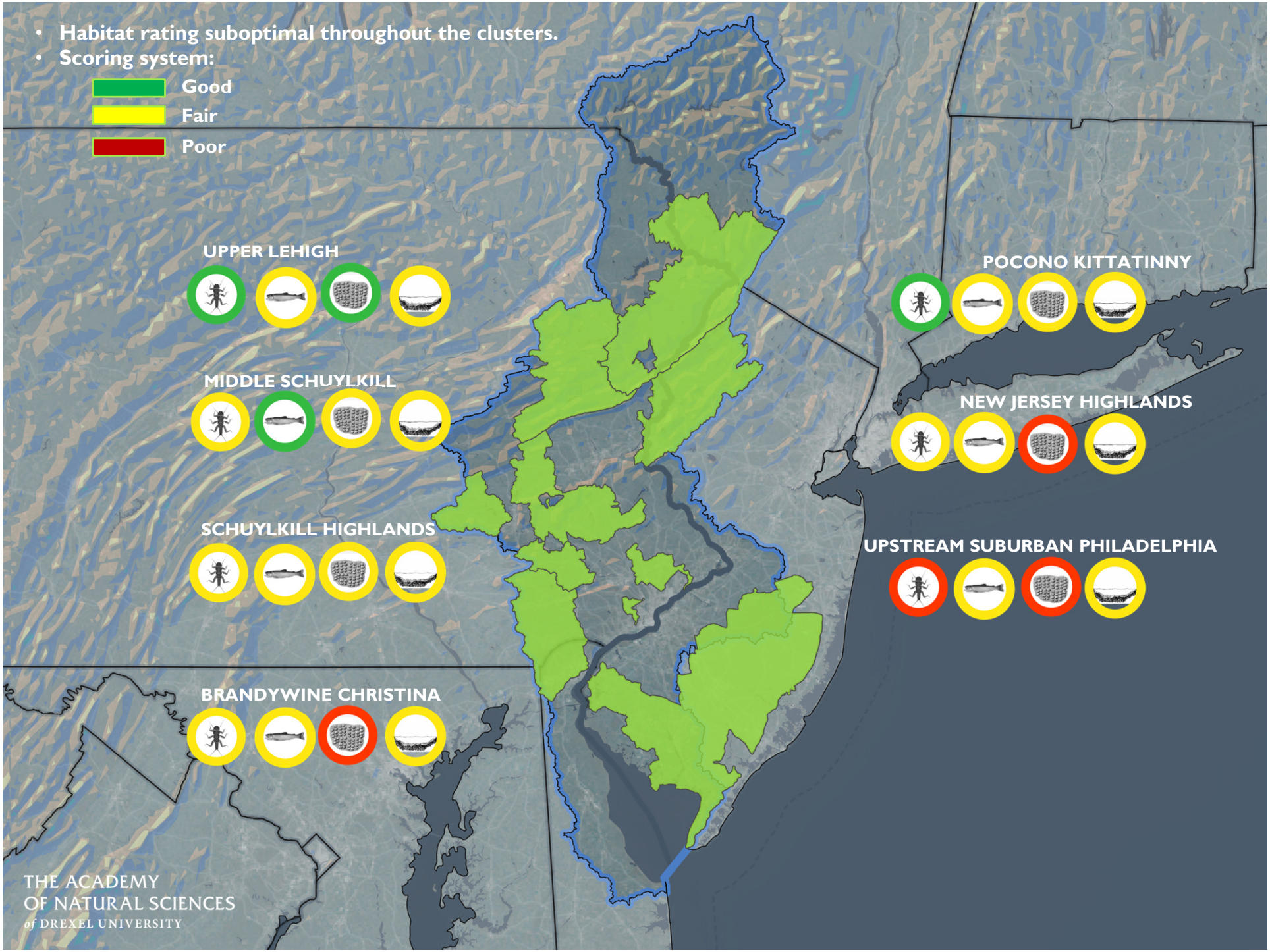
• Habitat rating suboptimal throughout the clusters.
• Scoring system:
Good
Fair
Poor
UPPER LEHIGH
MIDDLE SCHUYLKILL
SCHUYLKILL HIGHLANDS
BRANDYWINE CHRISTINA
POCONO KITTATINNY
NEW JERSEY HIGHLANDS
UPSTREAM SUBURBAN PHILADELPHIA
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# Indicator group ordination

es, diatoms

abitat, chemistry ordination scores

*100 diatom, macroinvertebrate, fish*

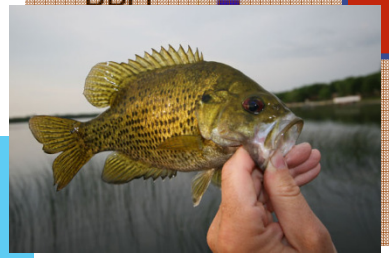
*Combined MDS*


Warm water fishes


re & sity nent

Transform: Fourth root
Resemblance: S17 Bray-Cu


Col wat fish

Low diversity

MSMC2
BCWC4
BCWC2
BCSR1
BCSR2
MSLC1
BCBW1
BCBW2
EWC
BUW
BEB
NUP
SAR
SALM
PPL
PPC
PCO
SCP
SCWP
SCSF
SCH
SCNF
PFB
SCLP
MSMK2
PLB
PMA
PTM
ULT
ULL
ULH
ULB
PRK
PBA

Forested region, some low development or agriculture

High development density

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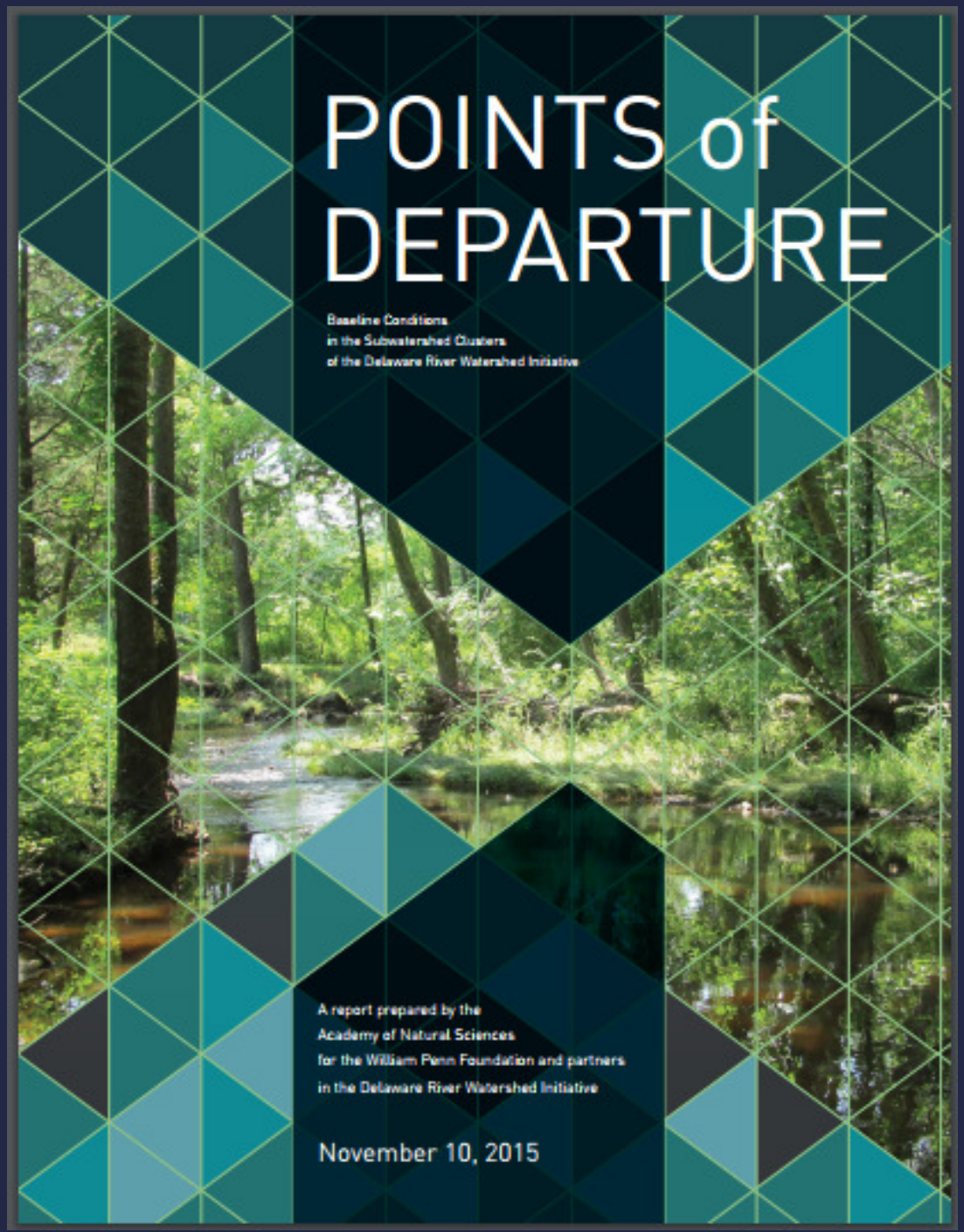


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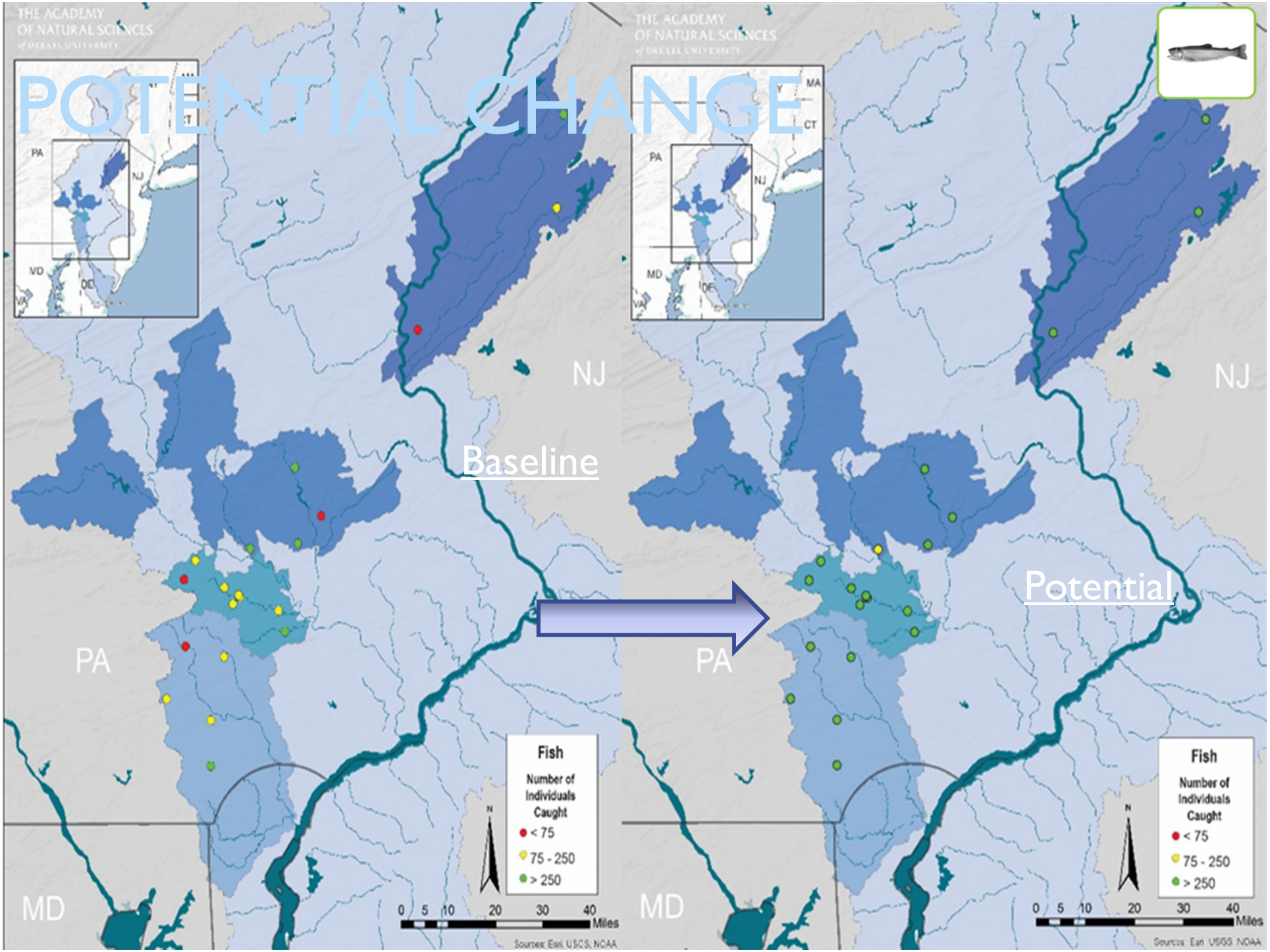
POTENTIAL CHANGE
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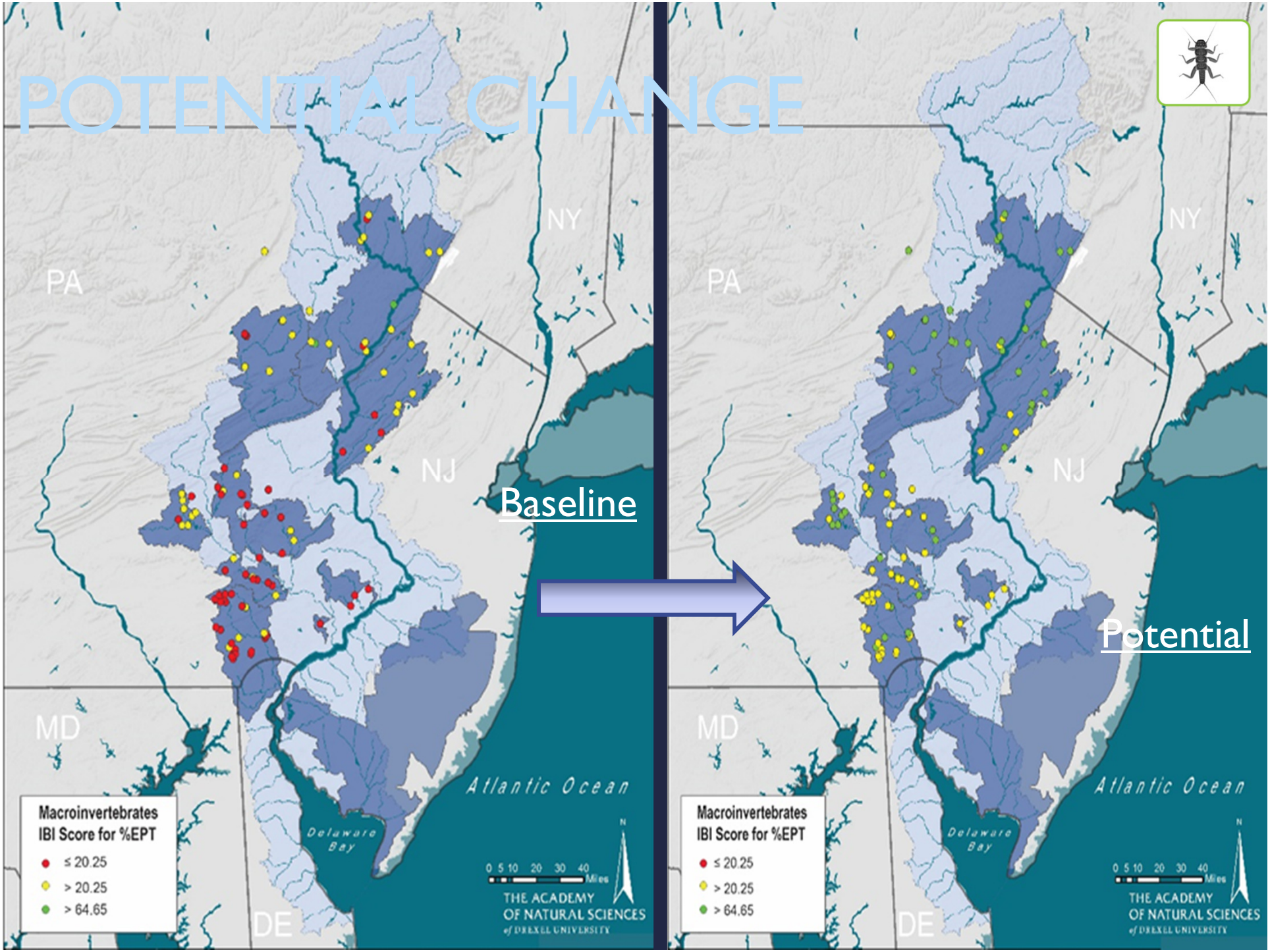
Baseline
Potential
NJ
PA
MD
MA
CT
VA
DE
Fish
Number of Individuals Caught
< 75
75 - 250
> 250
N
0 5 10 20 30 40
Miles
Sources: Esri, USGS, NOAA


POTENTIAL CHANGE
PA
NY
NJ
MD
DE
Baseline
Potential
Atlantic Ocean
Delaware Bay
Macroinvertebrates
IBI Score for %EPT
≤ 20.25
> 20.25
> 64.65
0 5 10 20 30 40
Miles
N
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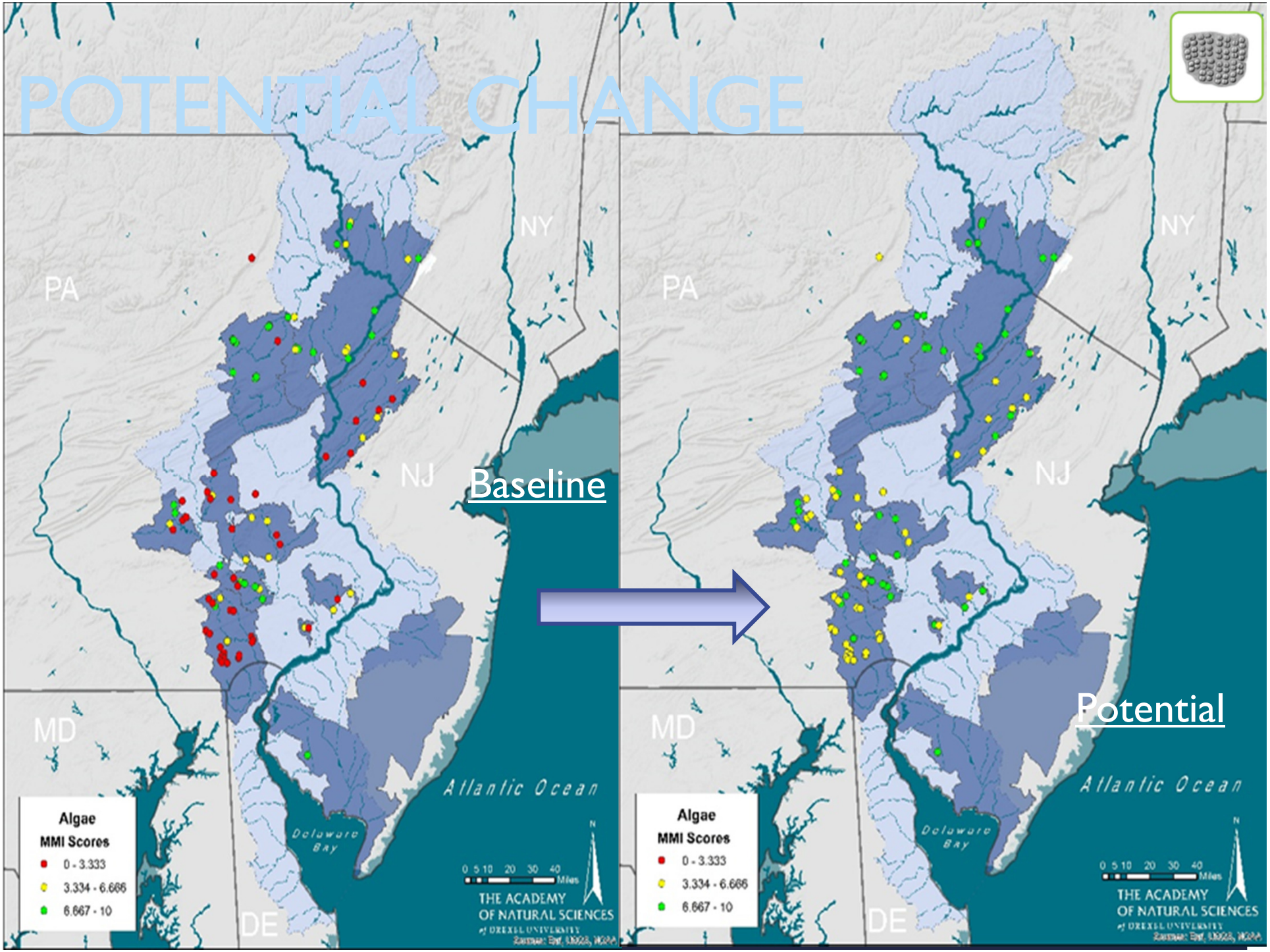
POTENTIAL CHANGE
NY
PA
NJ
MD
DE
Baseline
Potential
Atlantic Ocean
Delaware Bay
Algae
MMI Scores
0 - 3.333
3.334 - 6.666
6.667 - 10
0 5 10 20 30 40
Miles
N
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| | Cluster | Algae | | Macroinvertebrates | | | Fish | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Now | Future | Now | Future | | Now | | Future |
| Restoration | New Jersey Highlands | All sites dominated by high nutrient and pollution-tolerant taxa | Reduce dominance by tolerant taxa, increase from "poor" to "fair" | Tolerant, low mayfly, low diversity, low "flow-sensitive" | Higher in nearly all metrics | | No eels, lamprey, warm water fishes | | Greater diversity, more cool water fishes |
| Restoration | Brandywine-Christina | All but 1 site "poor," high percentage of indicators of high nutrient and ion concentrations | "Fair" IBI scores, with fewer nutrient-tolerant taxa | | | | Warm water assemblages, site-dependent, some cool water fishes (reproducing and stocked trout) | | Greater diversity, decreased biomass, more cool water fishes, more reproducing trout, increases inpollution-intolerant insectivores |
| Restoration | Middle Schuylkill | High nutrient and ion-tolerant taxa | Higher index values (fair-good) with lower nutrient-tolerant taxa | | | | | | |
| Restoration | Upstream Philadelphia | All but 1 site "poor," high percentage indicators of high nutrient and ion concentrations | "Fair" IBI scores, with fewer nutrient-tolerant taxa | All metrics low | Higher in nearly all metrics | | Low diversity | | More diversity, stable functioning and biomass |
| Restoration | Kirkwood-Cohansey | Not analyzed; to be included in 2015 | Not analyzed; to be included in 2015 | Some sites low diversity | Maintain high diversity in good sites, increase diversity in others | | Not analyzed; to be included in 2015 | | Not analyzed; to be included in 2015 |
| Protection | Schuylkill Highlands | Range of percentages of tolerant taxa, some sites low quality | Low quality sites: higher index range, Good sites: maintain quality | Tolerant, few "flow-sensitive" taxa, low diversity | Fewer pollution-tolerant taxa, higher diversity | | Trout in few sites, warm water fishes | | More trout & other cool water fishes |
| Protection | Upper Lehigh | All sites have high scores for nutrients and ions | Maintain high scores | Low % EPT, mayfly, relatively high pollution tolerant | Improve in EPT, lower pollution tolerant, maintain overall | Lehigh & Poconos (for fish) | Large streams | No eels, lamprey, some warm water fishes (ponds) | Maintenance of communities, more reproducing trout |
| Protection | Poconos-Kittatinny | Range of percentages of tolerant taxa, some sites low quality | Low quality sites: higher index range, Good sites: maintain quality | | | | Small streams | Sculpin, natural and stocked trout | Maintenance of communities, more native Brook Trout, more pollution-intolerant fish |

# Ecosystem improvement

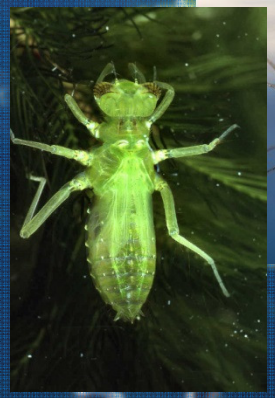
## *Fish*

| Clusters | Streams | Fish | |
|---|---|---|---|
| | | **Now** | **Future** |
| **NJ Highlands** | | No eels, lamprey, warm water fishes | Greater dive… more cool w… fishes |
| **Brandywine-Christina** | **Ag streams** | Warm water assemblages, site-dependent, some cool water fishes | Greater diversity, more cool water fishes |
| **Middle Schuylkill** | | | |
| **Schuylkill Highlands** | **Intermediate development & forested streams** | Trout in few sites, warm water fishes | More trout & other cool water fishes |
| **Upstream Philadelphia** | **Urban** | Low diversity | Focus on function, biomass |
| **Upper Lehigh** | **Large, forested rivers** | No eels, lamprey, some warm water fishes (ponds) | Greater diversity, more cool water fishes |
| **Poconos-Kittatinny** | **Small headwaters** | Sculpin, natural and stocked trout | Sculpin, reproducing trout |

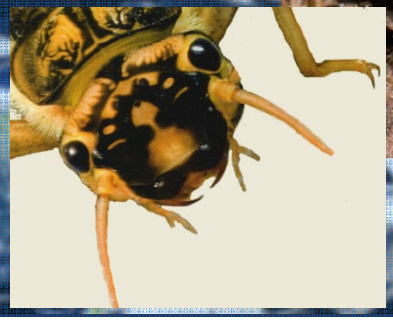
# Ecosystem improvement

*Fish and macroinvertebrates*

| Clusters | Macroinvertebrates | |
|---|---|---|
| | **Now** | **Future** |
| **NJ Highlands** | Tolerant, low mayfly, low diversity, low "flow-sensitive" | Higher in nearly all metrics |
| **Brandywine -Christina** | | |
| **Middle Schuylkill** | | |
| **Schuylkill Highlands** | Tolerant, low "flow-sensitive", low diversity | Fewer pollution-tolerant taxa, higher diversity |
| **Upstream Philadelphia** | All metrics low | Higher in nearly all metrics |
| **Upper Lehigh**<br><br>**Poconos-Kittatinny** | Low % EPT, mayfly, relatively high pollution tolerant | Improve in EPT, lower pollution tolerant, maintain overall |

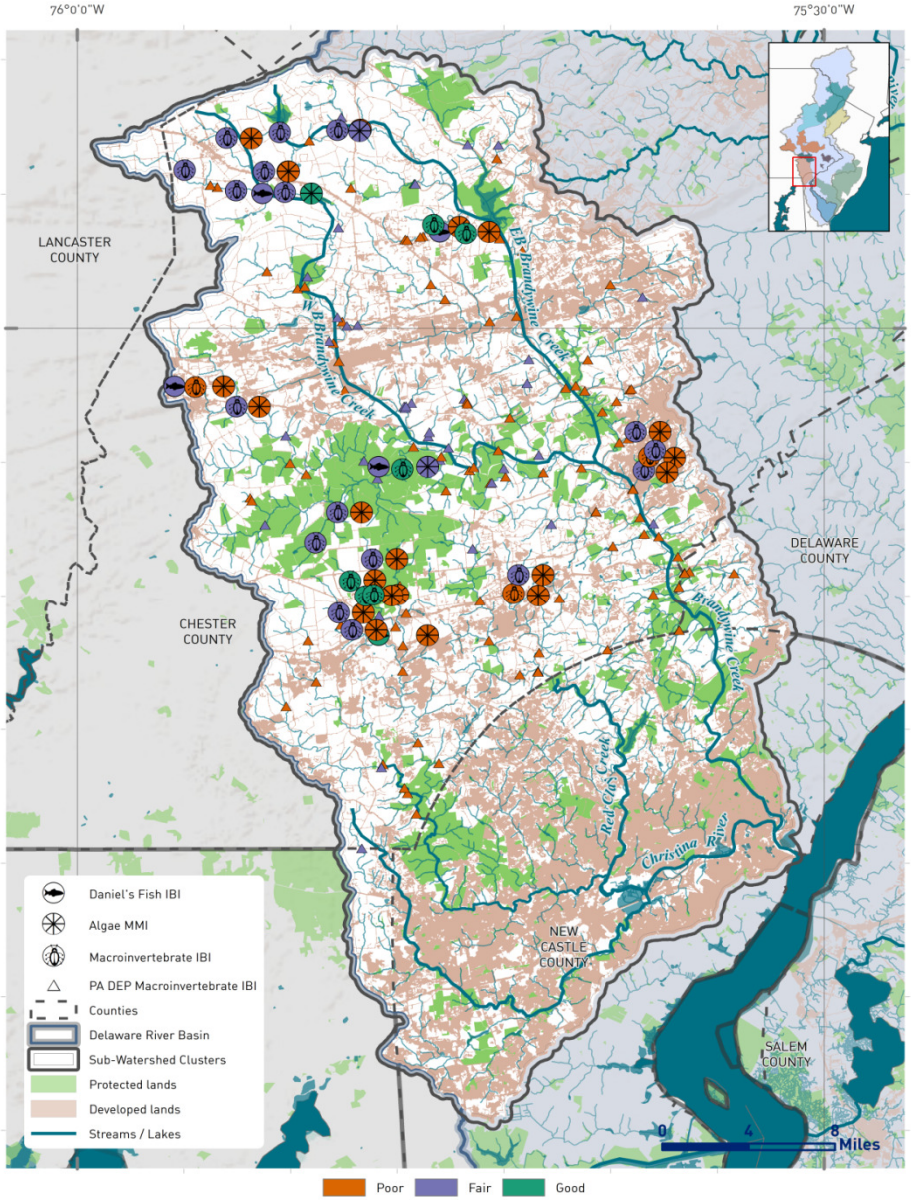






# BRANDYWINE AND CHRISTINA

Delaware River Watershed Initiative




## Summary Of Key Species as Biotic Indicators

### Notable Fish & Significance to IBI

**White Sucker *(Catostomus commersoni)***

Generalist feeder, tolerant to non specific stressors

**Tessellated Darter *(Etheostoma olmstedi)***

Insectivore, intermediate tolerance to non-specific stressors

**Common Shiner *(Luxilus cornutus)***

Generalist feeder, intermediate tolerance to non-specific stressors

**Average Daniels Fish IBI Score:**

43.20 (Fair)

### Notable Macroinvertebrates & Significance to IBI

**Midges: Chironomidae**

Those present here are pollution tolerant, mainly collector gatherers.

**Riffle beetles: Elmidae**

Require fast-flowing waters, moderately pollution tolerant, algae scrapers

**Spiny crawler mayflies: Ephemerellidae**

Pollution sensitive, collector- gatherers or scrapers

**Average Macroinvertebrate IBI Score:**

60.00 (Fair)

### Notable Algae & Significance to IBI

***Achnanthidium rivulare***

Nutrient tolerant, neutral pH optimum, grazer resistant

***Nitzschia inconspicua***

Nutrient tolerant, organic pollution tolerant, grazer resistant

***Amphora pediculus***

Nutrient tolerant, organic pollution sensitive, grazer resistant

**Average Algae MMI Score:**

2.15 (Poor)

# BRANDYWINE AND CHRISTINA

Delaware River Watershed Initiative

## Cluster Organization Summary

Organizational partners: Brandywine Conservancy, Brandywine Red Clay Alliance, Natural Lands Trust, The Nature Conservancy, Stroud Water Research Center*, University of Delaware Water Resources Agency. (*BCC monitoring partner)

Cluster Strategy: To protect and improve water quality via agricultural and urban restoration and direct land conservation, as well as efforts related to land management plans, regulatory tools, and funding. Conservation opportunities with high-impact potential have been pursued to bolster ongoing restoration efforts on impaired reaches. This concentrated effort is expected to result in measurable water quality improvements over a short time period.

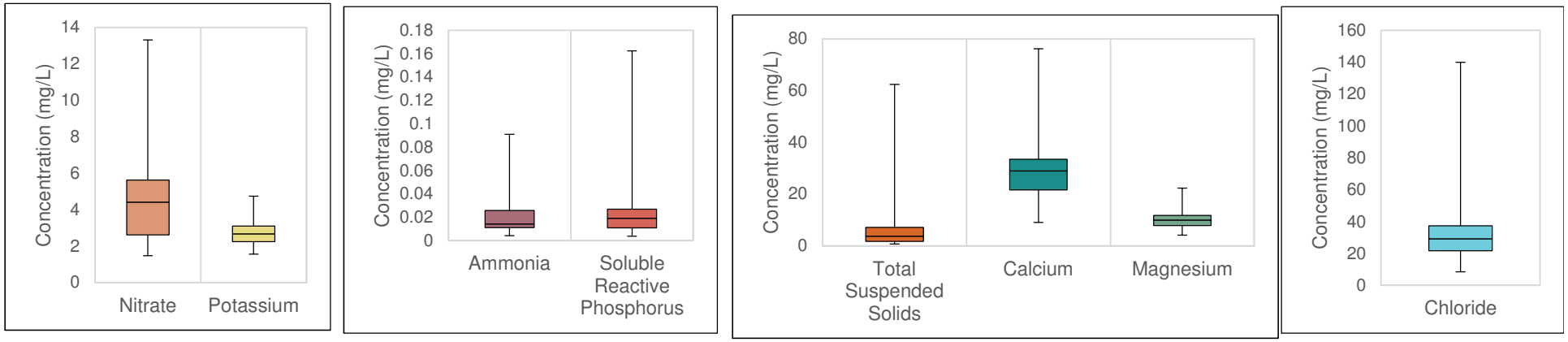
Monitoring objectives: Monitoring before, during and after completion of projects, combined with historical data, to produce a comprehensive idea of baseline conditions of the watershed and the improvement of water quality resulting from on-the-ground actions.

2013-2014 Sampling Sites: ANS/SWRC – 25

## Summary Of Habitat Assessment

In-stream habitat assessments are a composite of variables including flow type descriptions, particle size classifications, and embeddedness estimations. These features interact to influence biotic communities. Reaches sampled in the Brandywine-Christina cluster were dominated by glide (53%; fast-flowing but not as choppy as a riffle) and pool (29%; still or backflow) flow types. The flow type is often reflected in both substrate particle size and how embedded particles are. Particle size and embeddedness then, in turn, partially determine the area of habitat available for fish, macroinvertebrates, and algae within a reach. In the Brandywine-Christina cluster the dominant particle sizes were sand (26%), cobble (23%) and gravel (19%). The coarse gravel, cobbles, and boulders present were about 70% embedded (covered in fine sediment; high percentages can indicate erosion of upstream land). Overall this cluster is ranked 6 out of 7 in habitat quality and was given a grade of suboptimal.

## Summary Of Chemical Parameters




Water Chemistry: Box and Whisker Plots of select water chemistry parameters across the Brandywine-Christina Cluster for sites sampled seasonally in 2013 -2014. Almost half of sampling events exceed nitrate-nitrogen levels considered acceptable for aquatic life in warm water streams; all sites exceed standards for soluble reactive phosphorus. This might correlate to agricultural land use in the cluster, however, for TSS (also ag-related) only two sites exceed acceptable levels for warm water streams: BCBW3 on Honey Brook and BCBW2 on West Branch Brandywine. Additionally, two branches of Plum Run in West Chester, Pa., exceed levels for chloride, which could relate to road salts.

# ANS DRWI Team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THE ACADEMY
OF NATURAL SCIENCES
*of* DREXEL UNIVERSITY

# Delaware Watershed Research Fund

## Identified Objectives, Research Priorities and Logistics

- Objectives
  - Support an integrated research agenda for the Delaware Basin, supplementary to the actions of the DRWI
  - Explore questions related to protecting, restoring, and understanding healthy watersheds
  - Focus research efforts on

### Multidisciplinary Priorities

1. Focused watershed assessment programs linked to management efforts that test effectiveness and scale
2. Climate change impacts
3. Natural resource/ecosystem services

### Higher Resolution/Finer Detailed Priorities

1. Geographic Analysis for Planning (GAP analysis) of contaminants & stressors
2. Assessment of current available technology and need for improvement
3. Urban forest health/fragmentation

| Key Dates | |
|---|---|
| February 15, 2016 | Letter of Intent |
| March 1, 2016 | Invitation for Proposals |
| April 15, 2016 | Formal Proposal |
| May 31, 2016 | Funding Decision |

Fund logistics

- Total amount - $4,000,000
- Expected project amounts - $300,000 – $500,000
- Matching, collaboration and leveraging preference

ansgrants@drexel.edu

ansp.org/drwi/dwrf-grant

Contact with questions, or visit the fund website to access the RFP, recorded webinar and FAQ