

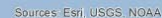


Macroinvertebrate Assemblages in the Subwatershed Clusters of the Delaware River Watershed Initiative

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THE ACADEMY OF NATURAL SCIENCES
of DREXEL UNIVERSITY

STROUD[™]
WATER RESEARCH CENTER



What are our objectives?

Integrative sites, 2013

Project sites, 2014



THE EIGHT SUB-WATERSHED CLUSTERS IBI DISTRIBUTION

PA DEP - PA IBI

- ▲ Poor (0-45)
- ▲ Fair (45.1-74)
- ▲ Good (74.1-100)

NAWQA - PA IBI

- Poor (0-45)
- Fair (45.1-74.0)
- Good (74.1-100)

NJDEP - CPMI

- Poor (0.00 - 6.00)
- Fair (6.01 - 10.00)
- Good (10.01 - 21.00)
- Excellent (21.01 - 30.00)

NJDEP - HGMI

- Poor (5.15 - 21.00)
- Fair (21.01 - 42.00)
- Good (42.01 - 63.00)
- Excellent (63.01 - 100.00)

NJDEP - PMI

- Poor (12.62 - 34.00)
- Fair (34.01 - 56.00)
- Good (56.01 - 63.00)
- Excellent (63.01 - 100.00)

Fish IBI

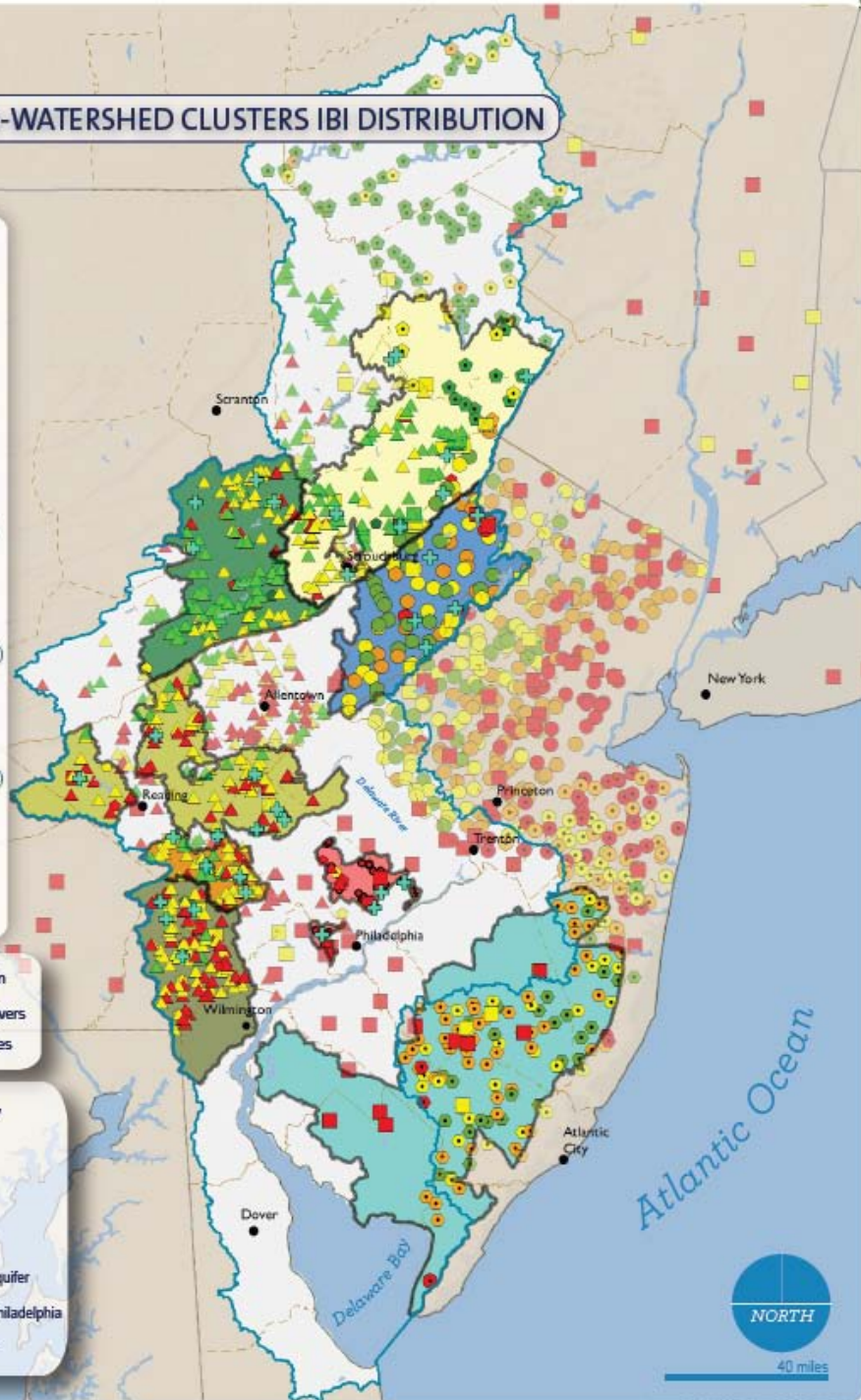
- Fair
- Good
- Poor

PWD - DEP IBI

- ◆ Poor (11.47 - 34.54)

- Delaware River Basin
- Major streams and rivers
- ⊕ ANS Monitoring Sites

- Poconos and Kittatinny
- Upper Lehigh
- Middle Schuylkill
- Schuylkill Highlands
- Brandywine Christina
- Kirkwood Cohansey Aquifer
- Upstream Suburban Philadelphia
- New Jersey Highlands



40 miles



Sampling approach

- Riffles, runs or pools?



Sampling approach

Quantitative ?

Surber or Hess

Hester Dendy

Leaf pack

Kick net or D-net



Timing compared with agencies

JANUARY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	FEBRUARY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28	MARCH S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	APRIL S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
MAY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	JUNE S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	JULY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	AUGUST S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
SEPTEMBER S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	OCTOBER S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	NOVEMBER S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	DECEMBER S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Spring

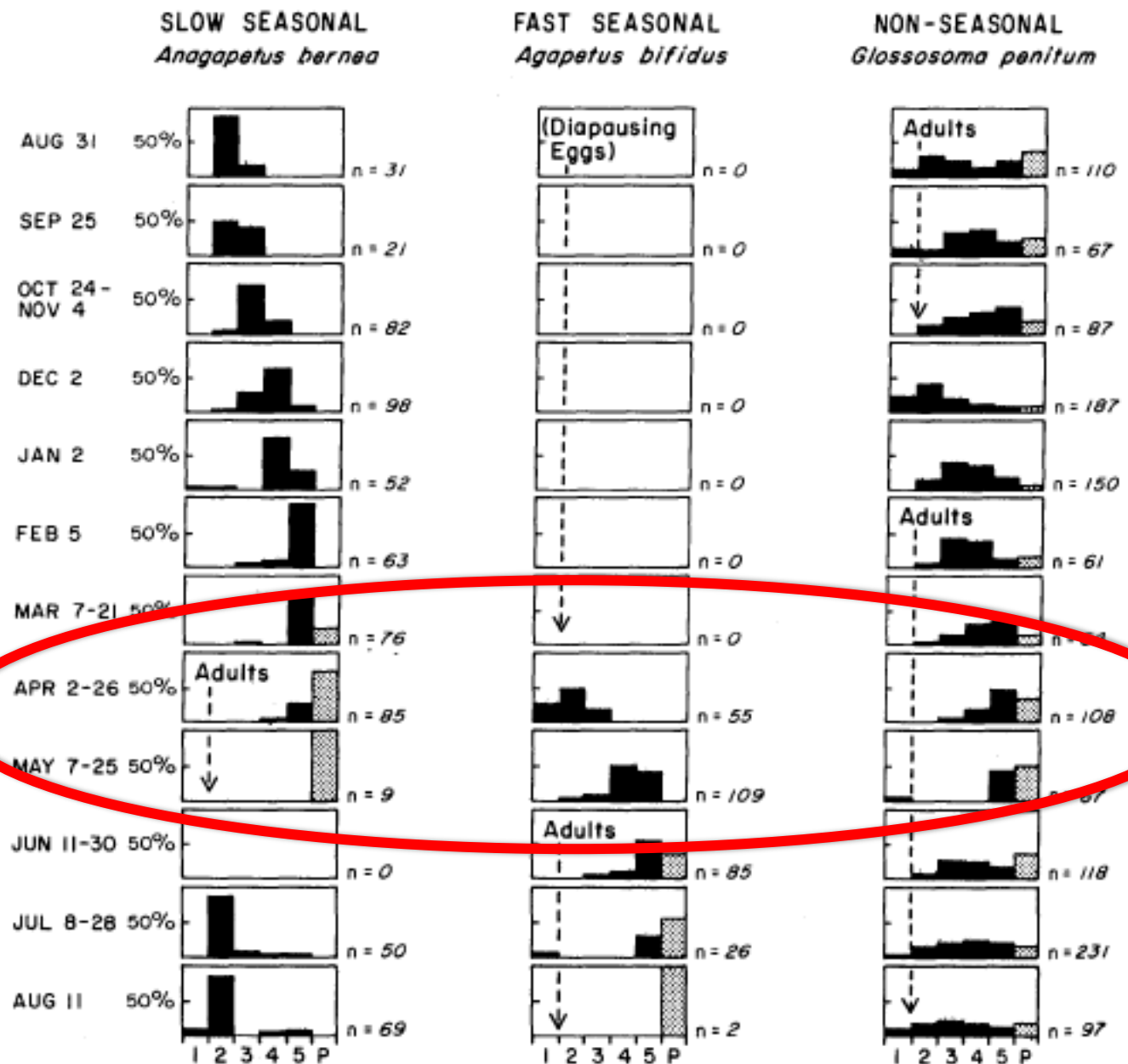


Figure 5.2. Age distribution of three glossosomatid caddisflies, illustrating life cycles. Field data are expressed as percentage composition per month for each instar. There are five larval instars; P = prepupa + pupa; n = number per sample. Flight period of adults is also indicated. (Data from Anderson and Bourne [1974].)

Spring

West Virginia North Fork River - Hatch Chart											
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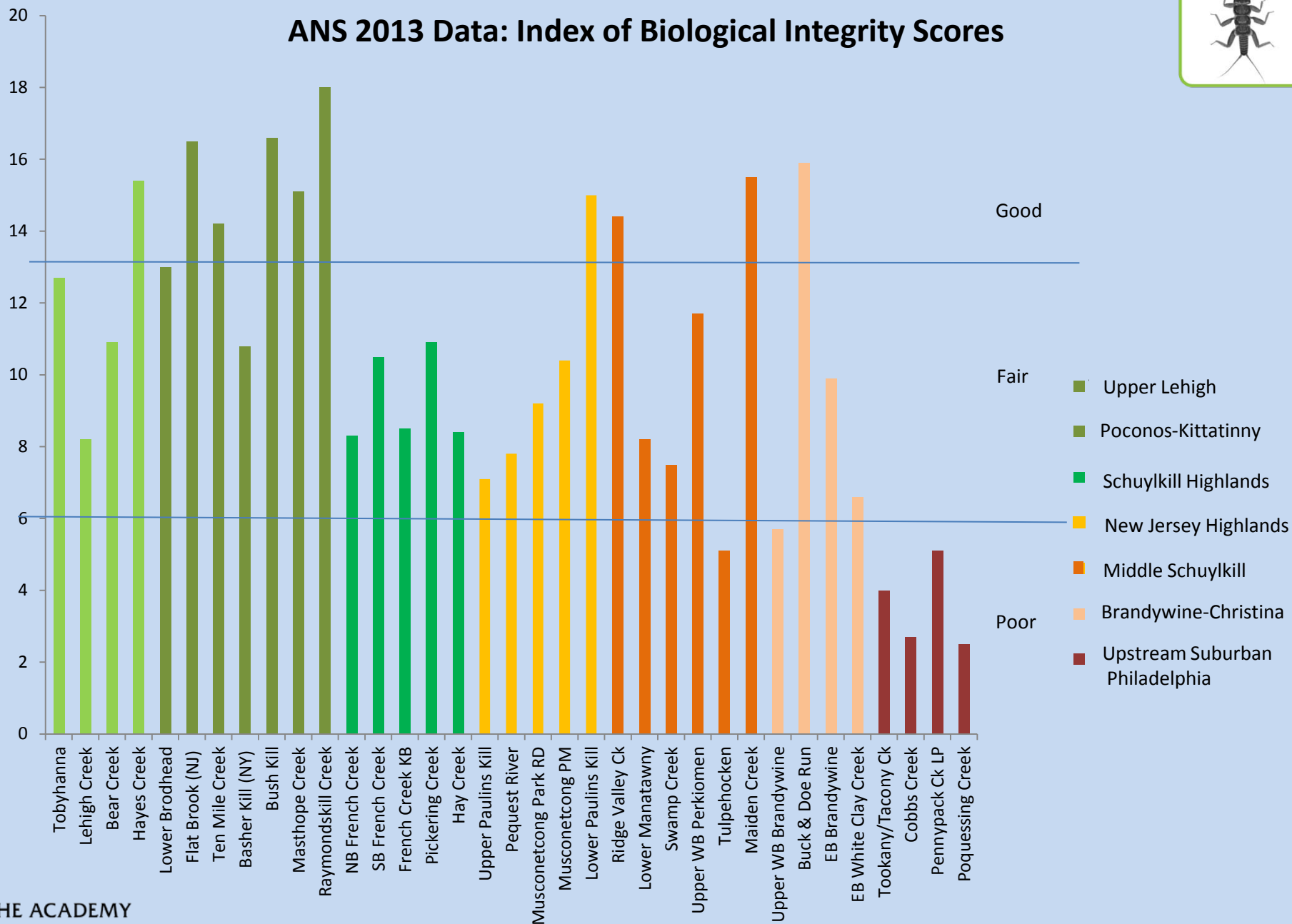
Mayfly Name	Mar				Apr				May				Jun				Jul				Aug				Sept				Oct				Remarks
Little Blue Winged Olive																												s18, early PM					
Quill Gordon																												s12, 14 early/mid PM					
Little Blue Quill																												s16, 18 late AM/early PM					
Henderickson																												s12,14 early/mid PM					
Gray Fox																												s12,14 early/mid PM					
March Brown																												a10,12 sporadic PM					
Green Drake																												s8,10 early/late PM					
Little Maryatt																												s14 late AM/late PM					
Sulfur Dun																												s12 late AM/late PM					
Little Sulfur Dun																												s18 mid/late PM					
Blue Winged Olive																												s12,14 AM sporadic					
Light Blue Winged Olive																												s16 AM sporadic					
Tiny White Winged Black																												s22,28 early AM/PM					
Dun Var Mahogany Dun																												s10,12 mid/late PM					
Light Cahill																												s12,14 PM sporadic					
Cream Variet																												s10 dusk late PM					
Pale Evening Dun																												s14,16 evening					
Yellow May																												a10,12 mid/latePM					
Dark Blue Quill																												s16,18 mid/late PM					
Week	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4					
*** Note: Hatch Chart based upon data from "Charlie Charmers"																													S - Hook Size &				
*** Start and End Dates may vary depending on weather																													Time of Day				

2013 Integrative site results



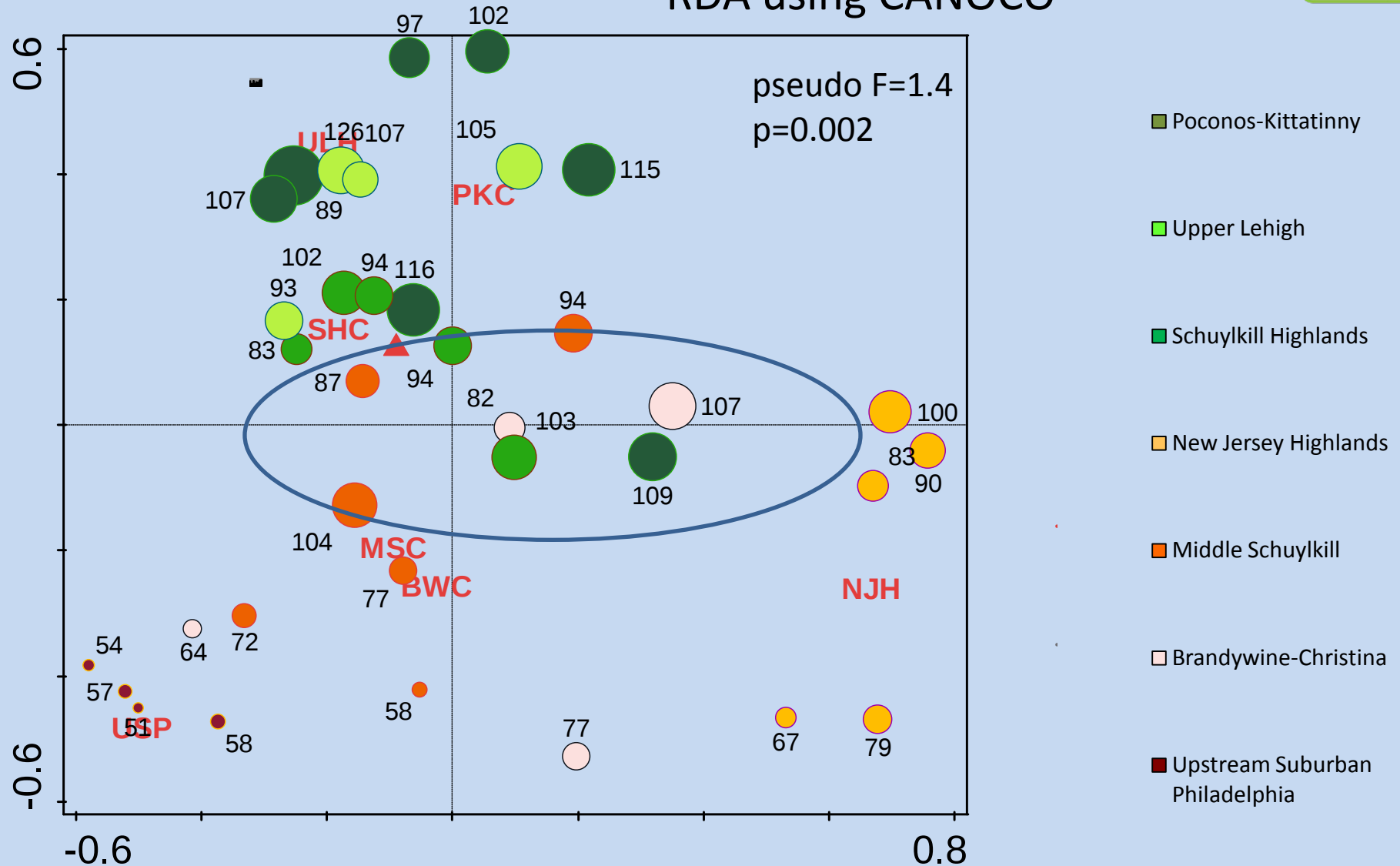


ANS 2013 Data: Index of Biological Integrity Scores



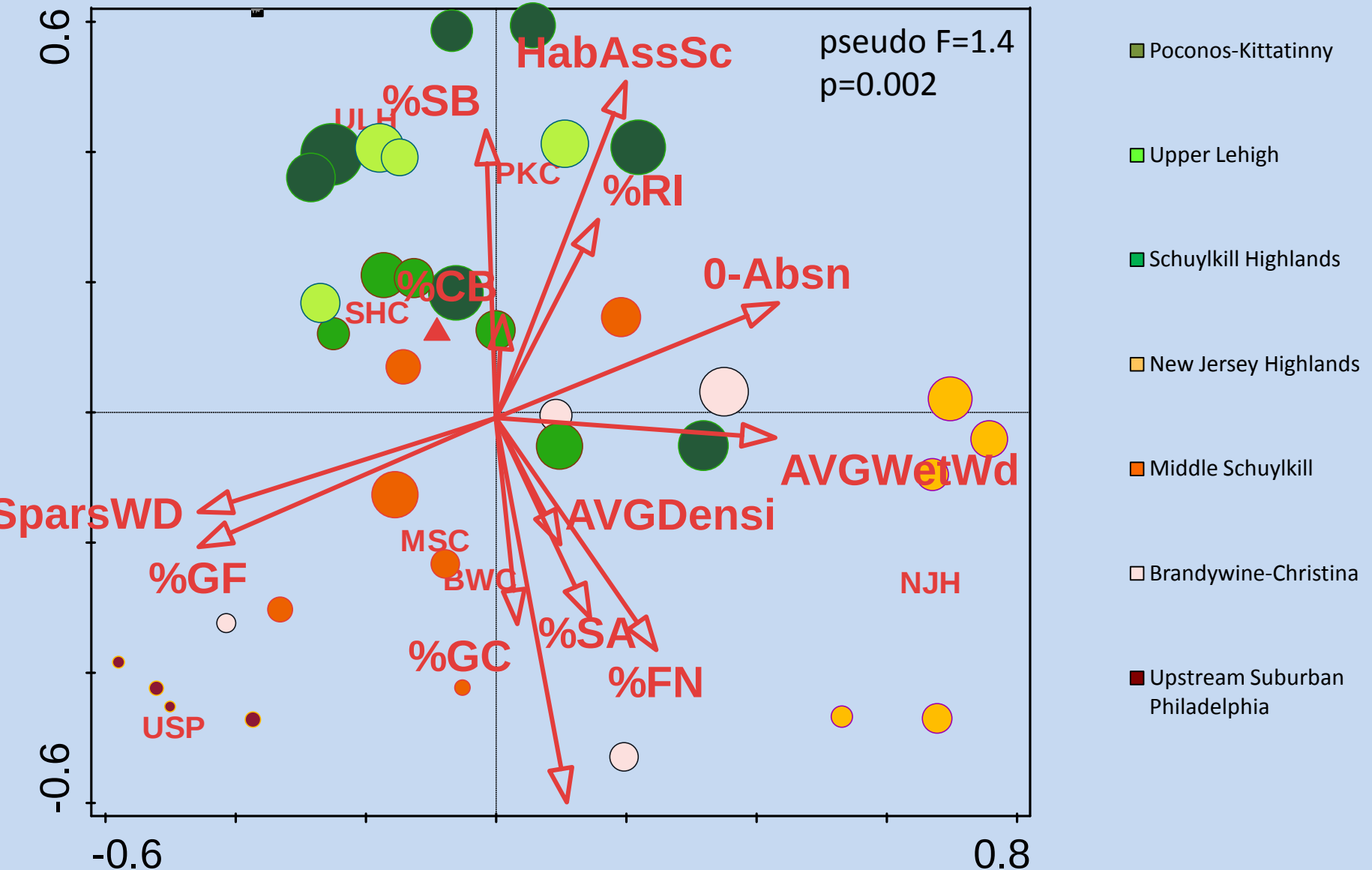
Macroinvertebrate species & habitat

RDA using CANOCO

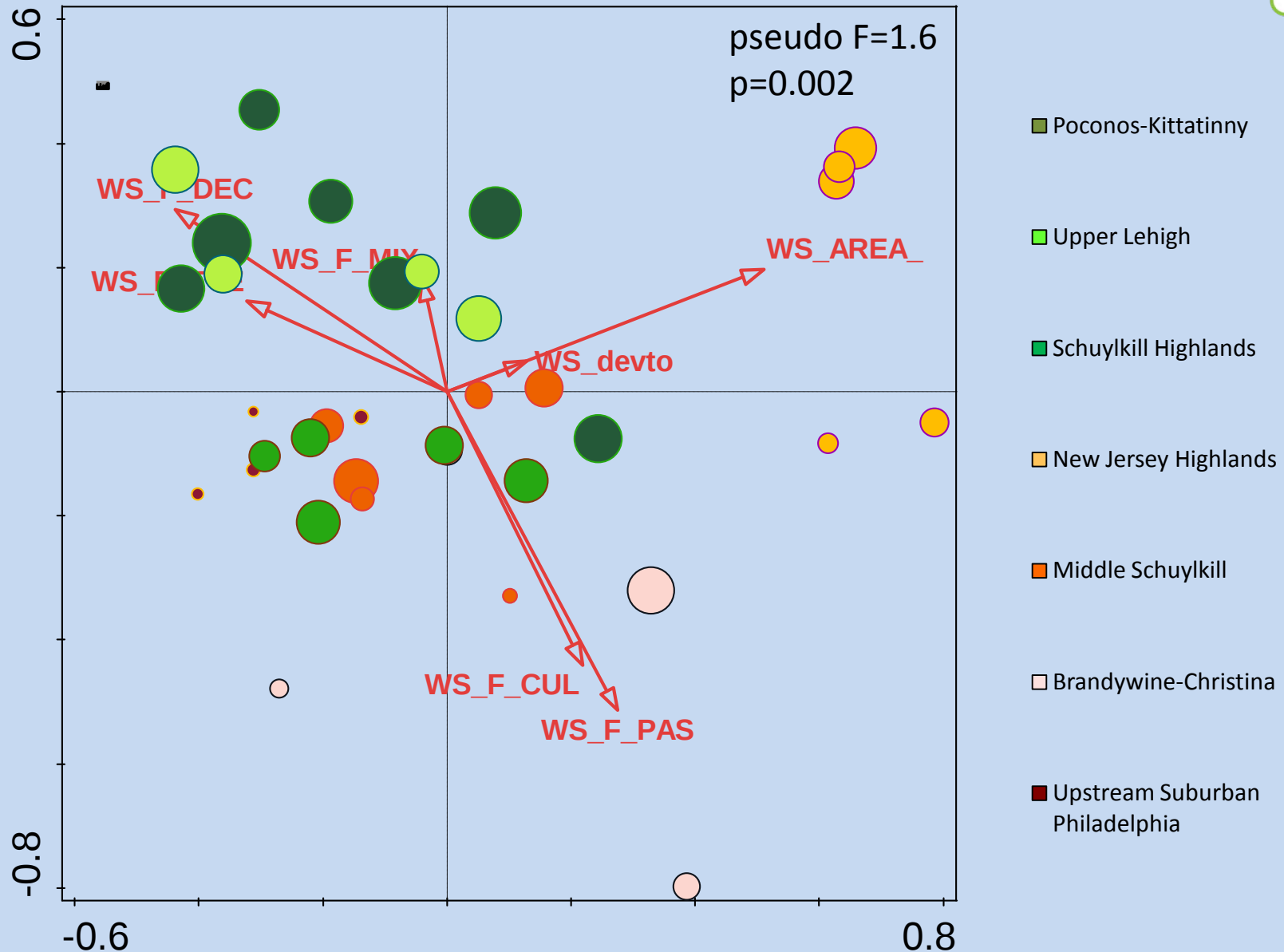


Macroinvertebrate species & habitat

RDA using CANOCO



Macroinvertebrate species & land use



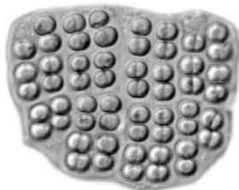
Indicator Species Analysis

Each cluster had at least 1 Indicator species

Cluster	Taxa, Pollution Tolerance Value (PTV)
Upper Lehigh	2 mayflies, 1 caddisfly (PTV=0-2), 1 midge (PTV=6)
Poconos-Kittatinny	2 mayflies, 1 fly (PTV=0)
Schuylkill Highlands	2 flies (PTV=5)
New Jersey Highlands	2 caddis (PTV=0-2), 1 mayfly (PTV=4), others (PTV=4-6)
Middle Schuylkill	1 mayfly (PTV=6)
Brandywine-Christina	1 mayfly (PTV=4), 1 midge (PTV=6)
Upstream Suburban Philadelphia	1 midge (PTV=6)

IndVal R package (DeCaceres, 2010
Dufrene & Legendre, 1997)

Indicators

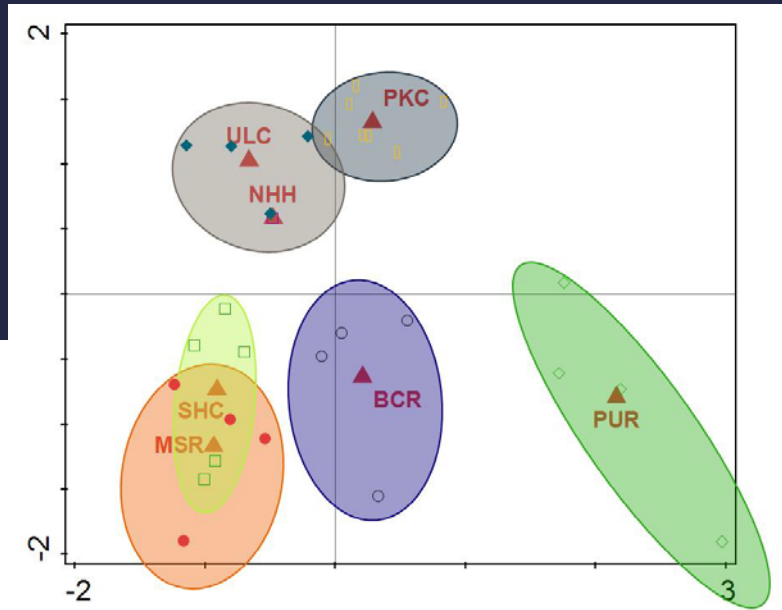
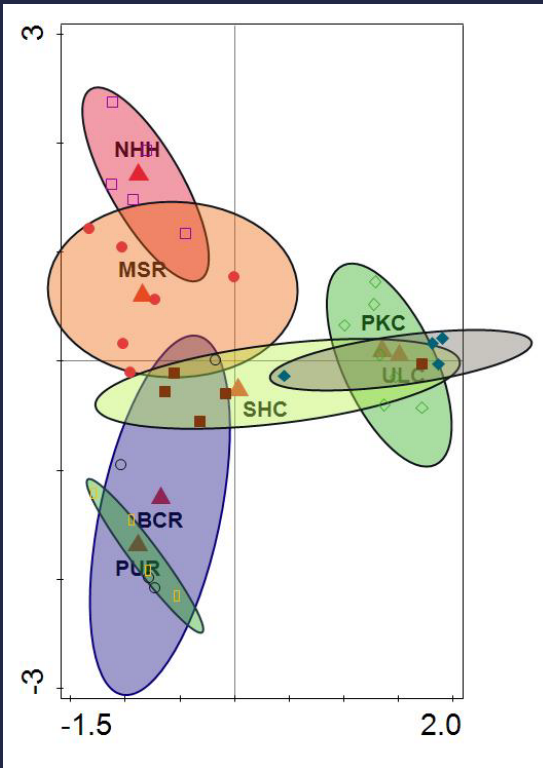


	No sites	Diatoms						Macrophytes						Invertebrates						Fish					
		max r^2		75 perc		share sg		max r^2		75 perc		share sg		max r^2		75 perc		share sg		max r^2		75 perc		share sg	
All mountain streams	87	•	0.37	•	0.24	●	85.2	•	0.36	•	0.20	●	62.1	•	0.31	•	0.23	●	84.4		0.16		0.09	●	46.4
All lowland streams	98	•	0.38	•	0.25	●	88.9	•	0.25		0.15	•	27.6		0.12		0.10	●	43.8		0.18		0.15	•	25.0
Lowland streams U15 U23	25		0.00		0.00		0.00	•	0.25		0.19		17.2		0.00		0.00		0.00	•	0.20		0.19		14.3
Lowland streams D03 K02	21	•	0.30	•	0.24	•	37.0	•	0.21	•	0.20		10.3	•	0.39	•	0.35		12.5	●	0.40	●	0.40		17.9
Lowland streams S05 S06	27	●	0.81	●	0.62	●	70.4	●	0.58	●	0.46	●	48.3	●	0.66	•	0.38	•	21.9	●	0.40	•	0.22	•	28.6
Lowland streams O02	25	●	0.56	●	0.40	●	70.4	•	0.38	•	0.38		13.8	●	0.44	●	0.41	•	31.3	•	0.20	•	0.20		3.6

Hering (2004)

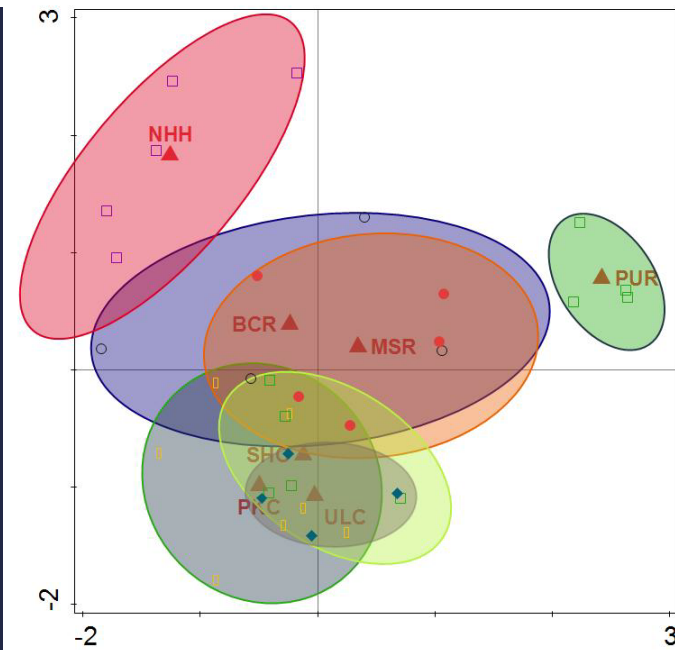
Indicator group ordinations

Algae



Macroinvertebrates

Fish



Next steps

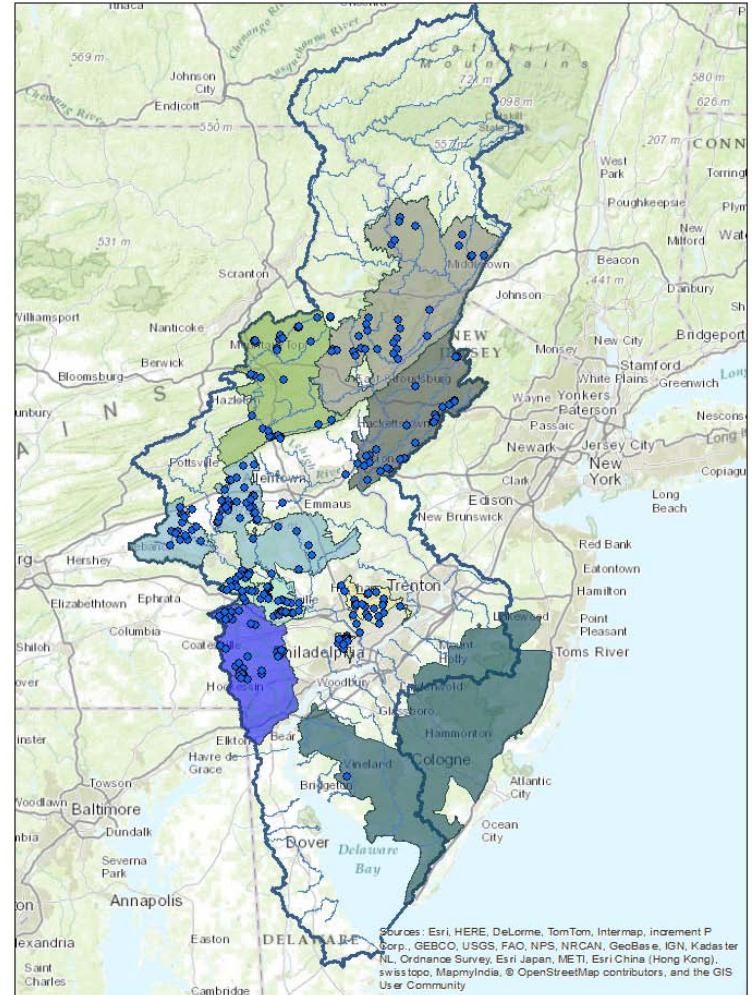
Functional analysis

Connectivity

Comparison with fish, algae

Use of 2014 data near projects

Adventive streams



Acknowledgements



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