VT EPSCoR Center for Workforce Development and Diversity

Miranda Lescaze
Declan McCabe
Bob Genter

Vermont EPSCoR
CWDD
Center for Workforce Development & Diversity
AT SAINT MICHAEL'S COLLEGE

Vermont EPSCoR

NSF

Vermont EPSCoR

CWDD

Center for Workforce Development & Diversity

AT SAINT MICHAEL'S COLLEGE

Goal: To increase the Vermont STEM workforce in size and diversity

Private Sector Technology Internship Program

The Vermont Technology Council is committed to helping connect in-state businesses with motivated, capable students, to the benefit of both. Businesses provide the opportunities; students provide the talent; and the Technology Council brings the two together.

Vermont Technology Council Internship Postings

Search:

Openings are still being added regularly, so keep checking!

To see all of the internships that have been filled CLICK HERE.

Company	City	State	Job Title	Job Responsibilities
Dan's, Inc	Burlington	VT	Web Developer - Perl	Dan's Inc is building a perl web app for schools, groups, and non-profits to use in the fundraising area. Our in-person salesforce will distribute the app, so it is not going to be sitting in an App Store with 500,000 other apps, hoping to get attention. As such, we expect many thousands people will use your code in the first year or two. Your job will be to build the site soup to nuts, working with Dan on the spec and the design, working to connect the app to other parts of the system that require connectivity, writing the code, and testing (with help from some of our testers), managing feedback, documenting.
DevSupport, LLD	Montpelier	VT	Unreal Engine Programmer	We are looking for a generalist programmer with Unreal 3 experience.
MBF Bioscience	w	v	Lab Technician	Use MBF products in a real lab environment. Acquire images for MBF and it's customers. Manage lab data and hardware.
MBF Bioscience	Williston	VT	Marketing Assistant	Provide assistance to the Marketing Director. Copy writing and editing. Website updates and product promotional material.
MBF	Williston	VT	Sales Assistant	Assist MBF's sales team. Coordinate information, manage data, assist in facilitating communication for

Governor's Institutes of Vermont

New Initiative - Scholarships

Students pursuing a STEM major in VT:

- Native American Scholarships
- First Generation Scholarships


SCHOLARSHIP AWARD

The Vermont EPSCoR
Center for Workforce Development and Diversity

proudly presents

Katie Bedard

with a $5,000 Native American Student Scholarship
for her pursuit of a STEM major in Vermont
Awarded August 16th, 2012

Dr. Judith Van Houten, State Director
Vermont EPSCoR

Miranda Lescaze, Director
Vermont EPSCoR CWDD

Flagship Program

Integrate students and teachers into EPSCoR research program

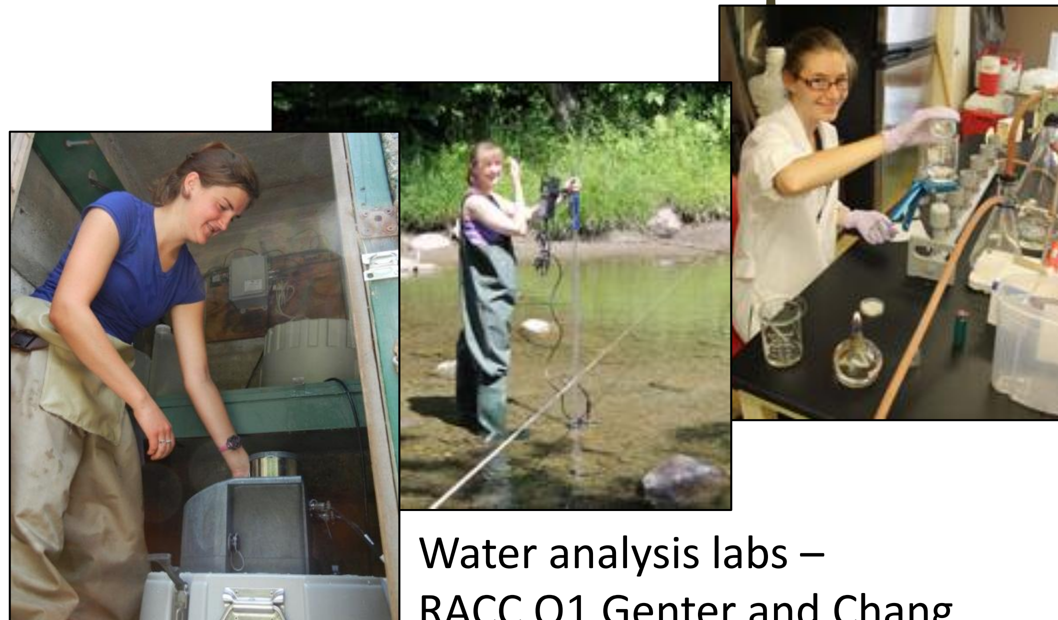
RACC
Research on Adaptation to Climate Change

RACC – Undergraduate Internships

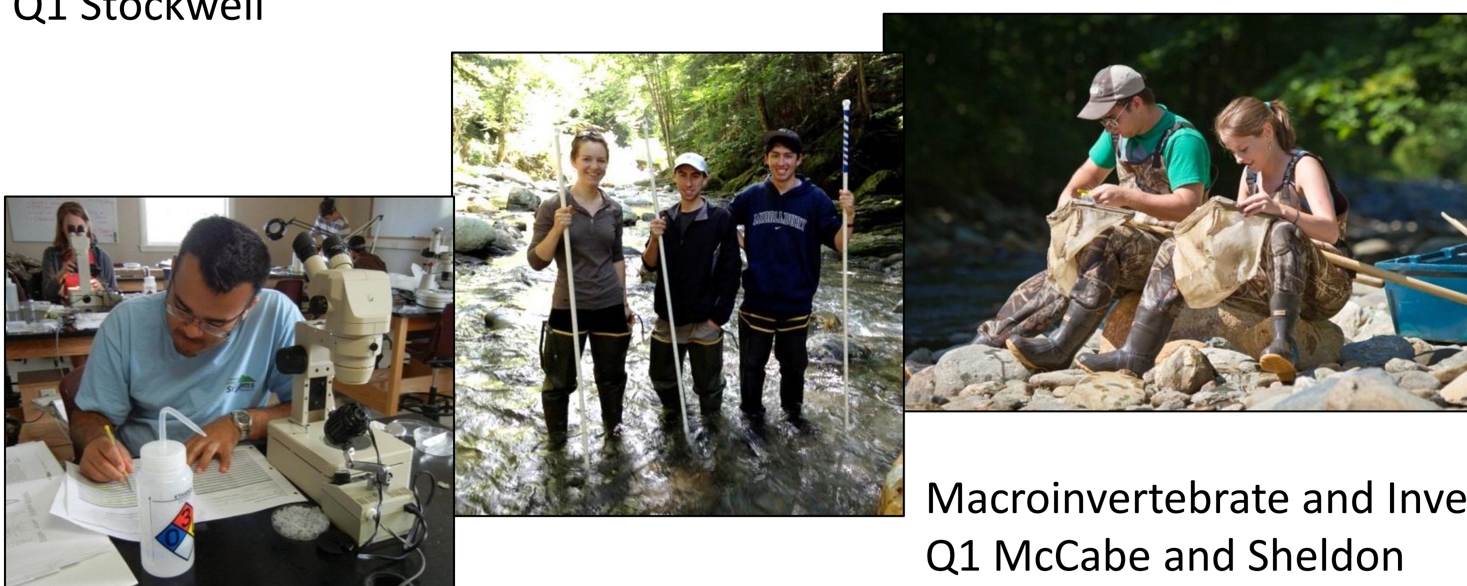
- Mentoring by RACC researchers
- Advancement of underrepresented minority students in STEM majors and careers

RACC – Undergraduate Internships

Lake Ecology lab –
RACC Q1 Stockwell

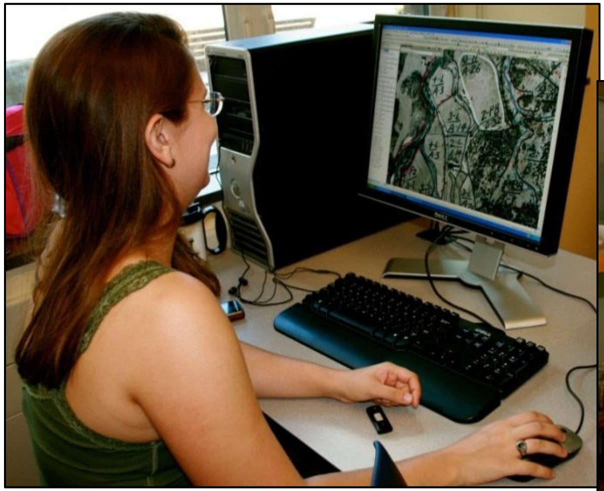


Water analysis labs –
RACC Q1 Genter and Chang



Macroinvertebrate and Invertebrate labs –
Q1 McCabe and Sheldon

RACC – Undergraduate Internships



Watershed Ecology and Hydrology labs –
RACC Q2 Bomblies, Wemple, Ross

Climatology labs –
RACC Q2 Dupigny-Giroux and Bacchus

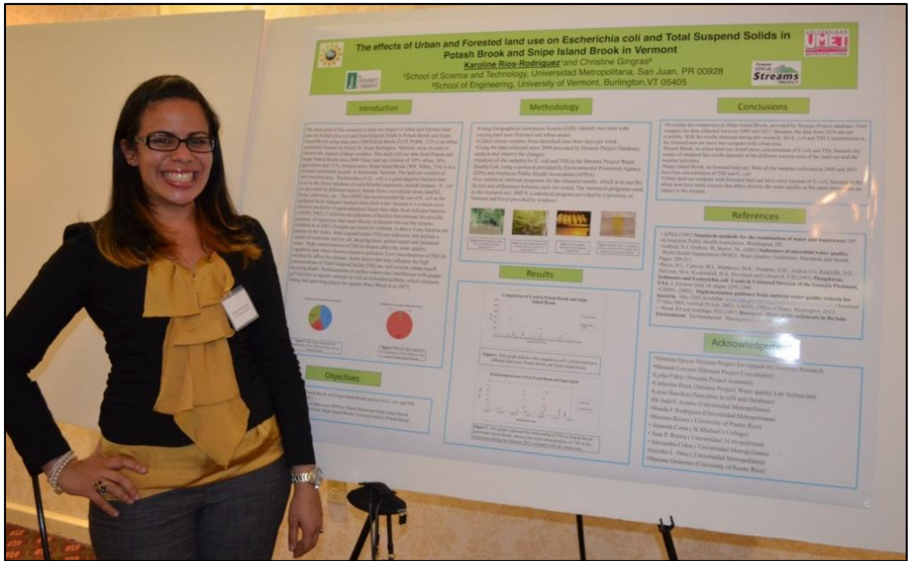
RACC – Undergraduate Internships

Environmental Policy and Management –
RACC Q3 Koliba , Zia and Kujawa

RACC – High School Program

The Streams Project:

- Experience in active research
- Advancement of underrepresented minority students in STEM majors and careers



The Streams Project

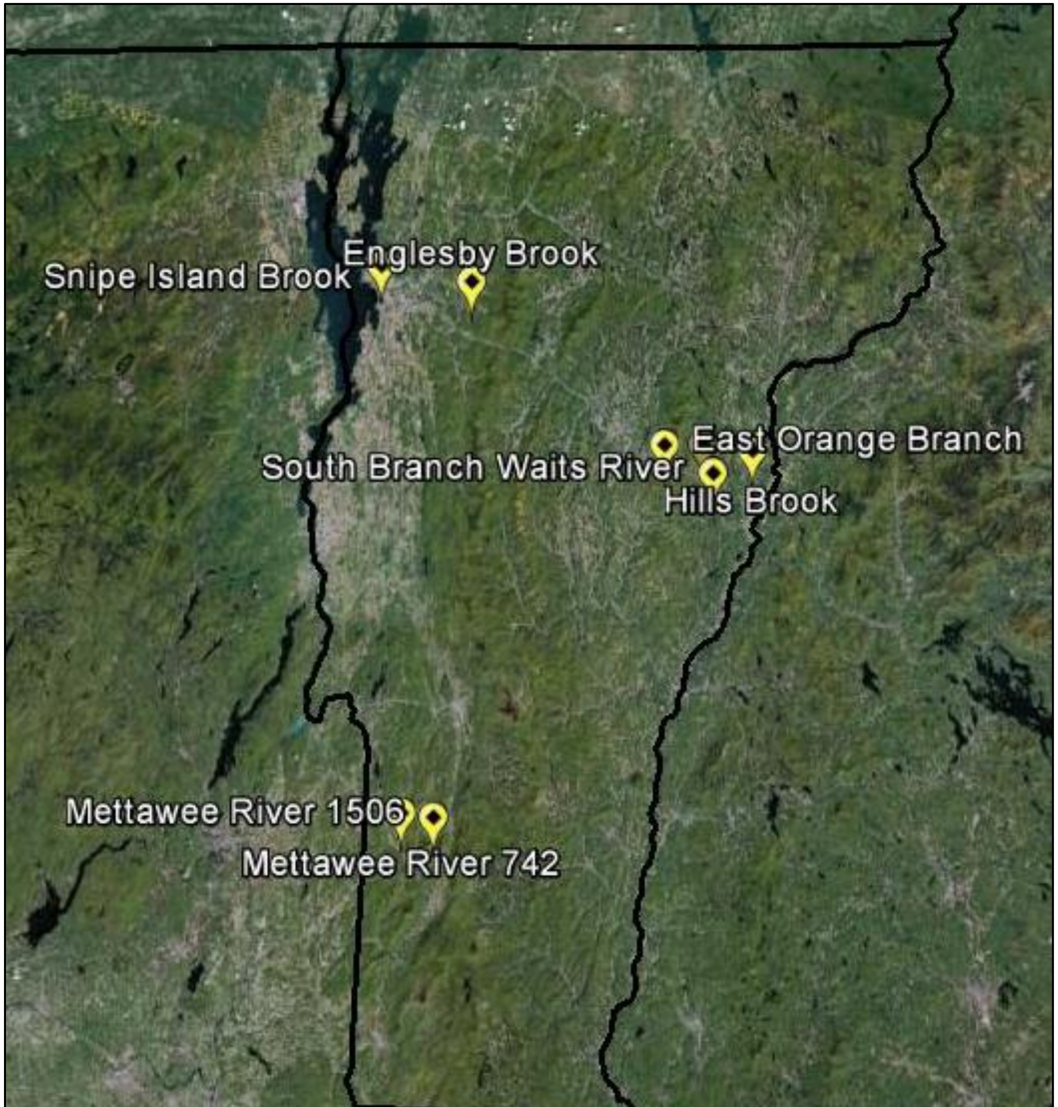
- Collect stream data - distributed network
- Community research – land use in response to a changing climate

The Streams Project

- Training week: Systems thinking, climate literacy, watershed ecology field and lab skills
- Precipitation monitoring: CoCoRaHS network
- Stream site data collection

Stage Sensor Sites

Macroinvertebrate Sites



Water Analysis Labs

- St. Michael's College – TSS analysis
- Johnson State College – Nutrient analysis

Water Analysis Lab
Johnson State College

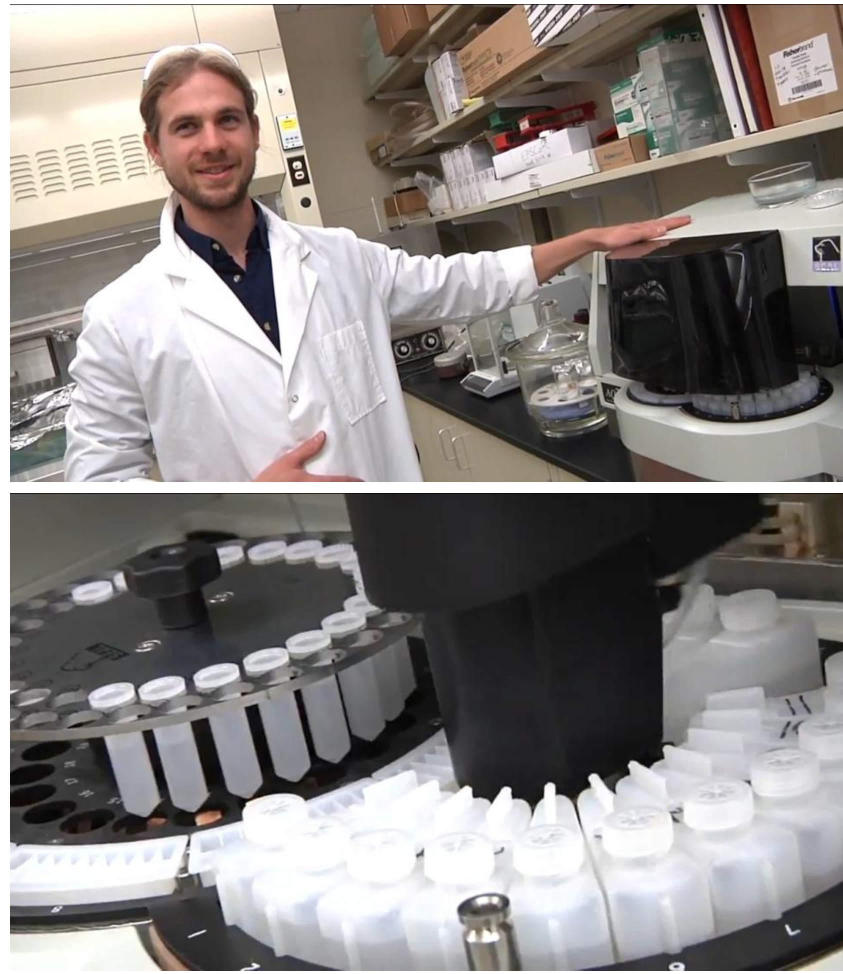
Bob Genter
Professor of Biology
Johnson State College, VT
16 August 2012

Sample Sources

- Chemical analysis of river and lake water
  - Lake Champlain – 1 ISCO site (May – Oct.)
  - Mississquoi River – 3 ISCO sites (May – Oct.)
  - Winooski River – 5 ISCO sites (May – Oct.)
  - Lamoille River – 19 sites (summer)
- Microbial source tracking for *E. coli*
  - Lamoille River – 19 sites (summer)

Chemical Analyses

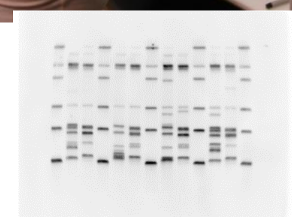
- Saul Blocher
  - Coordinating with Katie Chang, St. Michael's College
- Analytes
  - Phosphorus
    - Total P
    - Total dissolved P
    - Soluble reactive P
  - Nitrogen
    - Total N
    - Total dissolved N
    - Ammonia
    - Nitrate



Seal AQ2

Microbial Source Tracking for *E. coli*




Acknowledgements

Thank you Students

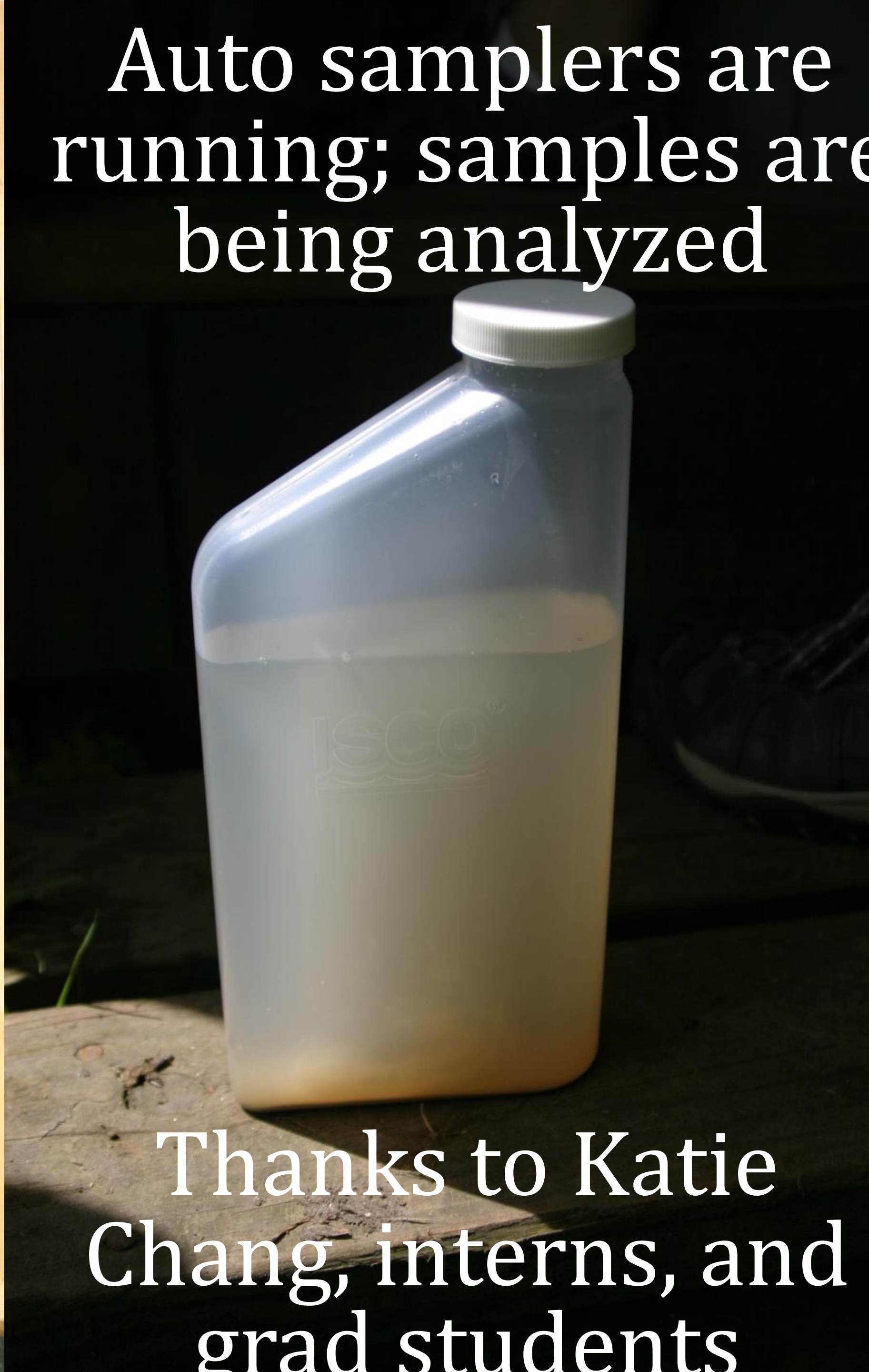
- Greg Perry
- Tim Thurston
- Benjamin Kirchner
- Jake Van Gorder
- Danielle Mendes
- Ryan Joy
- Saul Blocher
- Ben Massey
- Abbie Murphy
- Helen Birk
- Laura Salazar
- Gabriel Pérèz-Beyer
- Allie Compagna
- Corynne Dedeo
- Rebecca Richert
- John Dawkins

Acknowledgements

- Vermont EPSCoR
  - Judy Van Houten, Kelvin Chu
  - Miranda Lescaze, Kathyjo Jankowski, Liza Ray
  - Lexi Hazelton, Dawn Shackelton, Lydia Pitkin
- Jim Ryan, VTDEC
- Kim Komer & Christina Goodwin, Lamoille Valley Natural Resources Conservation District
- Catherine Donnelly, DJ D'Amico, Errol Groves
- Saul Blocher, Keith Kirchner, Barbara Murphy, Sharron Scott, Sandy Duffy, Nancy Hutchins, Nita Lanphear, Sue Mann, & EHS Department, JSC

Saint Michael's College Water Quality Lab objectives

1. Establish lab protocols, techniques, etc.
2. Install and operate Winooski tributary ISCOs
3. Coordinate storm sampling
4. Train high school teams and install stage sensors etc



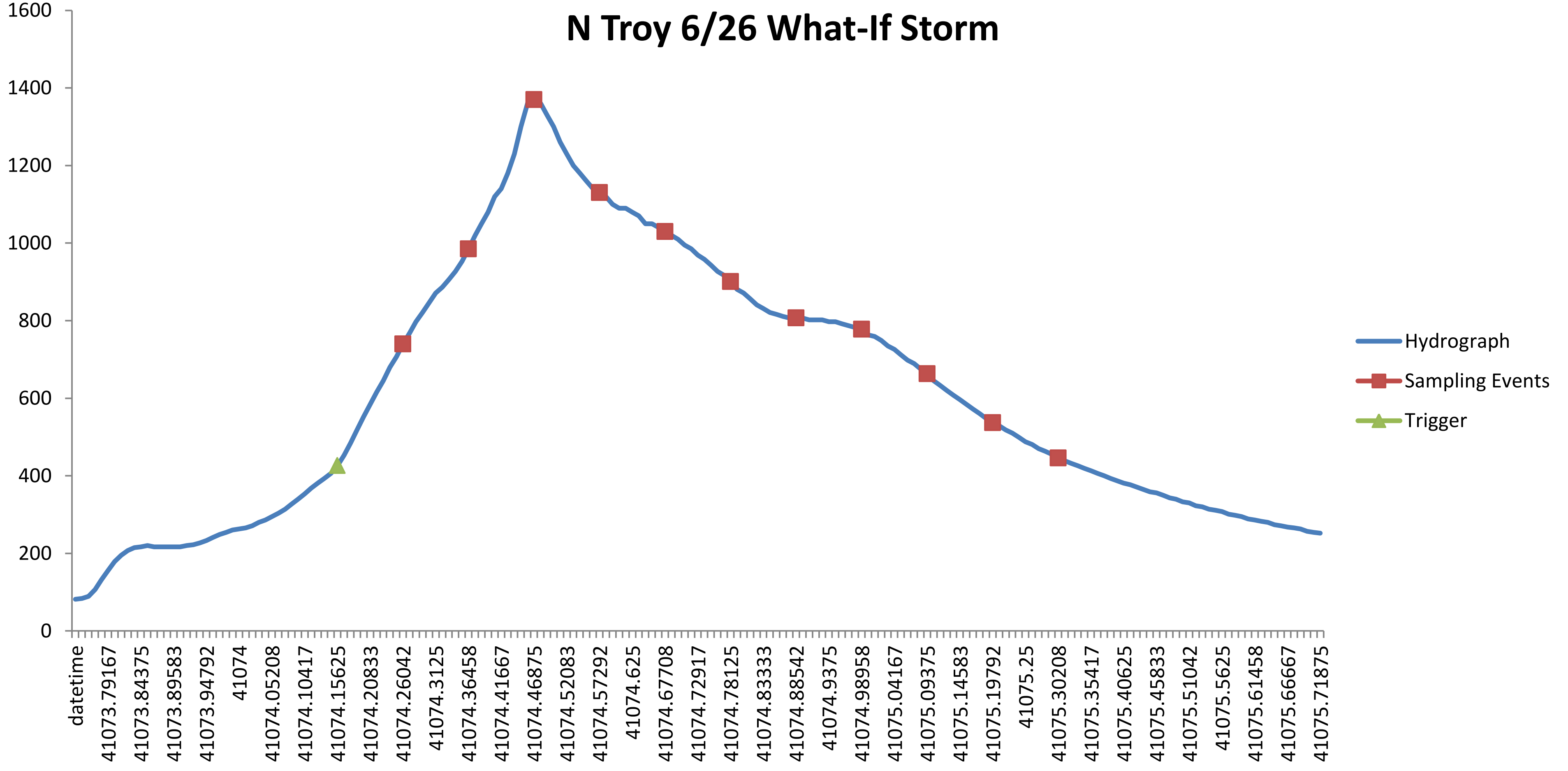
Auto samplers are running; samples are being analyzed

Thanks to Katie Chang, interns, and grad students

Saint Michael's water quality interns

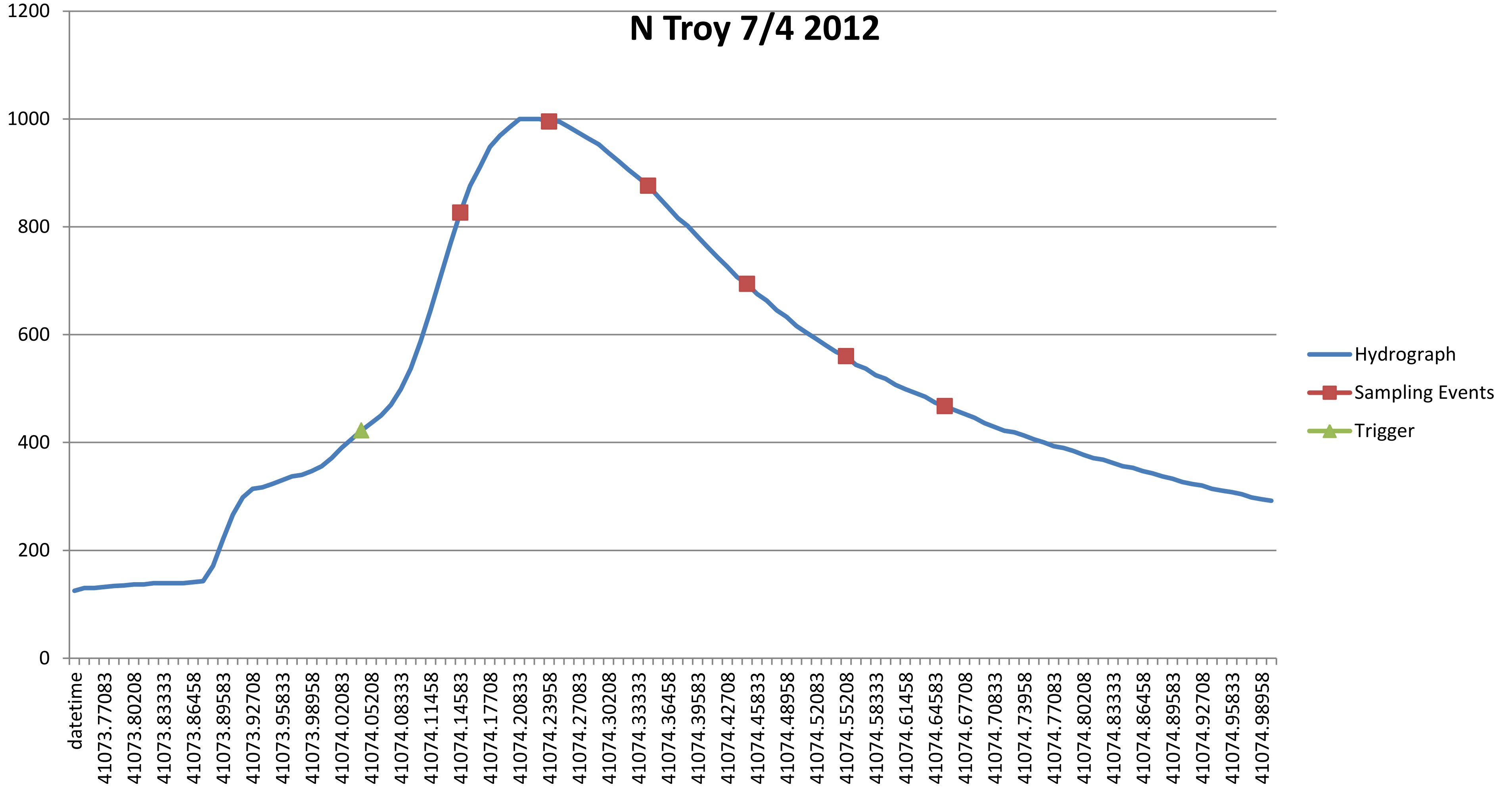
ISCOs programed for large storms

- 1 storm per month based on past site hydrographs
- Idealized storm using timed sampling:



Example of actual storm

- Stage-based sampling will better represent entire storm



Lab logistics!

- Interns sampled 3 storms
- Grad students have been actively involved in sampling and we will rely upon them more in late summer/fall
- Delivery of lake samples has worked perfectly and we are ahead of the sample load

Sample summary from Katie Chang

- As of August 5: 3 storms; 79 samples
- Allen Brook, N Troy, and Swanton sampled in all storms
- East Berkshire, Mad River, and Essex Junction Have been sampled at least once
- No samples from Winooski @ Montpelier

High school training

High school training

Sensor installation

Macroinvertebrate research

- Current field season
  - Baseline & post-storm sampling from gaged sites
  - Sediment manipulation in Browns River
  - Flow effects manipulation planned

- Ongoing modeling project; 53 site database; modeling watershed effects on invertebrate communities

- Recent work on standardizes effect size

Sampling

- Each stream:
- 4 samples taken using kick nets
- Identification by student interns
- EPA's preferred 14 metrics for rapid bioassessment calculated

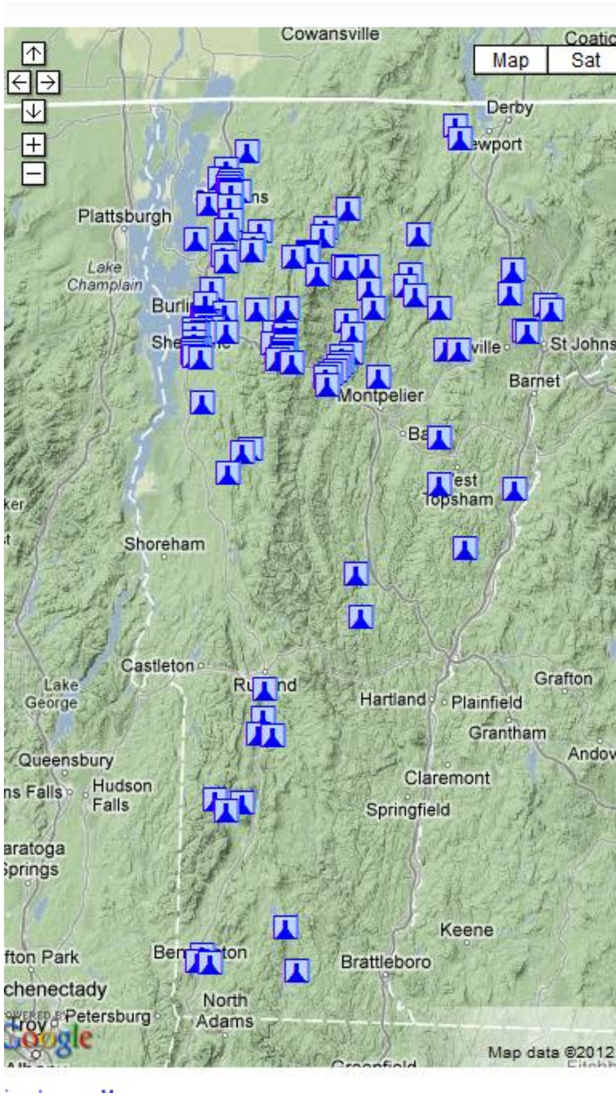
Samples serve many purposes

- Primary research questions
- Intern presentations (ASLO; LCRC; SACNAS etc.)
- High school outreach support

Landscape Model with Phil Yates

- GIS-derived watershed characterization
- Reclassified 2006 C-CAP (Costal Change Analysis Program) land coverage data

- Macroinvertebrate variables from 2008 through 2010
- Sum of 4 samples used to characterize each of 53 streams; along an urban/forested gradient



Landscape parameters

Catchment Area Acres

Agricultural Acres

Percent Catchment Agricultural

Urban Acres

Percent Catchment Urban

Forested Acres

Percent Catchment Forested

Upstream Distance Lake Pond (m)

Upstream Distance Dam (m)

Upstream Distance Bridge (m)

Upstream Distance Culvert (m)

Distance To Tributary Mouth (m)

Percent Catchment Highly Erodible Soils

Stream Order

E911 Structure Count

E911 Structures per Acre

E911 New 2008

Stream Gradient for 100m Stream Segment

Aspect for 100m Stream Segment Buffer

Sinuosity

Dominant Bedrock Class

Average Catchment Area Elevation (m)

Monitoring Site Elevation (ft)

Length Road Network in Catchment (km)

Length Road Network in Catchment (m)

Length Road Network Gravel (km)

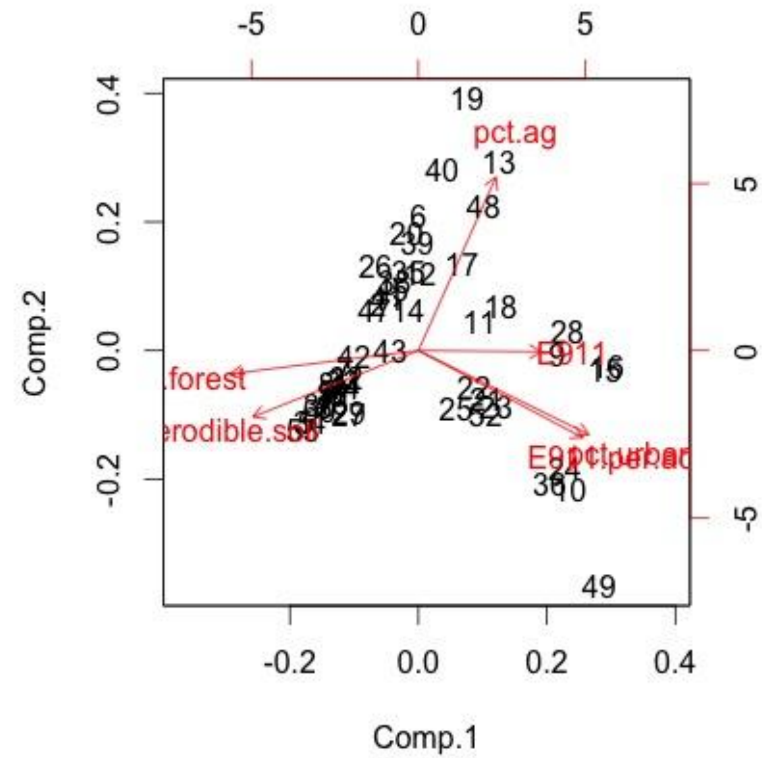
Length Road Network Gravel (m)

Parameters in the GAM

- Catchment Area Acres
- Forest principal component
- Agricultural component
- Upstream Distance Lake Pond (m)
- Upstream Distance Dam (m)
- Upstream Distance Bridge (m)
- Upstream Distance Culvert (m)
- Distance to Tributary Mouth (m)
- Stream Gradient for 100m Stream Segment
- Aspect for 100m Stream Segment Buffer
- Sinuosity
- Dominant Bedrock Class

Model details

- Principal components analysis used to generate a landscape axis that best explained each macroinvertebrate response variable



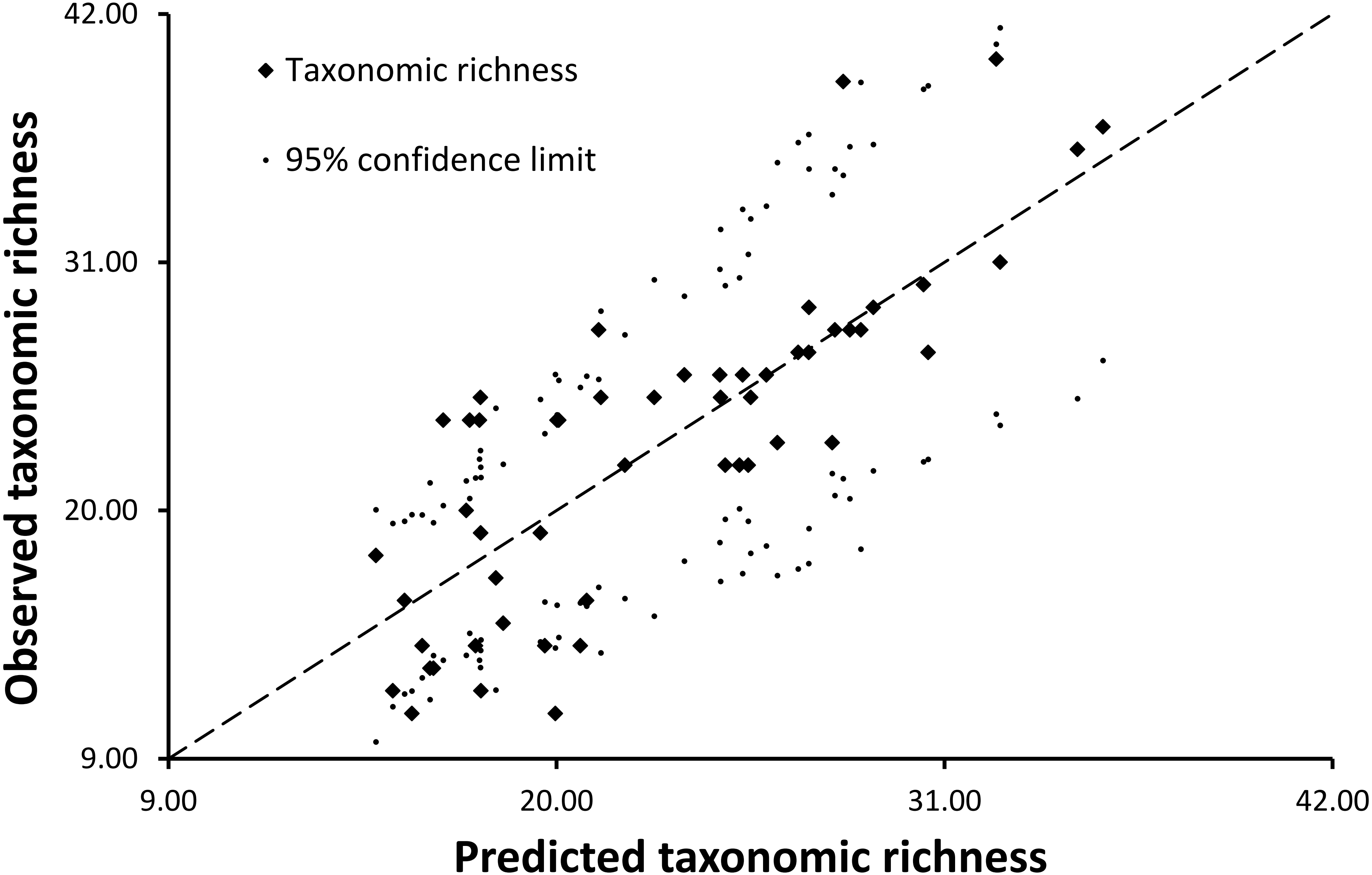
Model details

- GIS data used to predict occurrence of each species along the PCA axis based on a binary distribution

- The predicted species present data are summed to yield a predicted community

- Standard metrics can be measured from the predicted community and compared to observed

Example



Taxonomic richness
95% confidence limit
Observed taxonomic richness
42.00
31.00
20.00
9.00
9.00
20.00
31.00
42.00
Predicted taxonomic richness

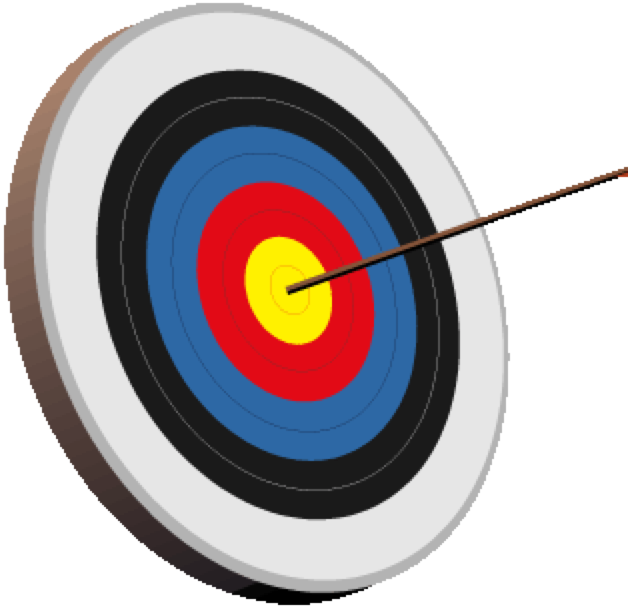
Which index best responds?

- Metrics yielding models with the tightest fit:
  - % filterers; % Ephemeroptera; % grazers; % clingers
- Metrics specifically responding to land use:
  - Forested land increased % EPT & % Ephemeroptera
  - Agricultural land increases % filterers & % clingers
- Metrics that could not be modeled:
  - Plecoptera richness; Trichoptera richness; # of intolerant taxa

Next steps

- Test the models using 6 new sites ranging in land use

- Generate expected metric values based upon GIS derived parameters



Techniques and Indices for Biomonitoring

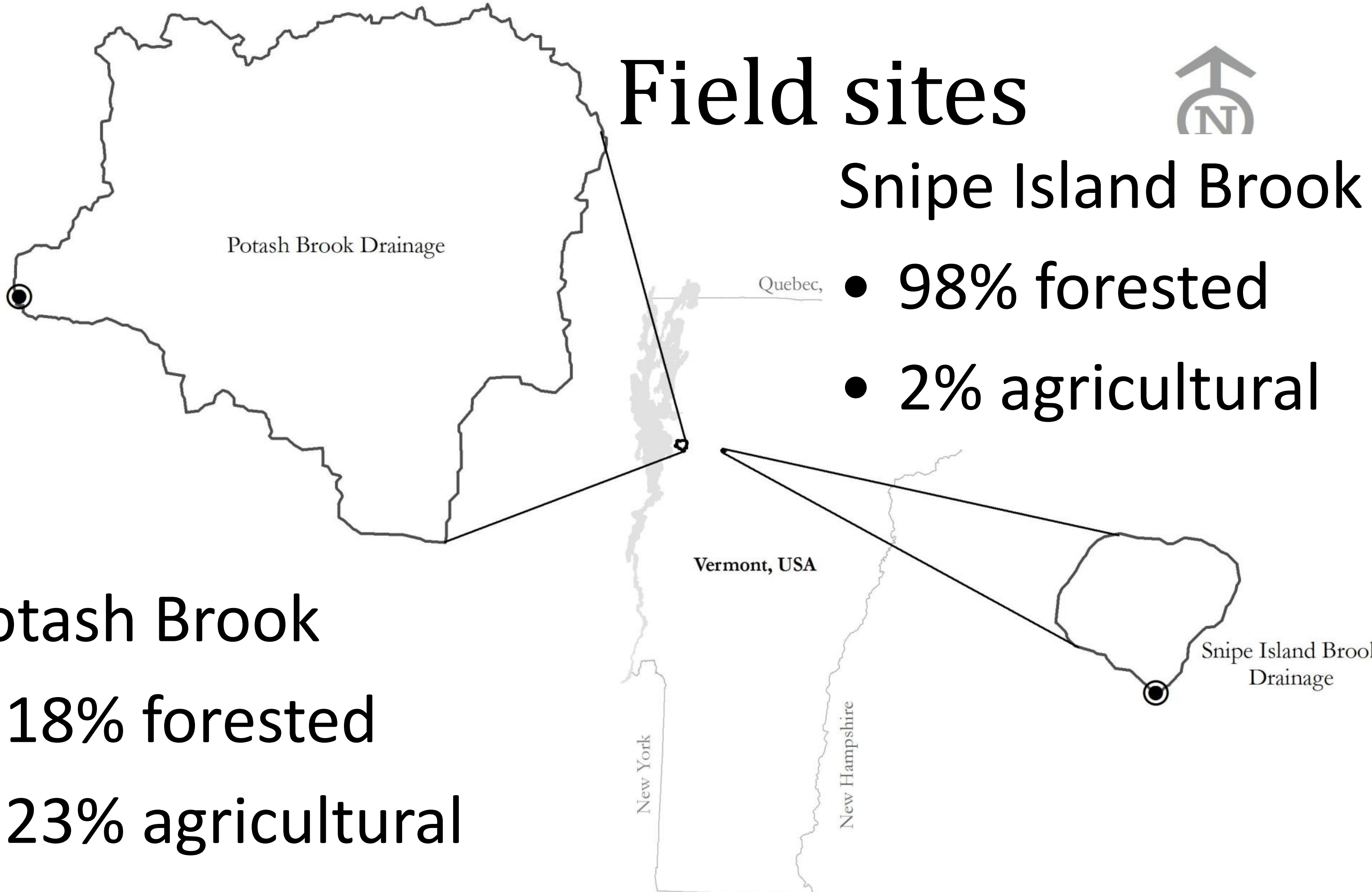
Declan McCabe

With indispensable help from:

Kaitlyn Berry; Alex Canepa; Tyler Gillingham; Erin Hayes-Pontius; Bridget Levine; Lexie Haselton

Work made possible by funding from Vermont EPSCoR with additional support from Saint Michael's College

Field sites



Snipe Island Brook

- 98% forested
- 2% agricultural

Potash Brook

- 18% forested
- 23% agricultural
- 38% urban

- Starting premise:

<u>These sites differ!</u>

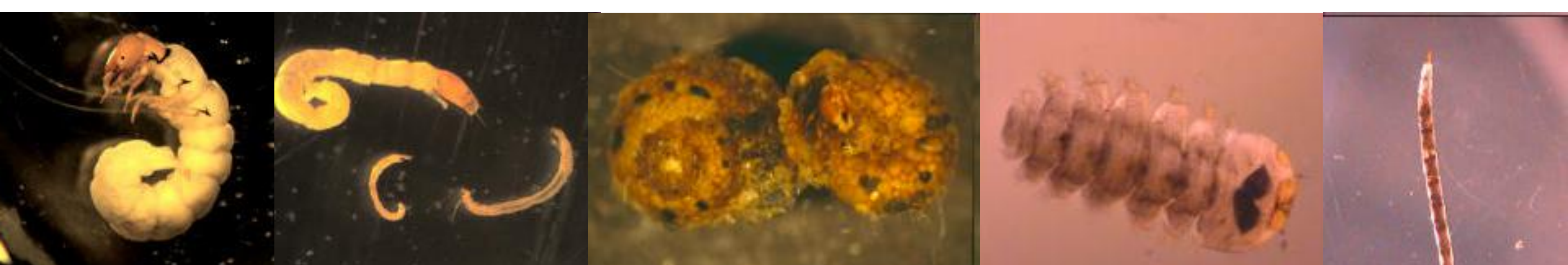
Experimental design

- 2 streams (forested & urban)
- 3 techniques: kick nets; Hester-Dendy multiplate samplers; bricks
- 4 time periods; 5 replicates per technique
- 120 samples; 7,470 macroinvertebrates

Why?

- Artificial substrate samples are considered more consistent than net samples (lower variance)

- Side-by-side comparisons are uncommon



What to measure?

- EPA's 14 candidate benthic metrics for measuring effects of perturbation (Barbour *et al* 1999):
- Vermont Departmental of Environmental Conservation biocriteria (2004)
- Merritt, Cummins, and Berg (2008)

Richness measures

Total No. taxa

No. EPT taxa

No. Ephemeroptera Taxa

No. Plecoptera Taxa

No. Trichoptera Taxa

Composition measures

% EPT

% Ephemeroptera

No. of Intolerant Taxa

Tolerance/Intolerance measures

% Tolerant Organisms

% Dominant Taxon

Feeding measures

% Filterers

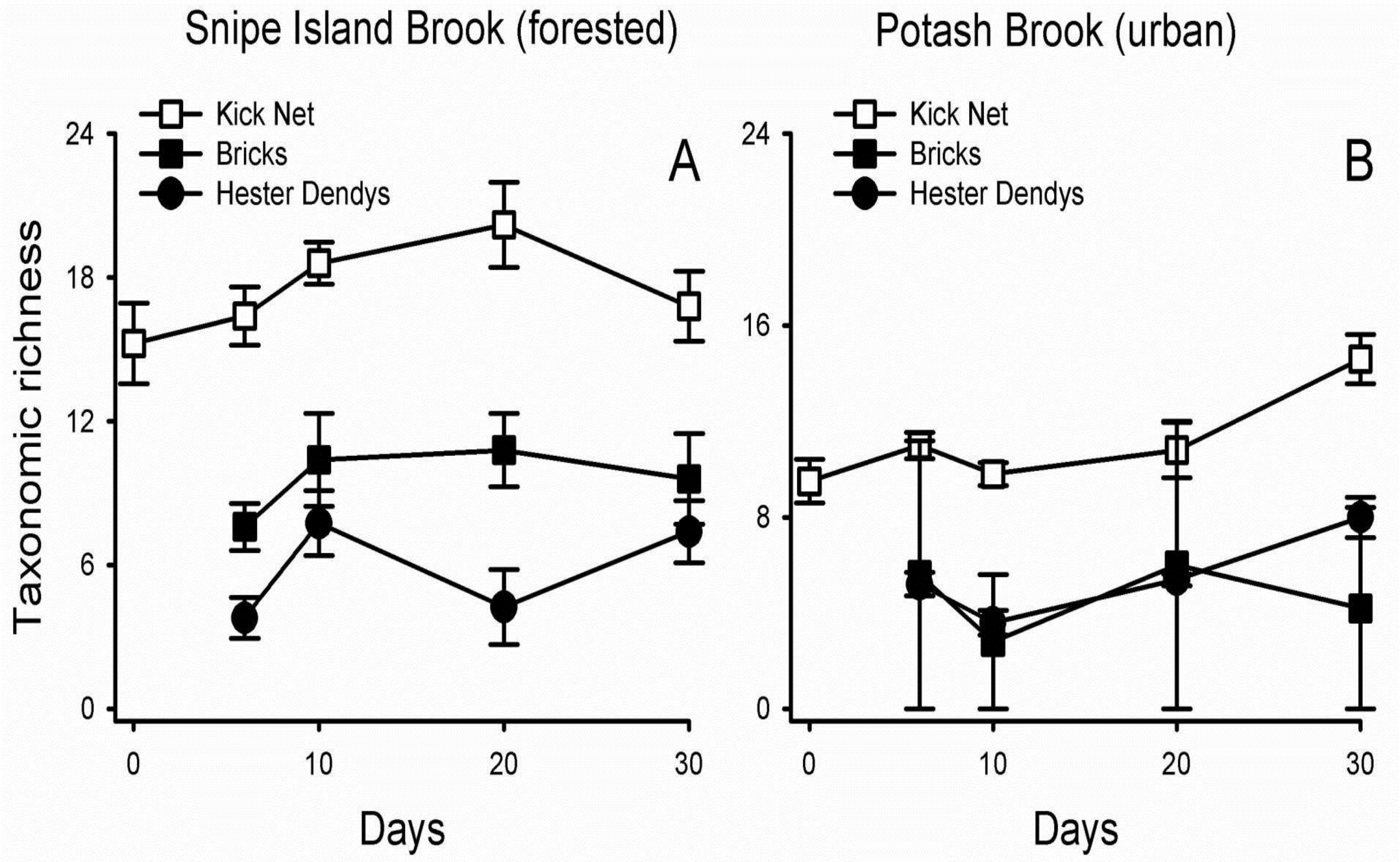
% Grazers and Scrapers

Habit measures

Number of Clinger Taxa

% Clingers

Results



Snipe Island Brook (forested)
Potash Brook (urban)
Kick Net
Bricks
Hester Dendys
A
B
Taxonomic richness
24
18
12
6
0
16
8
0
10
20
30
Days

Evaluating techniques!

	Days: 6, 10, 20, 30	EPA's prediction	Our observations
Richness measures	N: 5-5, 4-5, 5-5, 5-5		
Total No. taxa	0.004, 0.000, 0.002, 0.254	Decrease	d, d, d, -
No. EPT taxa	0.007, 0.000, 0.000, 0.067	Decrease	d, d, d, -
Ephemeroptera Taxa	0.002, 0.000, 0.000, 0.108	Decrease	d, d, d, -
No. Plecoptera Taxa	0.020, 0.005, 0.001, 0.152	Decrease	d, d, d, -
No. Trichoptera Taxa	0.481, 0.585, 0.105, 0.637	Decrease	-, -, -, -
Composition measures			
% EPT	0.000, 0.004, 0.003, 0.015	Decrease	d, d, d, d
% Ephemeroptera	0.001, 0.000, 0.000, 0.018	Decrease	d, d, d, d
No. of Intolerant Taxa	0.025, 0.000, 0.001, 0.004	Decrease	d, d, d, d
Tolerance/Intolerance			
% Tolerant Organisms	0.000, 0.005, 0.010, 0.922	Increase	i, i, i, i
% Dominant Taxon	0.000, 0.001, 0.003, 0.154	Increase	i, i, i, -
Feeding measures	*Etc etc etc.........*		

- *t* test each of 4 days for each technique
- 14 variables
- 56 chances to tell sites apart using each technique
- Count!

Which technique works best?

How often differences between streams were detected:

- Nets: 35 (+ 4 opposite hypothesized direction) *one visit; reusable*
- Bricks: 34 (+ 2 opposite hypothesized direction) *two visits; $0.85 per replicate*
- Hester Dendy samplers: 17 (+ 1) *two visits; $20 per replicate*

- Nets w second!

Which metric?

		required *N*	EPA prediction	Observed response
NSD means even with N = 24 - NSD; true also for abundance				
Richness measures	Total No. taxa	4	Decrease	Decrease
	No. EPT taxa	3	Decrease	Decrease
	No. Ephemeroptera Taxa	3	Decrease	Decrease
	No. Plecoptera Taxa	8	Decrease	Decrease
	~~No. Trichoptera Taxa~~	~~NSD~~	~~Decrease~~	-
Composition measures	% EPT	3	Decrease	Decrease
	% Ephemeroptera	3	Decrease	Decrease
	No. of Intolerant Taxa	7	Decrease	Decrease
Tolerance/Intolerance measures	% Tolerant Organisms	3	Increase	Increase
	% Dominant Taxon	4	Increase	Increase
Feeding measures	% Filterers	5	Variable	Increase
	~~% Grazers and Scrapers~~	~~NSD~~	~~Decrease~~	-
Habit measures	~~Number of Clinger Taxa~~	~~11~~	~~Decrease~~	~~Decrease~~
	% Clingers	4	Decrease	Increase

Some are also easier to measure!

More interesting questions?

- Null-hypothesis testing dominates biological sciences

$p > 0.05$

$p < 0.05$

Problems!

Other problems

- Null hypothesis is never true
- $p < 0.05$ is arbitrary
- Limited conclusions: *“ different ”* / *“ not different ”*
- We don’t answer this question:

“ How different? ”

But we can……….

Standardized effect size

- Measure the difference between means (eg abundance) between two sites
- Divide that difference by pooled sample standard deviation

$$d = \frac{\bar{X}_1 - \bar{X}_2}{s}$$

- Result: size of difference expressed in standard deviations

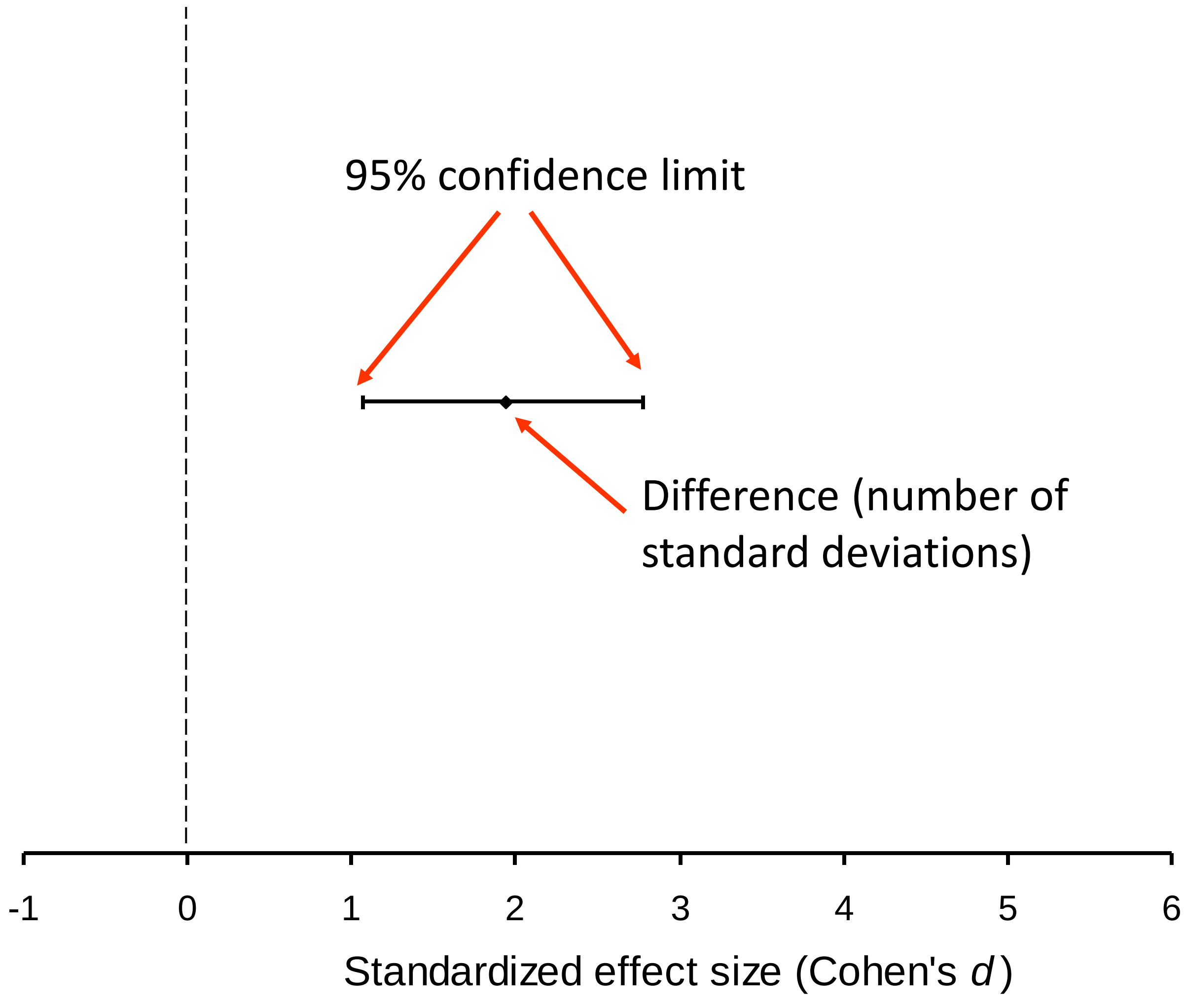
Example

Average American woman : 5' 4"
SMC women's basket ball players: 5' 9"
Taller than average?

Average American man : 170 lb
Sample of 13 Sumo wrestlers : 338 lb
Heavier than average?

p < 0.001 in each case
Standard interpretation: significantly different

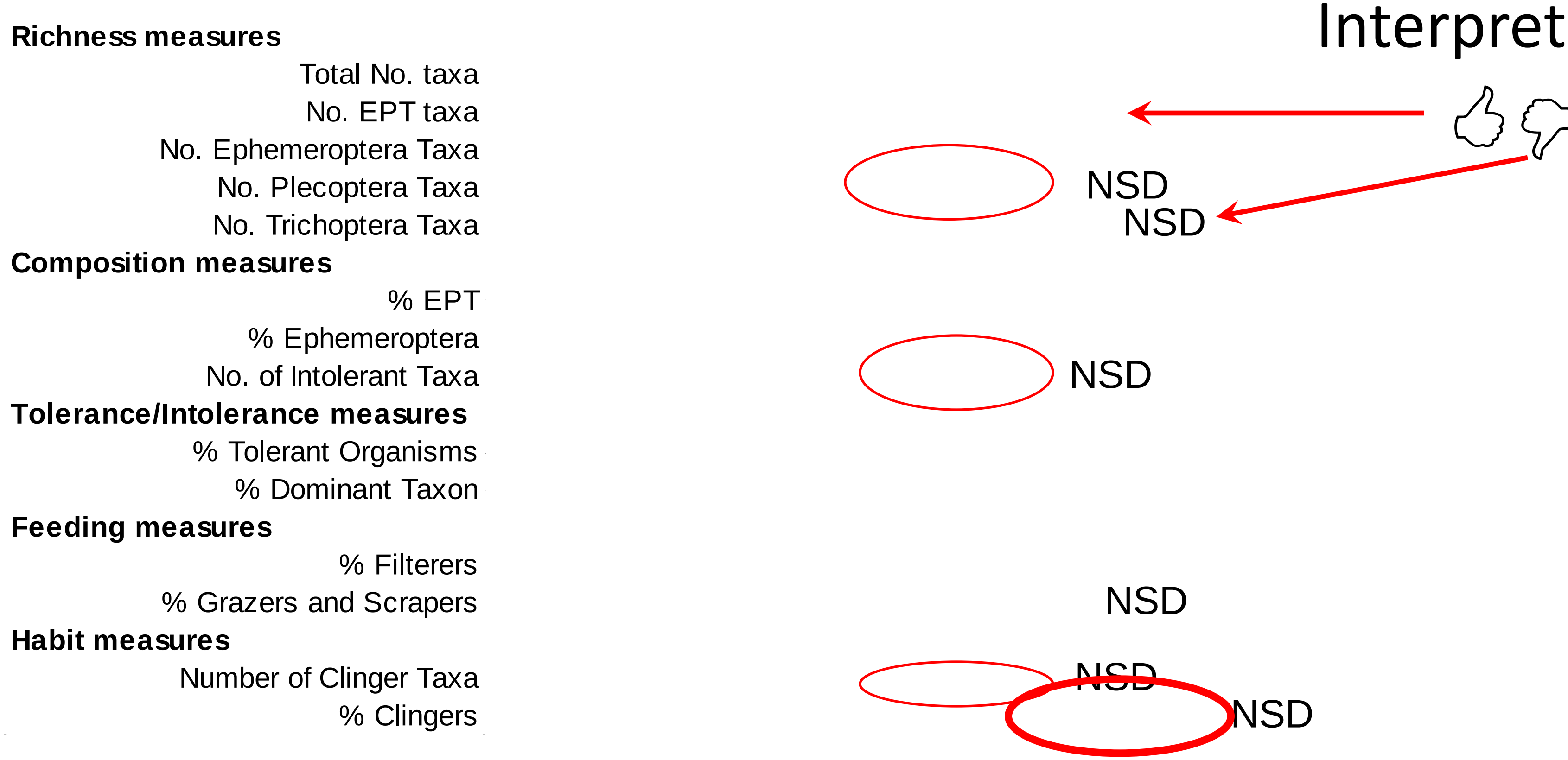
- Bball player height:



Size of an effect?

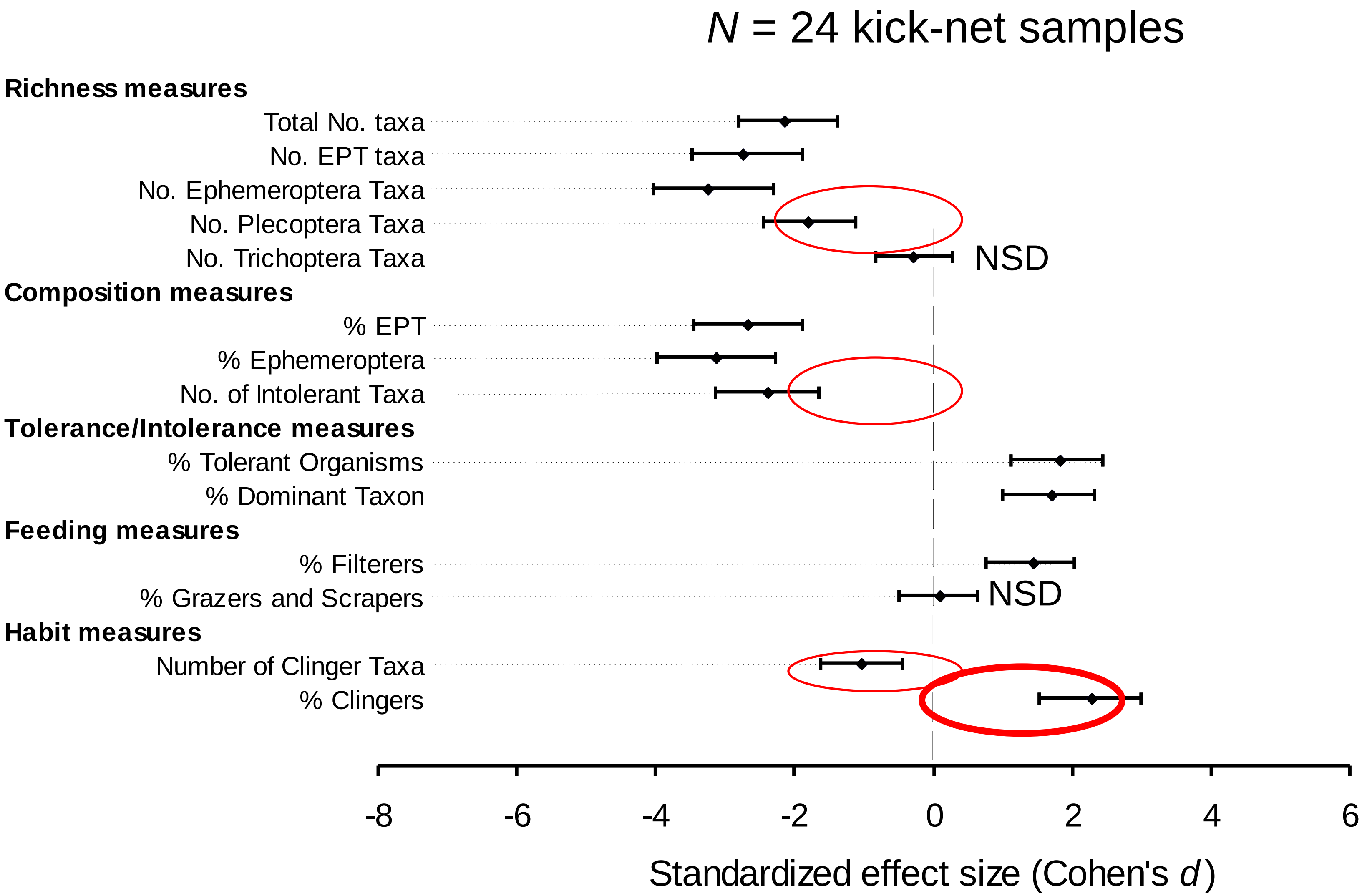
Standard statistical Interpretation

N = 6 kick-net samples



New information: Effect direction, magnitude, and 95% confidence interval of magnitude

Size of an effect?



New information: Effect direction, magnitude, and 95% confidence interval of magnitude

Take-home

- Artificial substrates *are* less variable….but
- Nets are still best for distinguishing sites
- *Because* larger effect size in this case trumps higher variance with net samples

Conclusions and recommendations

- Nets are best; but if you need substrates – use bricks (and save $19 per unit)

- Best and easiest metrics: total no of taxa; no of EPT taxa; no of E taxa; % EPT; % E; % dominant taxon

- Metric to consider: % tolerant organisms

- Standardized effect size is informative and facilitates comparison with other studies.


ERMONT