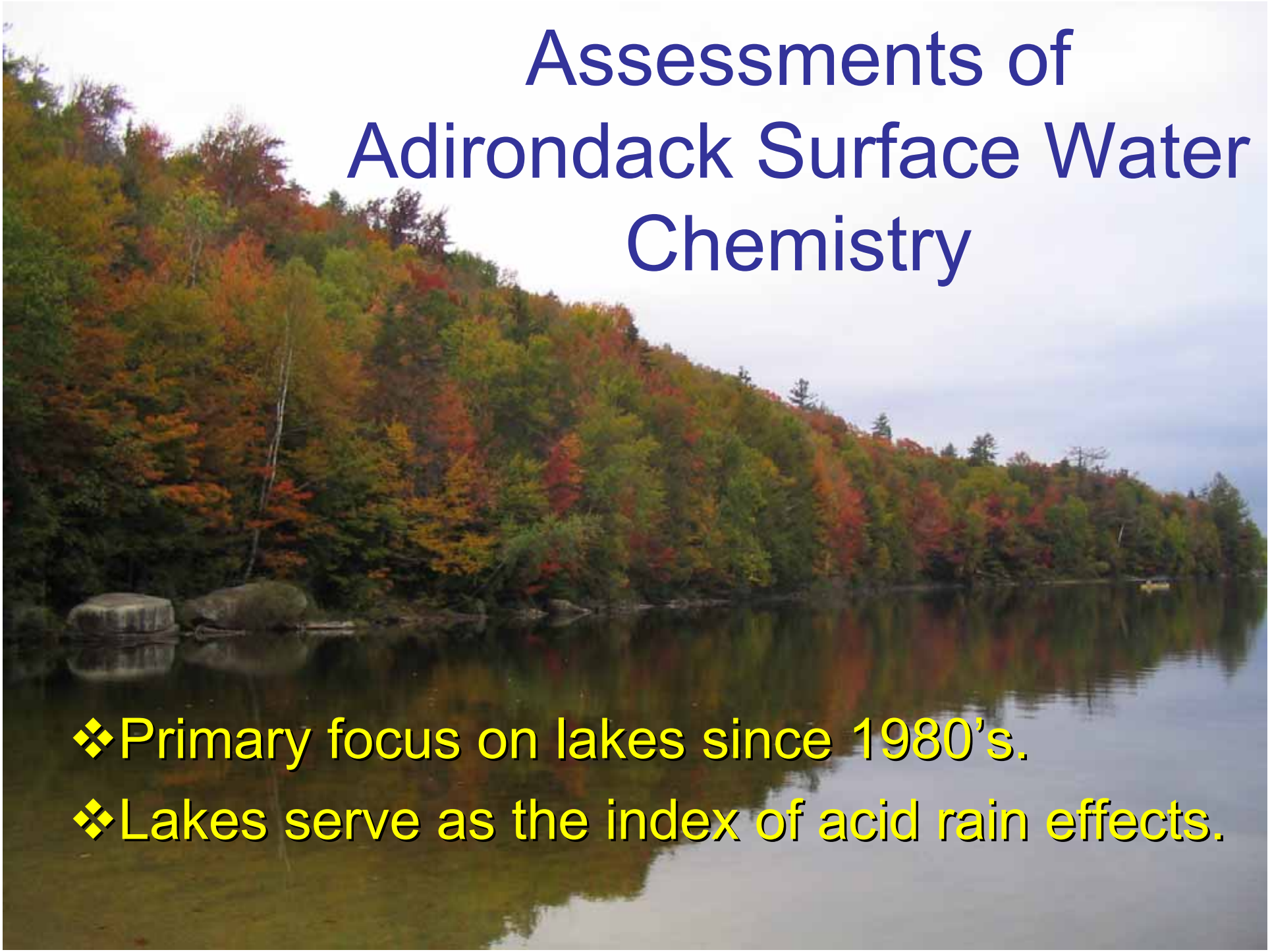
Oswegatchie-Black Stream Survey 2003-2005

Assessments of Adirondack Surface Water Chemistry



- Primary focus on lakes since 1980's.
- Lakes serve as the index of acid rain effects.

Lakes ≠ Streams
• Important habitat.
• Reflect terrestrial ecosystem.
• More prone to acidify than lakes.

Stream Chemistry as an Ecosystem Index of Acid Rain Effects

1. Integrates spatial variability of watershed processes.
2. Within stream processes don't overwhelm the signal.
3. Link between terrestrial and lake ecosystems.
4. Sensitive indicator, straightforward to measure.

Project Investigators

- Greg Lawrence, *U.S. Geological Survey*
- Karen Roy, Sue Capone, *NYS DEC/Adirondack Lake Survey Corporation*
- Howard Simonin, *NYS DEC, Fish, Wildlife and Marine Res.*
- Barry Baldigo, *U.S. Geological Survey*
- Sophia Passy, *University of Texas at Arlington*
- Robert Bode et al., *NYS DEC Stream Biomonitoring Unit*

Adirondack Effects Assessment Program (AEAP) Colloborators

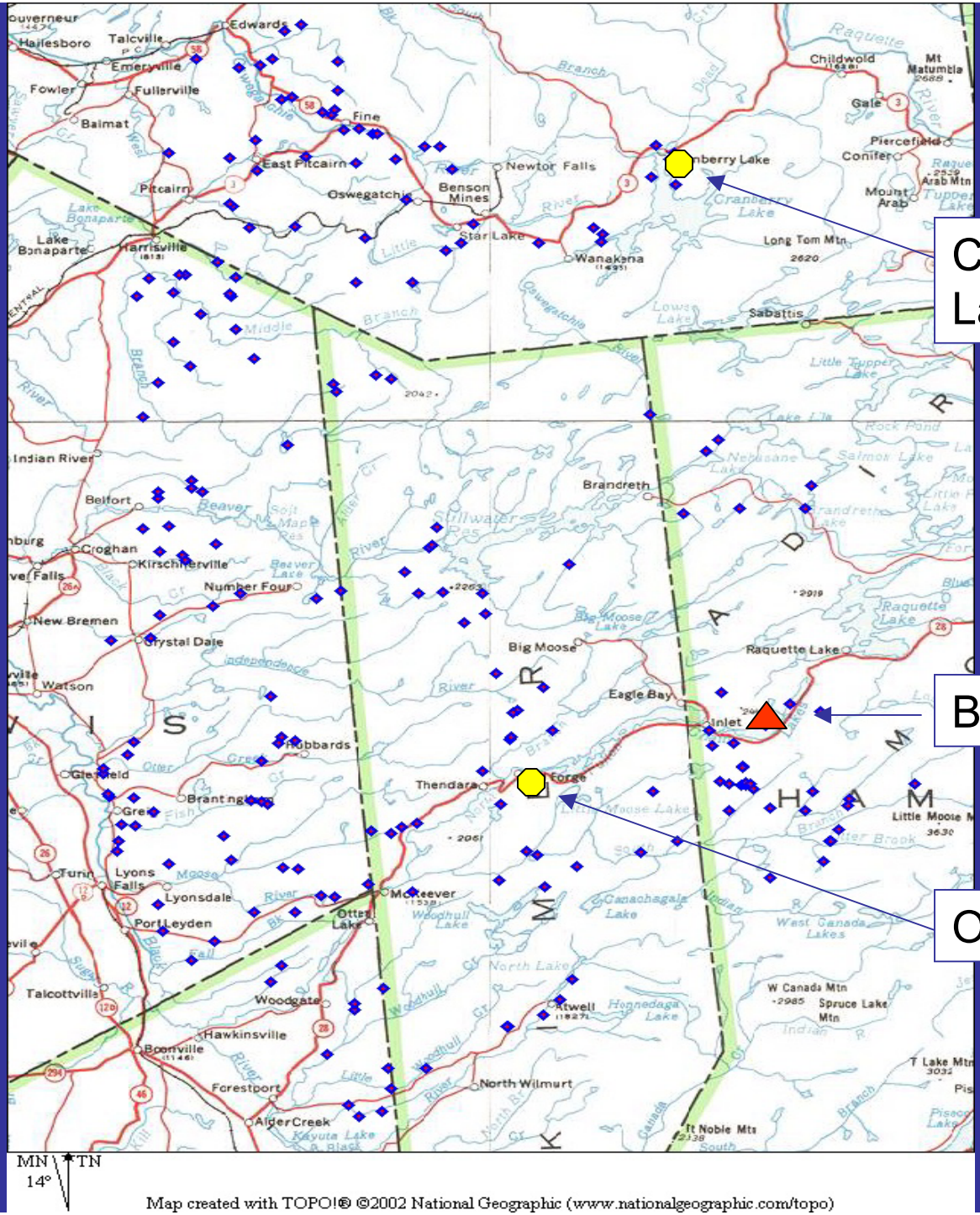
- **Sandra Nierzwicki-Bauer, Chuck Boylen**, *Rensselaer Polytechnic Institute, Troy, NY*
- **Jim Sutherland, Bob Bombard** – *New York State Dept. of Environmental Conservation.*

Project Tasks

1. 200-stream survey to assess acidification.
2. Macro-invertebrate sampling in 40 streams
3. Re-sampling of sites sampled in 1980's.
4. Soil sampling of 12 watersheds
5. Periphytic diatom sampling, all streams.

Sampling Challenges

- Flow variations – collection in 3 days.
- Accessibility – sample 200 of 565 accessible sites.
- Effects of lakes – exclude streams with upstream lakes and ponds with > 25% influence.



Map created with TOPO!® ©2002 National Geographic (www.nationalgeographic.com/topo)

Assessment Challenges

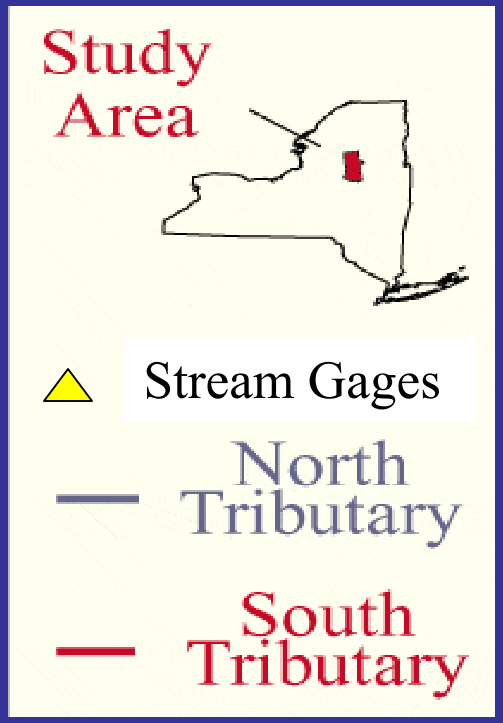
- Distinguishing between natural acidity and pollution-derived acidity.
- Characterizing longitudinal variability

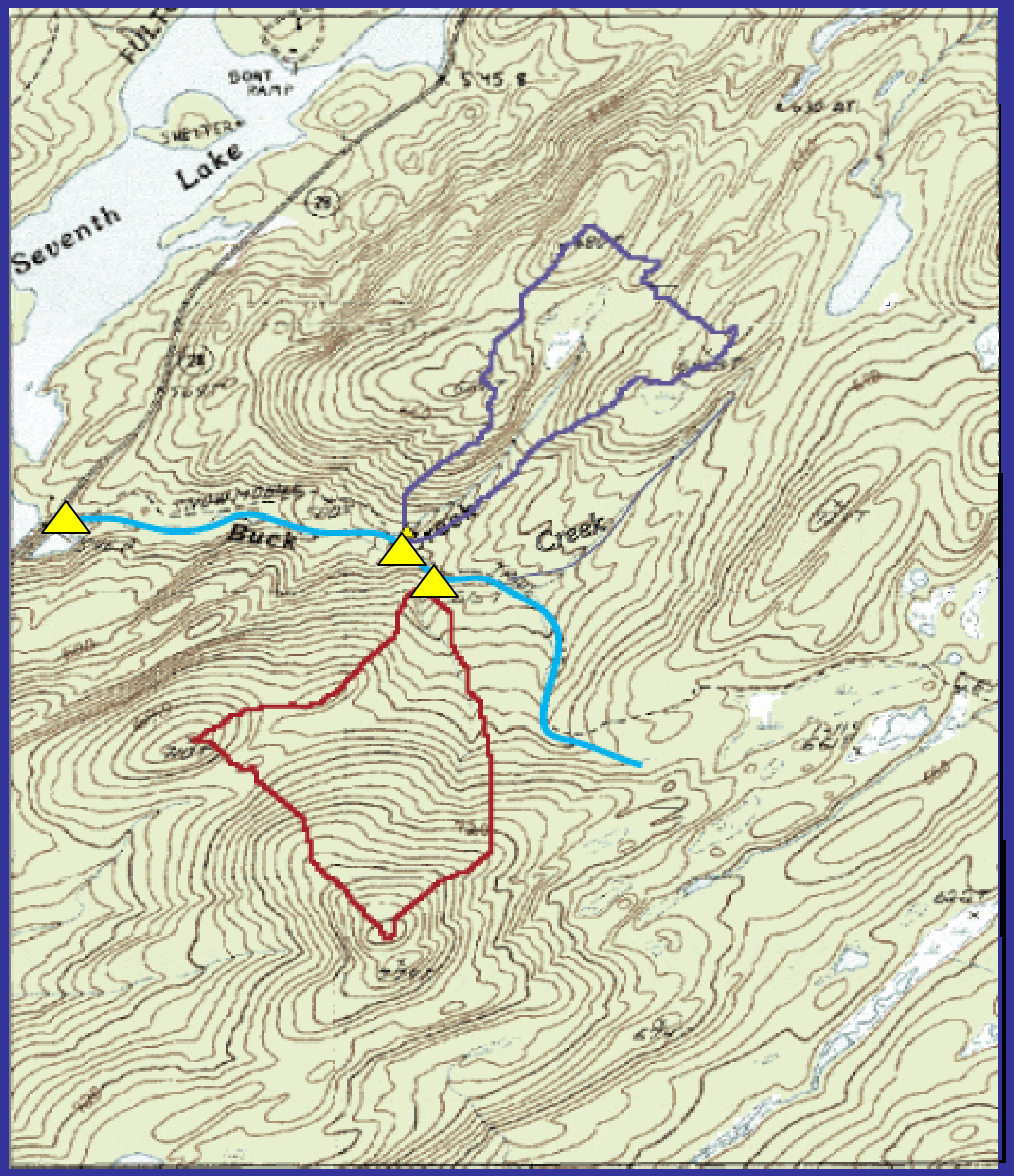
Buck Creek:

USGS

RPI-AEAP

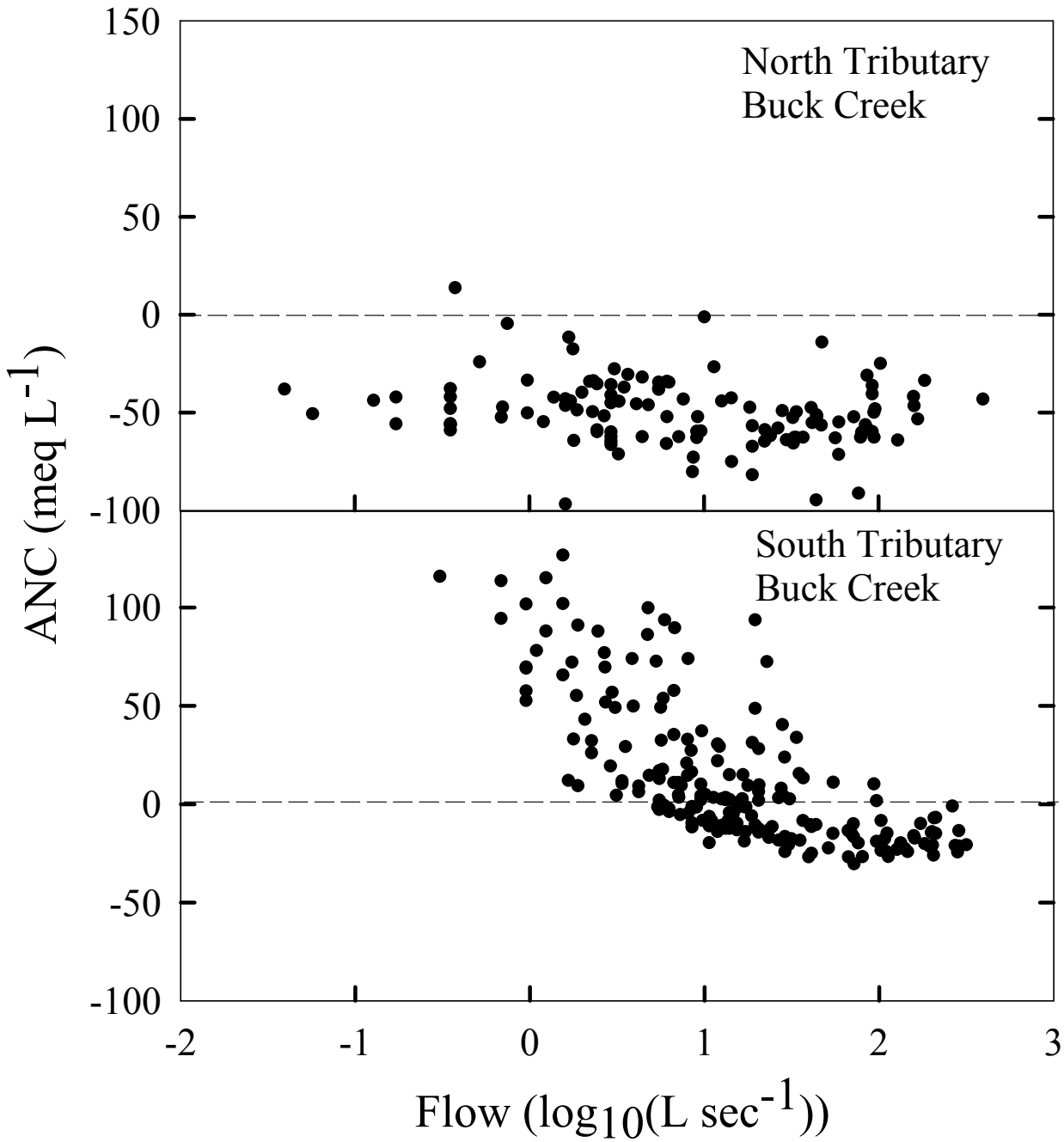
NYSDEC





Acid Neutralizing Capacity (ANC)

Acid Rain Effects?



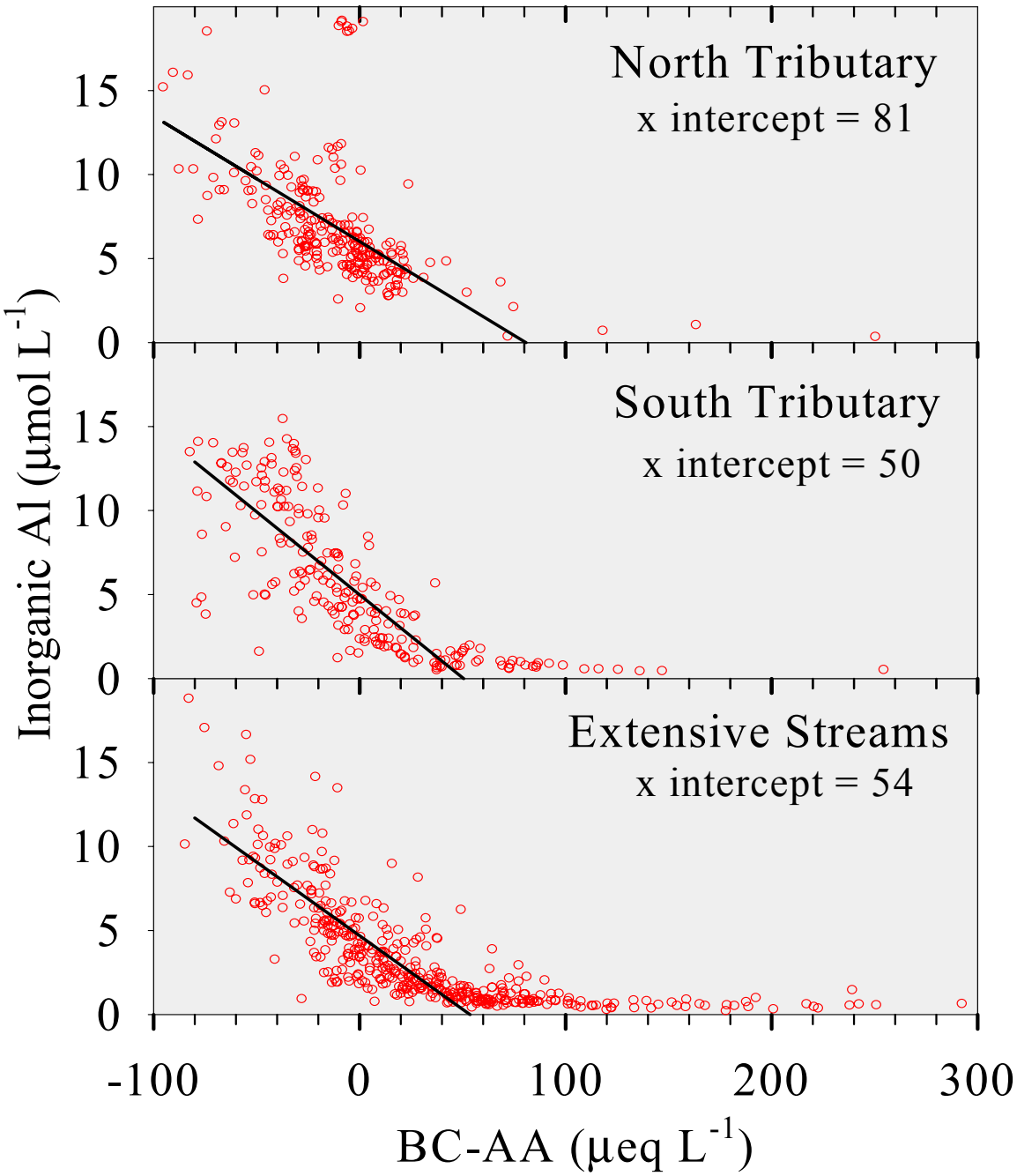
Base Cation Surplus

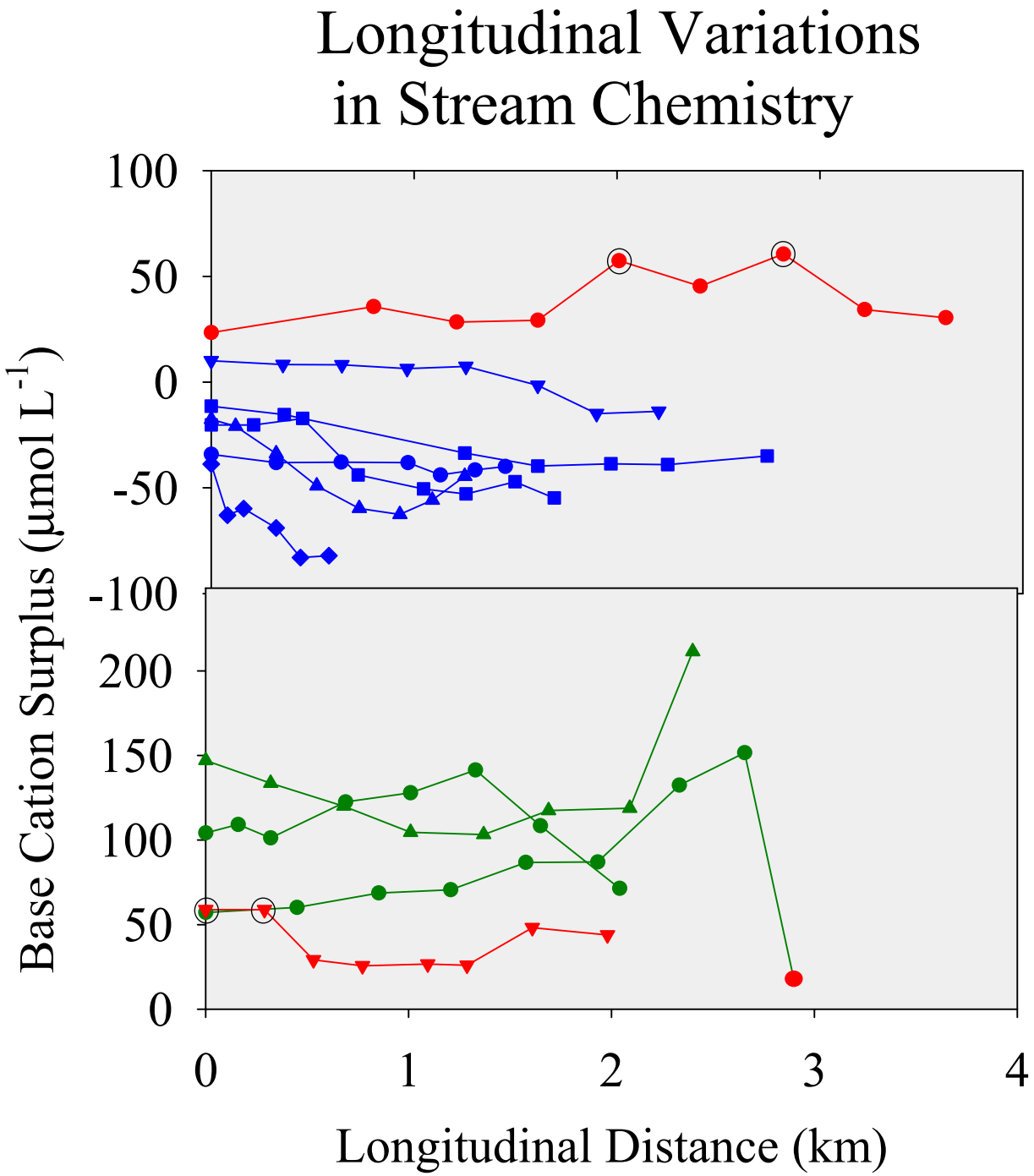
$$(Ca + Mg + Na + K) - (SO_4 + NO_3 + Cl)$$

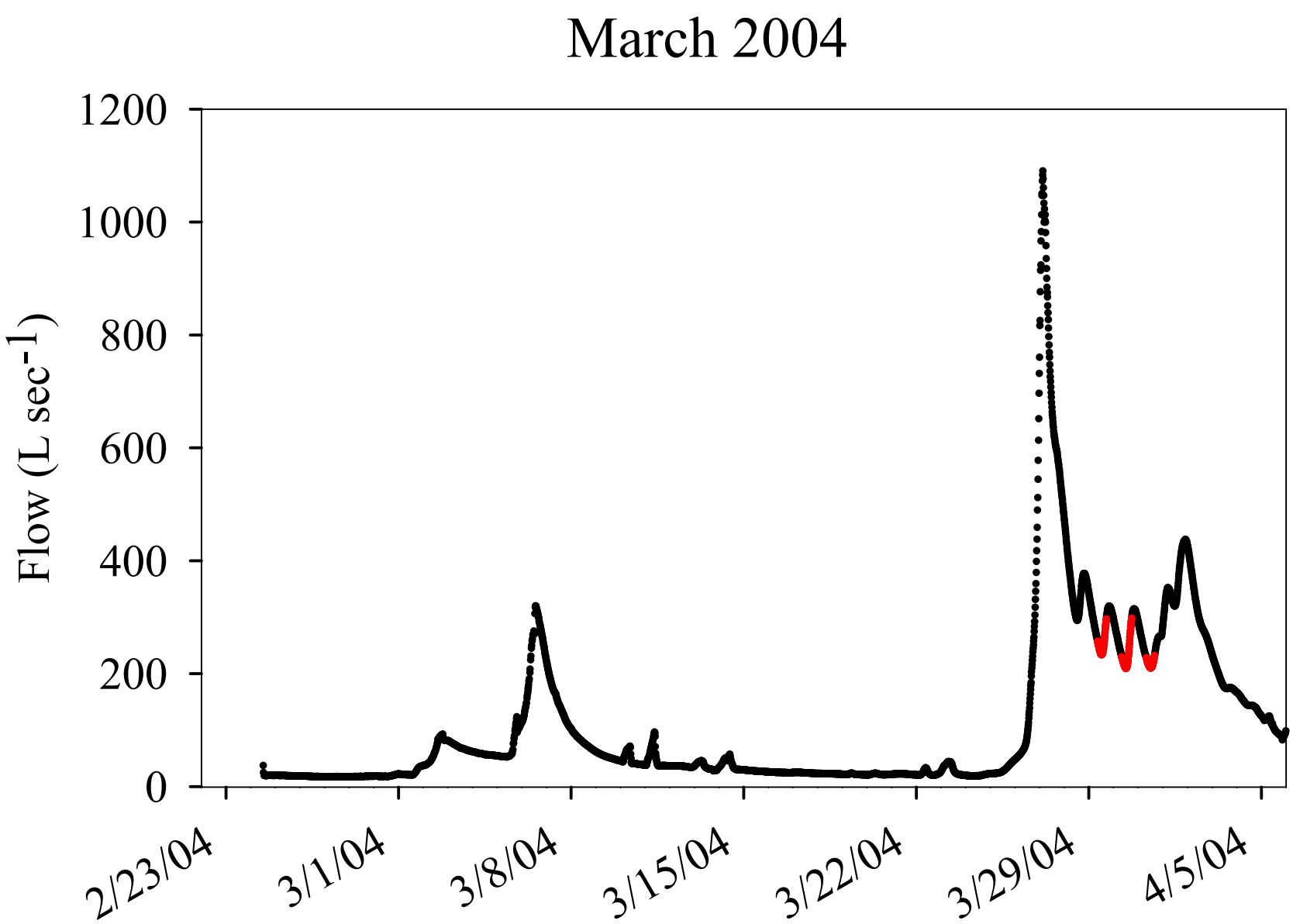
Base Cations – Acid Anions

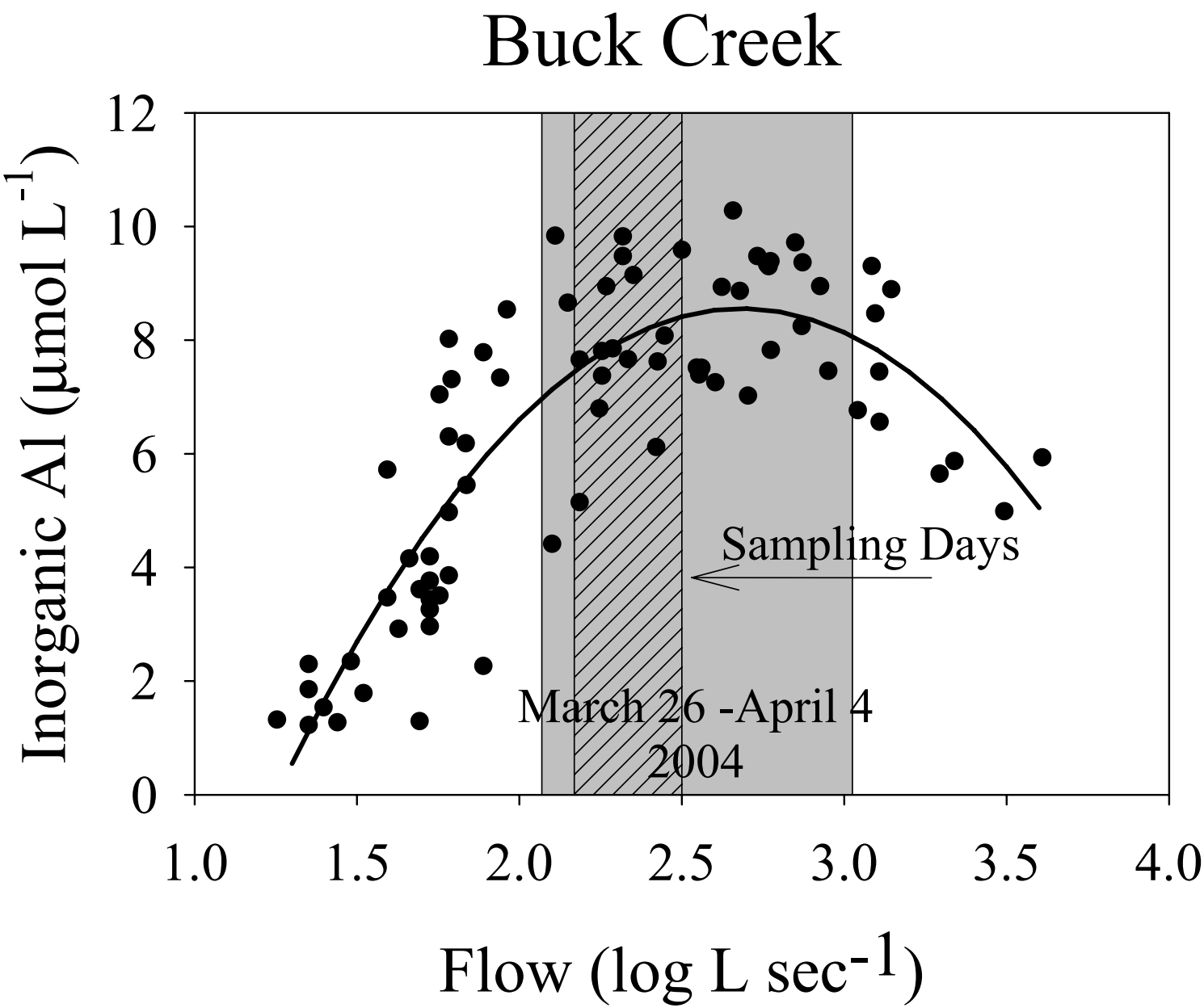
BC – AA

The Fundamental Problem: Mobilization of Inorganic Aluminum


North Tributary
x intercept = 81
South Tributary
x intercept = 50
Extensive Streams
x intercept = 54
Inorganic Al (µmol L-1)
BC-AA (µeq L-1)
15
10
5
0
-100
0
100
200
300

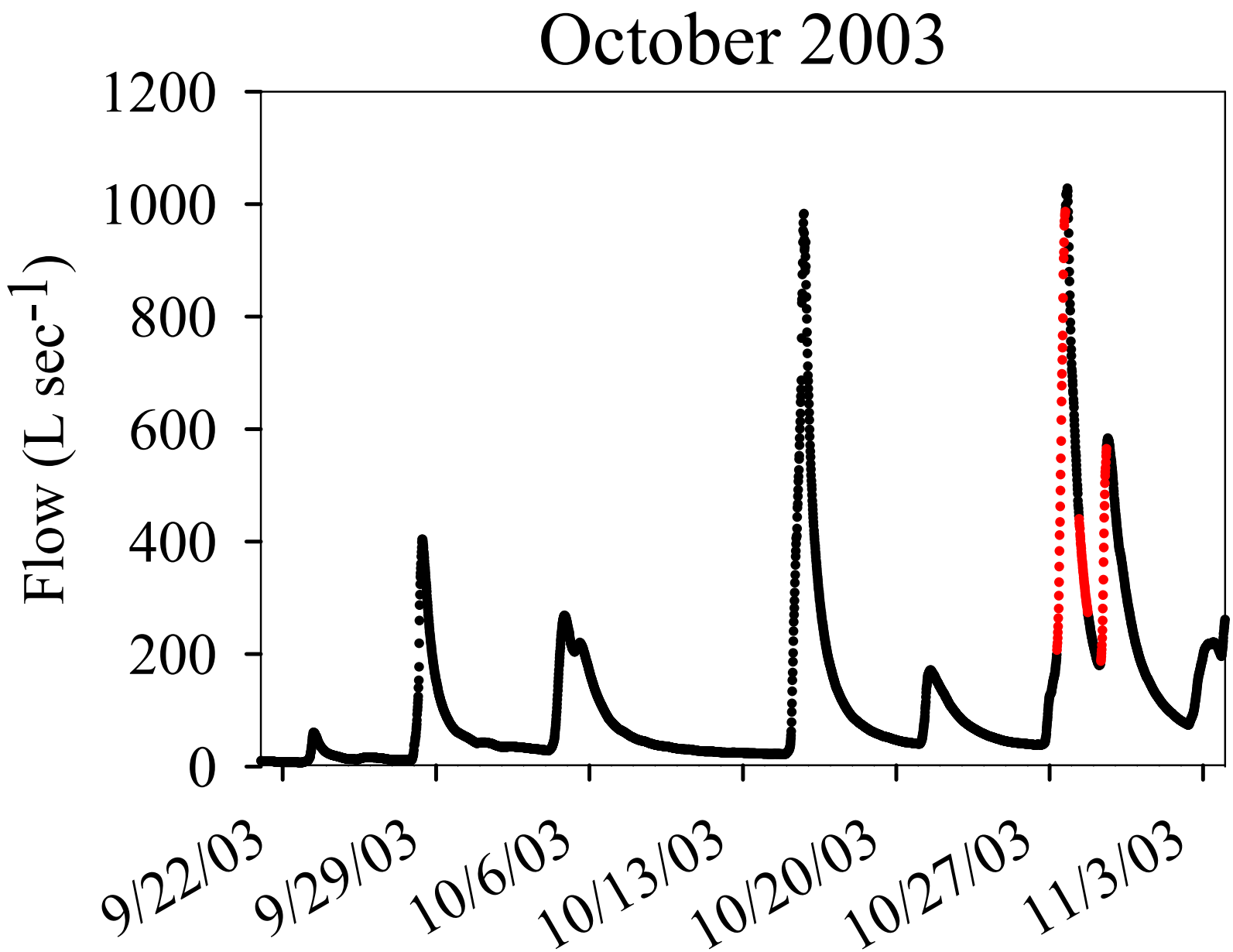

Longitudinal Variations
in Stream Chemistry
Base Cation Surplus (µmol L-1)
100
50
0
-50
-100
200
150
100
50
0
0
1
2
3
4
Longitudinal Distance (km)


March 2004
Flow (L sec-1)
1200
1000
800
600
400
200
0
2/23/04
3/1/04
3/8/04
3/15/04
3/22/04
3/29/04
4/5/04


Buck Creek
Inorganic Al (µmol L-1)
12
10
8
6
4
2
0
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Flow (log L sec-1)
Sampling Days
March 26 -April 4
2004

Results from Buck Creek

- March 2004 - *sampling near peak acidity.*
- Brook Trout Fingerlings - *90% Mortality with median Al of 6.0 μM for 10 days.*


October 2003
Flow (L sec-1)
1200
1000
800
600
400
200
0
9/22/03
9/29/03
10/6/03
10/13/03
10/20/03
10/27/03
11/3/03

Sampling Variations

Date	Site	Coef. of Variation (ANC)
Oct03	28004	59.0 %
Oct03	6020	7.3 %
Oct03	29008	12.3 %
Mar04	7024	5.8 %
Mar04	28630	15.0 %
Mar04	29008	6.6 %

Preliminary Results

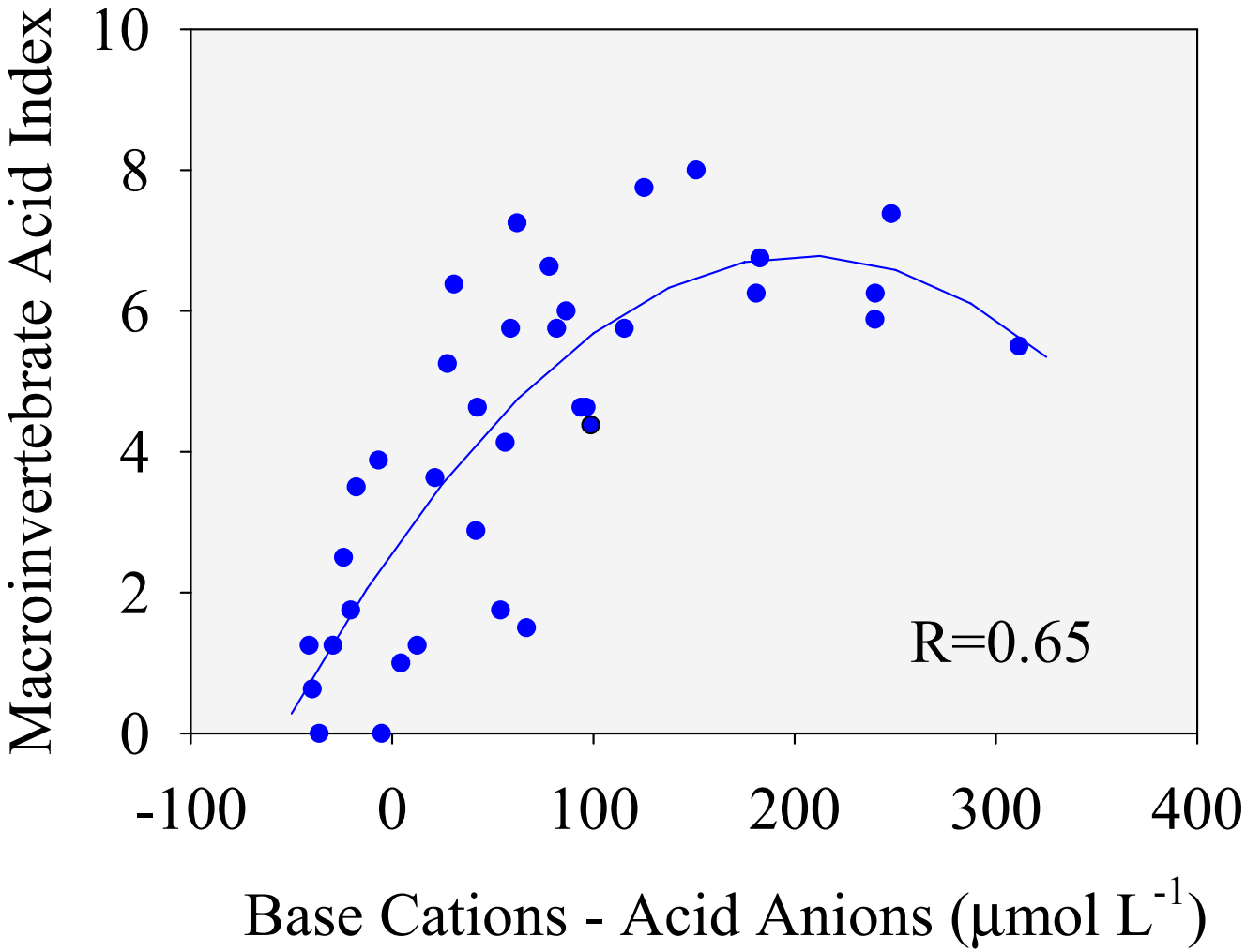
	Inorganic Al	ANC	pH
Threshold	2.0 μM	50 μeq L^{-1}	6.0
October 03	54%	66%	64%
March 04	45%	70%	64%

*Thresholds from Driscoll et al. (Bioscience, 2001)

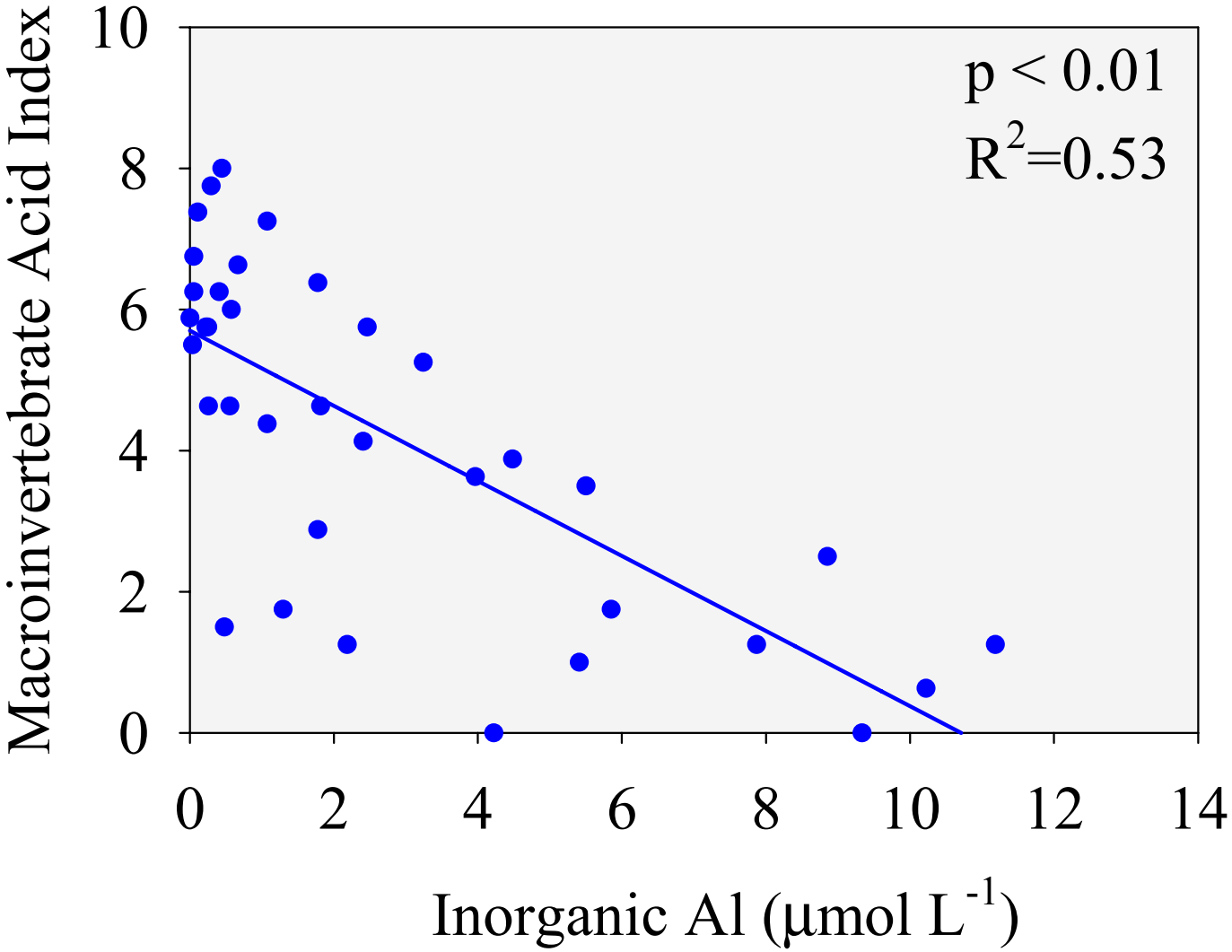
Stream Length Assessment

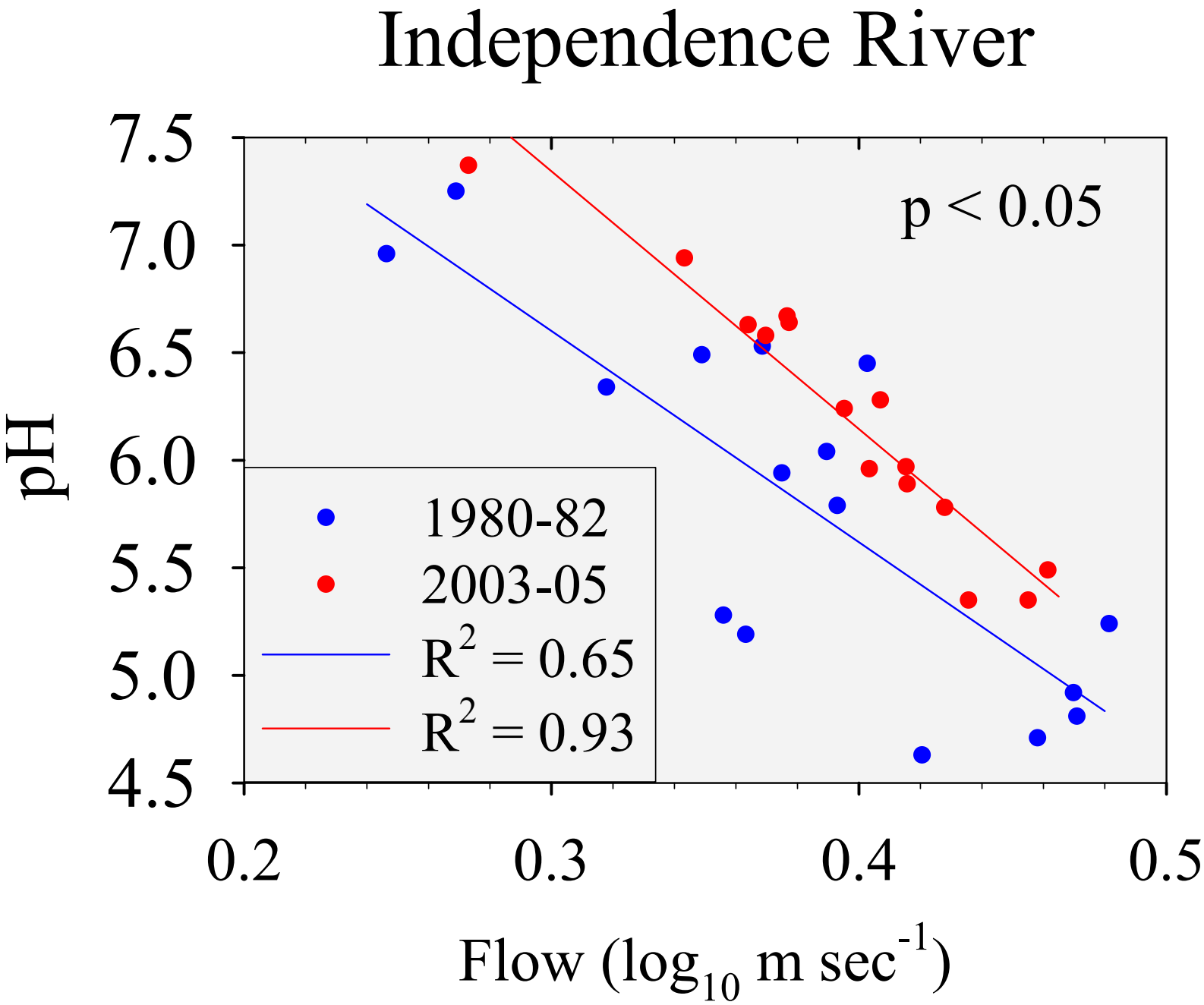
- Total stream length in study region = 4,322 km.
- Total accessable stream length = 1,237 km (28%).
- Total stream length sampled = 434 km (10%).
- Total stream length acidified, March 04 = 557 km.
- Total stream length not assessed = 3085 km.

Stream Macroinvertebrate Relations

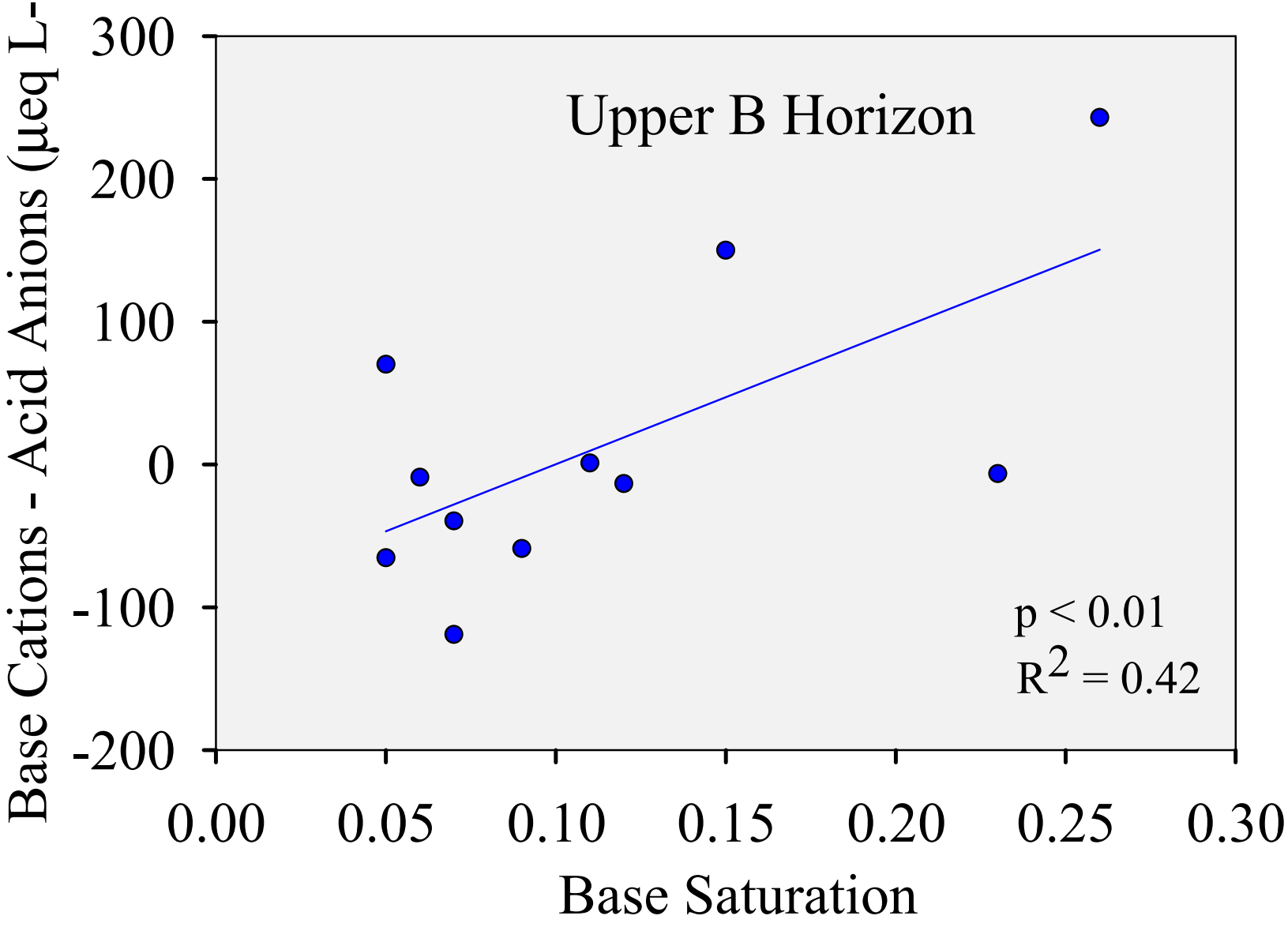


Stream Macroinvertebrate Relations

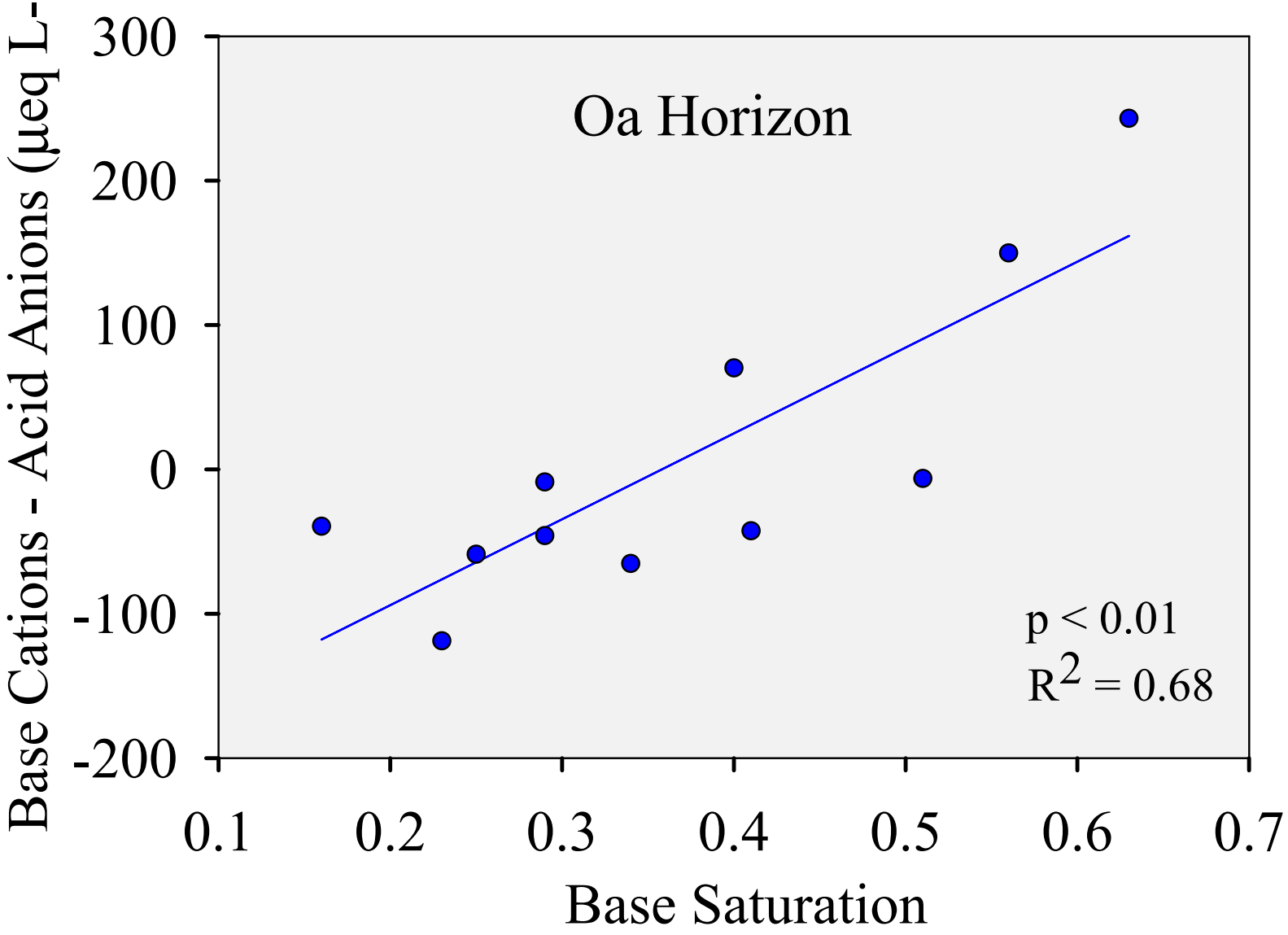


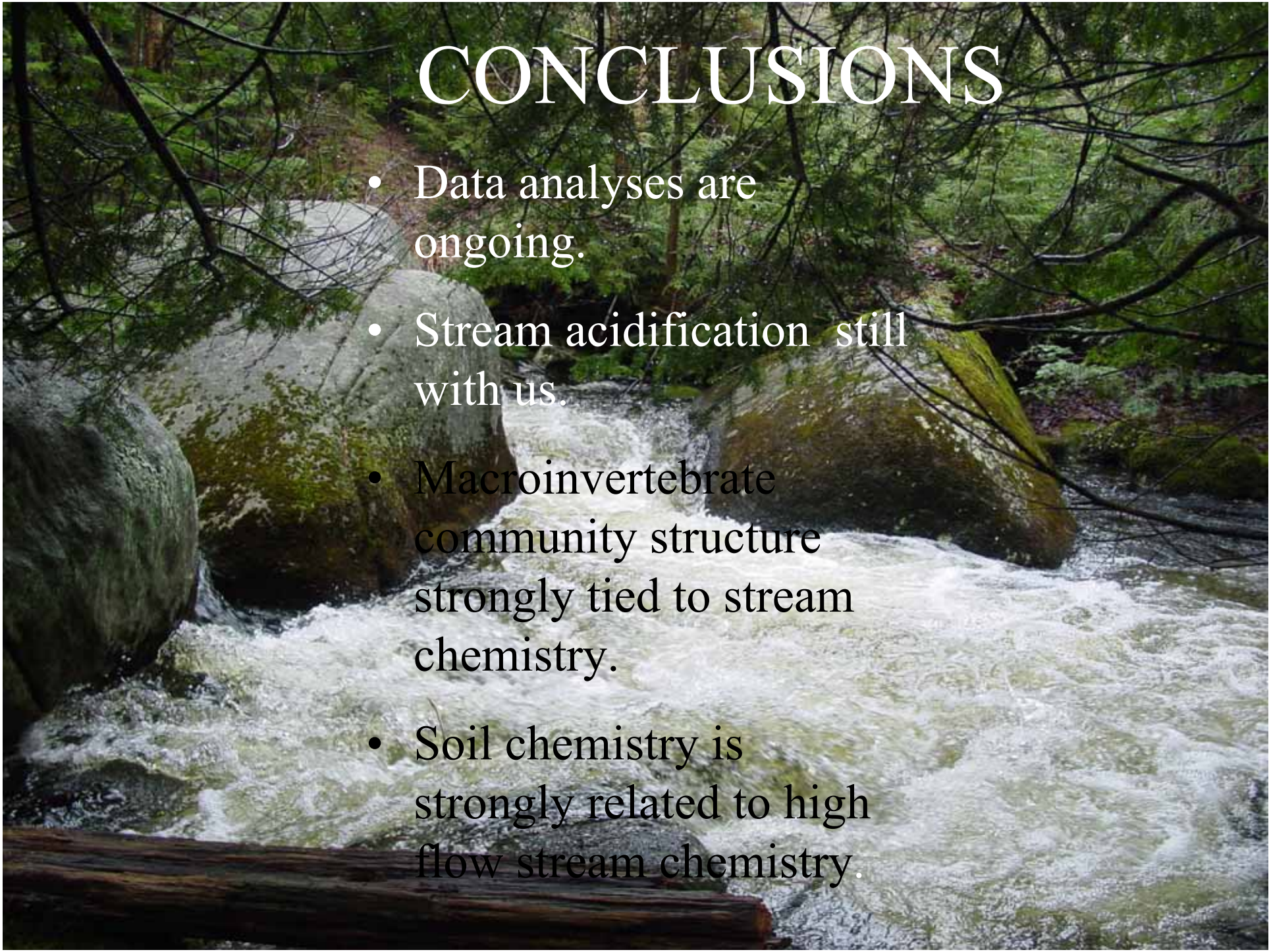

Independence River
p < 0.05
1980-82
2003-05
R2 = 0.65
R2 = 0.93
pH
7.5
7.0
6.5
6.0
5.5
5.0
4.5
0.2
0.3
0.4
0.5
Flow (log10 m sec-1)

Soil-Stream Chemistry Relationship



Soil-Stream Chemistry Relationship





CONCLUSIONS

- Data analyses are ongoing.
- Stream acidification still with us.
- Macroinvertebrate community structure strongly tied to stream chemistry.
- Soil chemistry is strongly related to high flow stream chemistry.