Biological and Physical Effects of Direct Hydromodification via Stream Bank Armoring

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Today's Presentation

- Motivation for the study
- Study design
  - ✓Description of type of "hydromodification"
- Results
- Implications and future directions

Collaborative Team

- **SCCWRP** – Eric Stein, Betty Fetscher, Rafi Mazor, Chris Solek

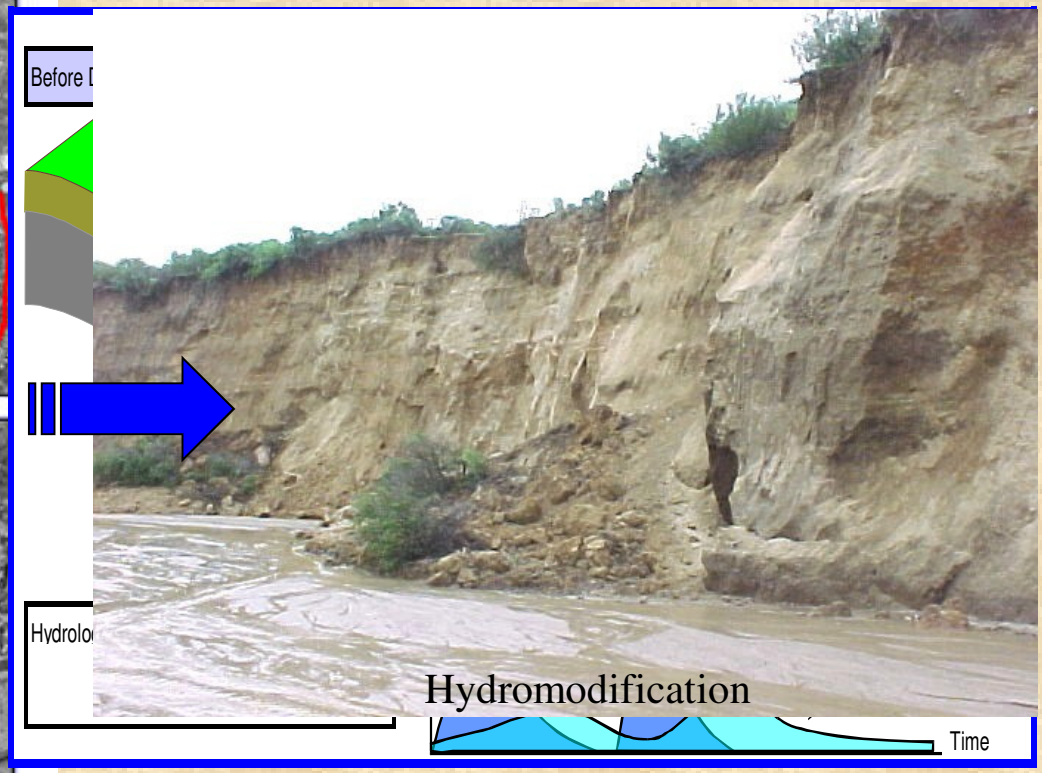
- **UC Berkel**ey – Matt Kondolf, Chris Alford, Carolina Zuri, Clare O'Reilly

- **CSU Stanislaus** – Matt Cover, Roxana Guardado

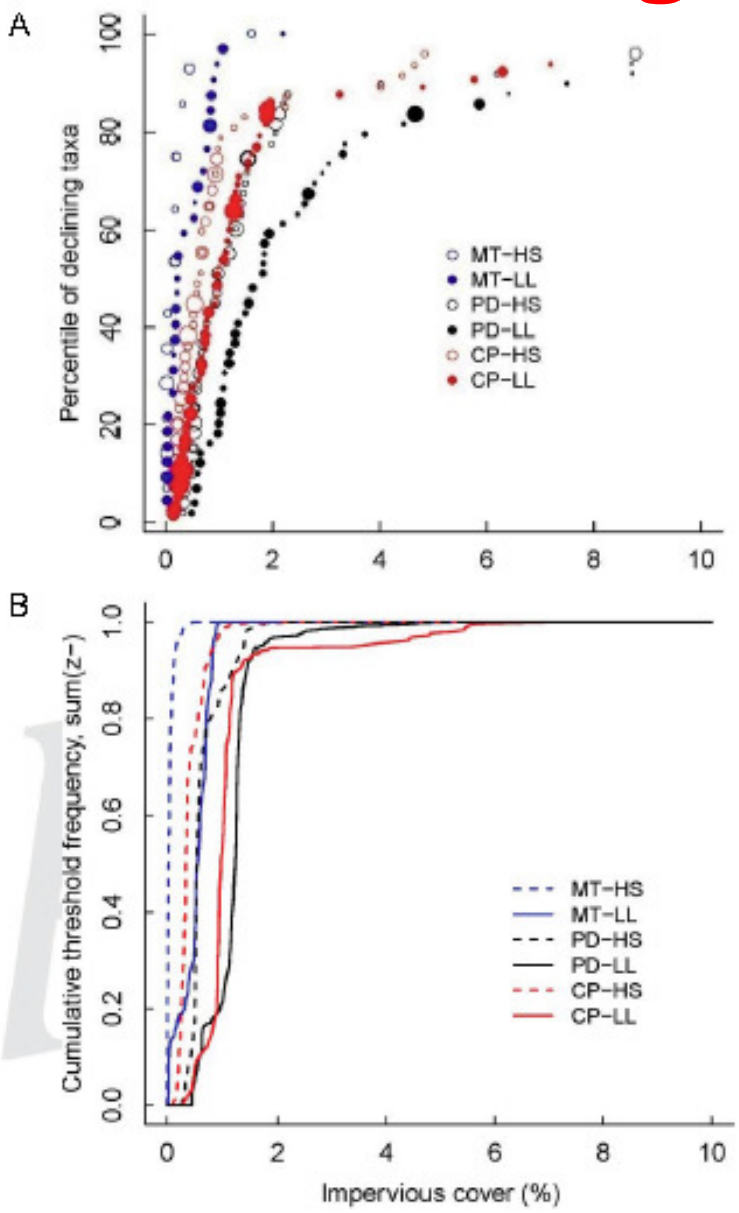
RECOVERY.GOV

Water Boards

Effect of Increased Impervious Cover



Biological Effects



King et al. 2011

- Decreases:
  - ✓ relative abundance of Plecoptera
  - ✓ richness of insect taxa
  - ✓ EPT Richness
- Increases:
  - ✓ tolerant taxa richness
  - ✓ richness of non-insects
  - ✓ Chironomid dominance

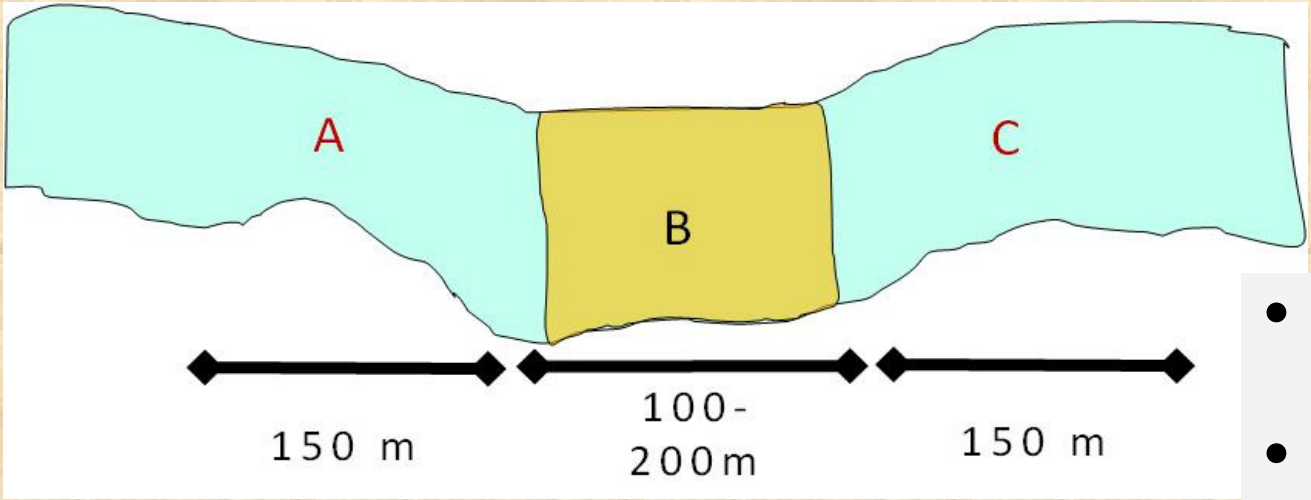
Typical Management Response

Study Questions

- Is channel armoring (direct hydromodification) associated with changes in the in-stream biological community?
  - ✓Are there mechanistic relationships that can be implied between physical or hydrologic changes and biological effects?

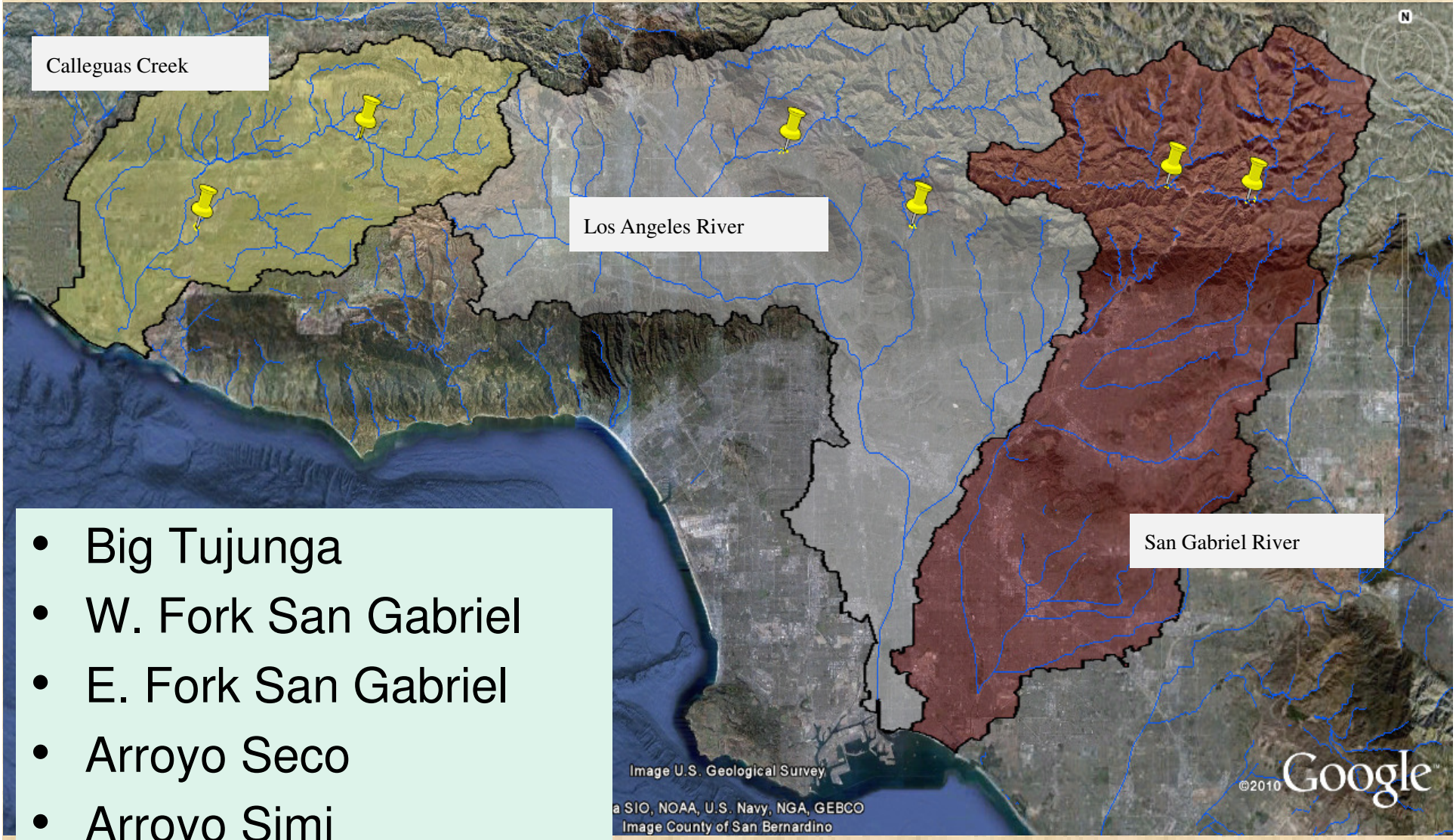
- Do the effect propagate downstream?

Study Design



- Benthic macroinvertebrates
- Stream algae
- CRAM
- Physical habitat (PHAB)
- Geomorphic assessment

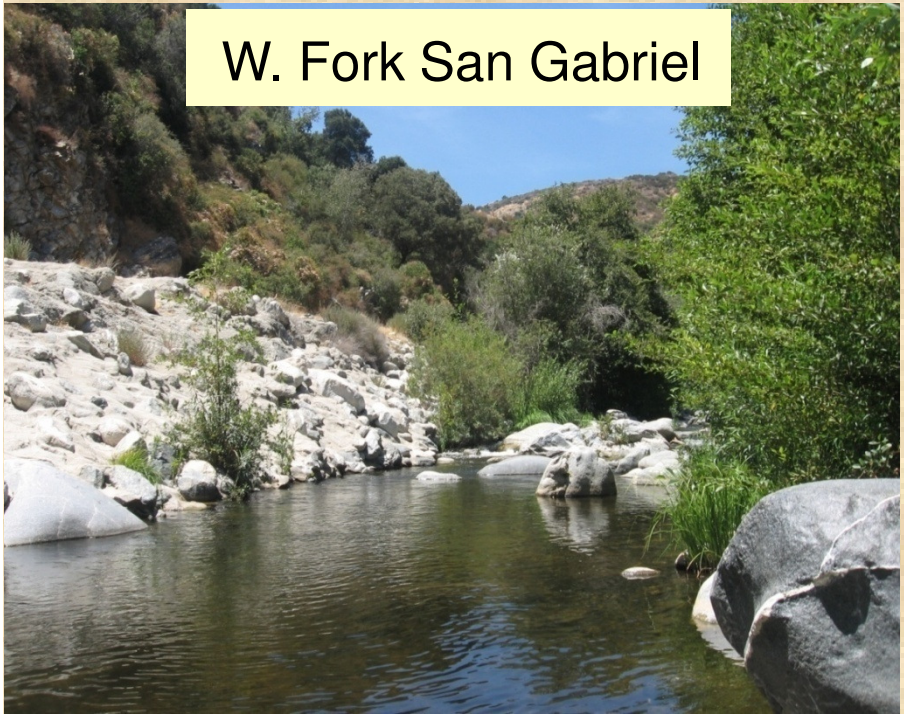
Study Sites



- Big Tujunga
- W. Fork San Gabriel
- E. Fork San Gabriel
- Arroyo Seco
- Arroyo Simi
- Conejo Creek

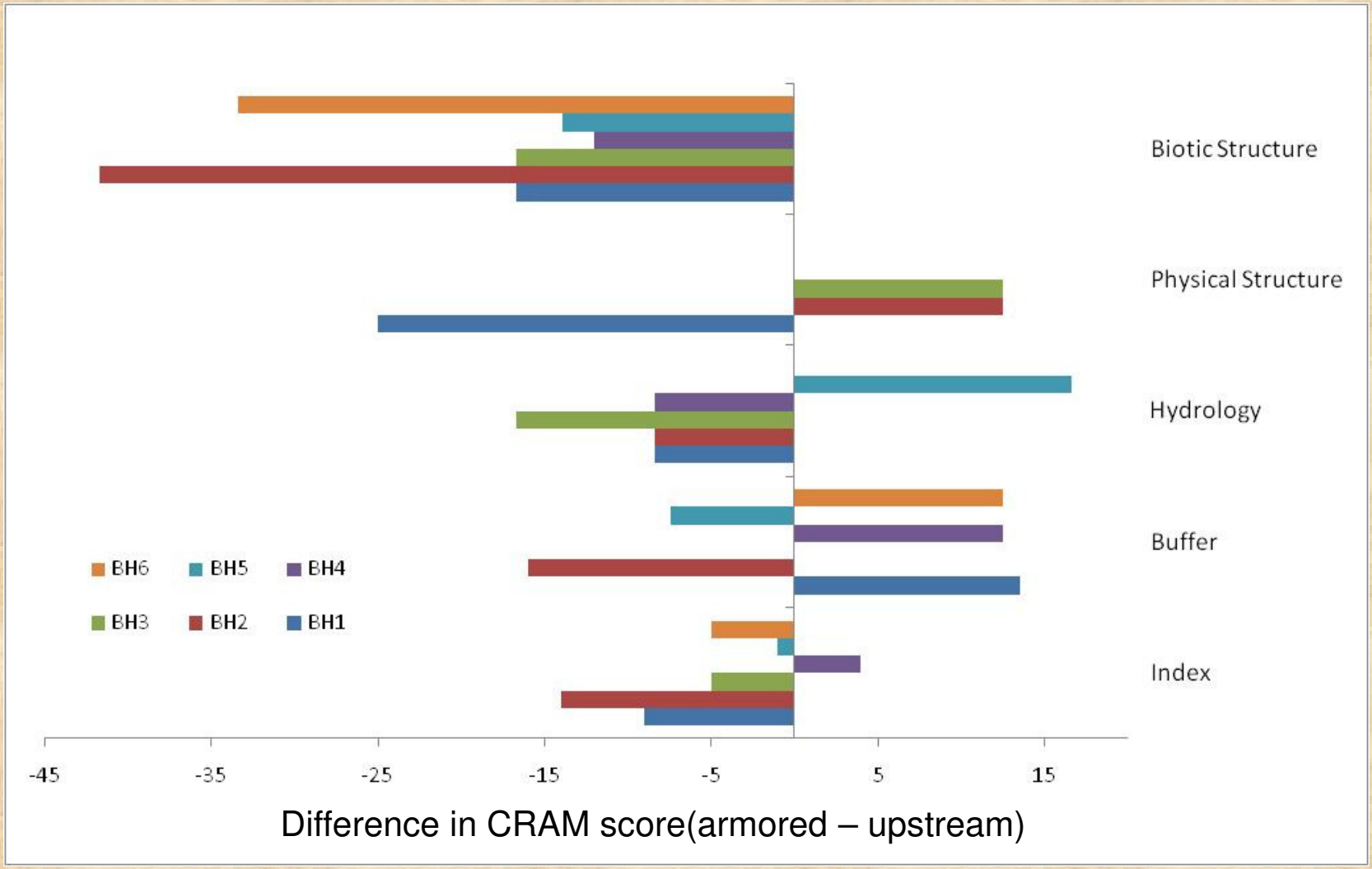

Arroyo Seco


Big Tujunga


W. Fork San Gabriel


Conejo

Effects Based on CRAM

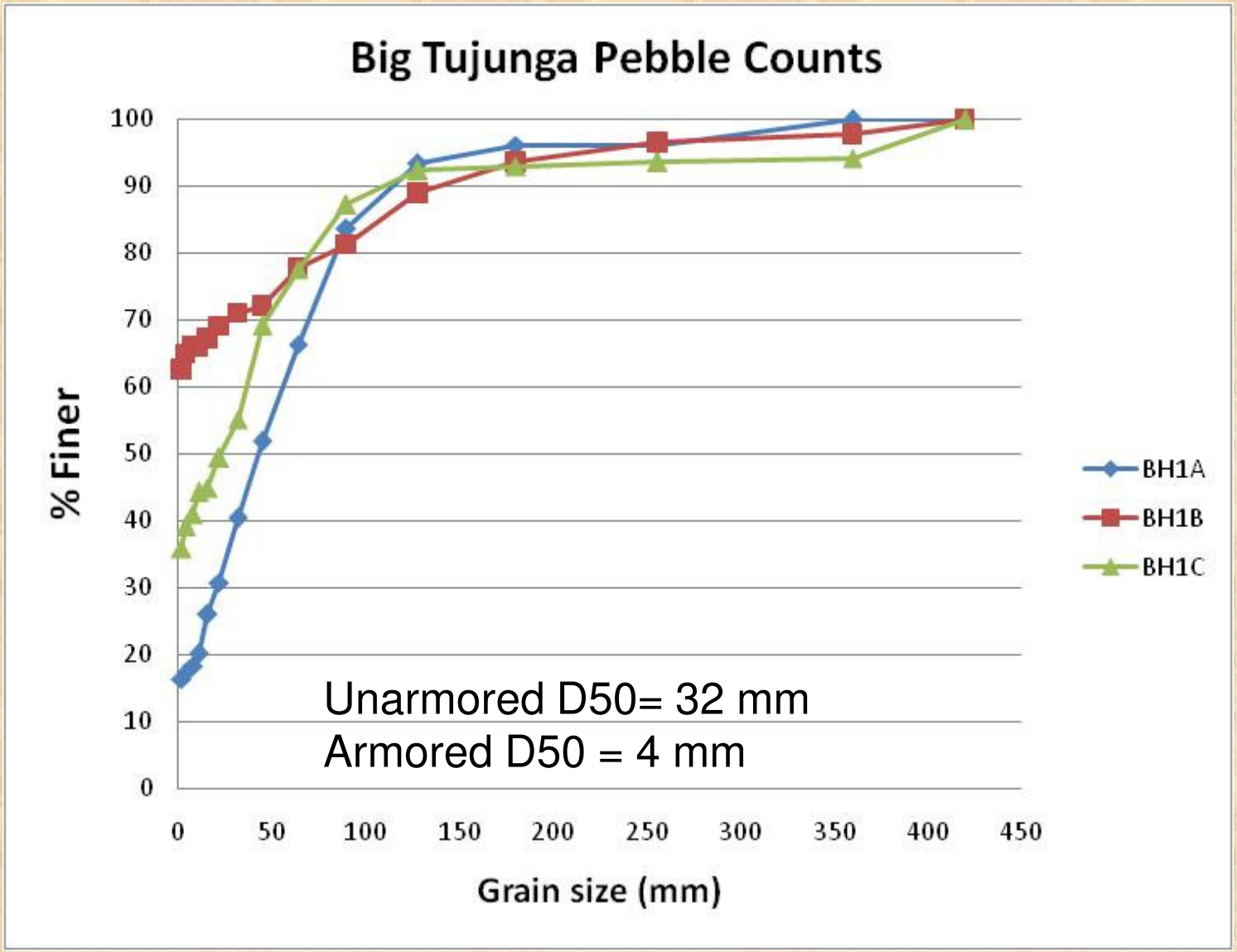


Physical Effects

	Site	%pools armored/ %pools upstream
BH1	Big Tujunga	1.25
BH2	W Fork San Gabriel	2.96
BH3	E Fork San Gabriel	0.85
BH4	Arroyo Seco	2.92
BH5	Arroyo Simil	0.8
BH6	Conejo Creek	0.93

- No consistent patterns
  - ✓ Site heterogeneity
- Some sites showed effects
  - ✓ More pools
  - ✓ Sediment deposition
- No downstream propagation

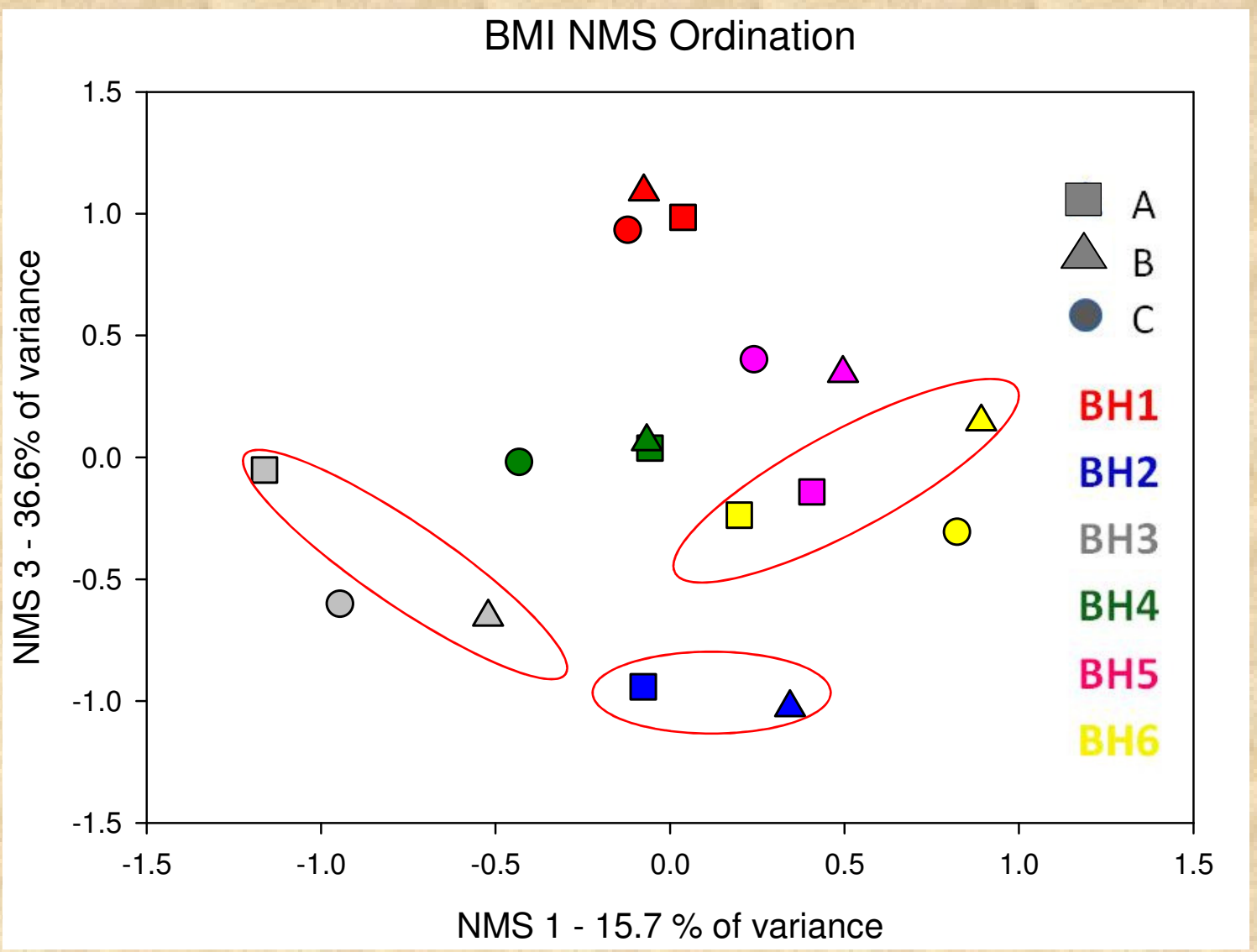
Sedimentation



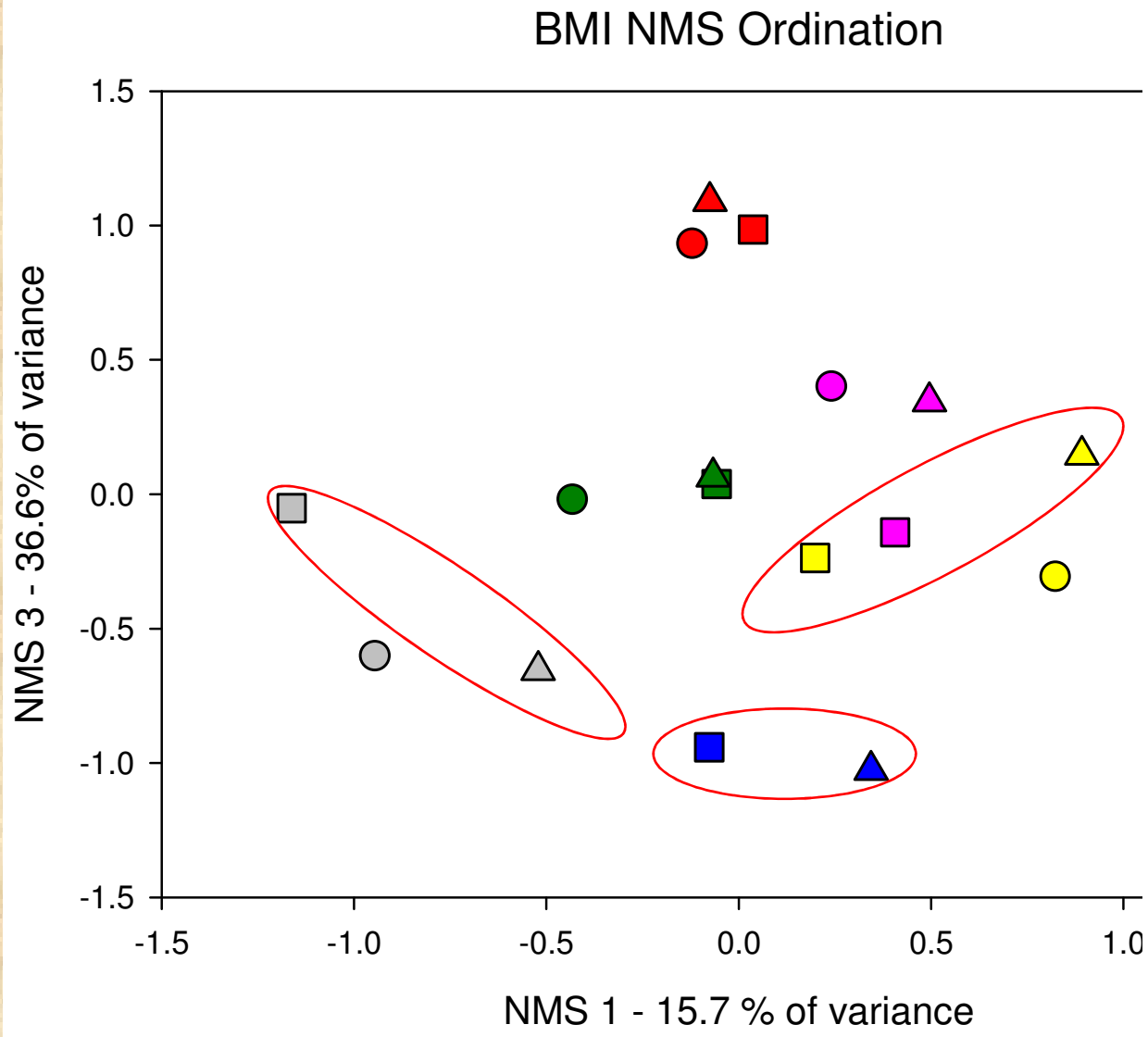
BMI Metrics
Upstream vs. Impact (p value)

BMI Metrics (expected response)	
SC-IBI Score (-)	40.2 / 36.4 (0.19)
Coleoptera Taxa (-)	**1.5 / 0.5 (0.055)**
EPT Taxa (-)	6.7 / 6.7 (0.50)
Predator Taxa (-)	4.8 / 5.8 (0.89)
% Collector Individuals (+)	80.0 / 81.0 (0.36)
% Intolerant Individuals (-)	5.0 / 3.0 (0.18)
% NonInsect Taxa (+)	25.8 / 23.0 (0.78)
% Tolerant Taxa (+)	**21.3 / 25.8 (0.08)**

NMS Ordination of BMI



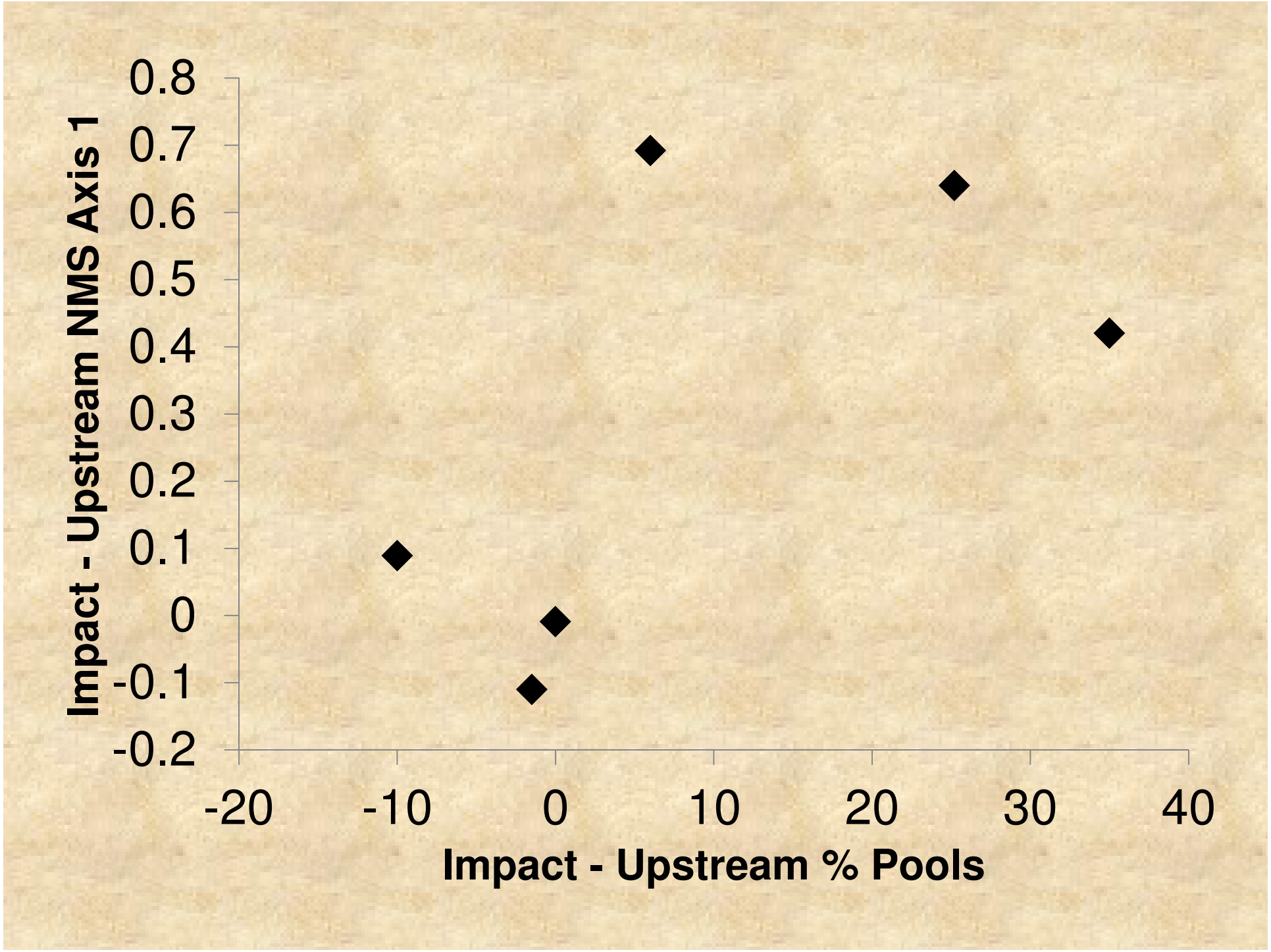
Benthic Invertebrate Results



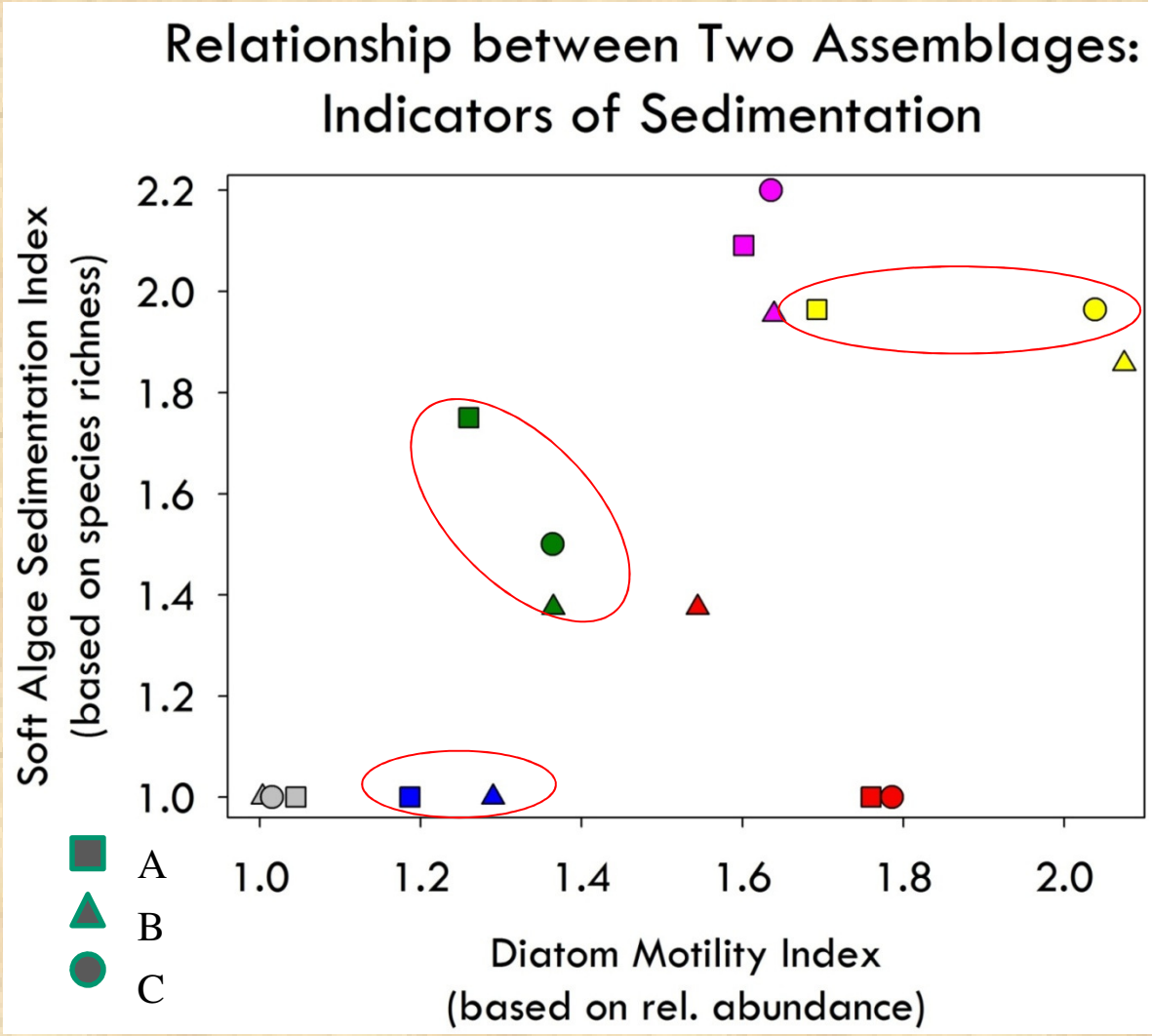
Correlations with Axis 1

Fastwater (-0.63)
Fine sed (0.57)

Ephemerella (-0.75)
Heptageniidae (-0.73)
Helicopsyche (-0.70)
Calineuria (-0.63)
Narpus (-0.62)
Tanytarsus (0.60)


Impact - Upstream NMS Axis 1
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-20
-10
0
10
20
30
40
Impact - Upstream % Pools

Algae Results



- No consistent patterns
- No differences in biomass
- Increase in sediment tolerant taxa in armored reaches at some sites
- No downstream effects

BH1

BH2

BH3

BH4

BH5

BH6

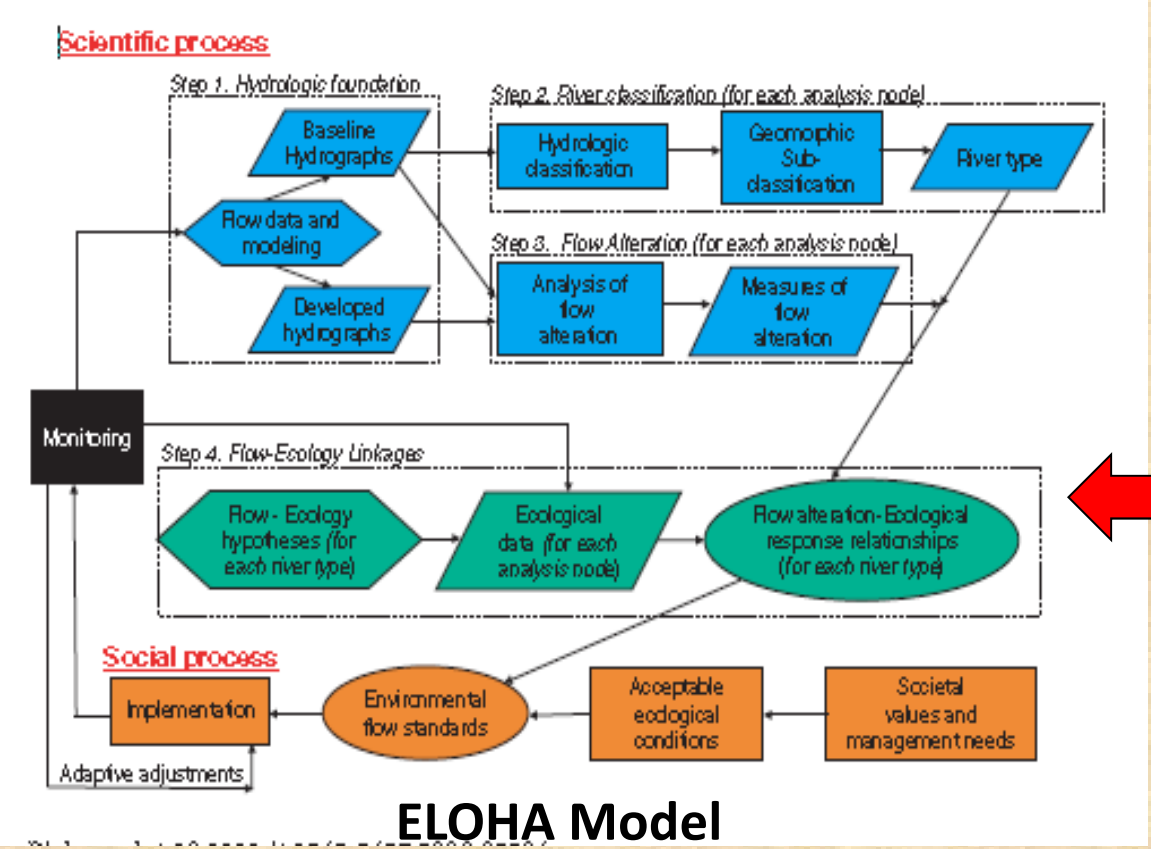
Overall Conclusions

- Biological indicators showed subtle, mechanistic responses to the physical changes in channel conditions in the armored segments, where they were present
  - ✓ Lower CRAM biotic structure scores
  - ✓ More tolerant invertebrate taxa
  - ✓ Sediment tolerant algae taxa
- Site specific factors influence level of response
  - ✓ Confinement
  - ✓ Upstream inputs
- Where responses occur, they suggest a definable mechanism, but responses did not occur at all sites
  - ✓ Sedimentation → sediment tolerant taxa
- No downstream propagation

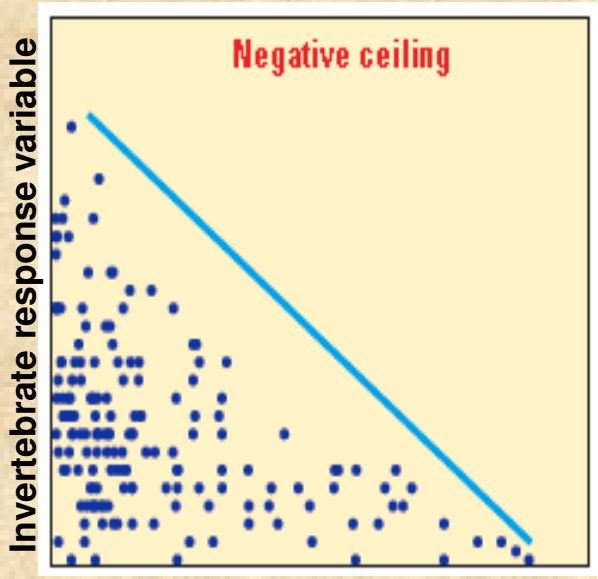
Overall Conclusions

- Biologically based assessments hold promise for monitoring and evaluation of effects of hydromodification
- Additional work is necessary to refine relationships between physical stress and biological response
- Focus on response at the functional trait level vs. the overall IBI or component metrics

Toward Flow-Ecology Models



ELOHA Model



QUESTIONS ?

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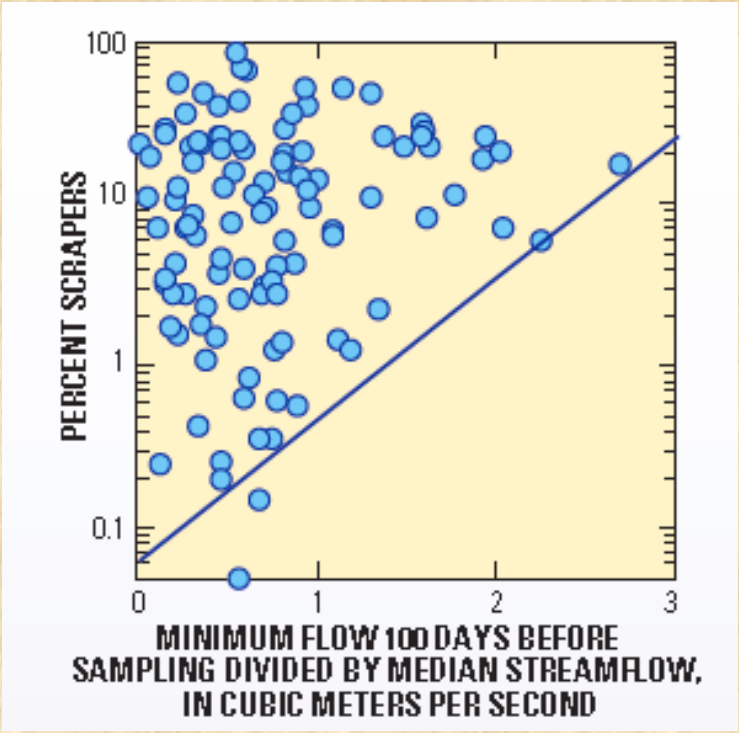

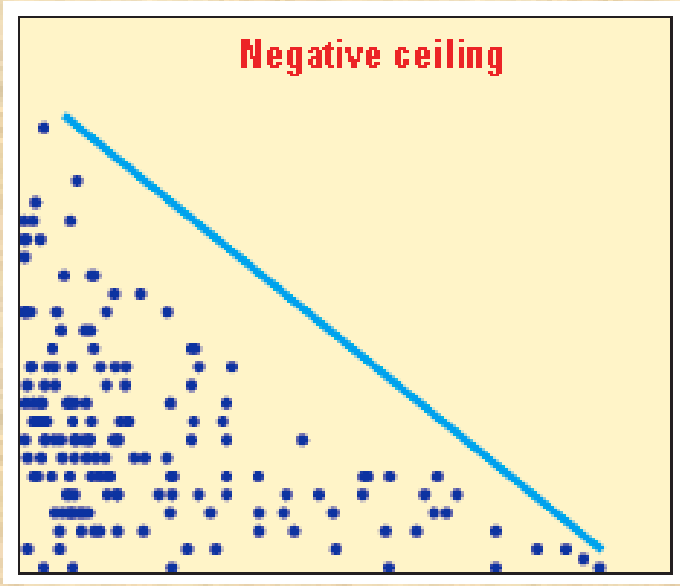

Invertebrate response variable

Streamflow variables

Physical Response of Streams