Aquatic Macroinvertebrate Assemblages of the upper Clear Creek Watershed and Whiskeytown National Recreation Area, California

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USGS
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  - Rhithron & Associates
  - University of Montana-biogeochemistry lab

Local Support

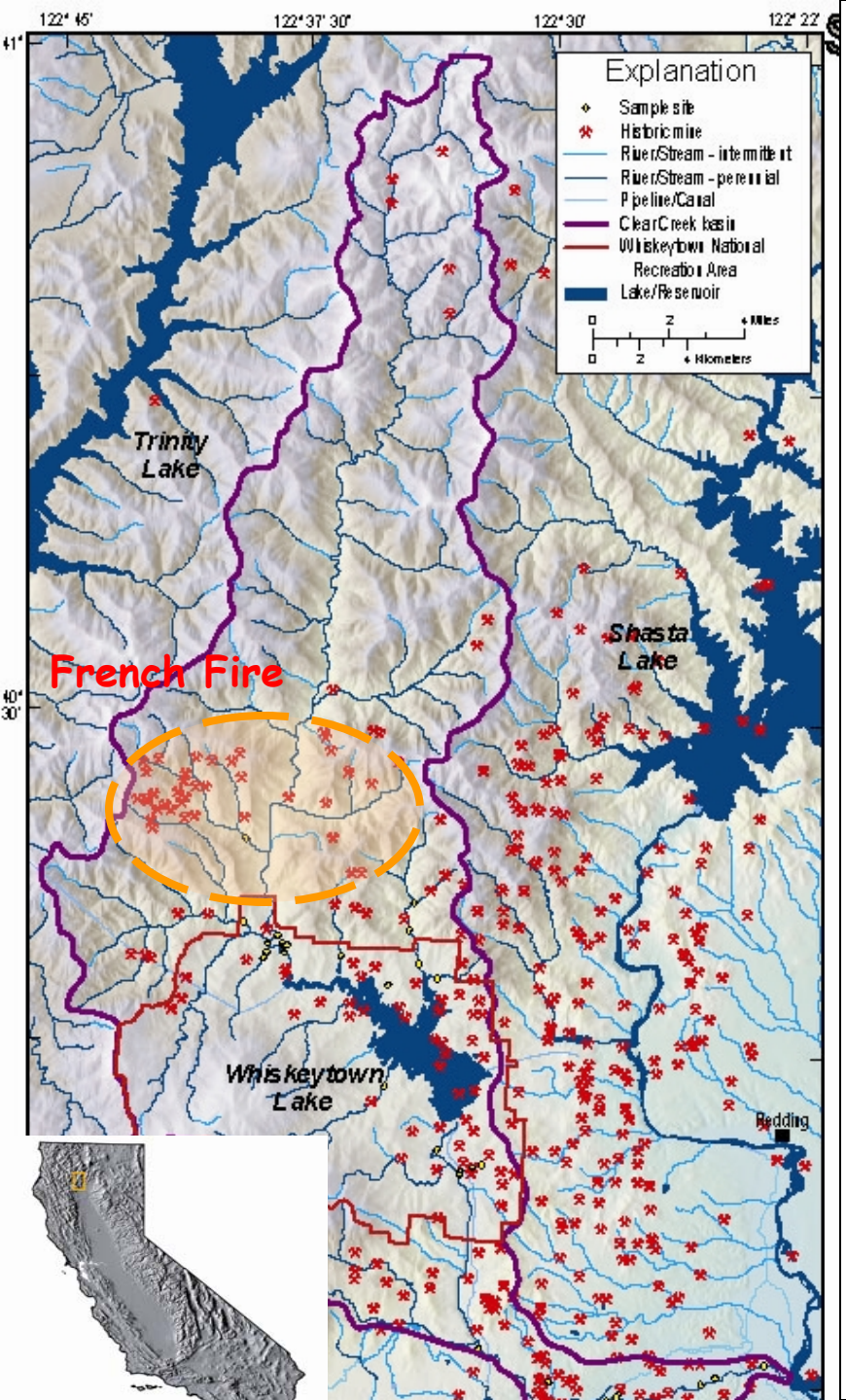
-French Gulch Hotel and Community

History USGS projects in Clear Creek/Whiskeytown NRA

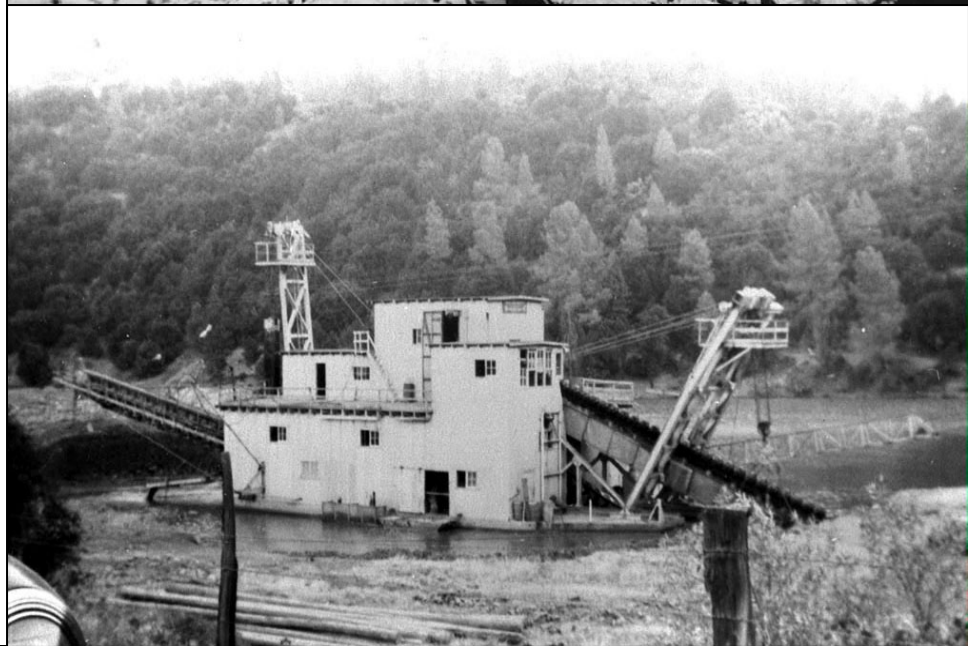
- Trace metals Reconnaissance 2002-03
  - (30 sites)
  - *Delineation of metals hot spots*
- Aquatic resource inventory/condition 04-05
  - (21 sites)
  - *Document current status of aquatic resources*
- Effects of French Fire (Aug-04) on aquatic resources 04-06
  - *(9 sites)*

**Assess possible changes in metals deposition/accumulation*

**Assess possible in community structure/IBI scores*


122° 45'
122°37' 30"
122°30'
122° 22'
41°
40° 30'
Explanation
Sample site
Historic mine
River/Stream - intermittent
River/Stream - perennial
Pipeline/Canal
Clear Creek basin
Whiskeytown National Recreation Area
Lake/Reservoir
0 2 4 Miles
0 2 4 Kilometers
Trinity Lake
Shasta Lake
French Fire
Whiskeytown Lake
Redding


Legacy impacts
historical gold mining
Logging
High Fire Frequency
Alteration of hydrology
for infrastructure



Current possible impacts

- Commercial mining and associated waste
- High Fire Frequency
- Post-fire Salvage logging
- Recreational mining,
  - (i.e. Suction Dredging)

Sites/collection methods

- 21 sites total :
- 17-fall 04; 9-spring 05; 21-fall 05; *9-Spring/Fall 06*

- 2 macroinvertebrates (BMI) sample types:

EMAP- Reach Wide Sample-RWS-(11 sq ft 500cnt)
EMAP-Targeted Riffle Sample-TRS- (8 sq ft 500cnt)

- Fish Community sample, 3-pass depletion at most sites

- 1 Periphyton sample Top-rock Scrape method:
  - *AFDM, Chl-a and Pheophytin- analyzed triplicate*

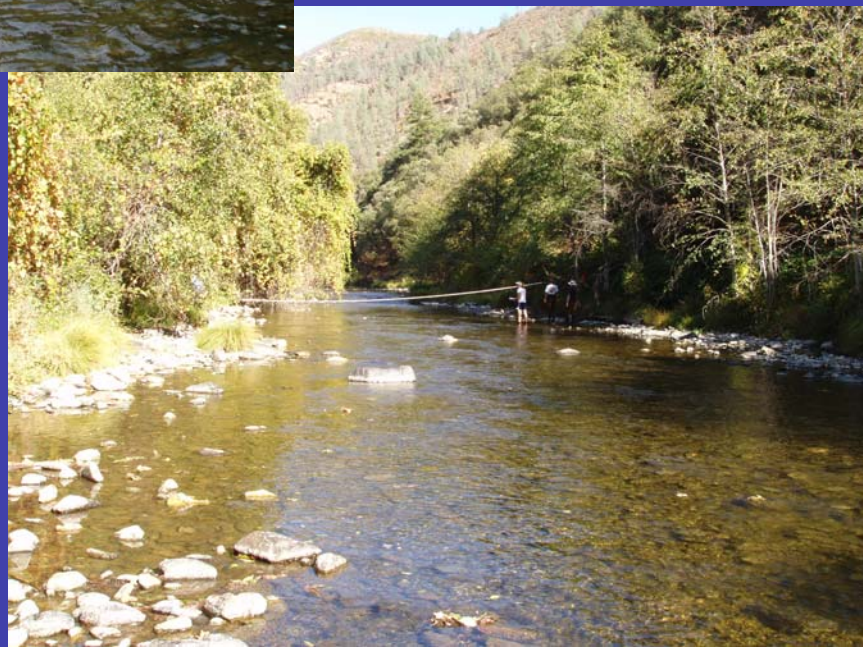
- Habitat-NAWQA 11 transects; pebble counts
- Bed Sediment chemistry-triplicate samples at fire sites.
- Metals analyses in periphyton, insects, and fish
- Water chemistry: Major ions, Metals (except HgT), and Nutrients

Clear Creek upstream of Reservoir

CLCR3

CCAR

CLCR4



Low Tributaries

North West side

South side

South Side High Tributaries

BR2

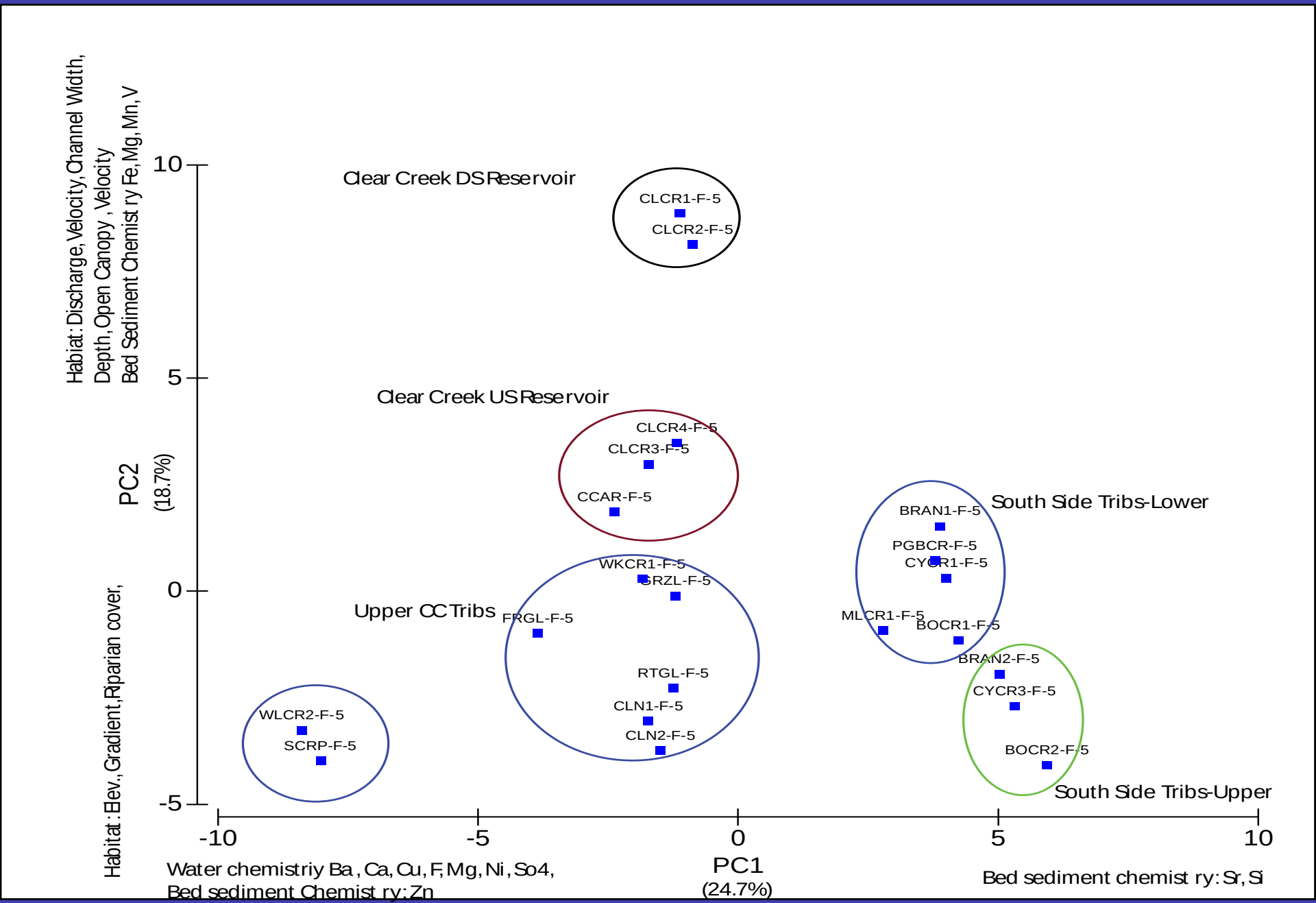
BO2

CY3

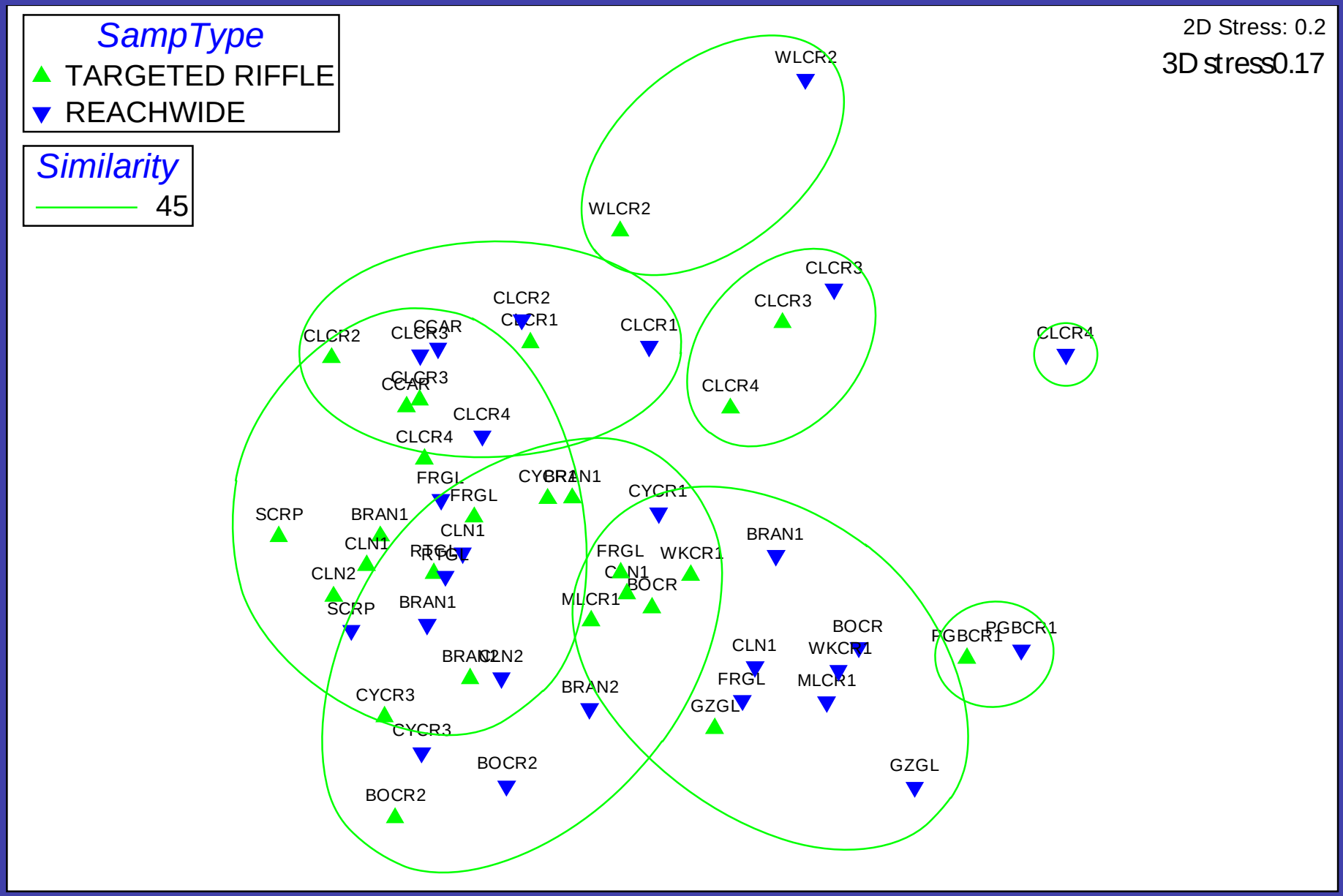
Analyses

- Environmental data-PCA
- NMS/DCA-community patterns
- BEST/CCA-community-environment relations
- Macroinvertebrates samples were scored by North Coastal California BMI-IBI developed by DFG-ABL (Rehn et al 2005)
- Comparison of BMI method types and indicators
- Analyzed metals patterns over time

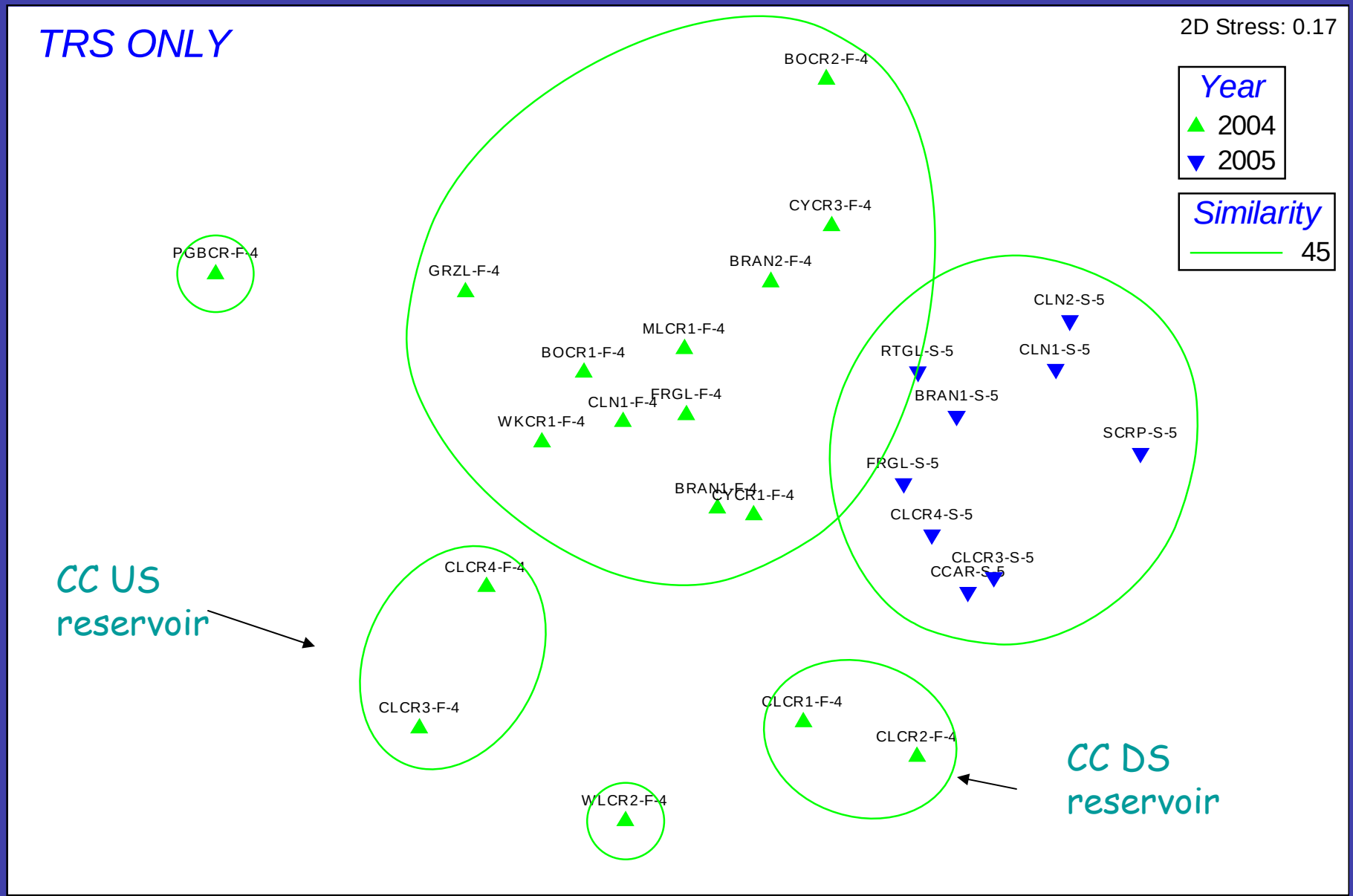
PCA of Environmental Parameters



Fall 04- Spring 05 NMS By BMI Method



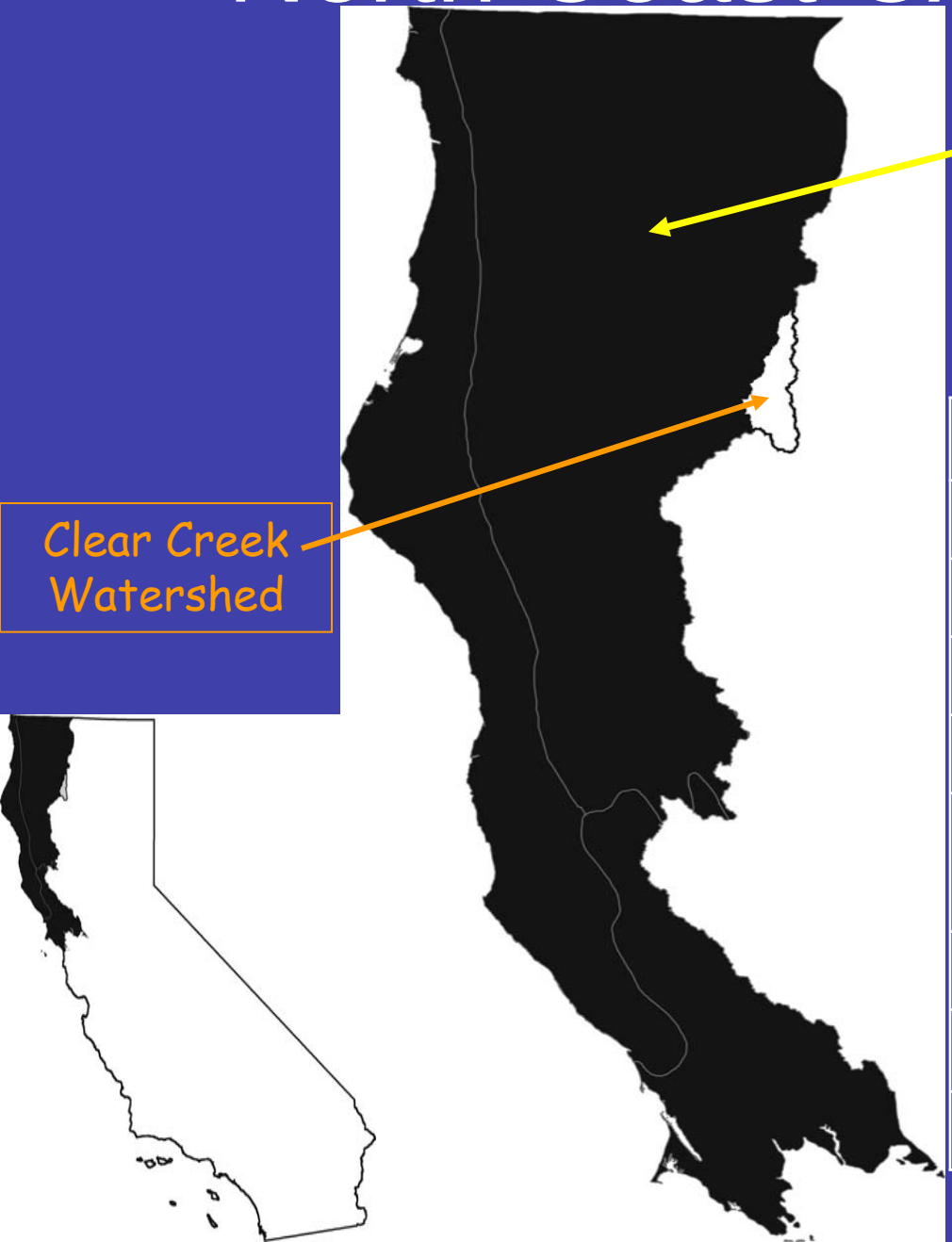
BMIs Targeted Riffle Only NMS: community difference amongst years = seasons



BEST/CCA-Environmental Parameters influencing Community Patterns

FISH F04, S05, F05	BMI Reach Wide F04, S05	BMI Targeted Riffle F04, S05	ALGAE F04, S05
CV_Velocity	CV_Velocity	CV_Velocity	CV_Velocity
Gradient	Gradient	Gradient	Gradient
Elevation	Mean Algal AFDM	Mean Algal AFDM	Mean AFDM
Substrate size	Total Nitrogen	Total Nitrogen	Total Phosphorus
%Riffle	**Water**: Cu, K, Ni	Chl-a/Pheophytin	Chl-a/Pheophytin
Depth		Channel Width	**Water**: Cl, Ni, Zn
		Water: Ni	

North Coast CA BMI-IBI



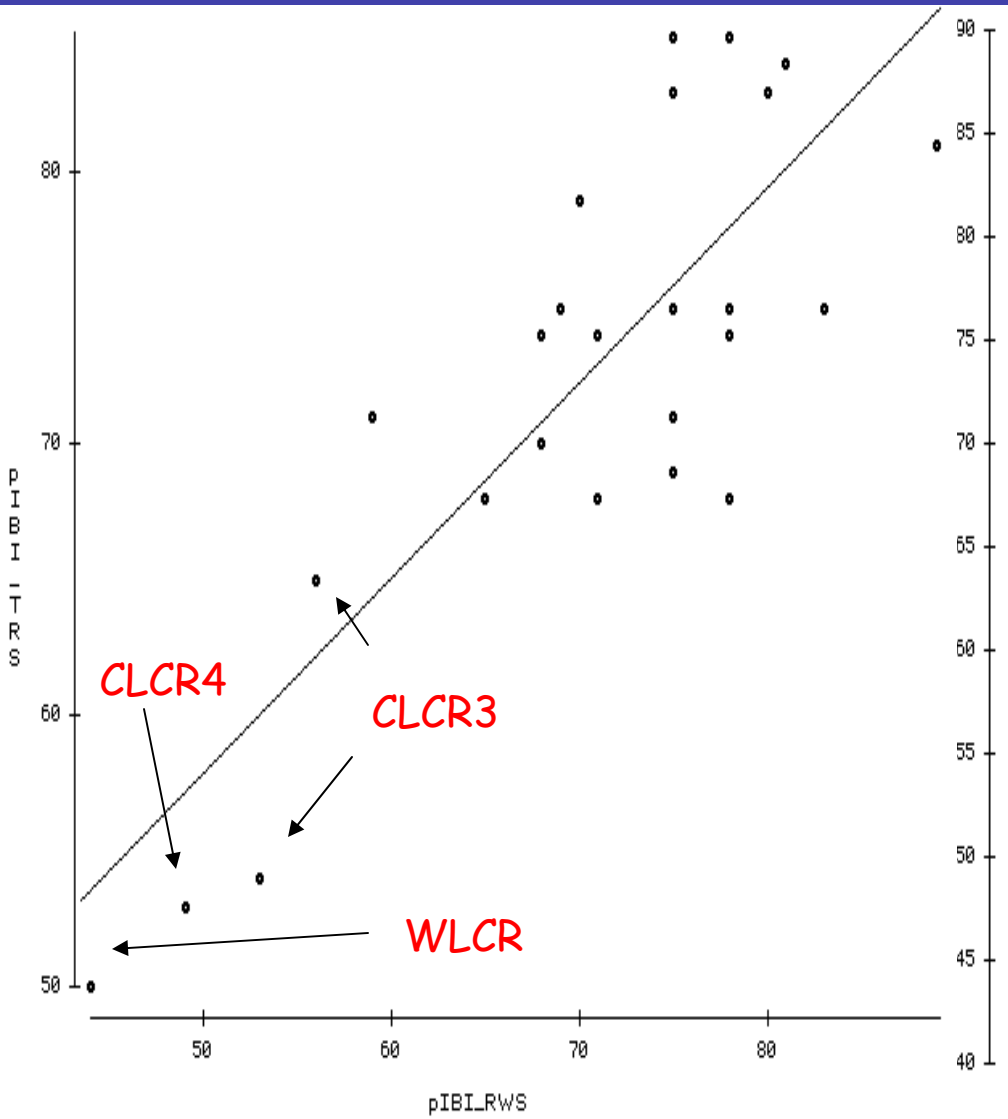
Clear Creek Watershed

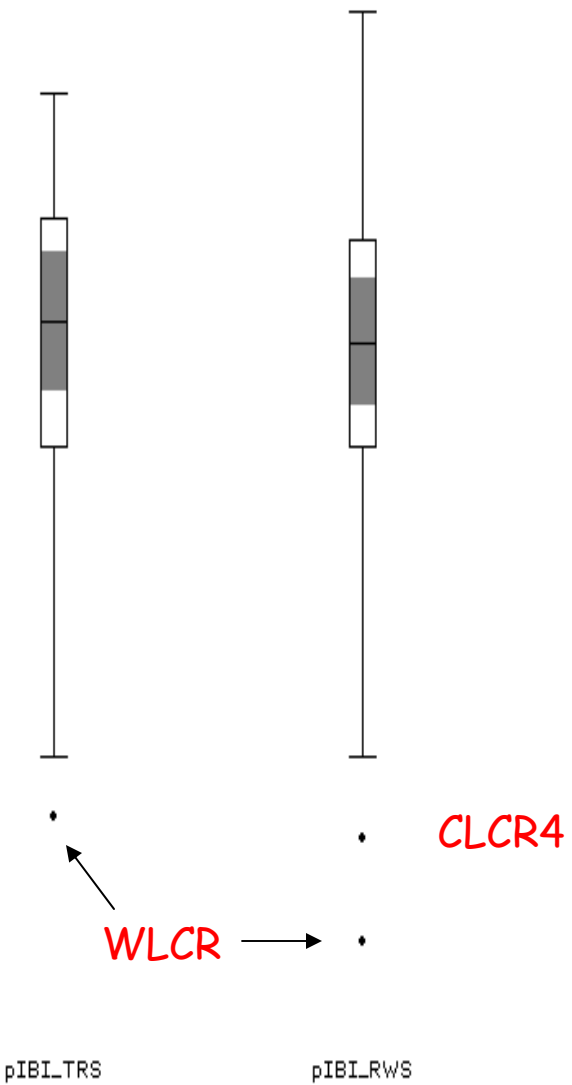
Developed based on 257 sites throughout Northern Coastal California Region screened 65 metrics on landscape and local stressors to come with 8 metrics for the IBI

North Coast IBI Metrics**
EPT Richness
Coleoptera Richness
Diptera Richness
% Intolerant Individuals
% Non-Gastropoda Scraper Individuals
% Predator Individuals
% Shredder Taxa
% Non-Insect Taxa

*(**Rehn et al, 2005 Draft., CA-ABL)*

Correspondence of BMI methods according to IBI Scores (rescaled to 0-100)

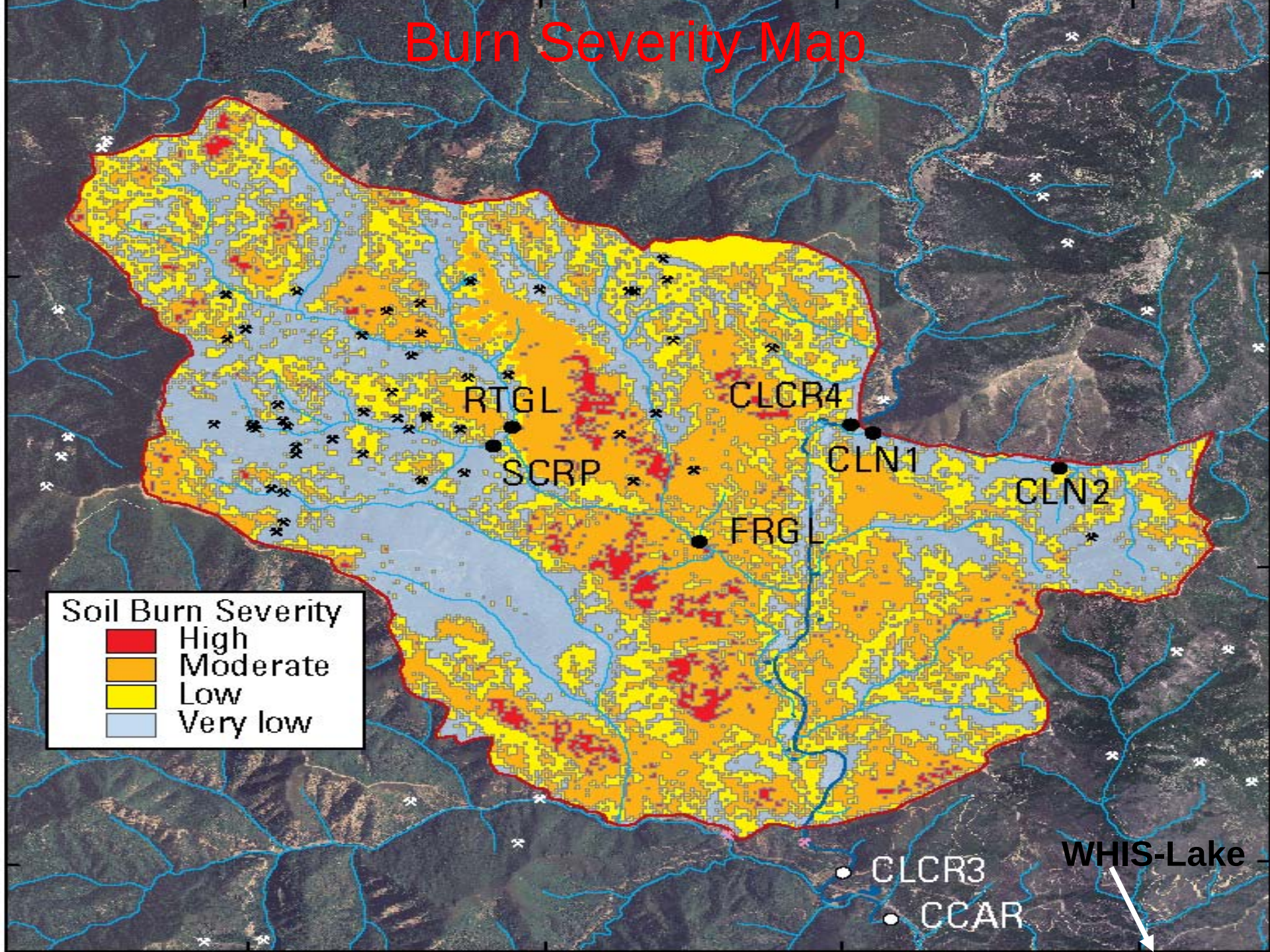




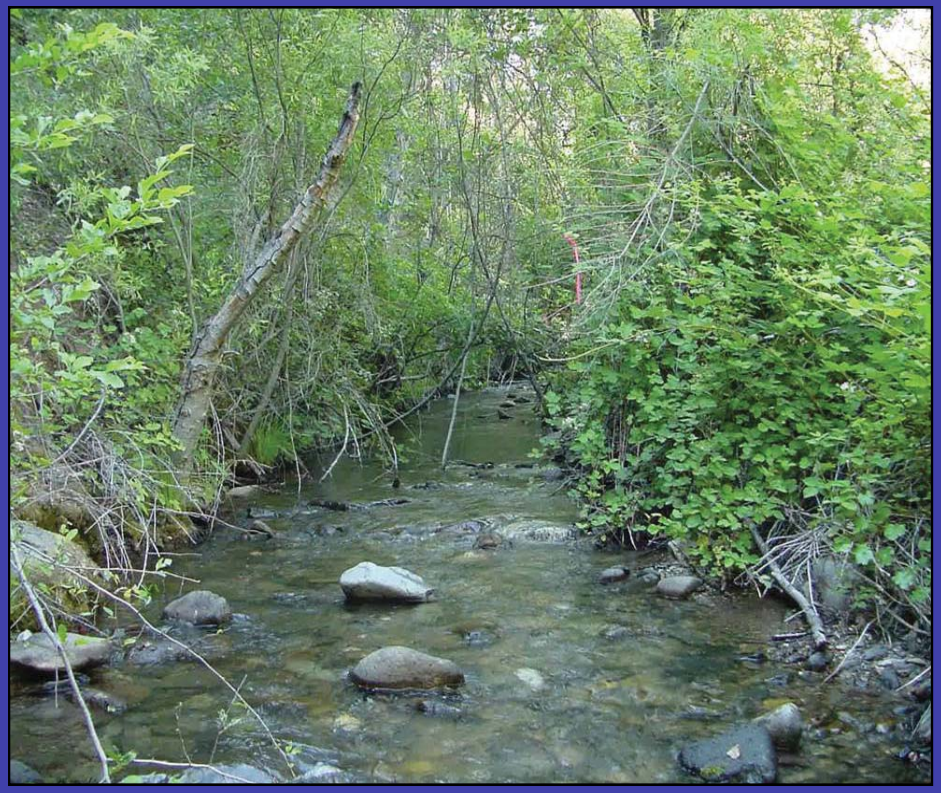
Correspondence of Algal and BMI Indicators

	IBI TRS	IBI RWS	Algae NMS 1	Algae NMS 2	TRS NMS 1	TRS NMS 2	RWS NMS 1	RWS NMS 2
IBI TRS	1							
IBI RWS	**0.818**	1						
Algae NMS1	**-0.504**	-0.377	1					
Algae NMS2	-0.37	-0.382	-0.001	1				
TRS NMS1	0.197	0.327	0.234	-0.208	1			
TRS NMS2	**0.595**	0.511	**-0.619**	**-0.624**	0.001	1		
RWS NMS1	-0.226	-0.37	-0.141	0.319	**-0.925**	-0.17	1	
RWS NMS2	**0.692**	**0.632**	**-0.681**	-0.571	-0.122	0.888	0	1


So What about the fire ?


Burn Severity Map
RTGL
CLCR4
SCRP
CLN1
CLN2
FRGL
Soil Burn Severity
High
Moderate
Low
Very low
CLCR3
CCAR
WHIS-Lake

FRGL before the French Fire

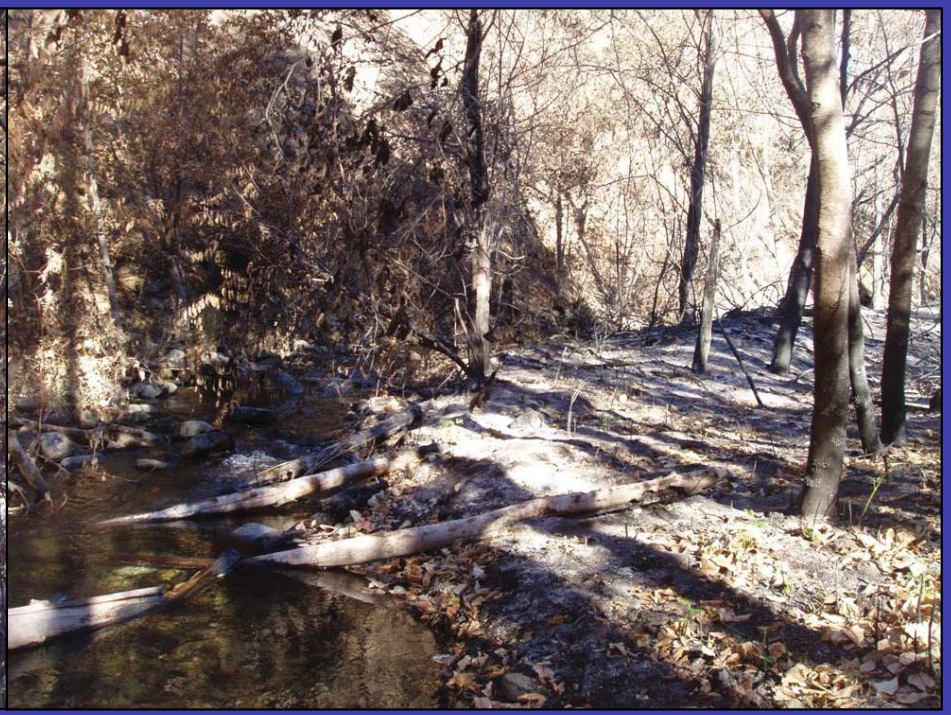


June 2002 (Before French Fire)

Spring 2003 (Before French Fire)

1month after the Fire

September 2004 (1 month after the fire)



FRGL Spring/Fall 05

June 2005

September 2005

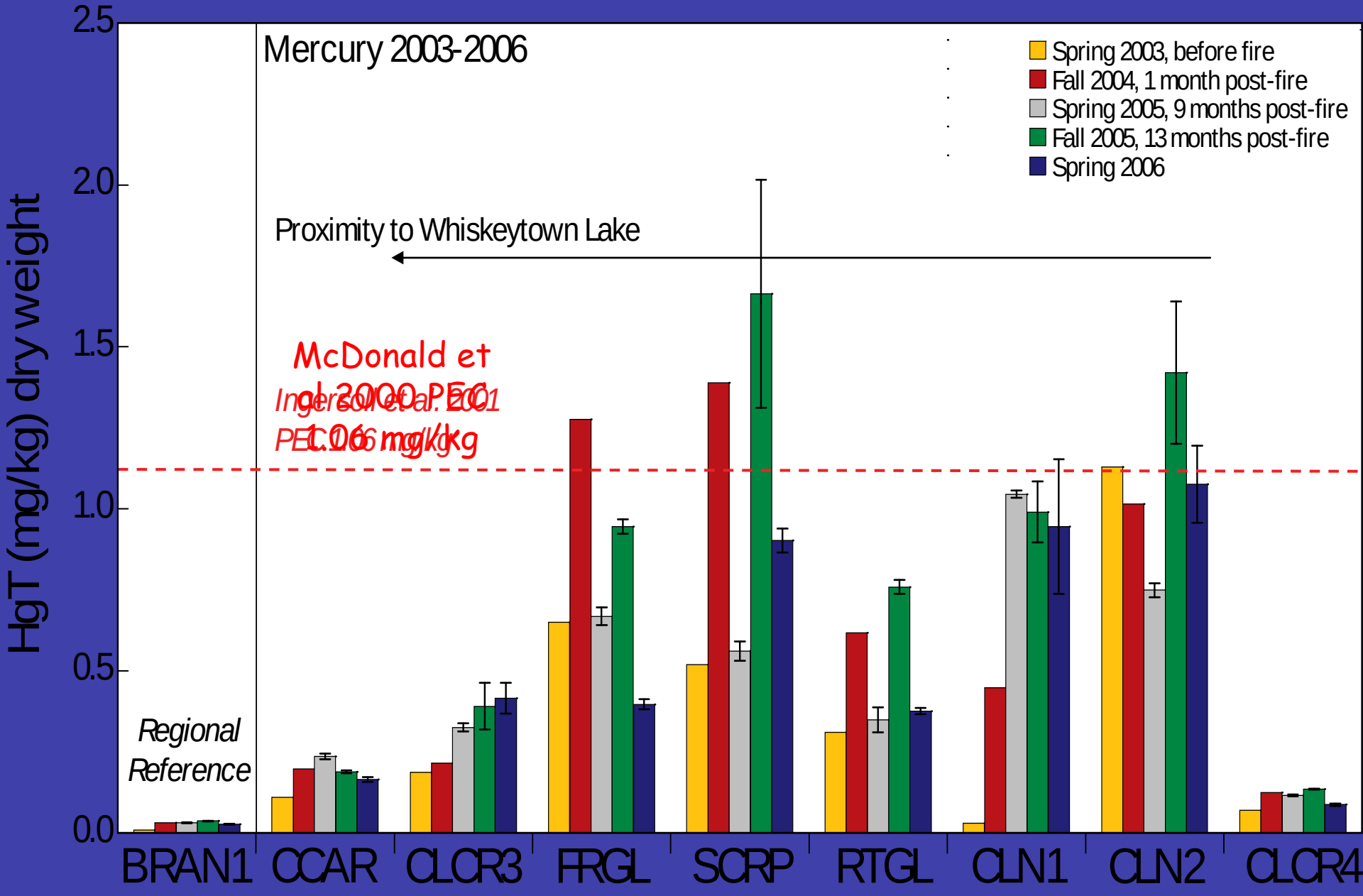
FRGL Spring/Fall 06

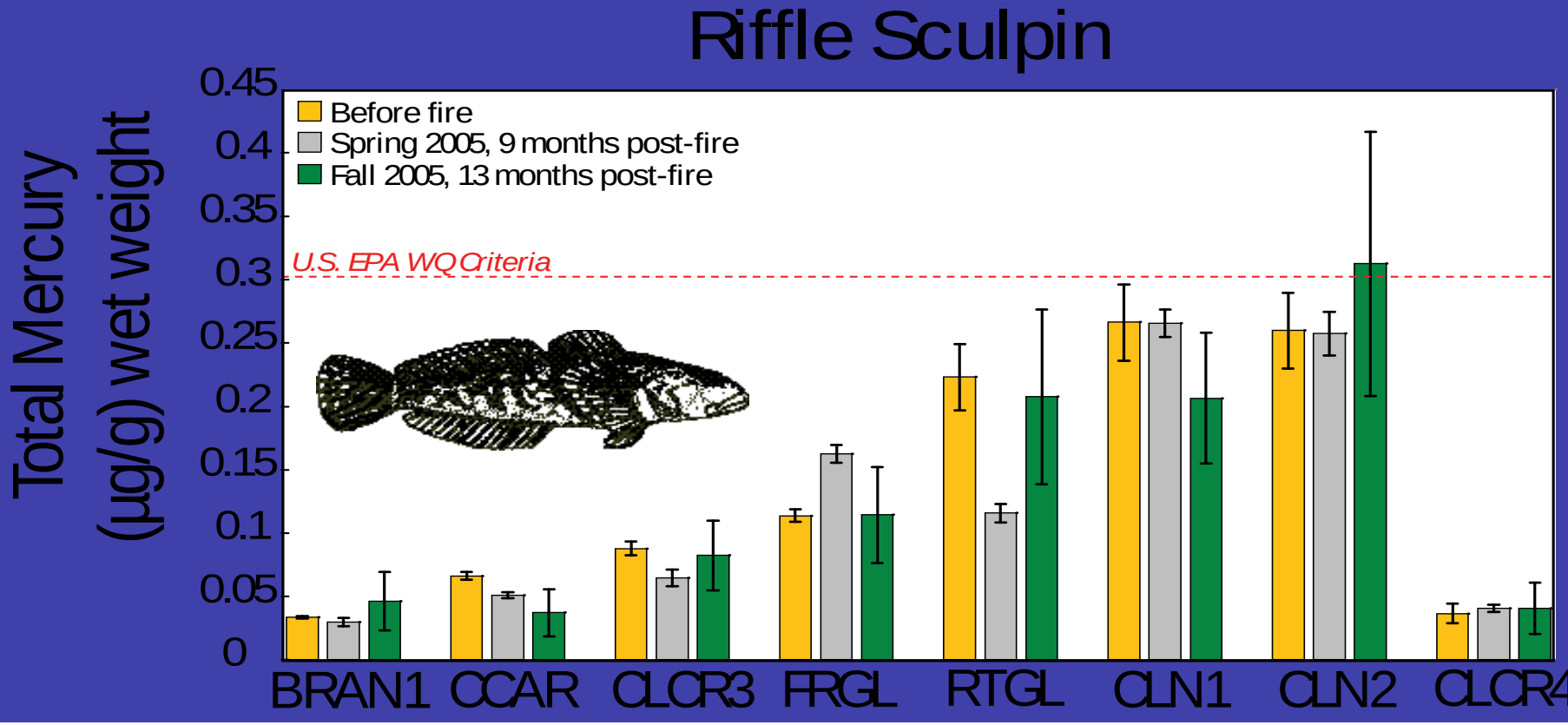
April 2006 Runoff Event Post French Fire

September 2006 -turbidity caused by suction dredger upstream

Metals
deposition & accumulation
patterns over time

Mercury in Sediment Over Time

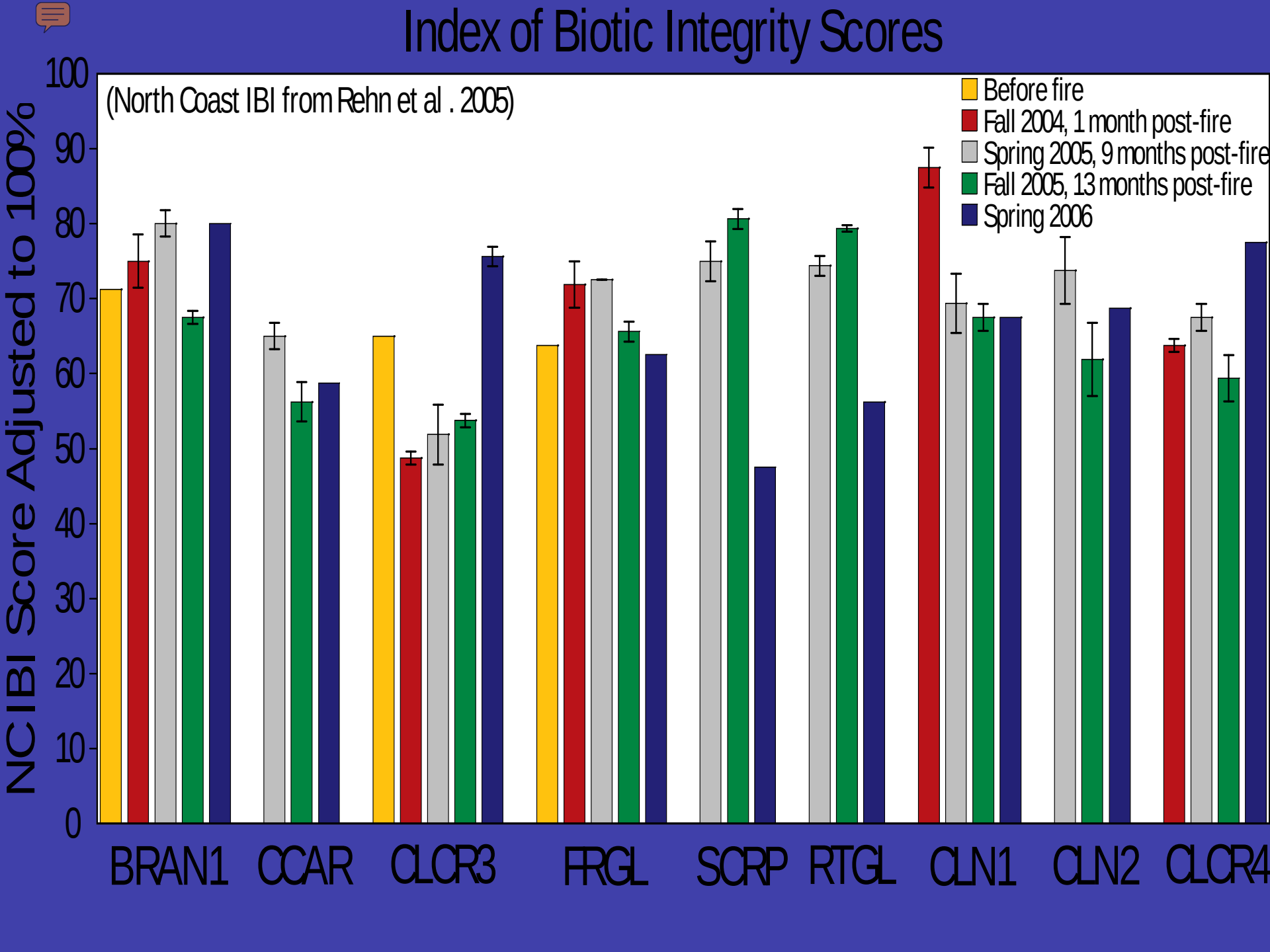


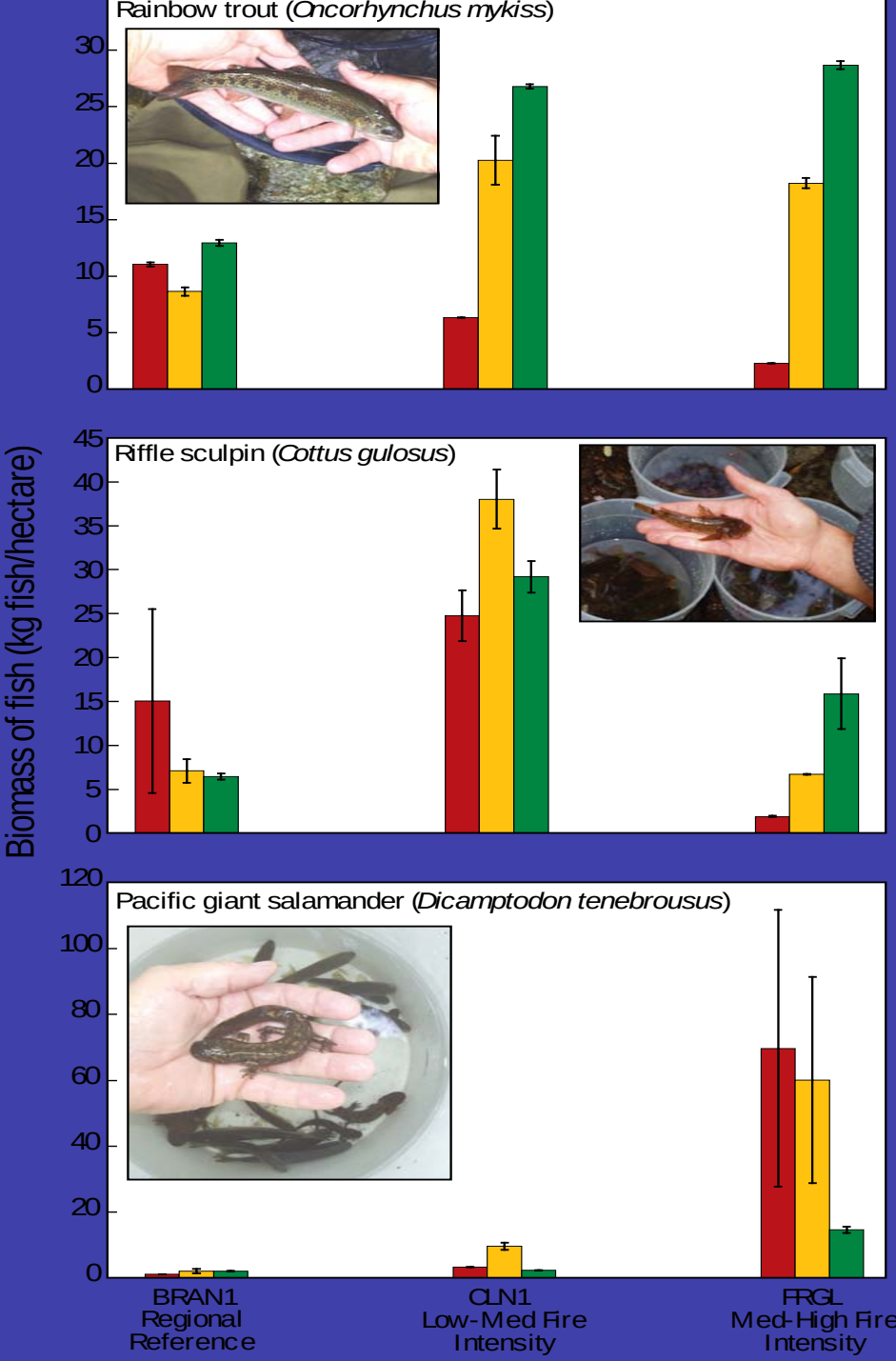


- Patterns for mercury in fish are consistent amongst trout and sculpins and appear to be relatively stable over time. CLN2 was the most elevated site within the fire study sites.

Community patterns over time

Index of Biotic Integrity Scores





Fish showed a significant decrease in numbers and biomass at FRGL a moderately to high intensity burn site.

Pacific Giant Salamander showed an inverse trend to fish suggesting potential recruitment event and possible use of refugia by the salamanders in interstitial spaces that would not be available to fish

Red-Fall04

Gold-Spring 05

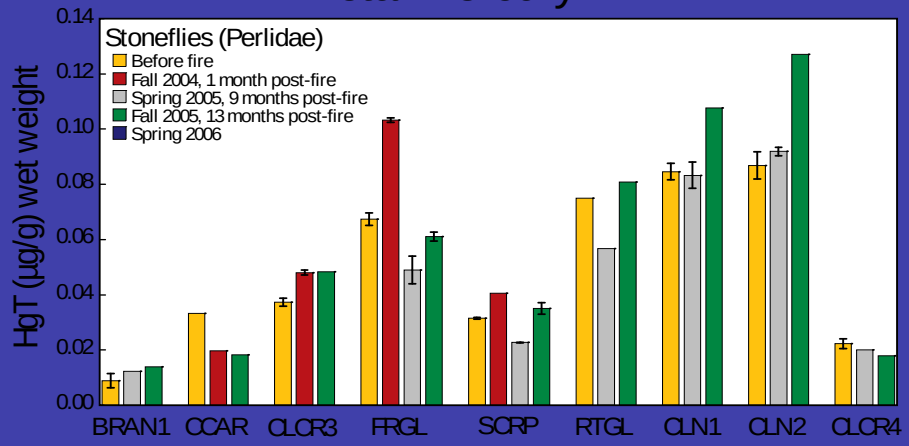
Green-Fall 05

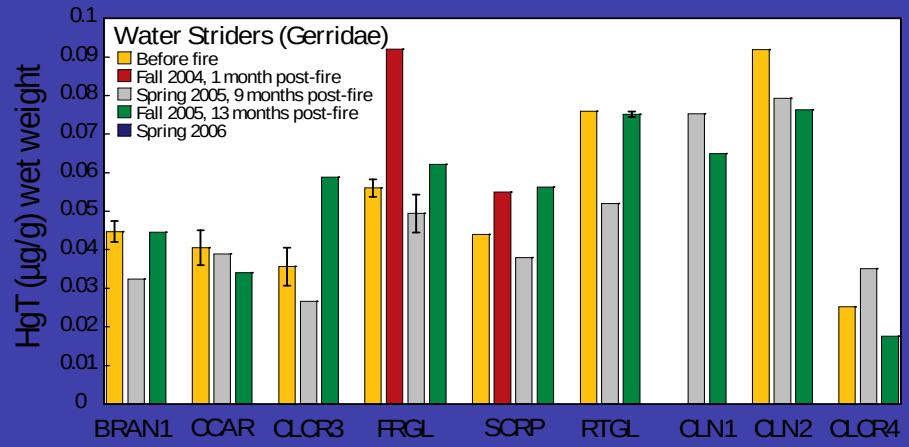
Summary of Results

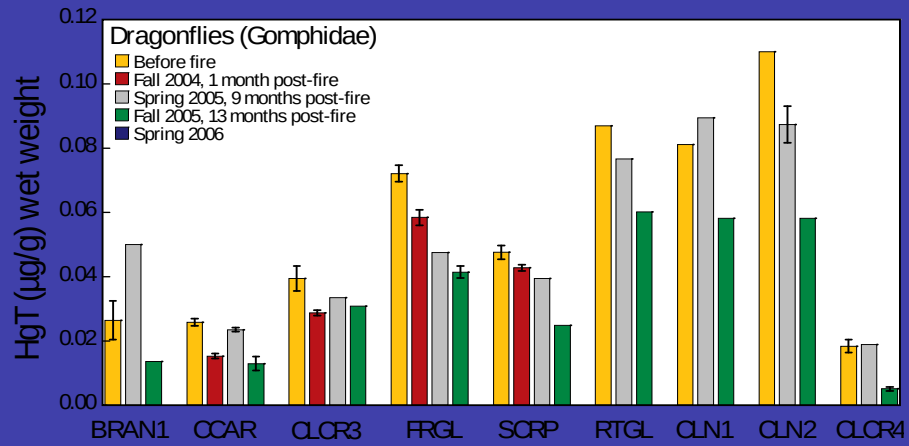
- Most sites are in Whiskeytown NRA are in good condition based on the BMI community data
- Consistency of indicators both on the basis of environmental drivers and amongst community measures
- Seasonal differences in BMI composition
- IBI scores were minimally affected by seasons or methods
- Conclusion about the fire:
  - Metal deposition/accumulation patterns difficult to attribute to fire
  - Persistence of invert. community and quick recovery of fish


Thank you

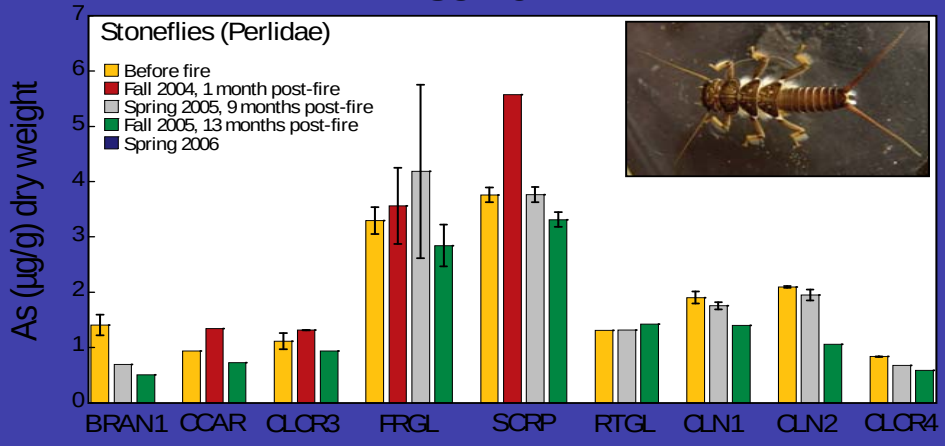
Total Mercury

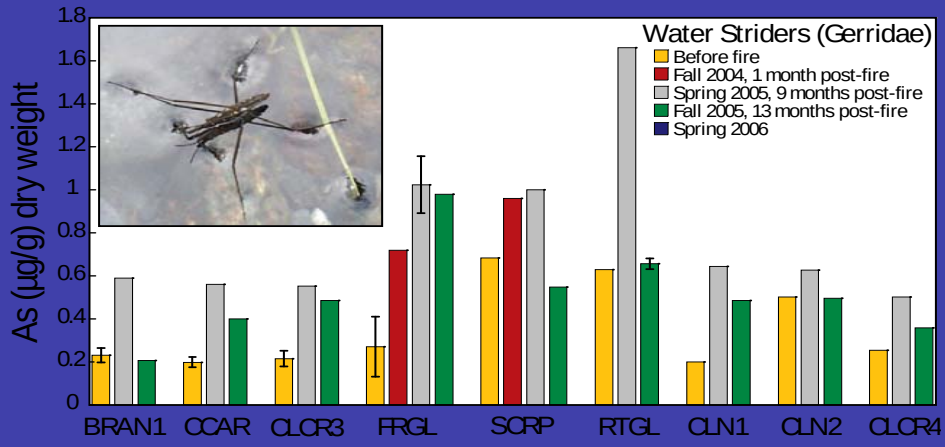


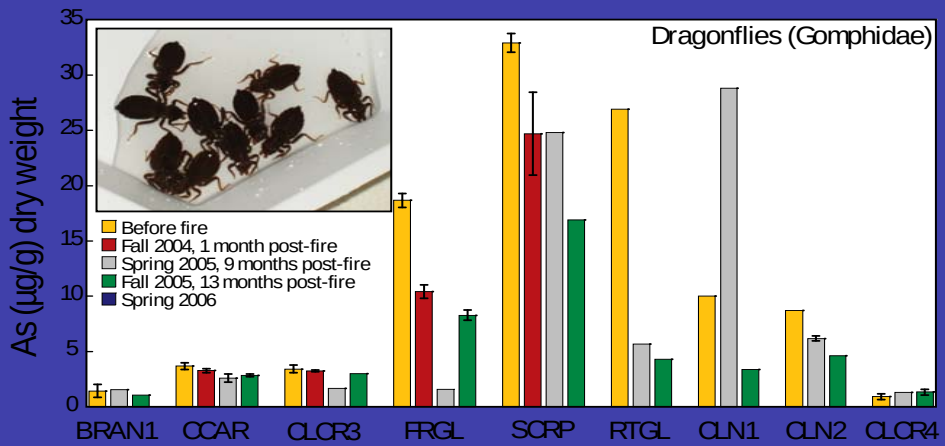




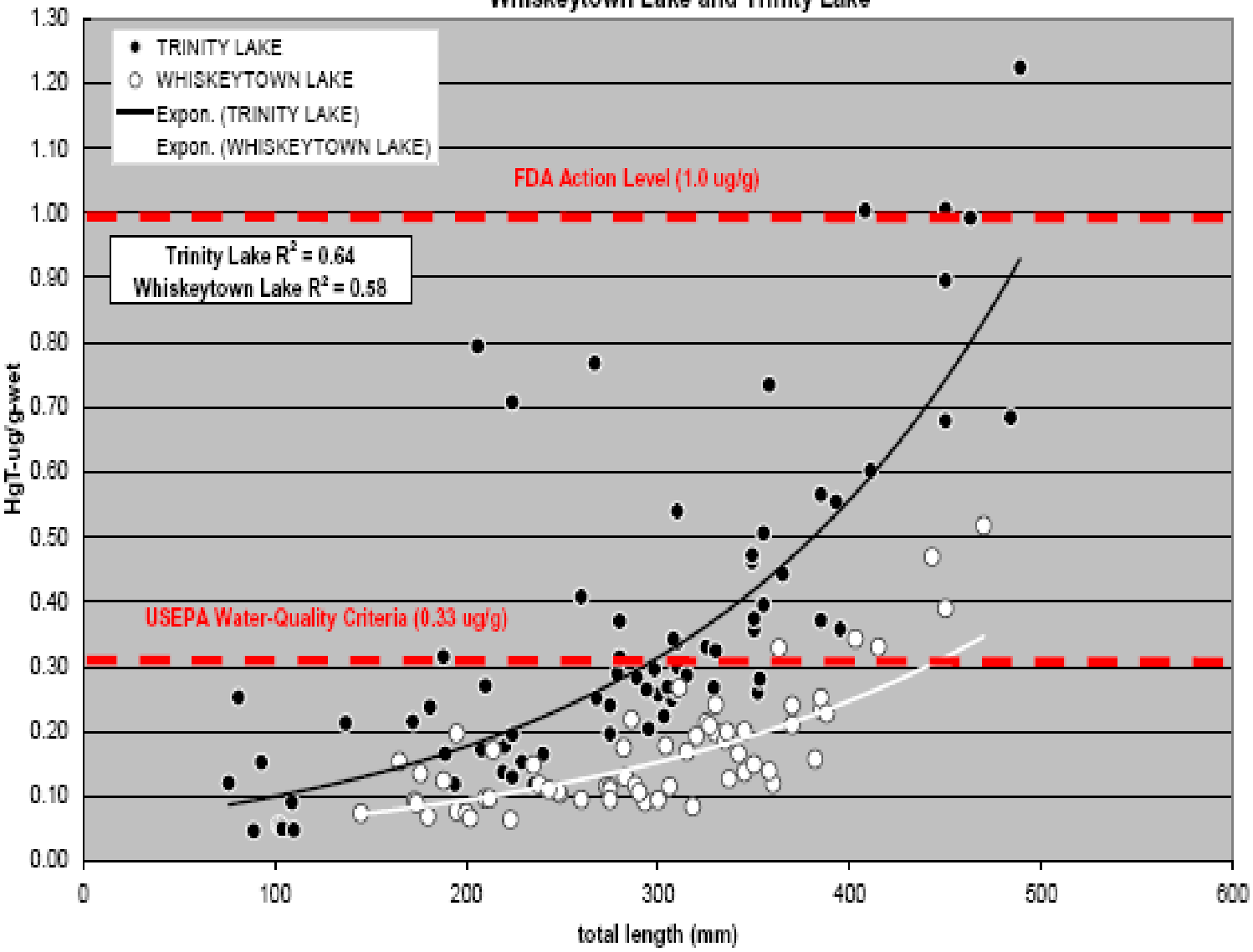
Arsenic





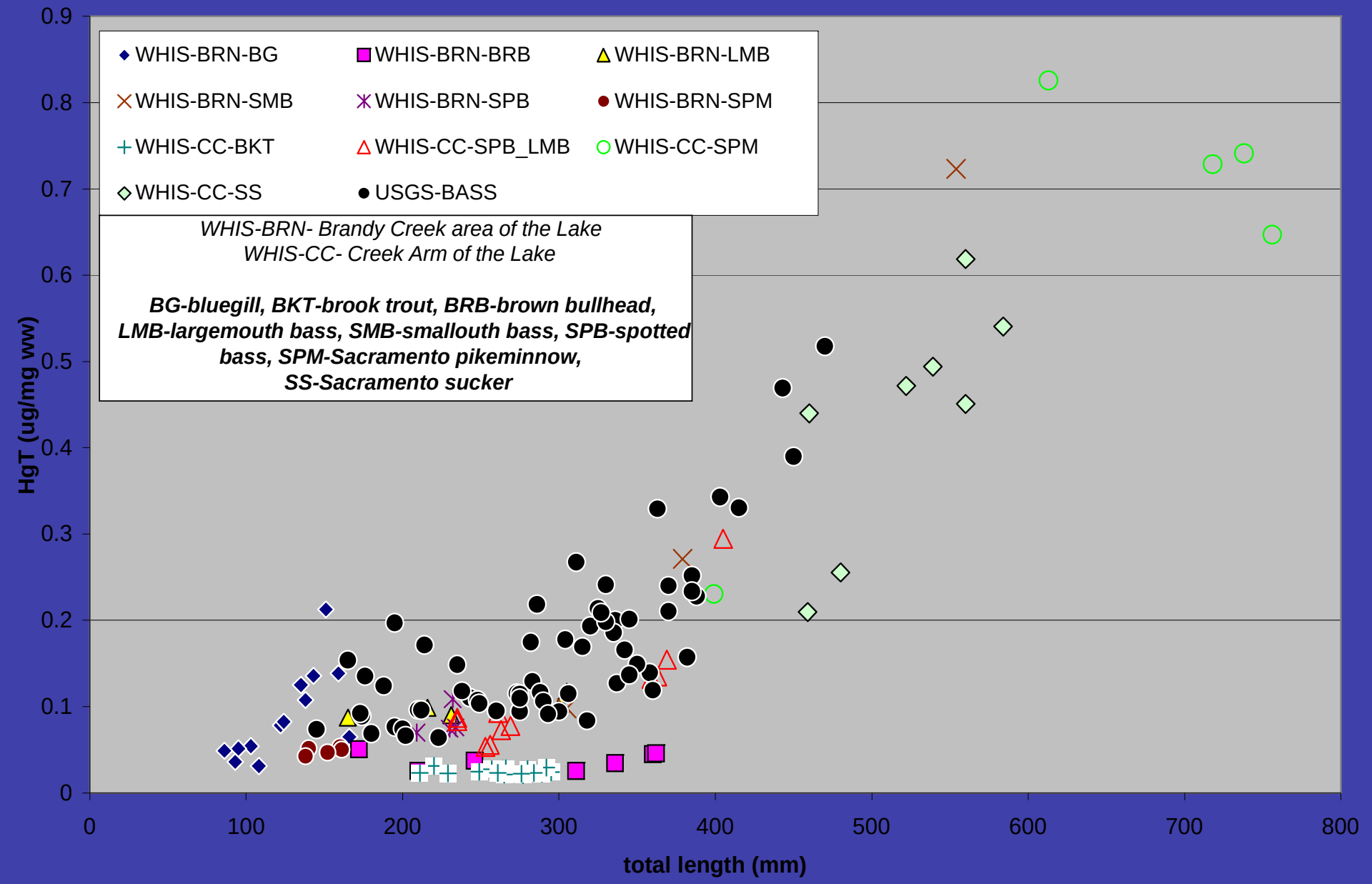


Comparison of Bass Data between Whiskeytown and Trinity Lakes

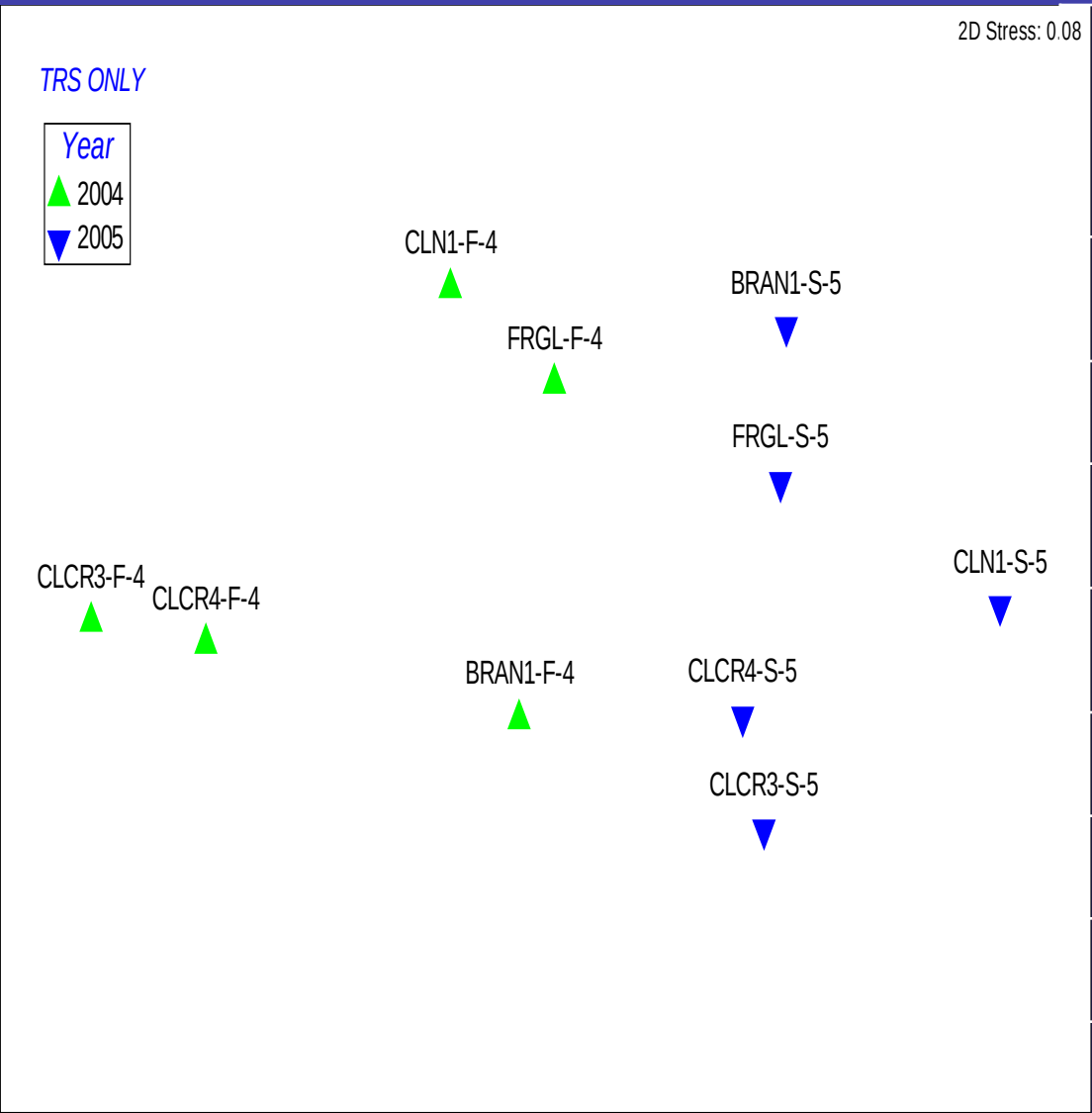


Draft Data-Subject to Revision Do not Cite

Whiskeytown Lake USGS 2005-DFG 2006 Collections

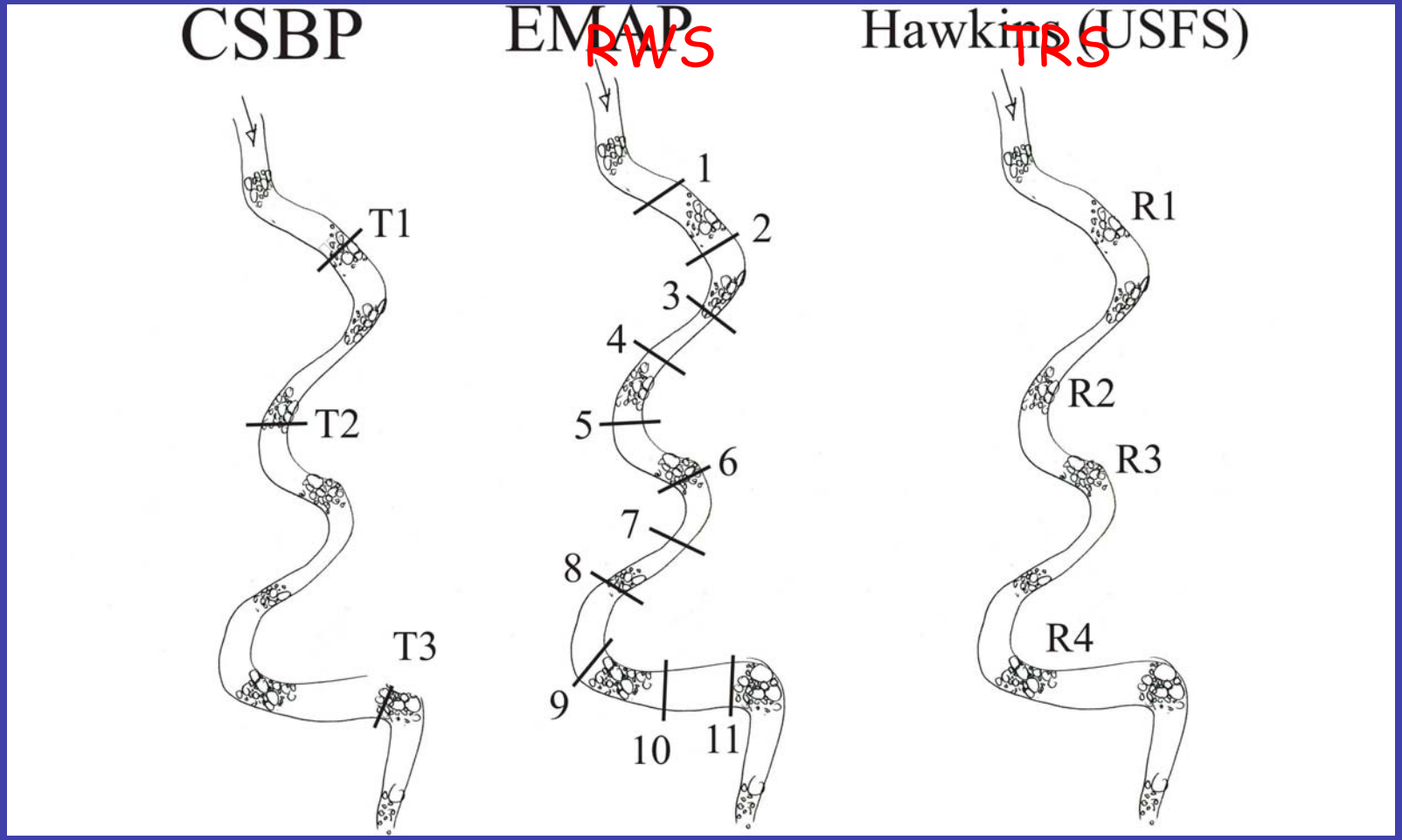


Fire Sites-Targeted Riffle: Difference in abundance between years of major taxa



	Fall 2004	Spring 2005	
Species	Ave. Abund	Ave. Abund	Ave. Diss
Baetis sp.	7.76	16.38	2.65
Glossosoma sp.	0.27	7.17	2.12
Hydropsyche sp.	9.65	3.87	1.81
Simulium sp.	5.51	6.92	1.34
Tvetenia sp.	1.69	5.6	1.21
Gumaga sp.	5.3	2.34	1.16

Macroinvertebrate collection methods



- 3- 2ft² areas composited at each of 3 transects
- 18ft² total area

- 11- 1ft² areas composited at each site
- 11ft² total area

- 2- 1ft² areas at each of 4 riffles
- 8 ft² total area

Mean Substrate Size Over Time