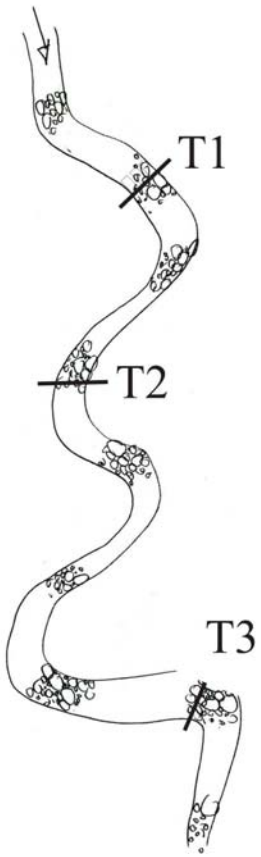
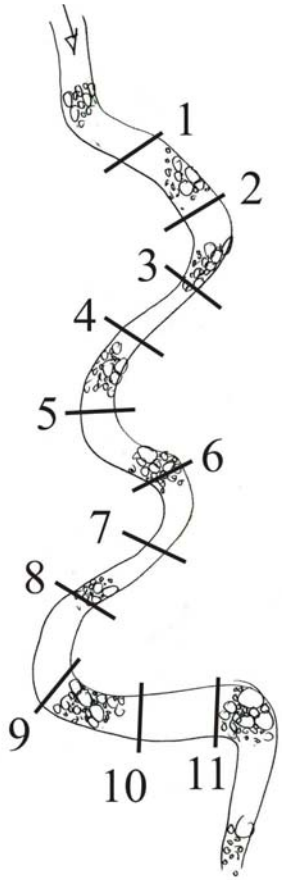
Comparability of Benthic Macroinvertebrate Sampling Methodologies

CSBP



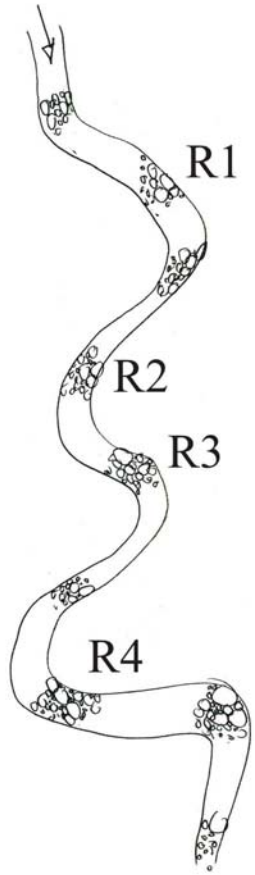
- 3- 2ft² areas composited at each of 3 transects
- 18ft² total area

EMAP Reach-Wide Composite (**RWC**)



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

EMAP, USFS Targeted-Riffle Composite (**TRC)**



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

Lab Analysis:

-**RWC**: 500 organisms from composite sample

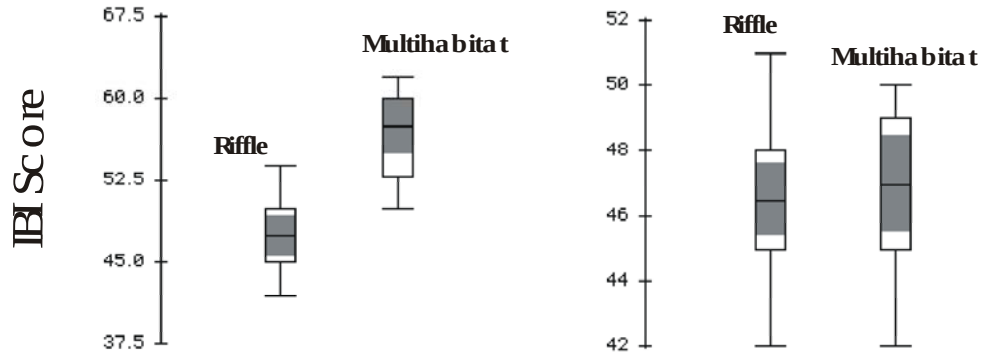
-**TRC**: 500 organisms from composite sample

-**CSBP**: 900 organisms total ; 3 transects kept separate, 300 counts each

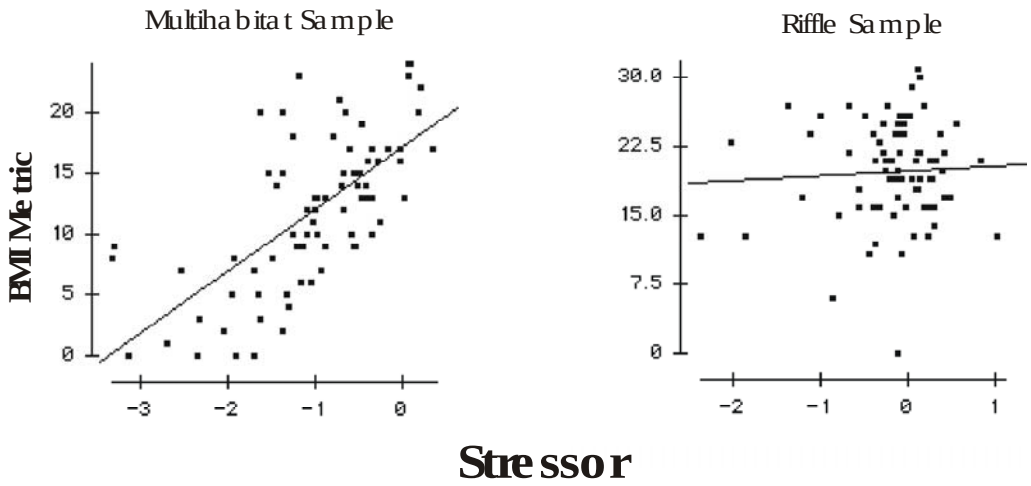
- All organisms were identified to species when possible.

Three things we need to know to compare bioassessment methods:

1. How does each method characterize reference conditions?



2. Do the methods have different sensitivity to stressor gradients?

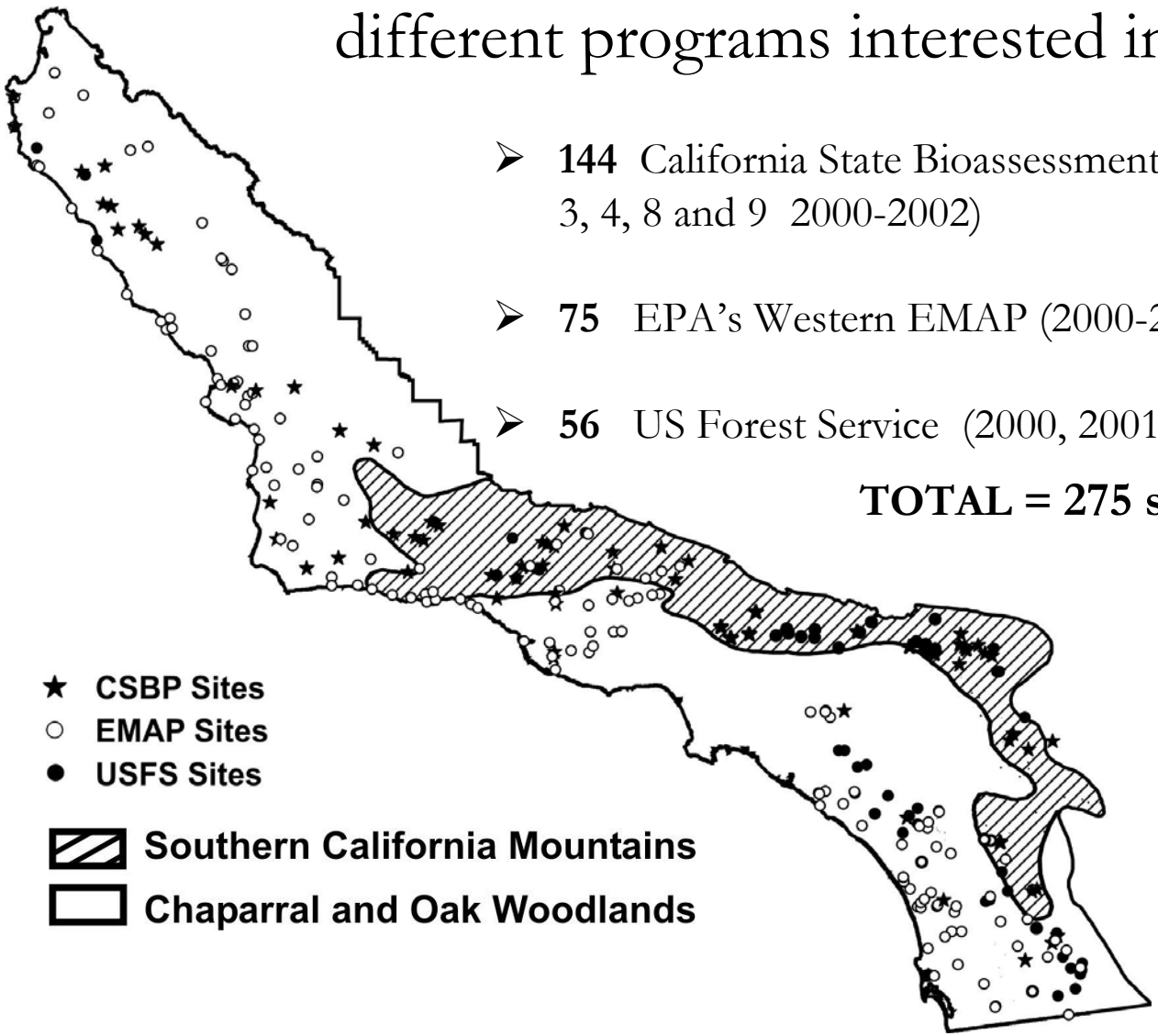


3. What is the within-site measurement error associated with each method?

SoCal IBI: combined BMI data collected under several different programs interested in the region

- **144** California State Bioassessment Protocol (Regional Boards 3, 4, 8 and 9 2000-2002)
- **75** EPA's Western EMAP (2000-2003)
- **56** US Forest Service (2000, 2001)

TOTAL = 275 sites



Initial Comparisons for southern California IBI:

77 EMAP sites sampled in 2000, 2001

- Sites sampled throughout California (across habitats, ecoregions, etc.)

- All three methods used to sample each reach at the same time:
  - RWC (multihabitat)
  - TRC (targeted riffle composite)
  - CSBP (targeted riffle – 3 transects)

- Sampling was nested within a reach to avoid sampling bias

Data Analysis:

- 7 metrics were calculated for each site:

- Based on preliminary work in SoCal…

  - # Scraper Taxa
  - # Coleoptera Taxa
  - # Predator Taxa
  - % Collectors (Gatherers and Filterers)
  - # EPT Taxa
  - Average Tolerance Value
  - % Tolerant Taxa

Relative Ranks:

$$Score = \sum \left(x_i - \bar{x} \right) / \, sem_i$$

x_i = site value for the *i*-th metric;

$\bar{x}$ = overall mean for the *i*-th metric;

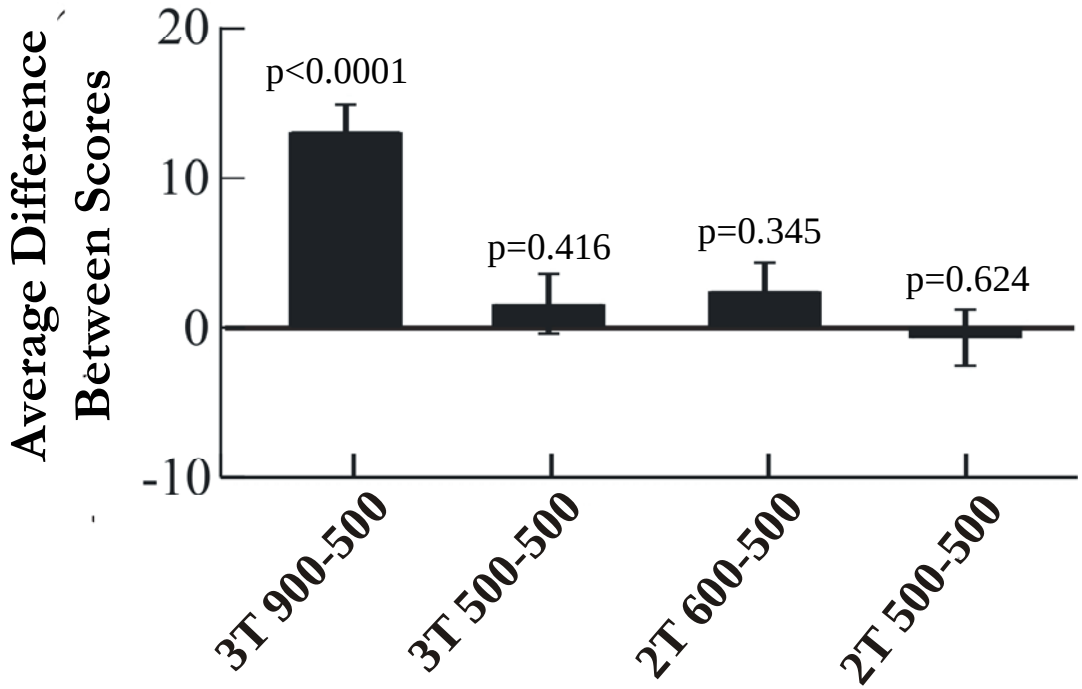
sem_i = standard error of the mean for the *i*-th metric.

Site scores are scaled to a mean of ‘0’.

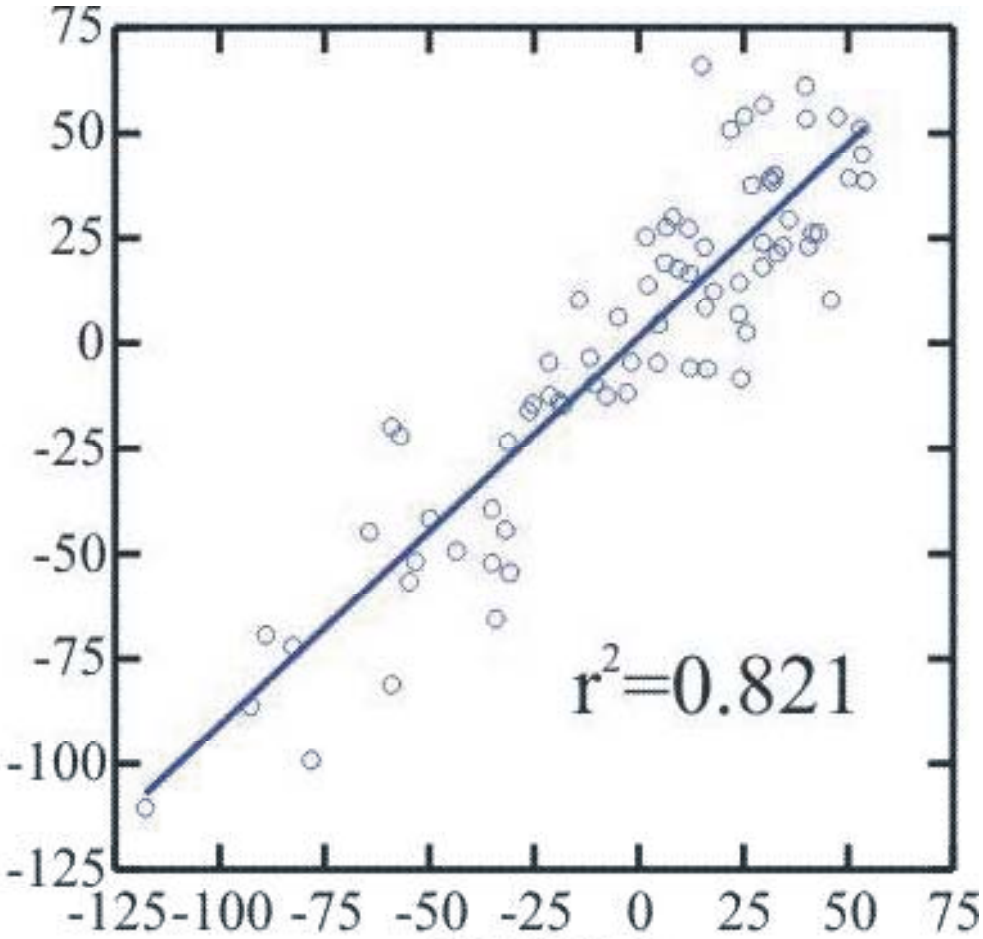
We used the relative ranks to answer two questions:

1. Do 900 count CSBP samples systematically score higher than TRC (500 count) samples?

2. Do CSBP samples adjusted to a 500 count by random resampling of taxa score differently than TRC (500 count) samples?

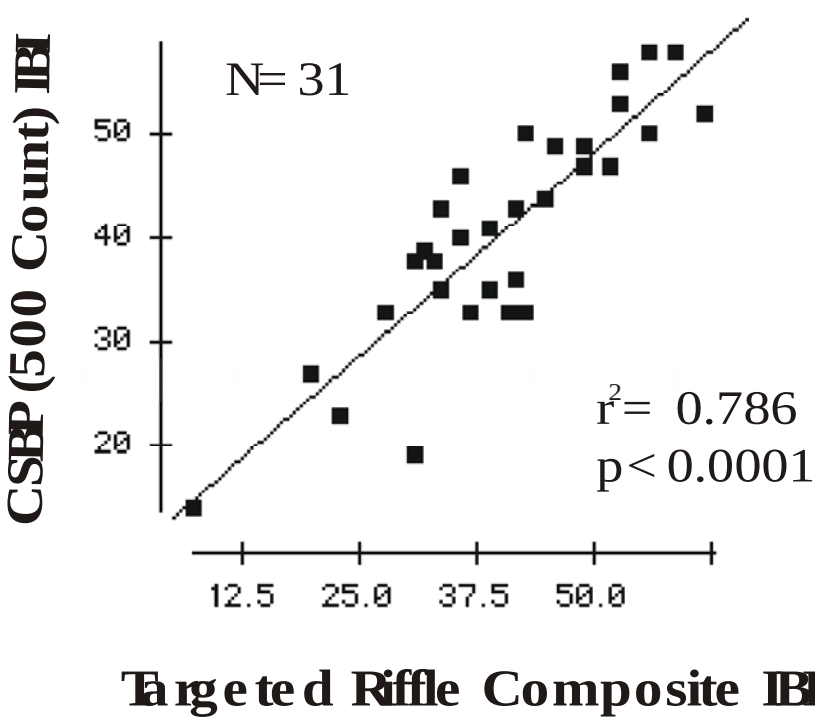


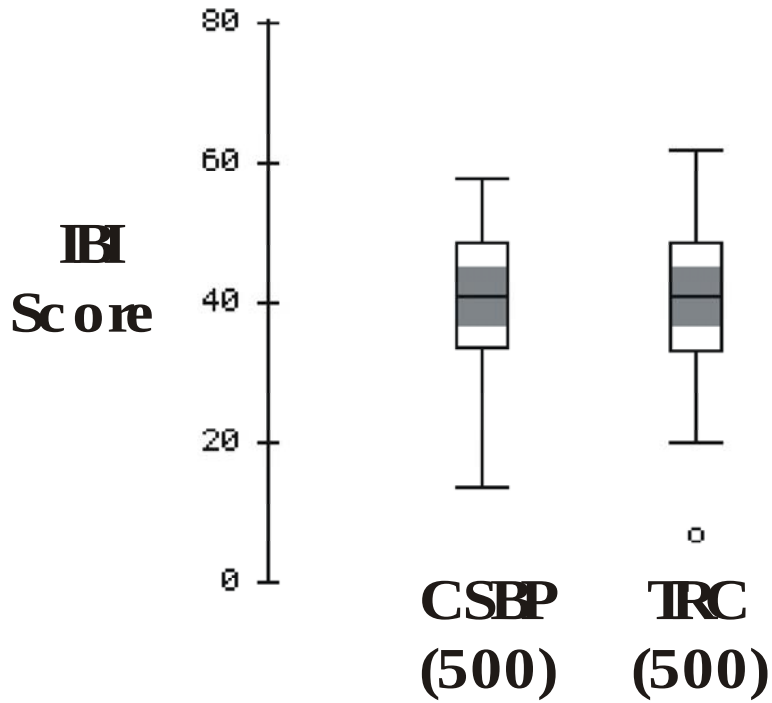
CSBP (500)
Relative Rank



TRC Relative Rank

After we developed an IBI…





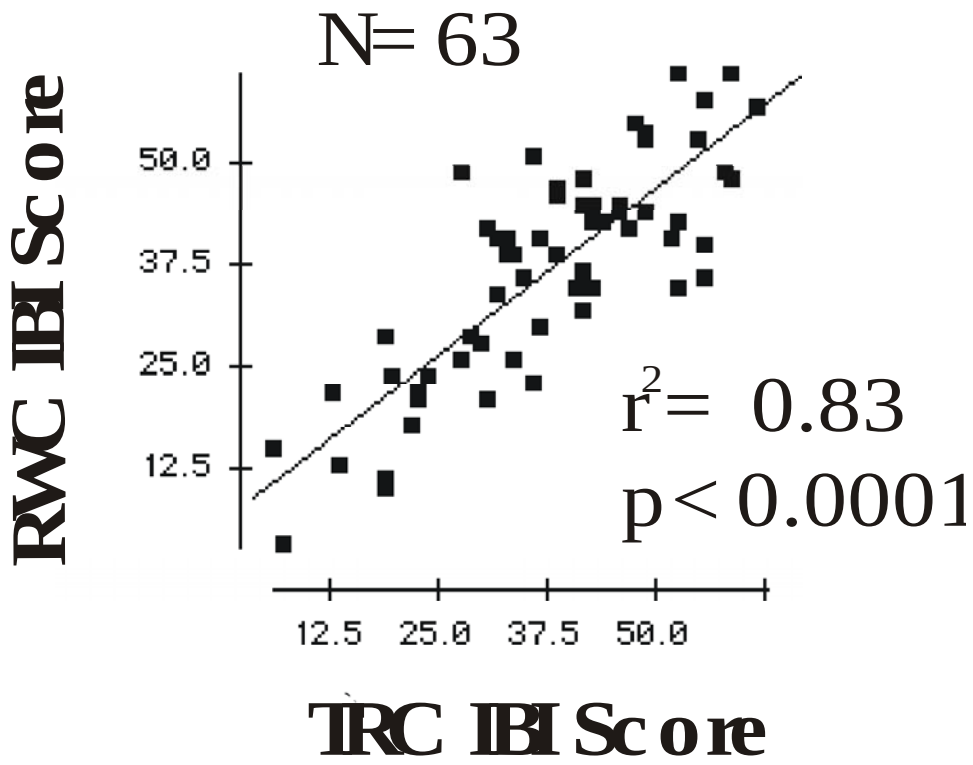
…we could compare IBI scores instead of relative ranks.

Conclusion: CSBP and TRC are comparable with two modifications to CSBP:

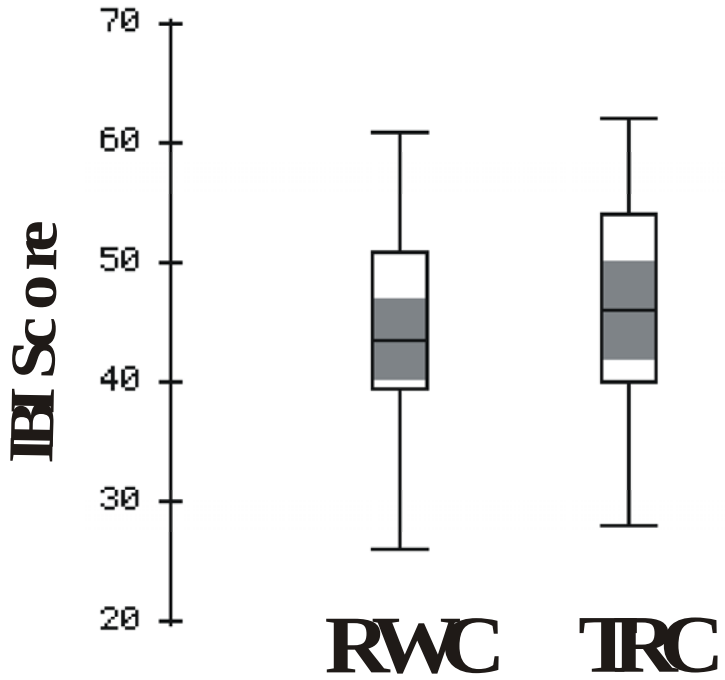
1. Combine data from all 3 CSBP transects into one cumulative taxa list (900 count).

2. Randomly subsample 500 organisms from 900 organism CSBP composite.

Reach-wide Composite IBI Scores vs. Targeted Riffle Composite IBI Scores



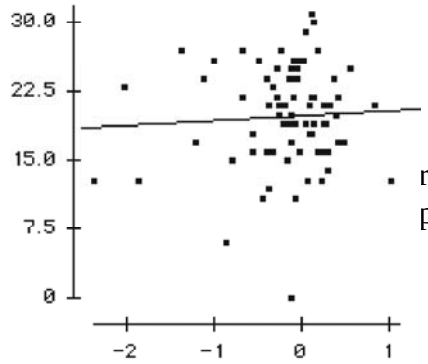
Southern California Reference Sites Only (n=28)



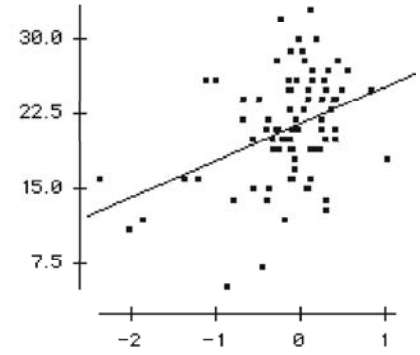
TRC

RWC

North Coast (n=81)



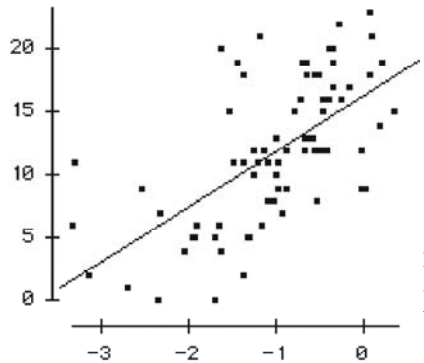
r^2=0.473
p=0.652



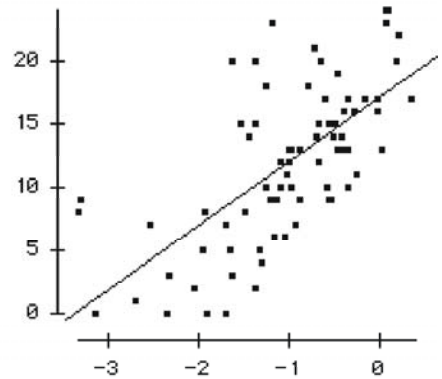
r^2=3.69
p=0.0004

EPT Richness

Central and Southern Coasts (n=75)

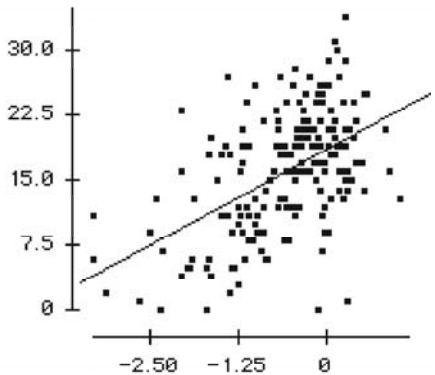


r^2=4.39
p<0.0001

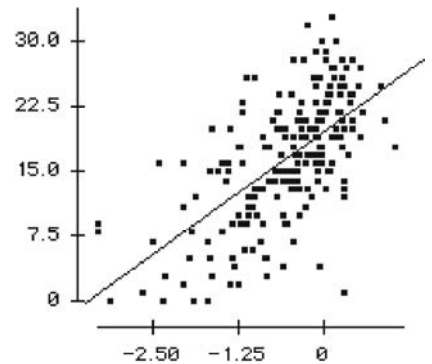


r^2=5.11
p<0.0001

Statewide (n=201)



r^2=4.40
p<0.0001



r^2=5.76
p<0.0001

Log Relative Bed Stability

TRC

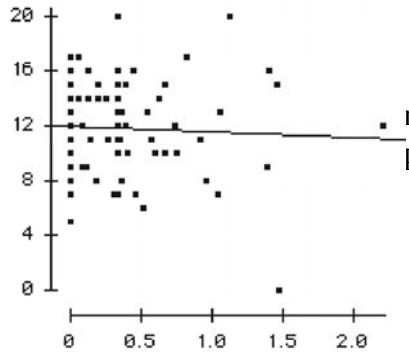
RWC

North Coast (n=81)

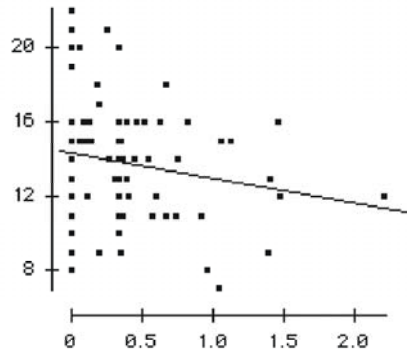
Central and Southern Coasts (n=75)

Statewide (n=201)

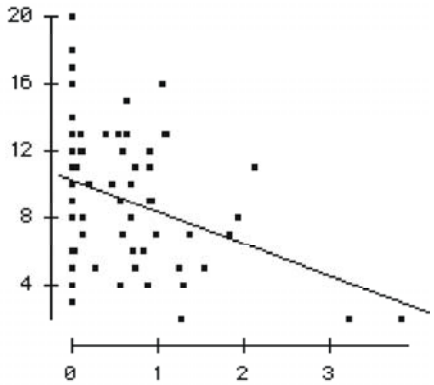
Predator Richness



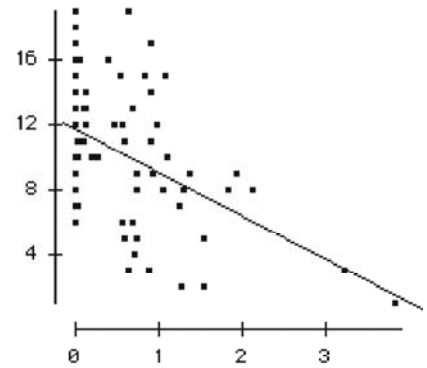
r^2=-0.397
p=0.651



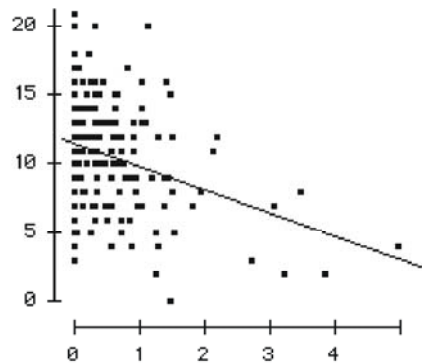
r^2=-1.31
p=0.104



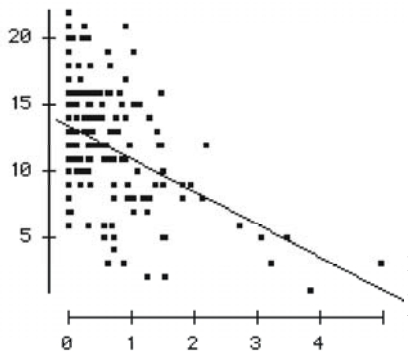
r^2=-0.192
p=0.0011



r^2=-2.71
p<0.0001



r^2=-1.68
p<0.0001



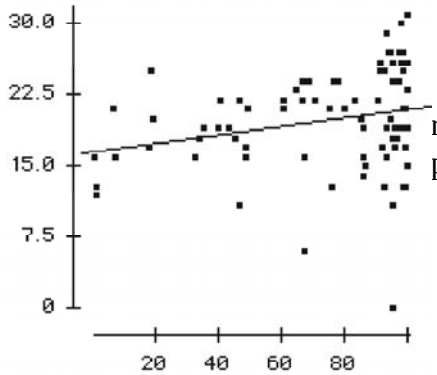
r^2=-2.48
p<0.0001

Riparian Disturbance

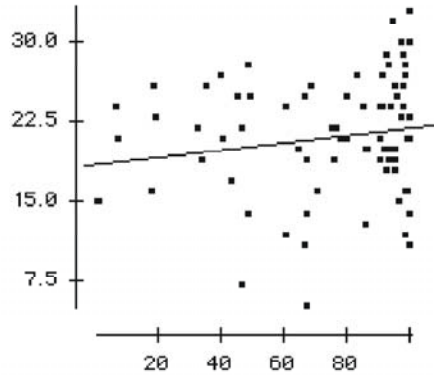
TRC

RWB

North Coast (n=81)



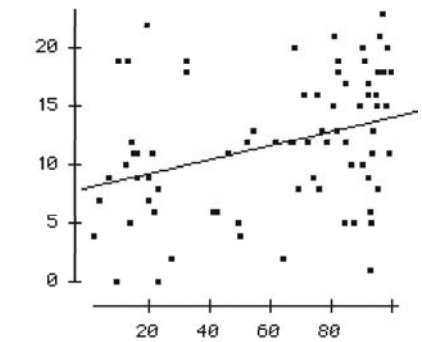
r^2=0.044
p=0.028



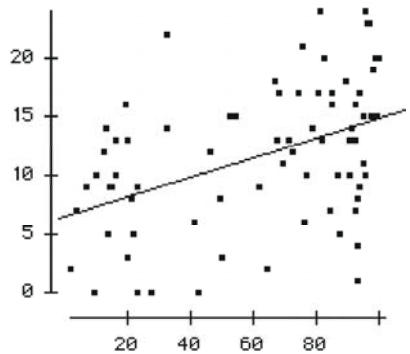
r^2=0.033
p=0.119

EPT Richness

Central and Southern Coasts (n=75)

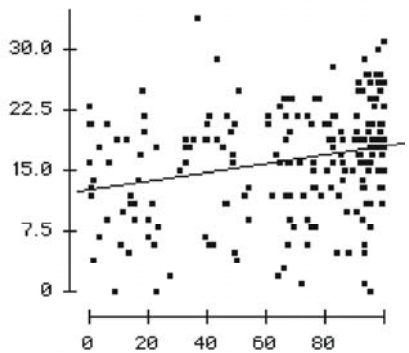


r^2=0.059
p=0.003

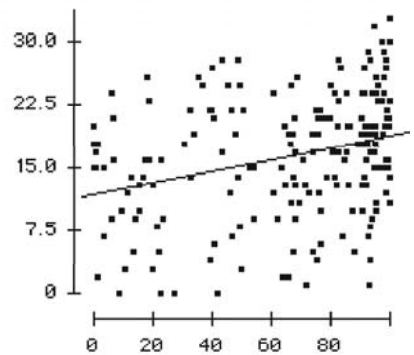


r^2=0.083
p<0.0001

Statewide (n=201)



r^2=0.053
p=0.0004



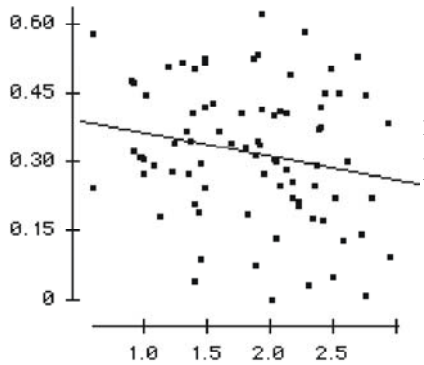
r^2=0.069
p<0.0001

Canopy Density

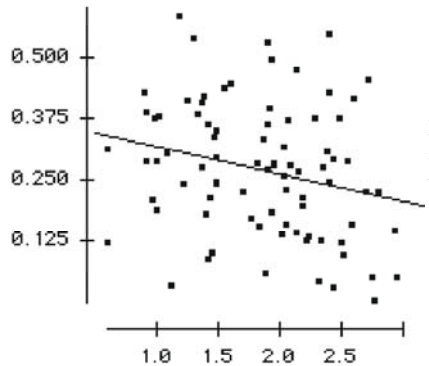
TRC

RWC

North Coast (n=81)



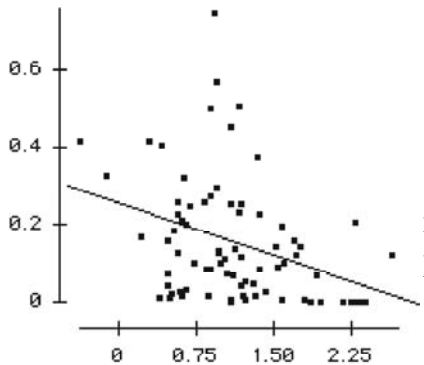
r^2=-0.051
p=0.062



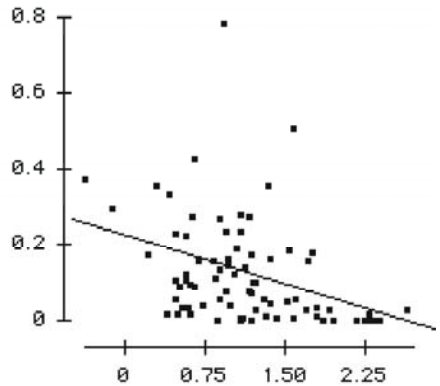
r^2=-0.057
p=0.025

Central and Southern Coasts (n=75)

% Intolerant

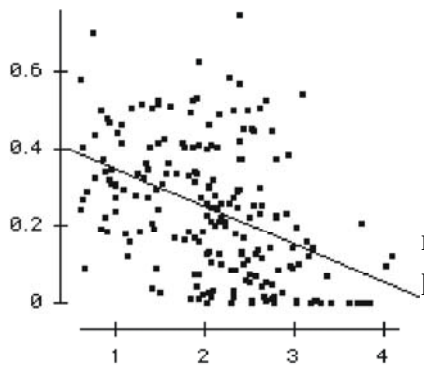


r^2=-0.092
p=0.0017

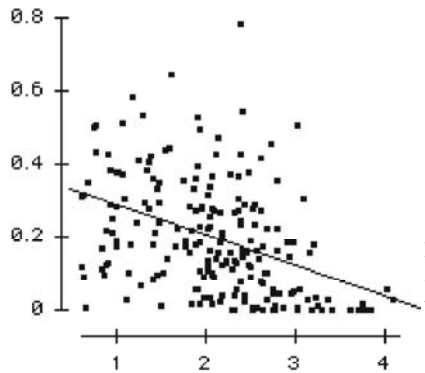


r^2=-0.086
p=0.0008

Statewide (n=201)



r^2=-0.097
p=0.<0001



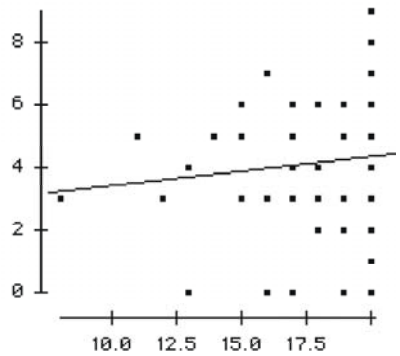
r^2=-0.083
p<0.0001

Log Chloride

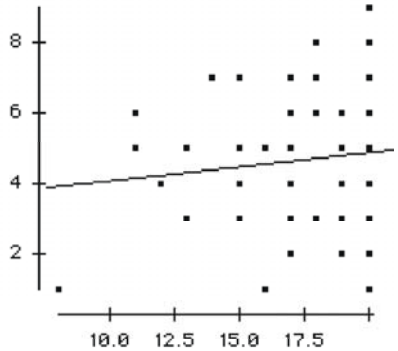
TRC

RWC

North Coast (n=81)



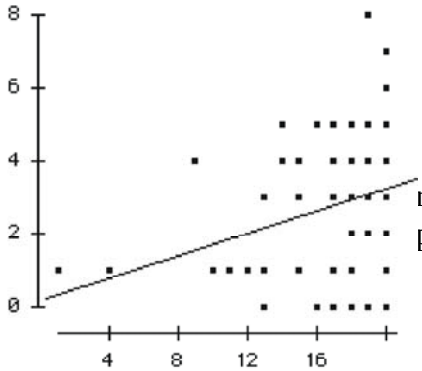
r^2=0.095
p=0.296



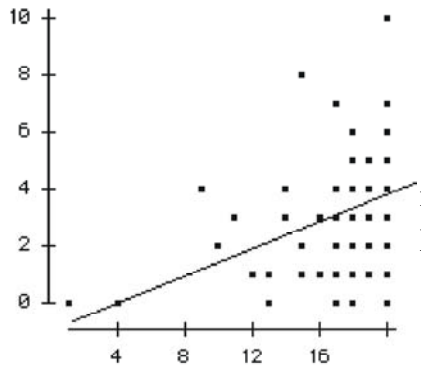
r^2=0.079
p=0.36

Central and Southern Coasts (n=75)

Coleoptera Richness

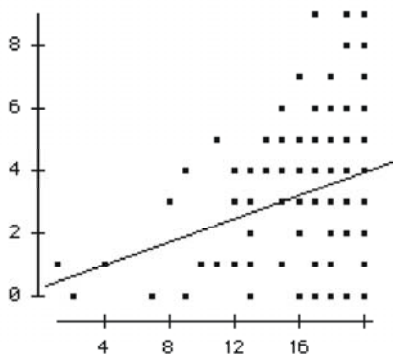


r^2=0.154
p=0.01

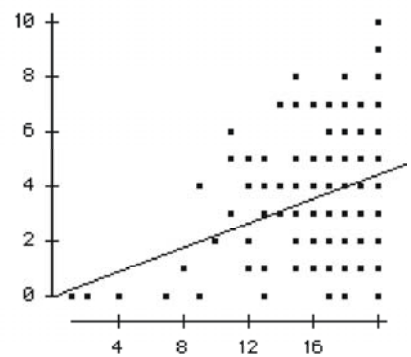


r^2=0.241
p=0.0002

Statewide (n=201)



r^2=0.184
p<0.0001

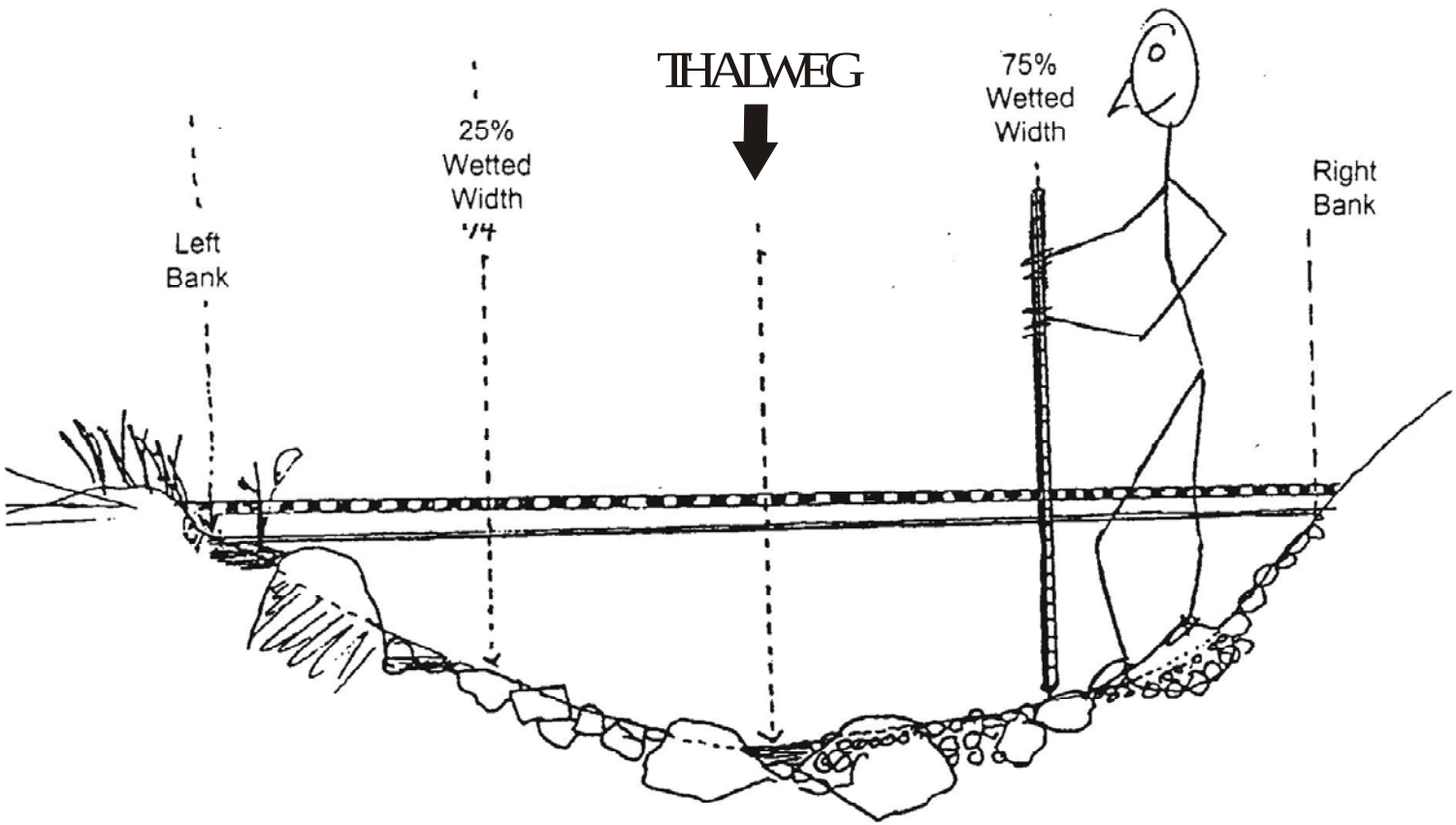


r^2=0.219
p<0.0001

Channel Alteration


But what about low gradient systems?

THALWEG PROFILE: 100 measurements of habitat type per reach: riffle, run, cascade, pool, glide



The Truth about Riffles:

1. Of 201 sites, 87% (175 sites) are at least 50% slow water

2. 53% (106 sites) are at least 75% slow water

3. 12% (24 sites) are at least 90% slow water

So the similarity of the methods can't be due to a preponderance of riffles in the average stream…

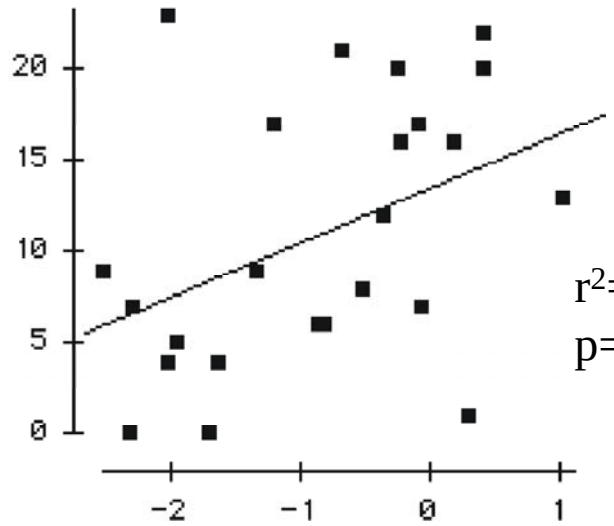
Comparisons include and can be directly applied to low gradient systems…

Statewide: 24 sites with > 90% slow water habitat

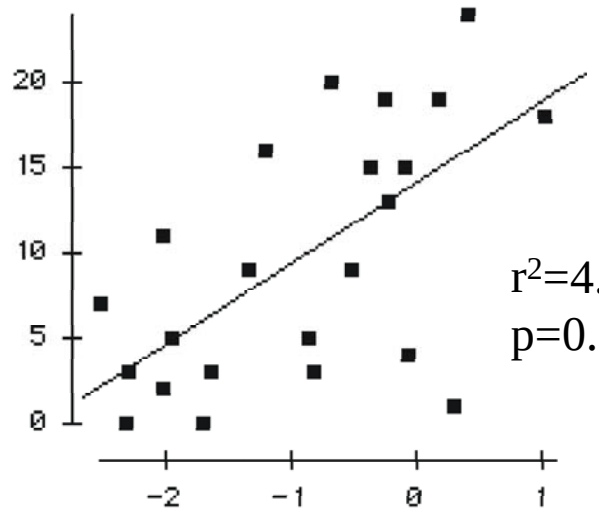
TRC

RWC

EPT Richness



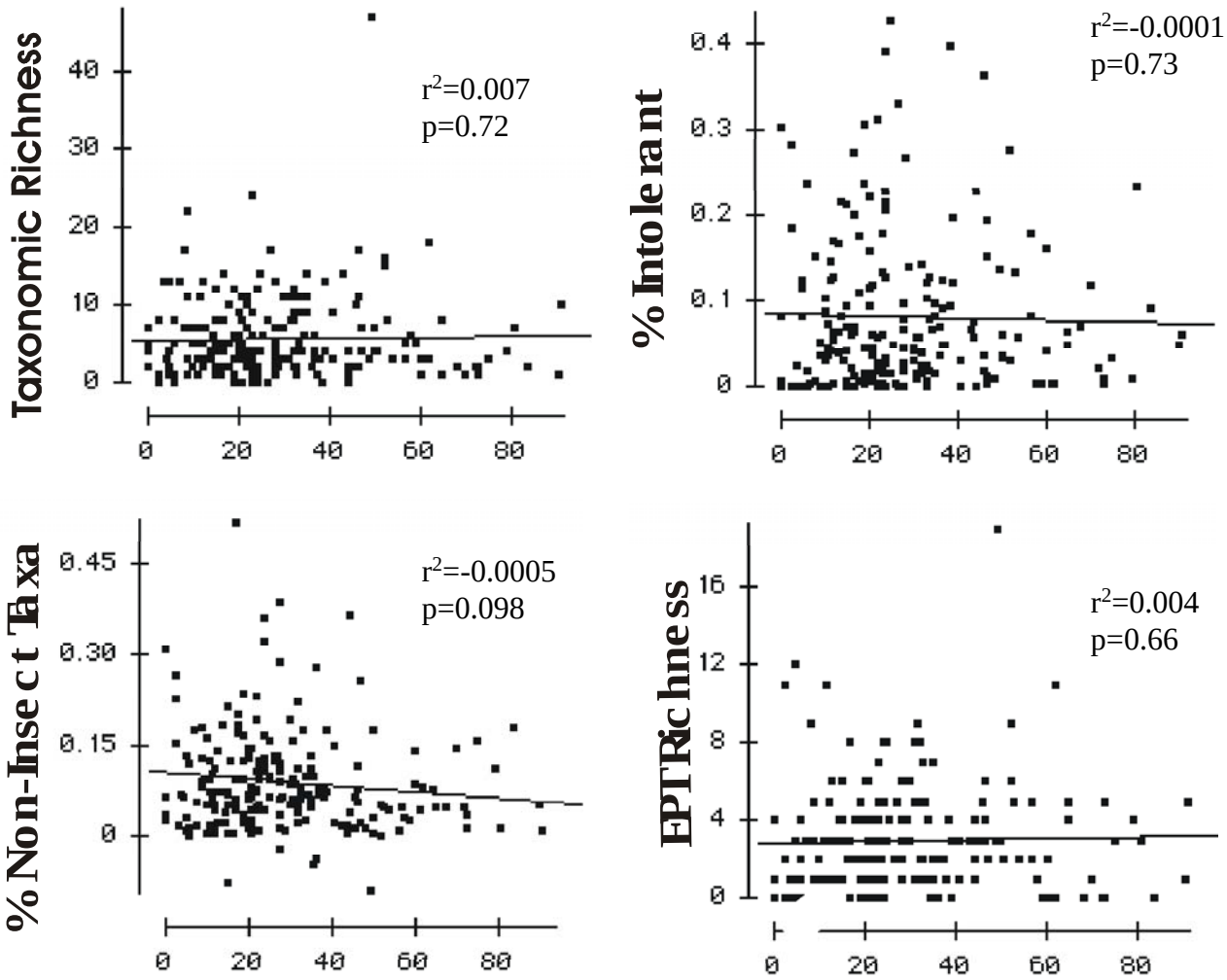
r^2=3.01
p=0.039



r^2=4.75
p=0.0011

Log Relative Bed Stability

Absolute Differences in IBI Scores



Conclusions:

1. CSBP data sets can easily be combined with TRC data sets by converting 900 count CSBP composites to 500 count composites by random resampling of taxa.

2. Reach-Wide Composite data sets are directly comparable to Targeted Riffle Composite data sets based on:
   -similar characterization of reference conditions
   -similar sensitivity to anthropogenic stressors
   -seems to hold even when riffles are less common

3. Final analysis must include estimate of within site measurement error.

4. BMI sampling methods used in ambient biomonitoring validate one another *and* the use of quantitative biocriteria to assess and report on ecological integrity in streams.