Long-Term Bioassessment Data Sets – Utility in Discerning Climate Change Signals

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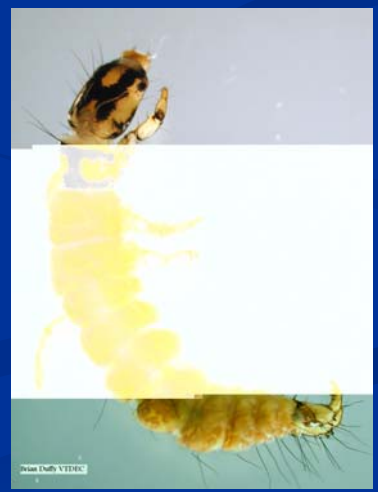
Overview

- Characteristics of state biomonitoring data sets
- Potential signals
- Fixed stations vs probablistic approach
- Taxonomy issues
- Closing thoughts



Bioassessment Data Sets

- Design based on monitoring objectives
  - CWA mandates
- Three main questions:
  - Status of aquatic resources, various scales
  - Impairment decisions (based on comparison to reference locations)
  - Comparison of condition to previous assessment

Spatial evaluations emphasized

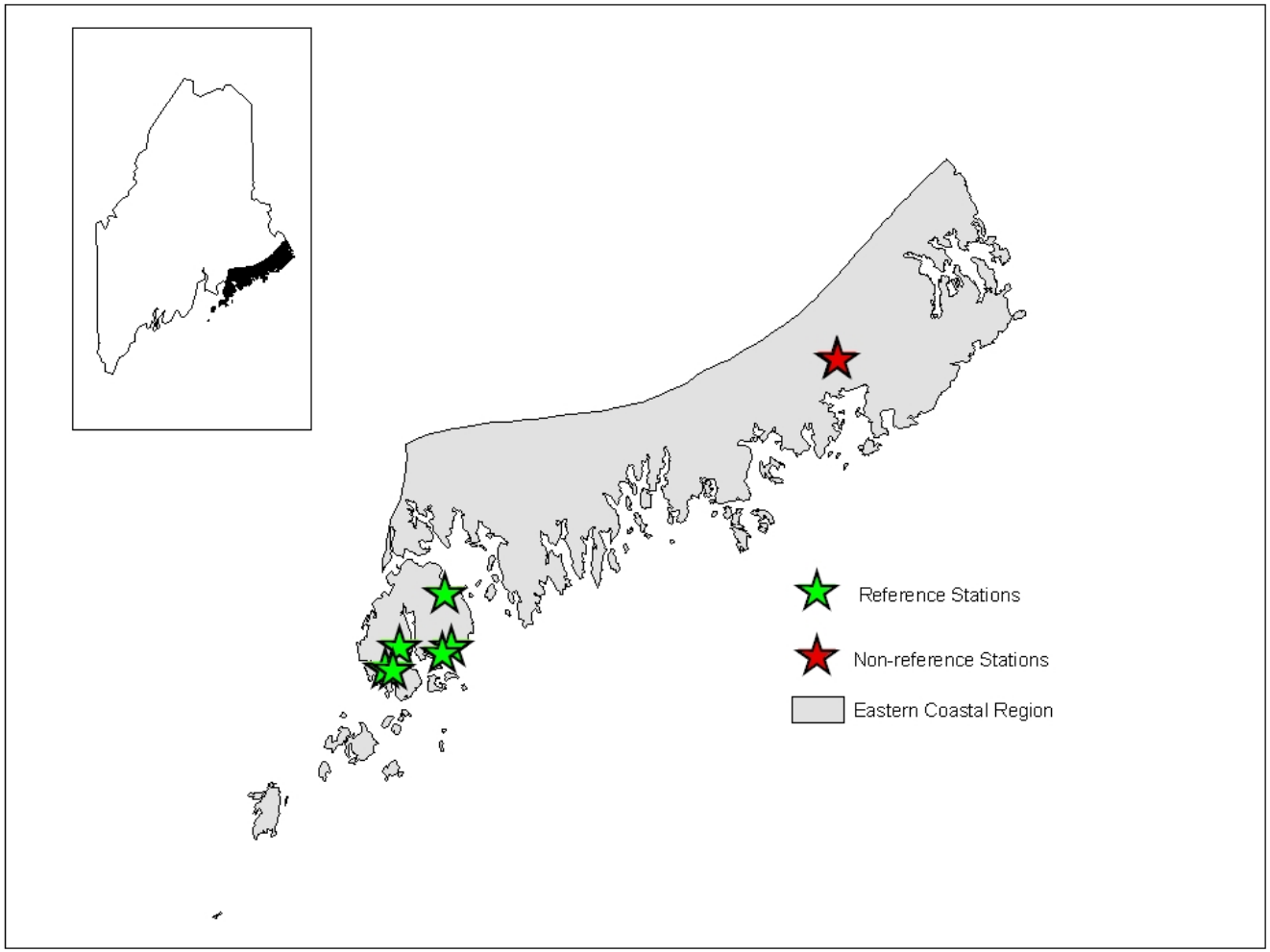
Now we want to incorporate climate change evaluation

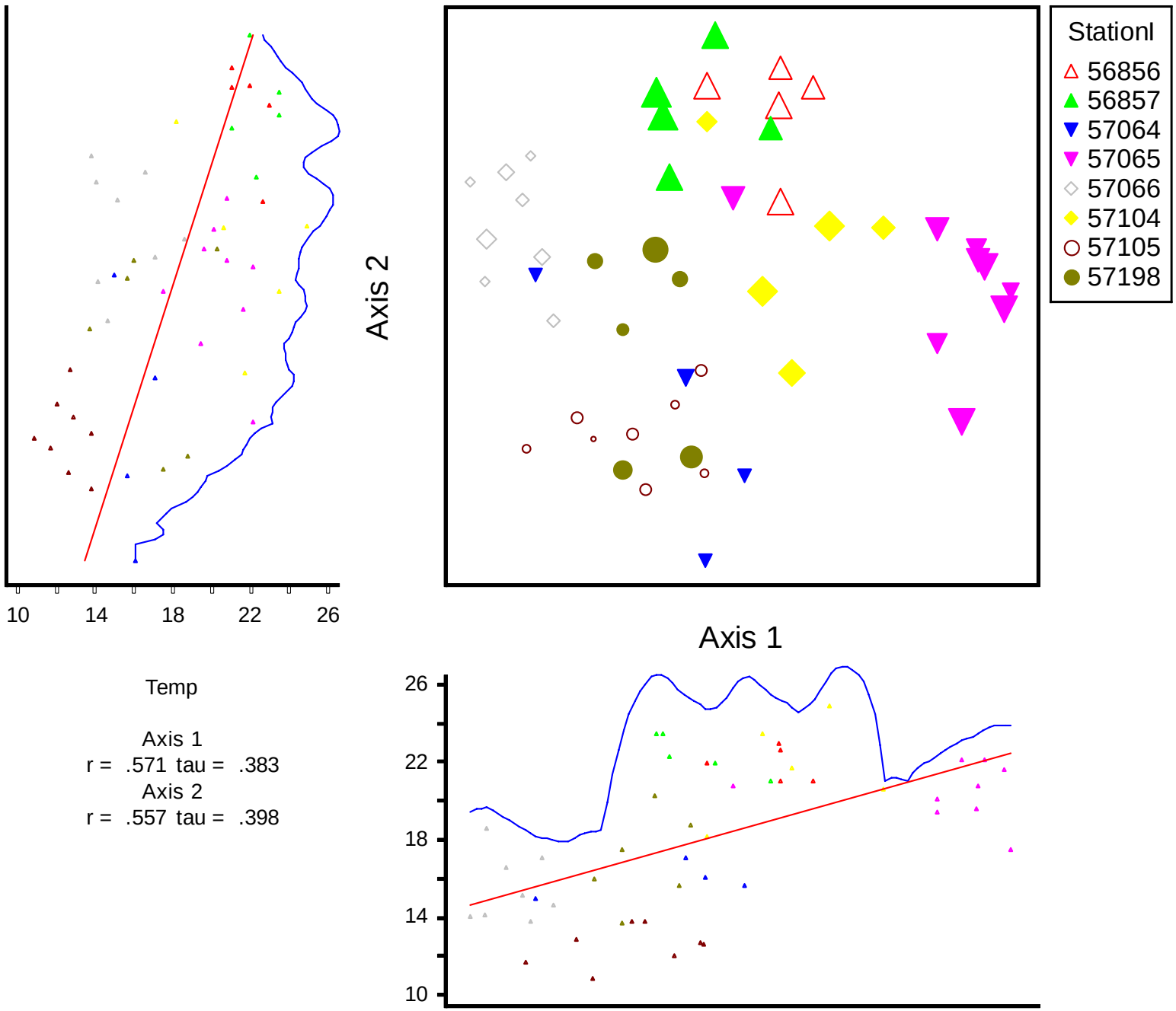
- Emphasize long-term temporal trends
- Availability of adequate temporal data – duration and frequency
- "Regional" consistency of trends – single (fixed) location vs population of "representative" locations
- Are the trends real, or artifacts of methods changes over time (taxonomy, sampling procedures)?
- Types and extent of covariables

Availability of Adequate Long Term Data Maine Example

# Years Sampled	Reference Stations (AA & A)	Non-Reference (B & C)	Not Classified
10-19	2	4	0
5-9	10	30	0
2-4	94	183	0
1	116	302	1

Maine Sampling Stations
In Eastern Coastal Region (Ecoregion 82)
(6 of 8 are reference locations)

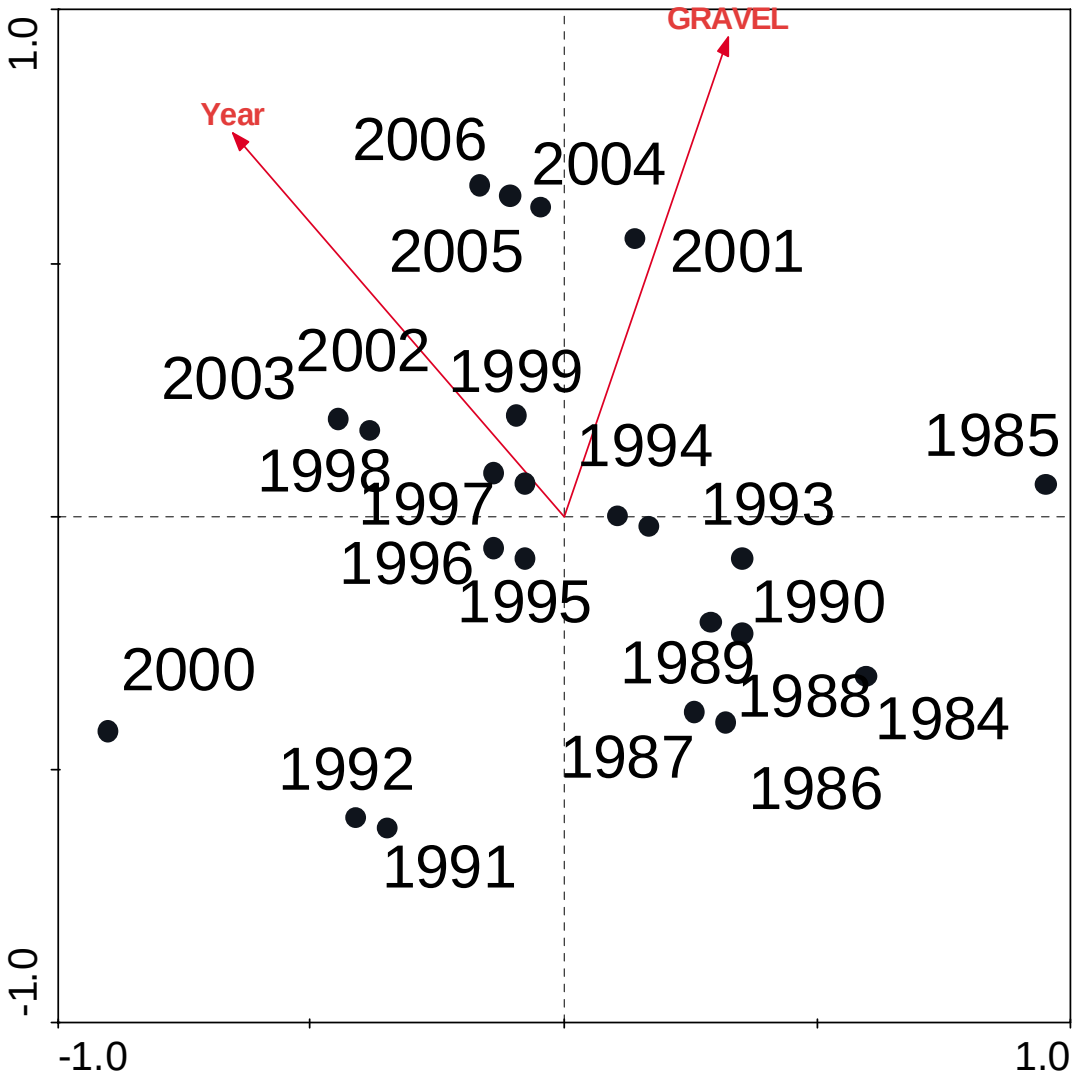




Temp

Axis 1
r = .571 tau = .383
Axis 2
r = .557 tau = .398

Sheepscot River

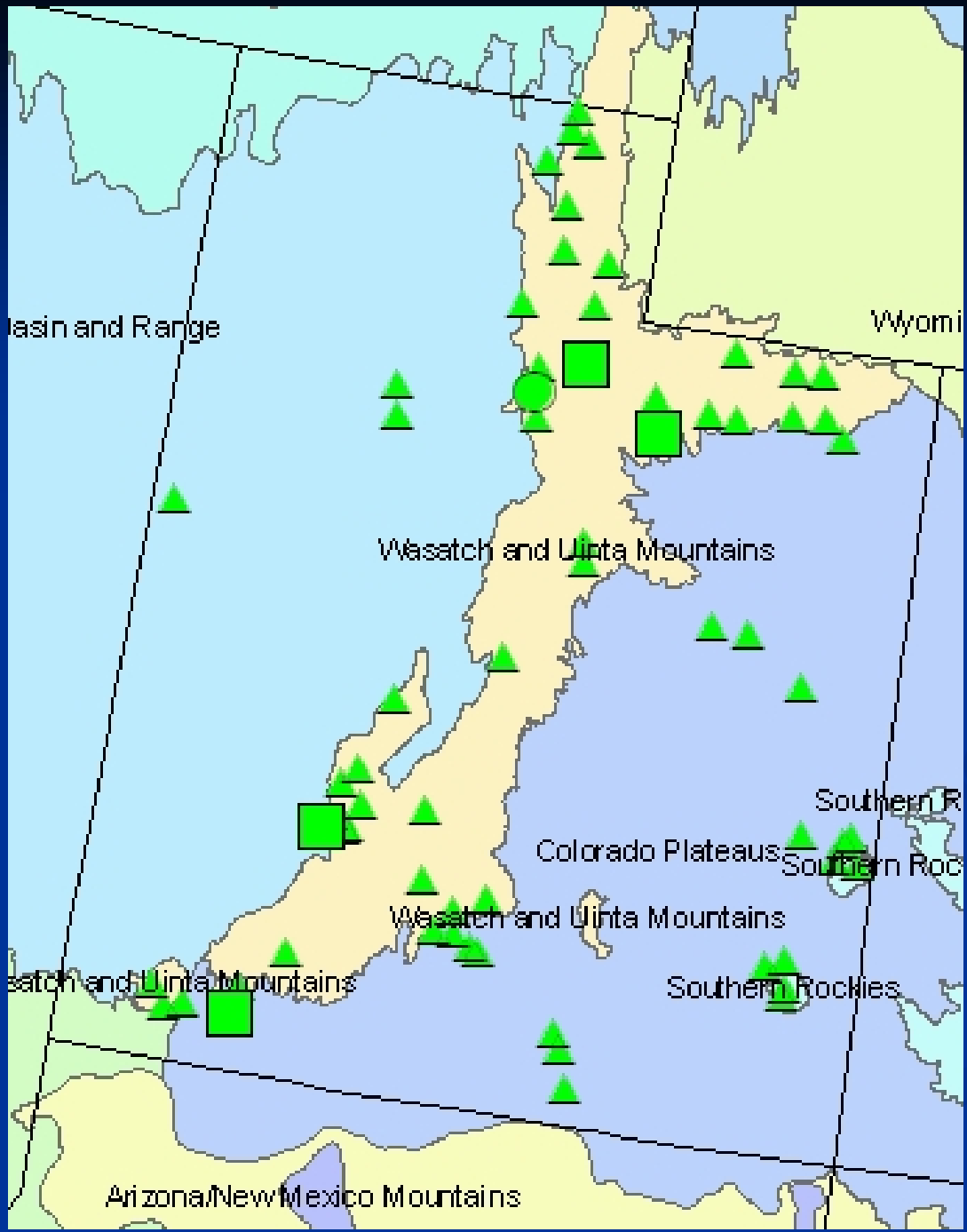


Year is strongest factor

Availability of Adequate Long Term Data Utah Example

# Years Sampled	Reference Stations	Unclassified Stations
10-19	4	3
5-9	4	29
2-4	7	178
1	54	300

Utah Reference Stations



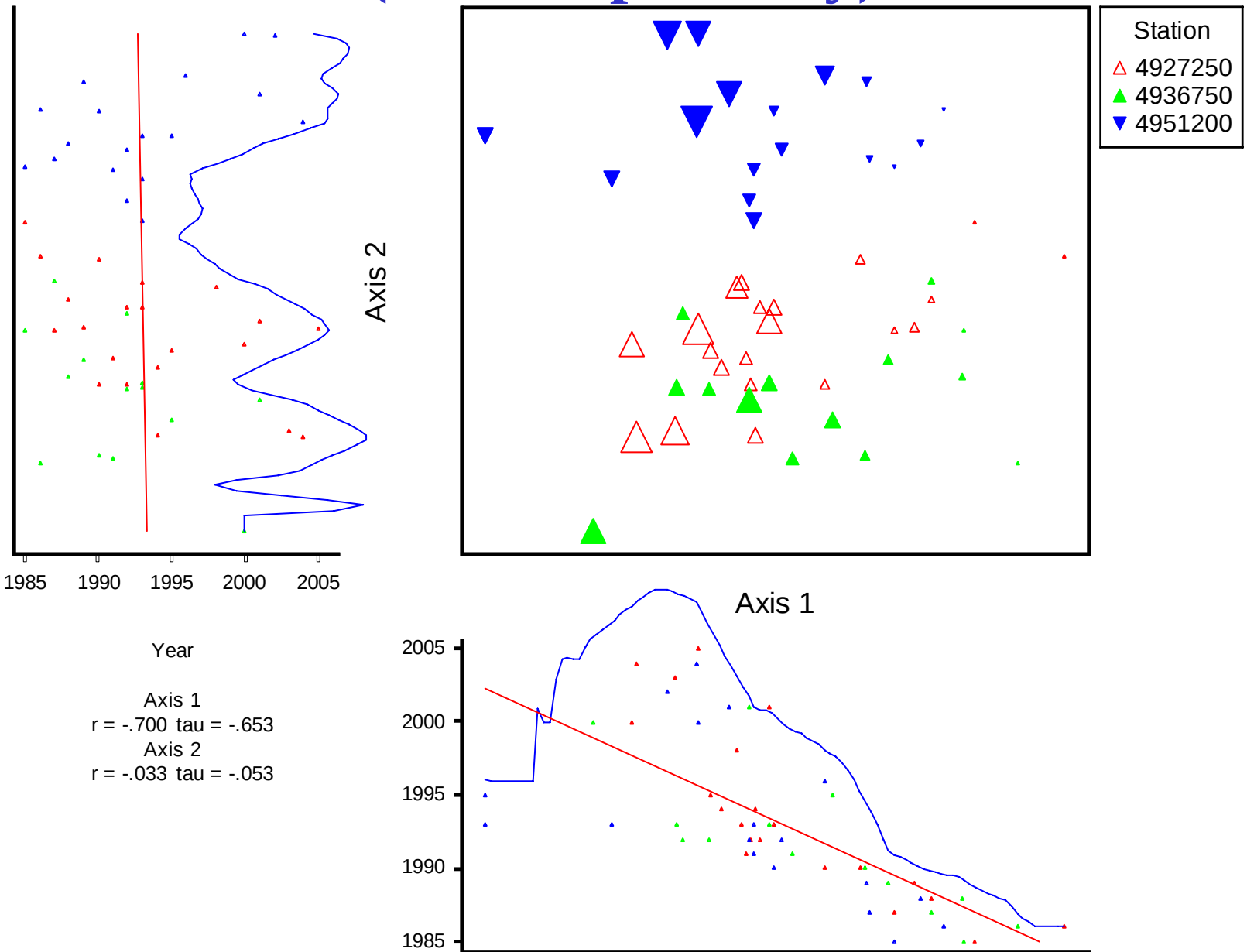
Legend

Stations - Utah DEQ (Years Sampled, Ref sites)

MapClass

- REF (10-19)
- REF (5-9)
- REF (1-4)
- States

Utah – 3 reference locations/2 ecoregions (fall samples only)



Are observed long-term trends real or artifacts?

Taxonomy

- Changes in taxonomists
- Changes in level of detail
- Increasing knowledge (better keys)

What was done to "fix" taxonomic differences? – Utah Example

- Lab changed in 1998
- Machine-check for taxa occurring early but not later, and visa versa
- Findings reviewed by expert, cross-checked with active local taxonomist

What was done to "fix" taxonomic differences? – Utah Example

Found examples of:

- Taxa (genera, species) called different names between time periods/labs (misnamed, or name changes)
- Taxa left at family (or other higher level) by one lab, taken to finer level by another
- More of a taxon left as "unidenfied" at one time or another

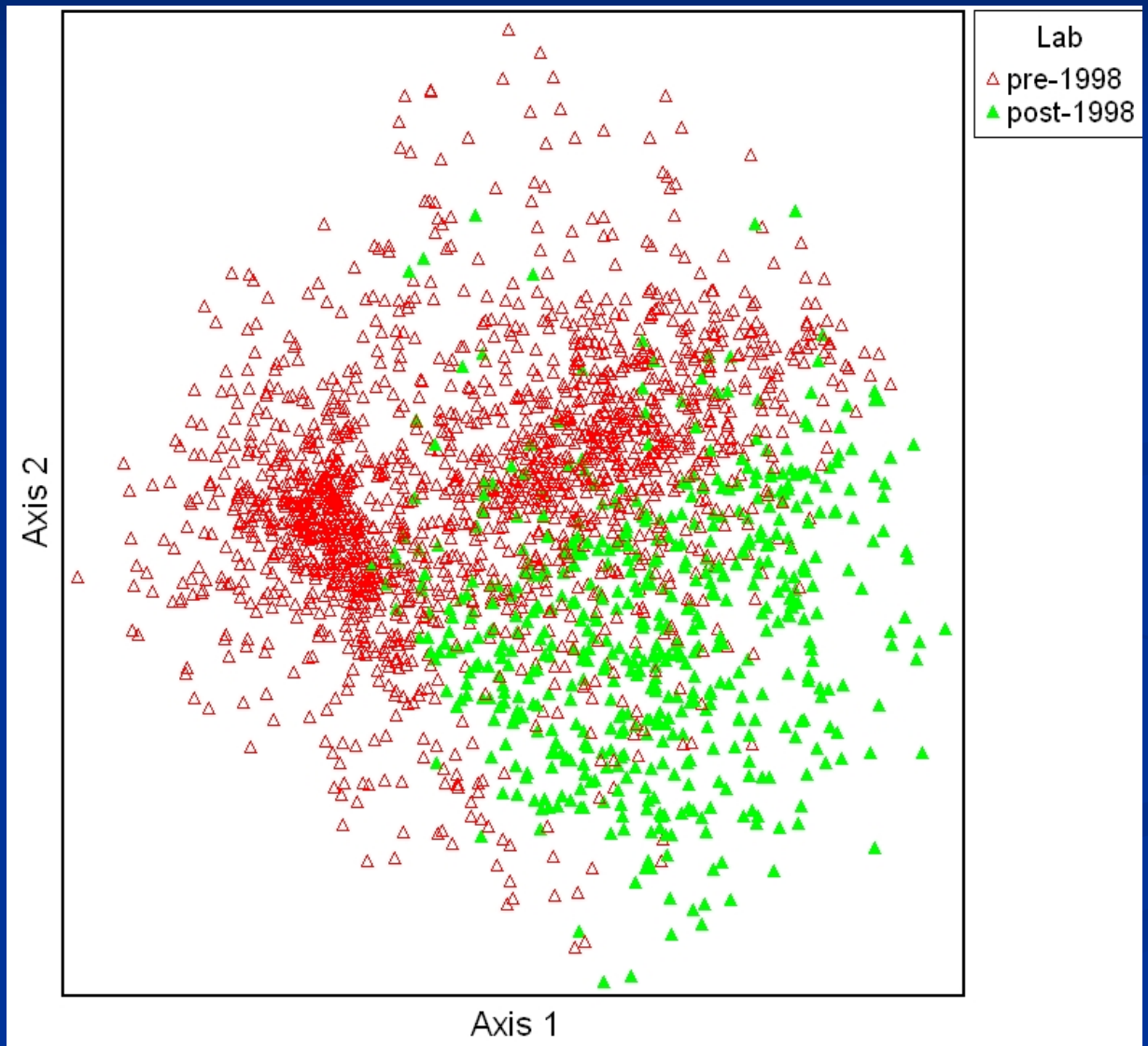
What was done to "fix" taxonomic differences? – Utah Example

- Often summed to uniform higher level (genus from species, family from genera) to remove "artifact" differences in taxon abundances, richness, etc over time
- Sometimes defined an OTU to combine names not reliably differentiated, but not lose other valid genus/species information in that family

Other Factors

- Sample splitting and processing may have changed, search for "big and rare" taxa added
- Reporting of replicate counts (by rep, or summed for station) varied
- Poor documentation on whether counts for whole samples (reps combined) were averages or sums

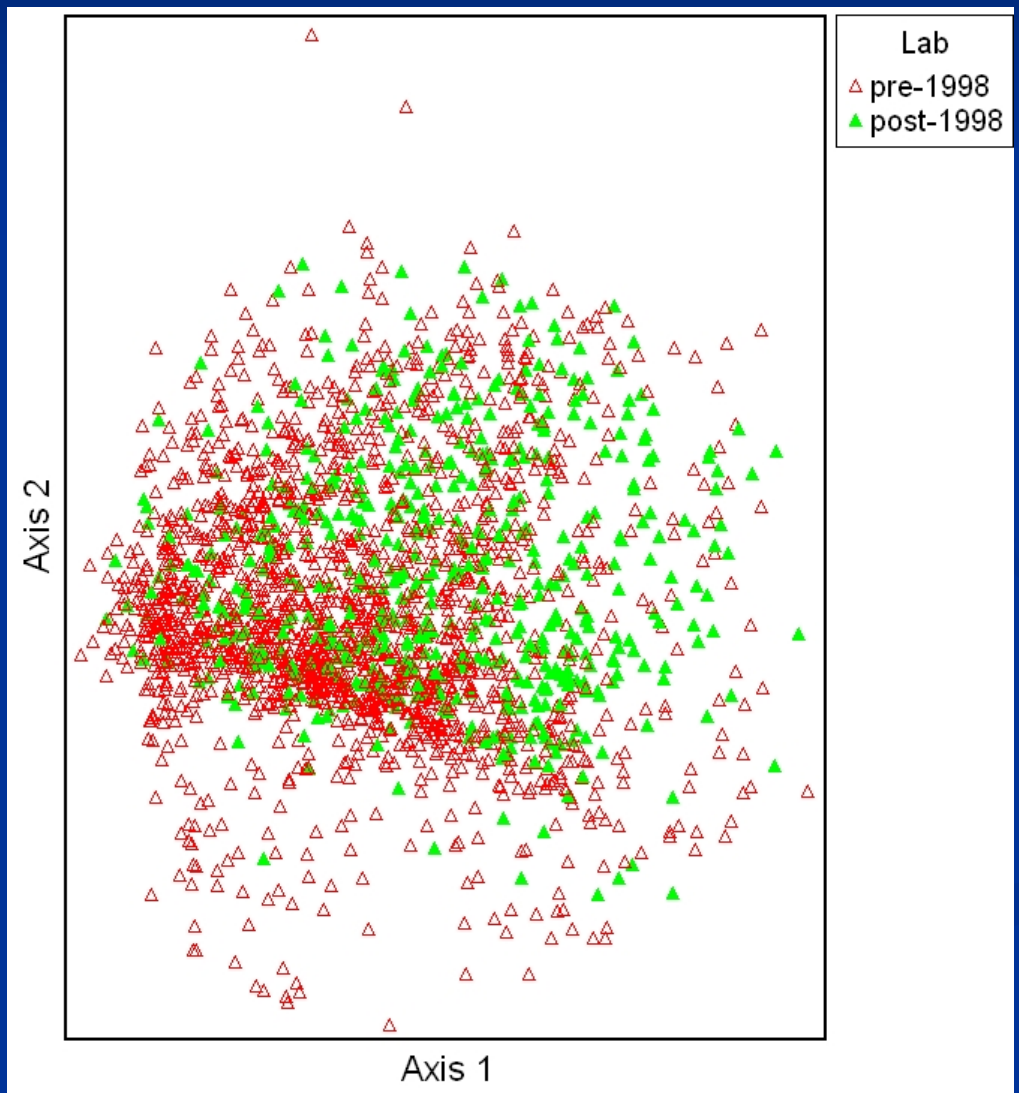
Utah DEQ Bioassessment Data, Benthic Invertebrates, 1977-2005, original data



Multivariate community analysis (NMDS)

Change in taxonomy lab reflected as change in community composition

Utah DEQ Bioassessment Data, Benthic Invertebrates, 1977-2005, "OTU" corrections

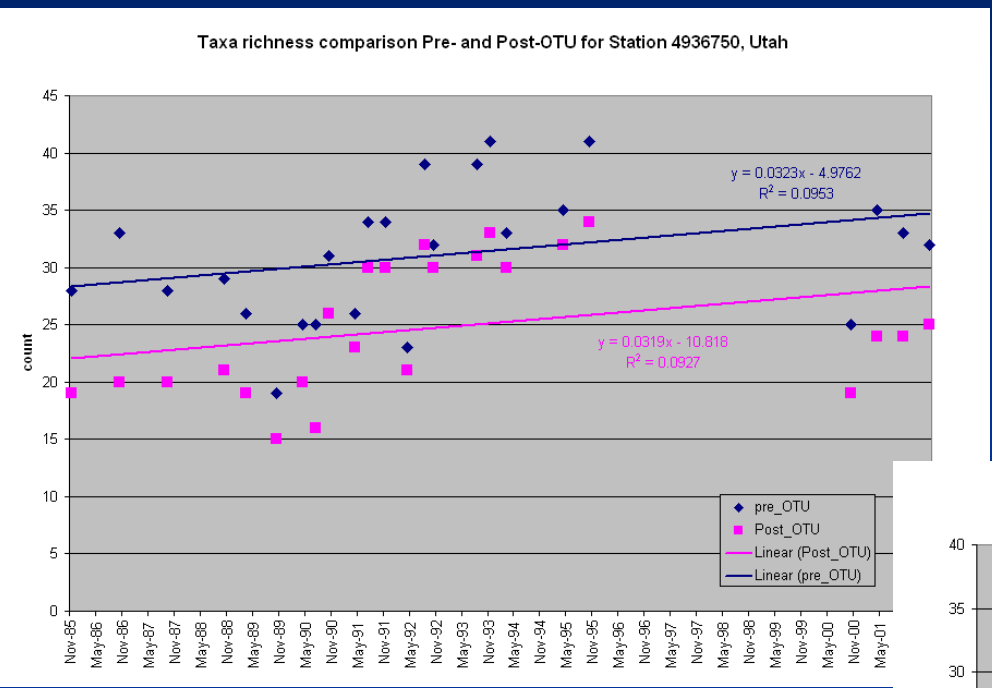


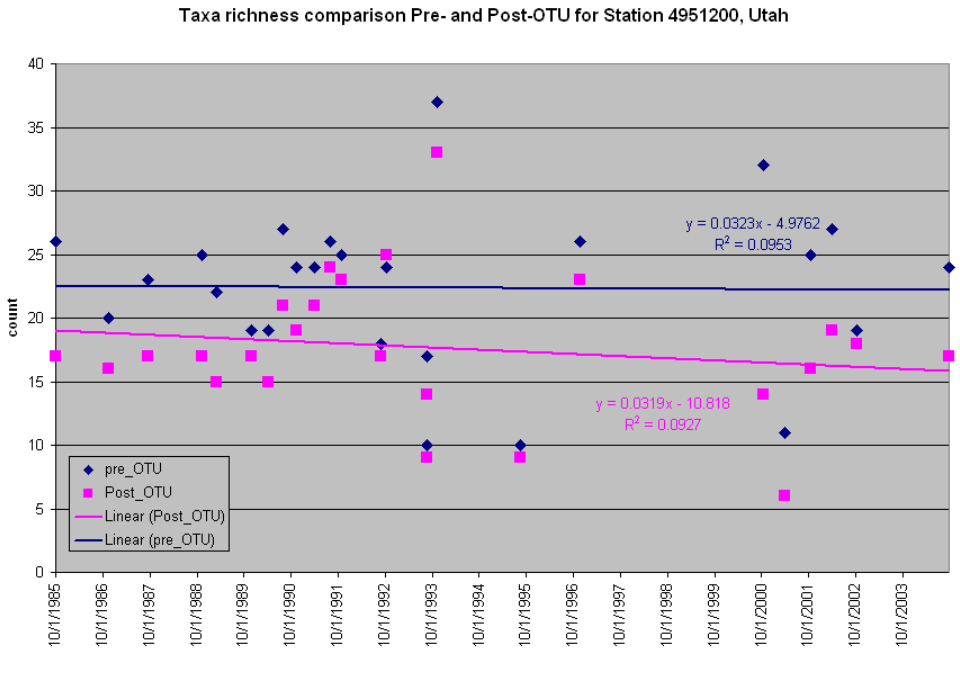
OTU "fixes" eliminated artifact of community change due to lab change

Could "valid" long-term trends still be found?

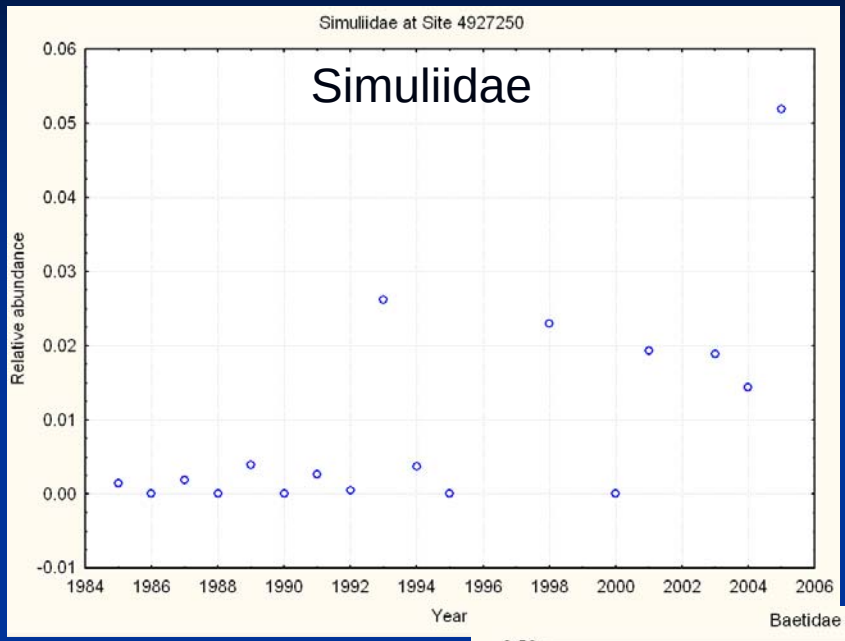
	Total Taxa Richness	
Station (Utah references)	Pre-OTU Fix	Post-OTU Fix
4927250	143	81
4936750	122	69
4951200	120	74

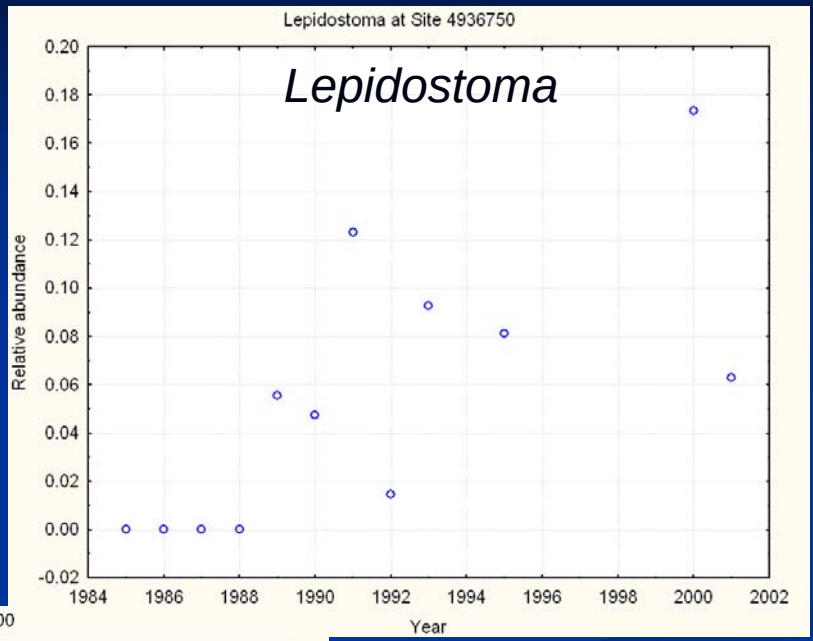
Could "valid" long-term trends still be found?

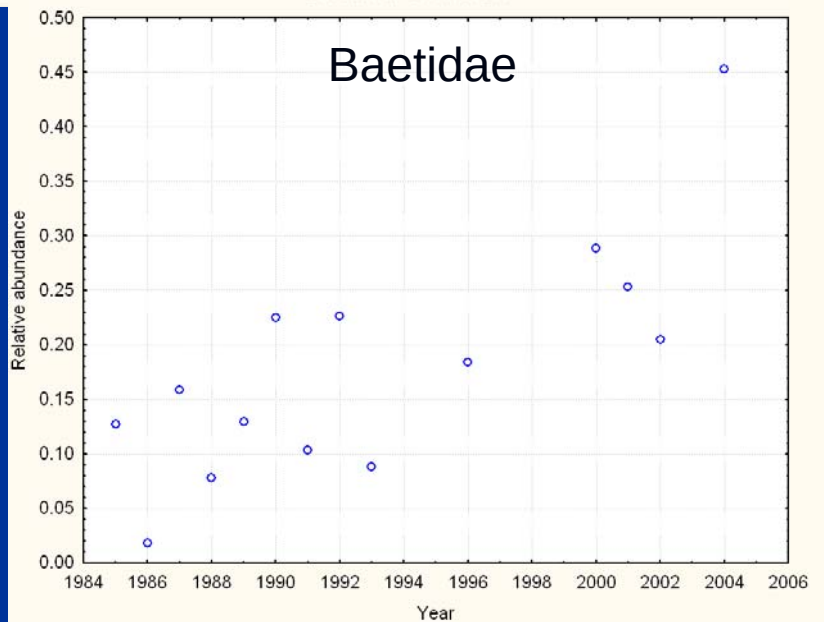




Valid taxa trends have also been found







Closing Thoughts

- Monitoring design issues:
  - fixed stations – representative of ecoregion?
  - Random stations: low power for trends
- Single stations have lower variability over time than multiple stations
- Single design won't answer all questions
  - Fixed stations for trends
  - Random stations to characterize basins, ecoregions

Closing Thoughts

- Much time spent in reviewing and "fixing" long-term data sets, even those that are well QC'd. This is critical – time well spent
- Hemispheric climate drivers (ENSO, NAO) may account for interannual variation – could enhance confidence in long-term trends
- Long-term, continuous monitoring of temperature and flow are critical, and too often lacking.