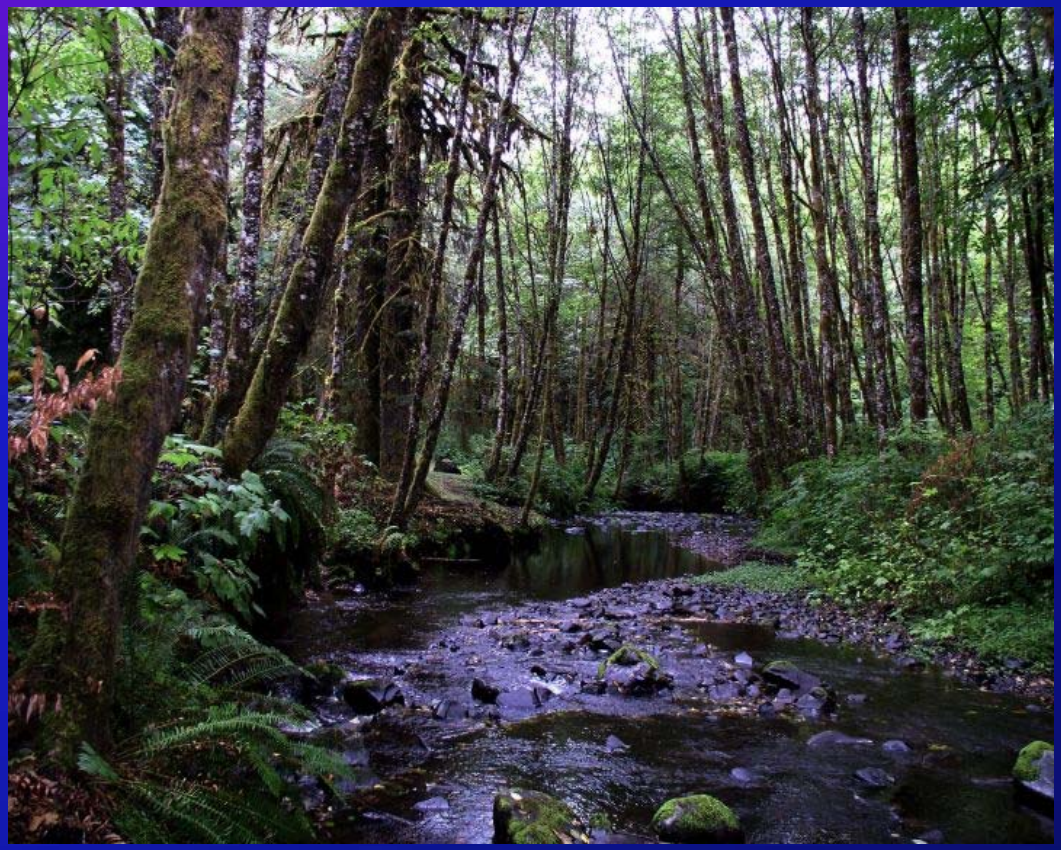
Setting sediment benchmarks using multiple analytical methods.



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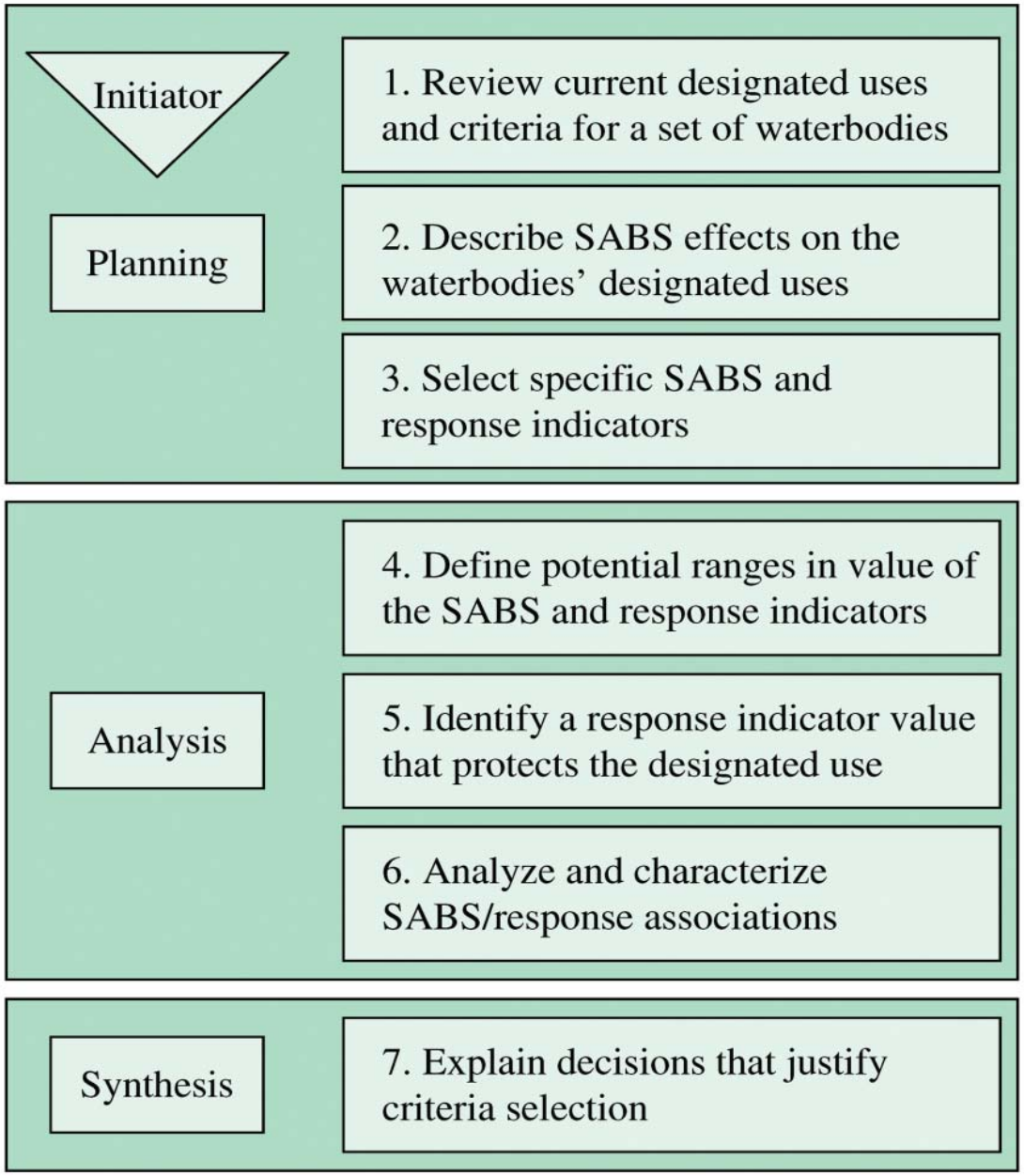
3/19/2009
NEAEB

Problem Statement

- Oregon DEQ would like to set numeric benchmarks for bedded sediment conditions in rivers and streams throughout the state to protect aquatic life uses

Steps for developing water quality criteria as described in the SABS Framework (EPA 2006)



- Step one:

  Review current designated uses

Aquatic Life Use

- Step 2:

  Describe SABS effects

Established Literature

Step 3:
Select Sediment & Response Variables

Bedded Sediment

- % fines (silt and smaller)
- % sand and fines
- Relative Bed Stability (RBS)
  - Observed/Expected mobile sediment conditions
  - Calculated from WSA/NRSA stream habitat measures
  - Kaufmann EPA/ORD

Biology

- Benthic Macroinvertebrates
  - Index and metrics
  - Metrics specific to sediments
- Vertebrates
  - Index and metrics

Compile data

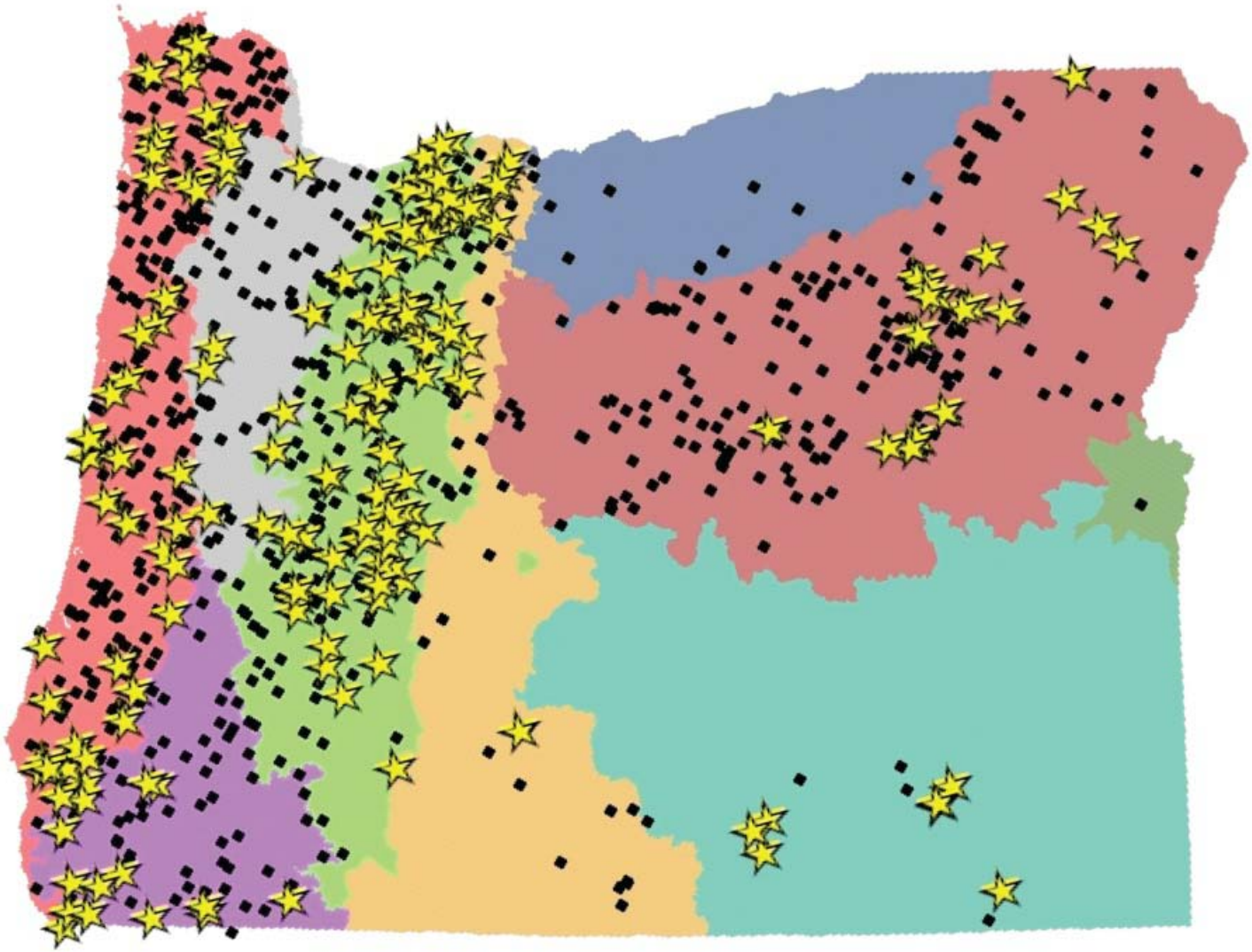
- 14 data sets with site, sediment, and biological data
- 909 sites
- 162 reference sites

Sample Collection Program
Oregon Plan
Oregon streams & rivers 1997
EMAP John Day
REMAP Cascades
REMAP Coastal
REMAP Deschutes
EMAP Statewide
OP Lower Columbia
Stream Sediment, OR 2000-02
EMAP Reference Condition
BPA Reference Site Survey
OP Lower Columbia Reference
EMAP Reference Sites
Pine Creek

Step 4: Potential Ranges of Values

- Reference sites
  - Minimal disturbance
  - Natural (Desirable) Condition
  - Define reference without referring to sediments
- Classification
  - Partition the natural variability
  - Techniques: PCA, ordination, box plots
  - In this case – considered stress effects

Reference and other sites in OR

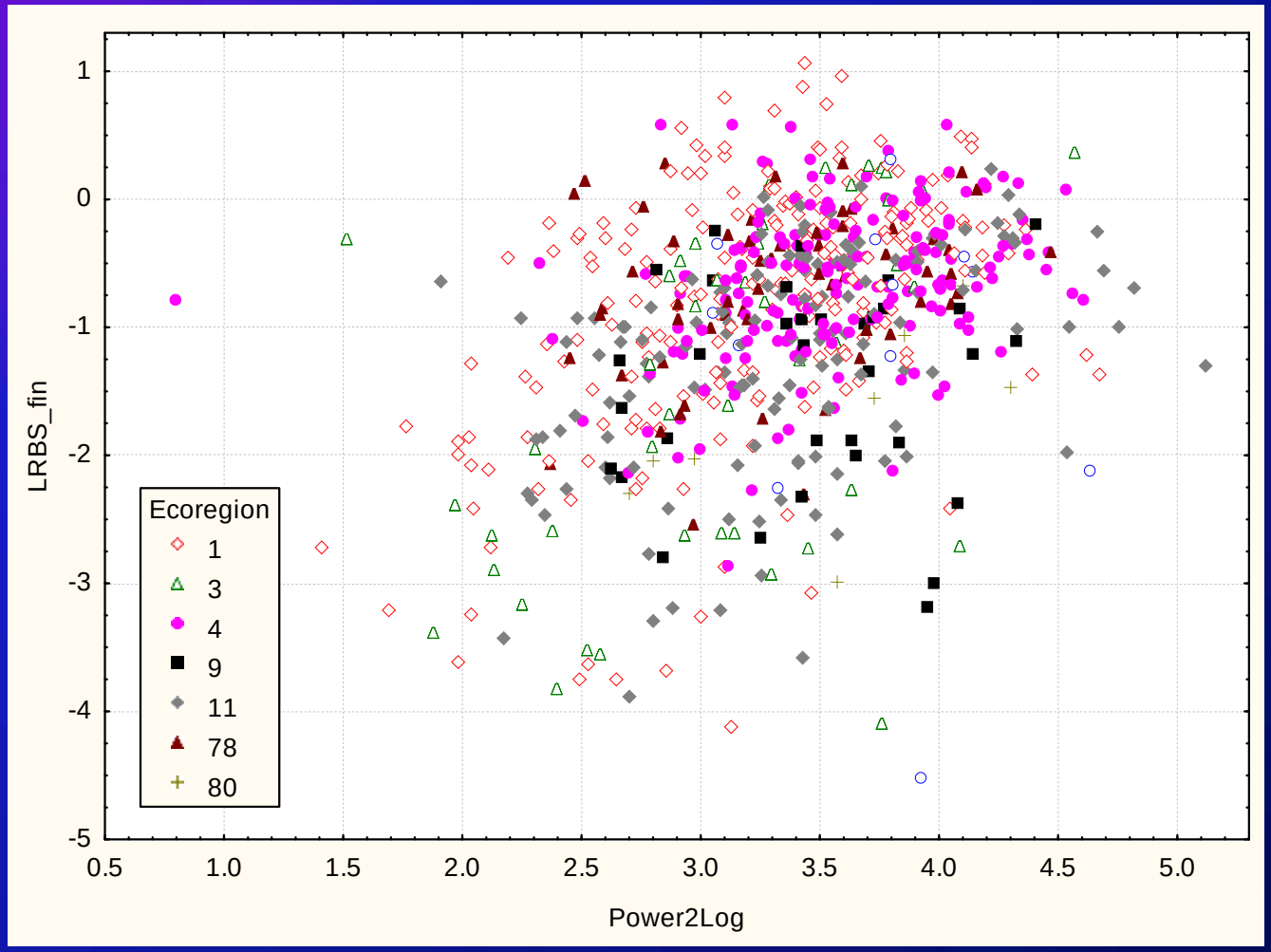


Potential Classification Variables

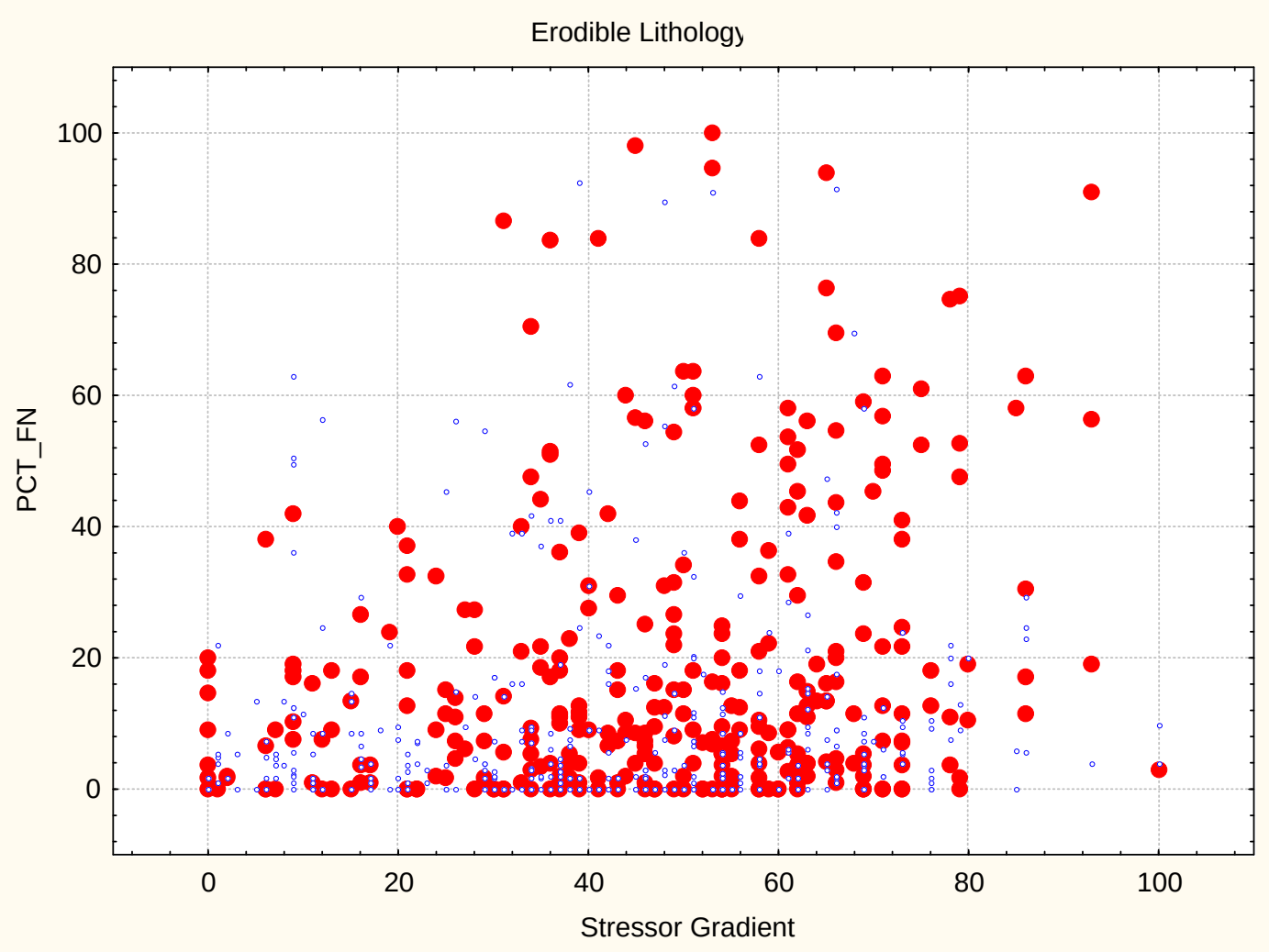
- What are the most influential variables effecting sediment conditions?
- Required extensive GIS analysis

Elevation
Hydrology
Catchment size
Climate (Precipitation)
Lithology
Soils
Landslides
Fire
Land Use
Land Cover
Roads

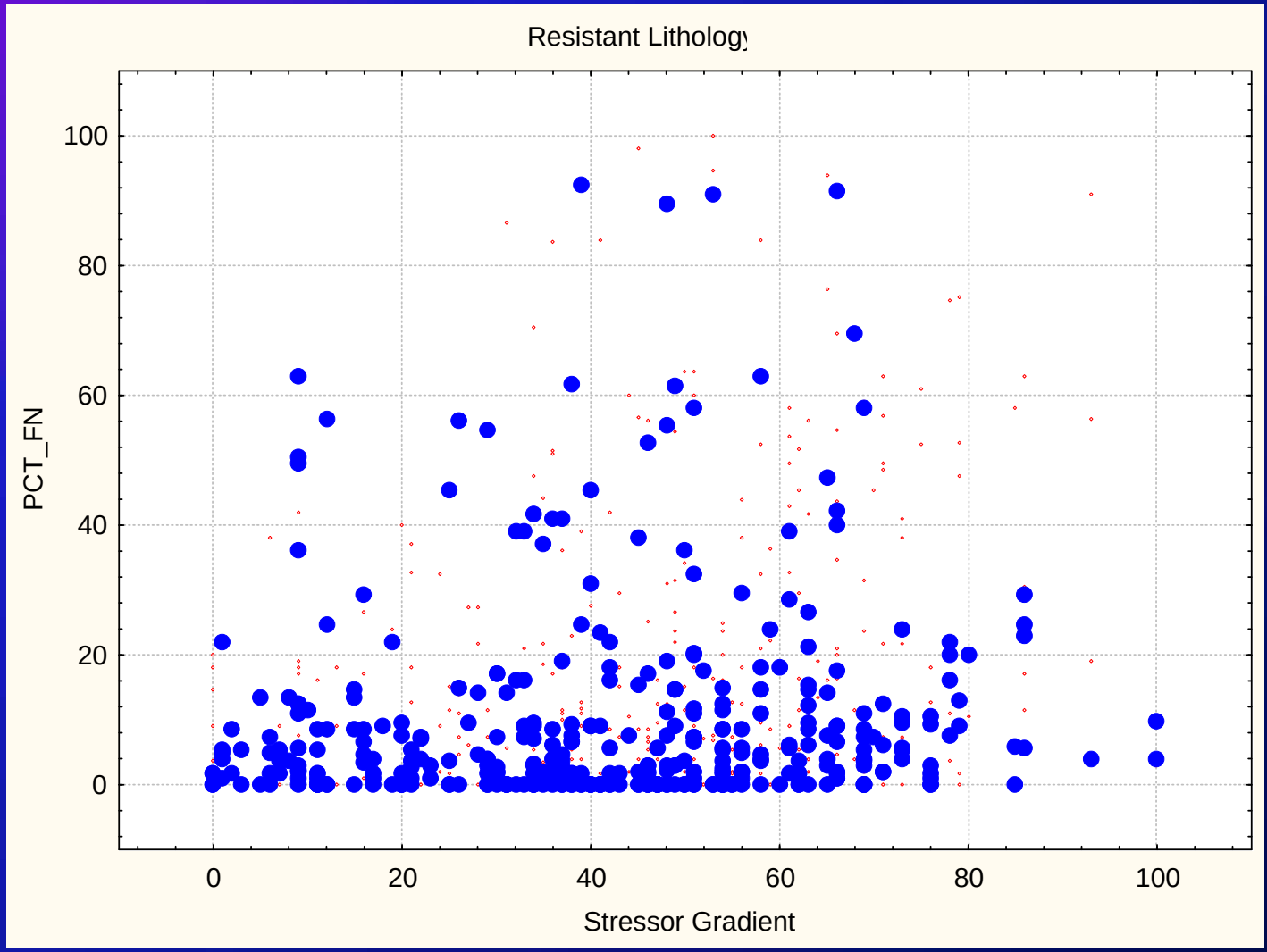
Site Classification / Stream Power



Erodible Lithology



Resistant Lithology



Stream Classes

1. High Stream Power, Resistant Lithology
2. Low Stream Power, Resistant Lithology

3. High Stream Power, Erobible Lithology
4. Low Stream Power, Erodible Lithology

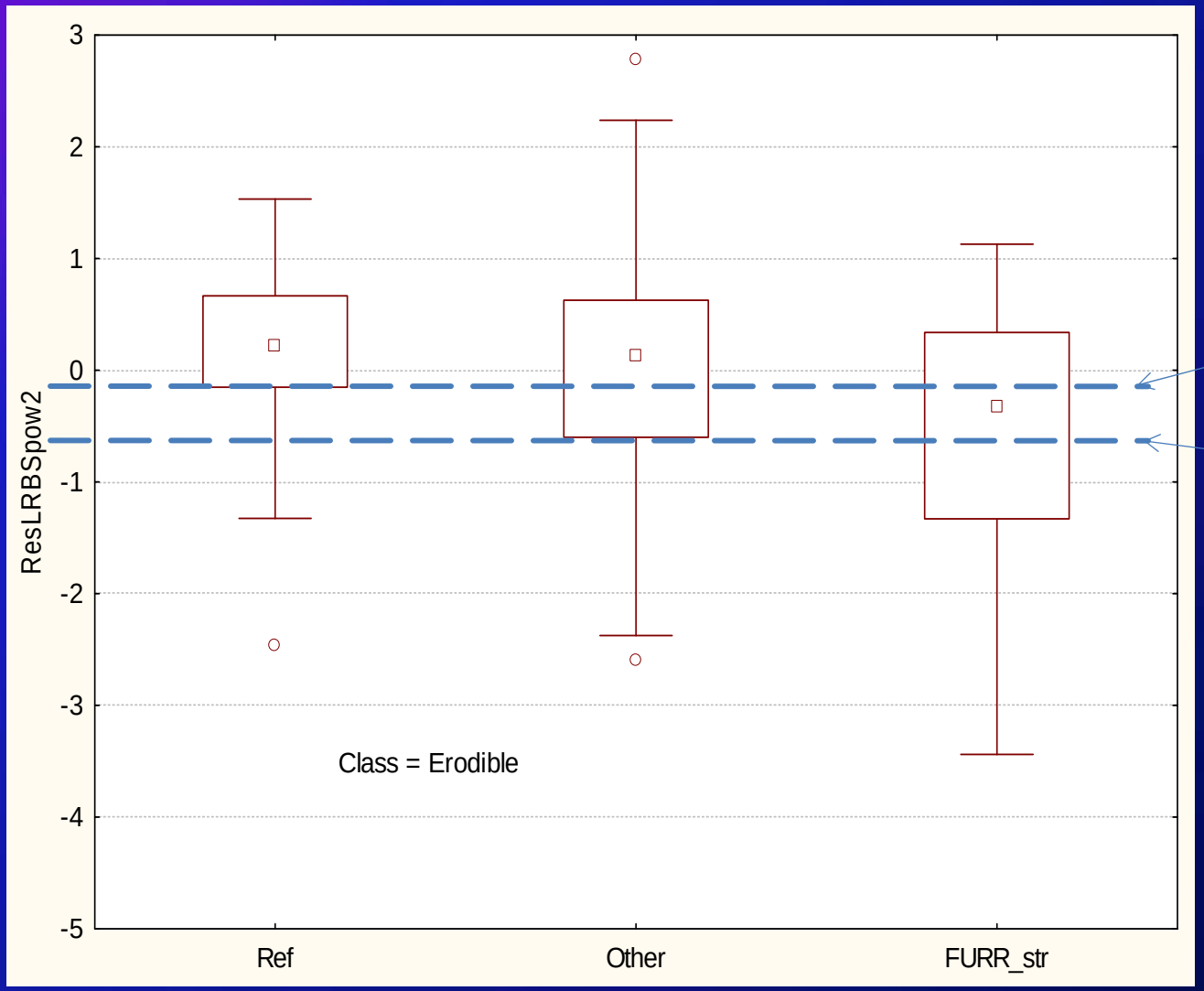
Step 5: Identify protective levels

- Biological responses
  - Biocriteria/Benchmarks
  - O/E taxa richness (0.8 – 0.9)
  - Vertebrate IBI
  - Percentile of reference metric distributions
- Pure sediment conditions
  - Expected sediment stability or composition

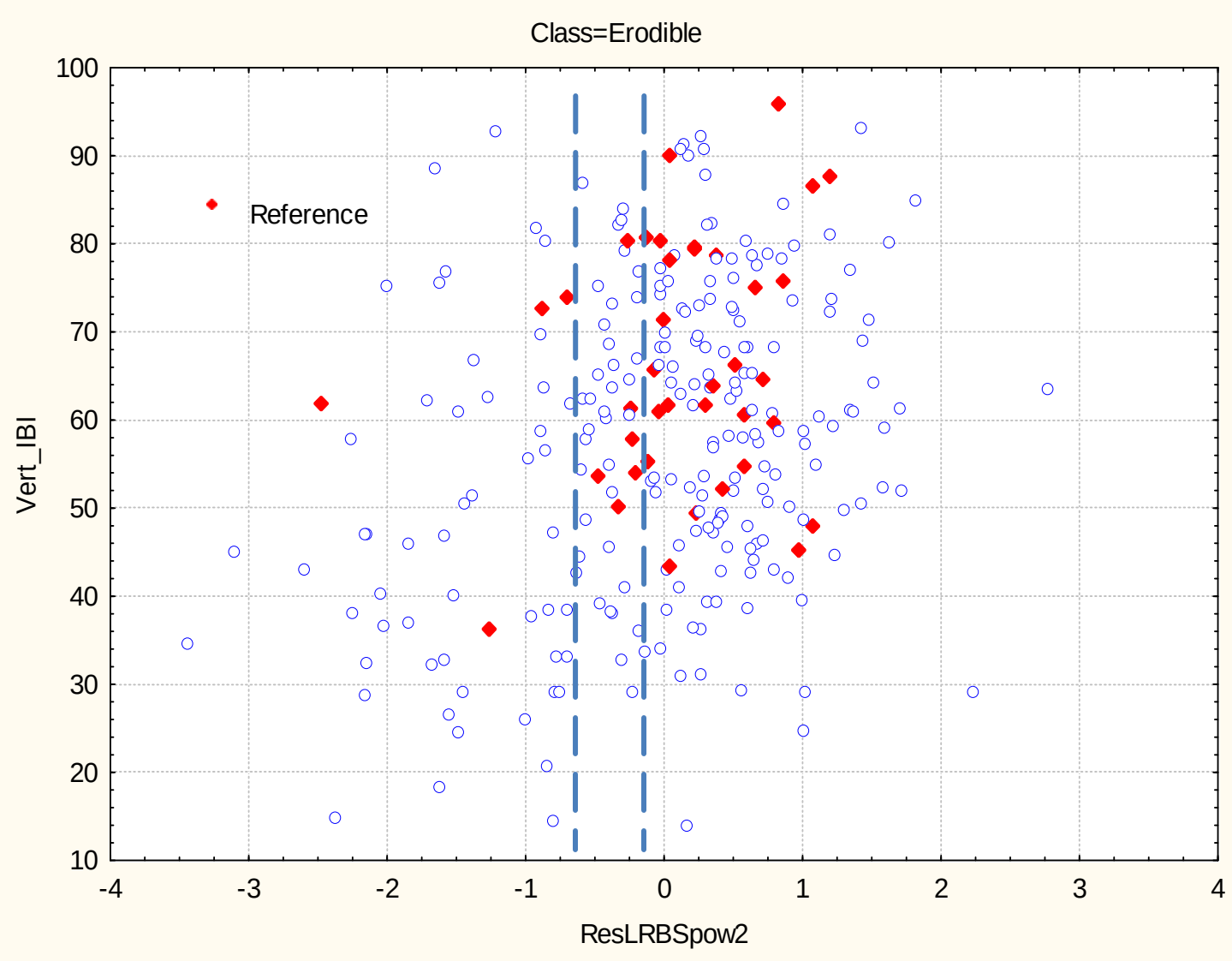
Step 6: Stressor-response associations

- Reference Conditions
  - What do we expect of the sediment conditions in the absence of human disturbance?
- Quantile Regression
  - Can we detect the effects of one stressor and relate it to biological integrity?
- Conditional Probability
  - What are elements of biological risk and how do they point to sediment changepoints?

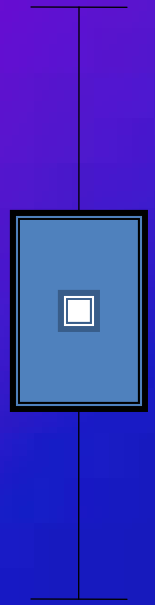
Reference Conditions



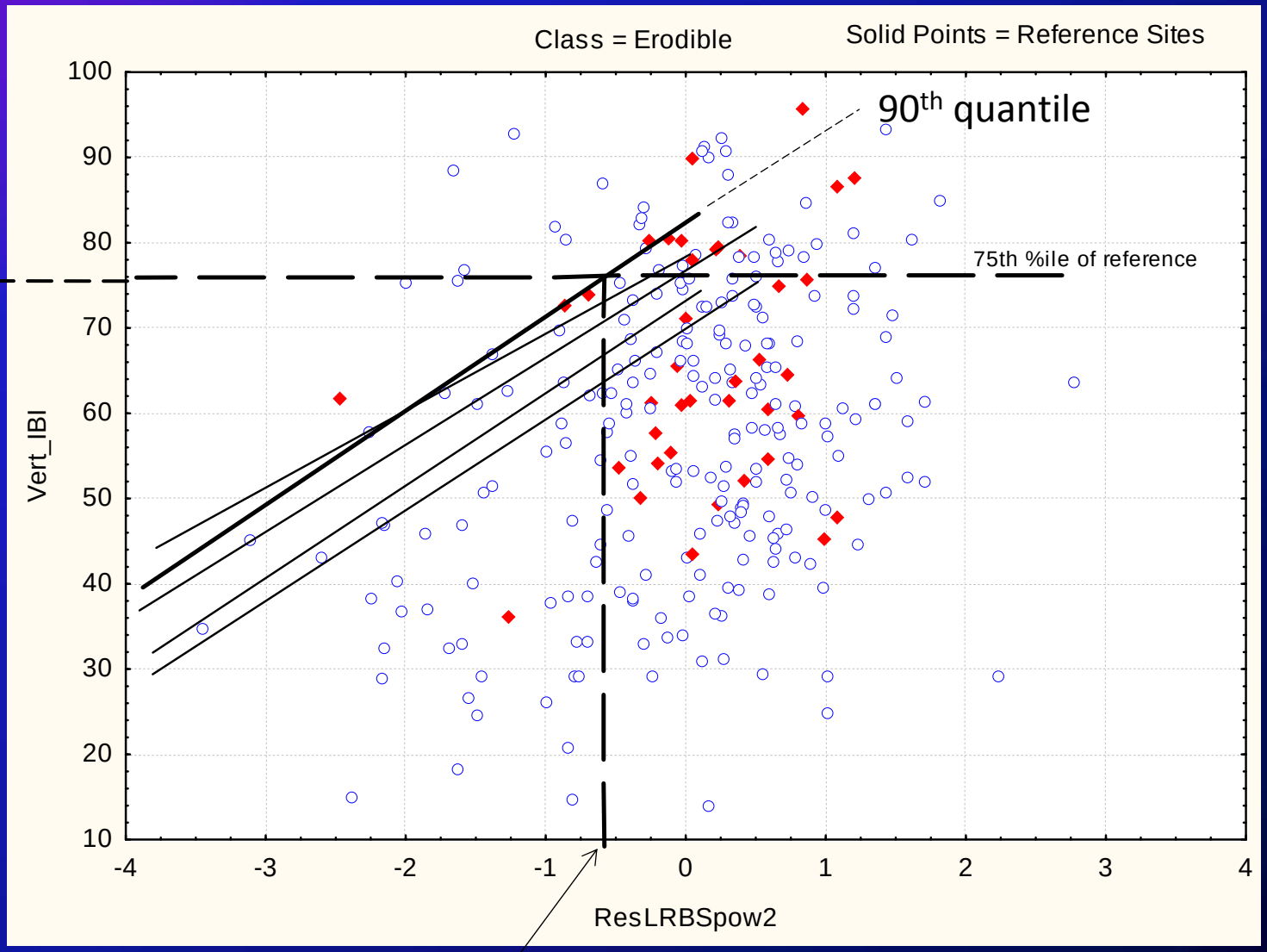
Reference Relationships to Biology



Quantile Regression / Intersection

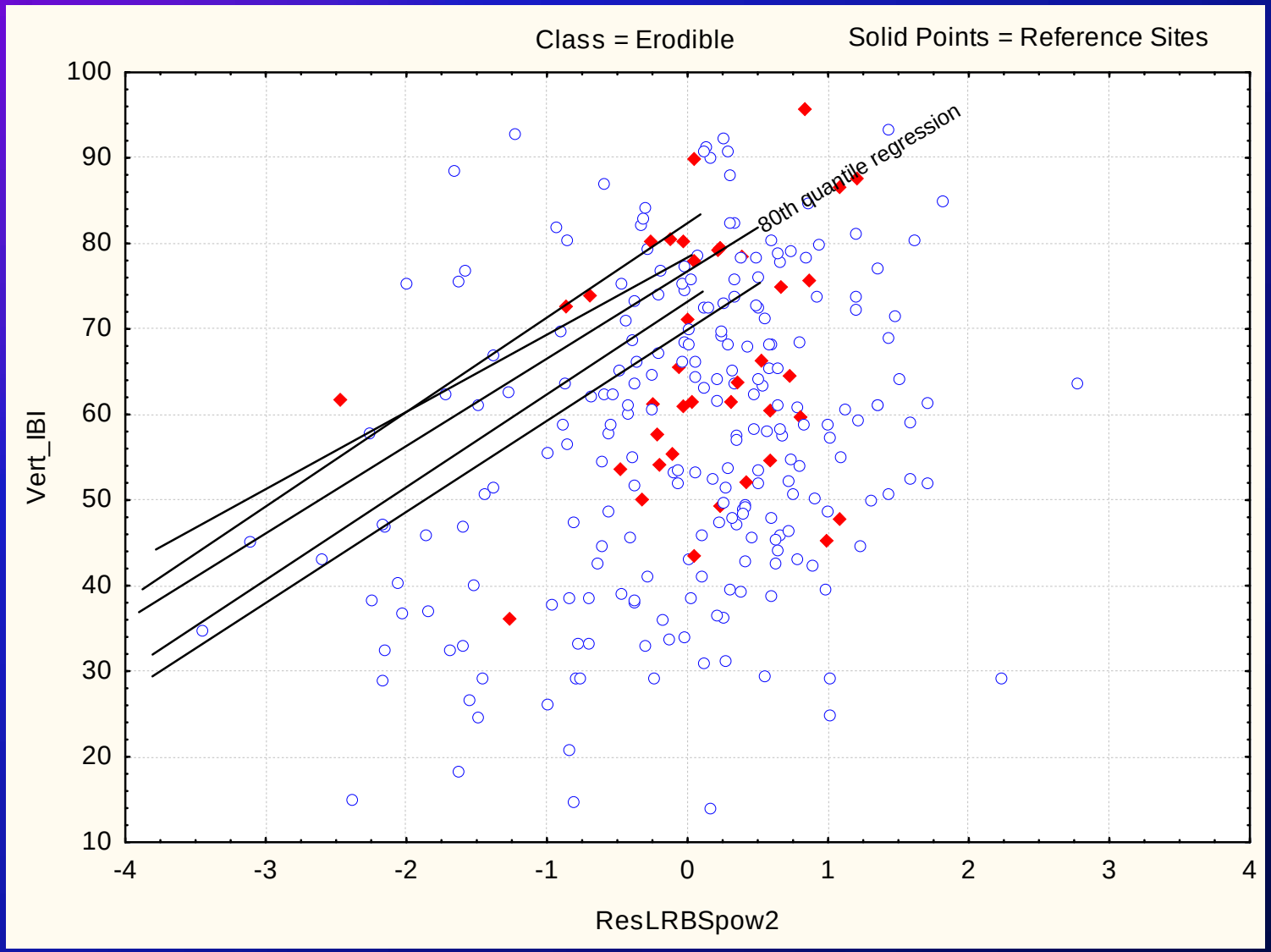


Vertebrate IBI Reference

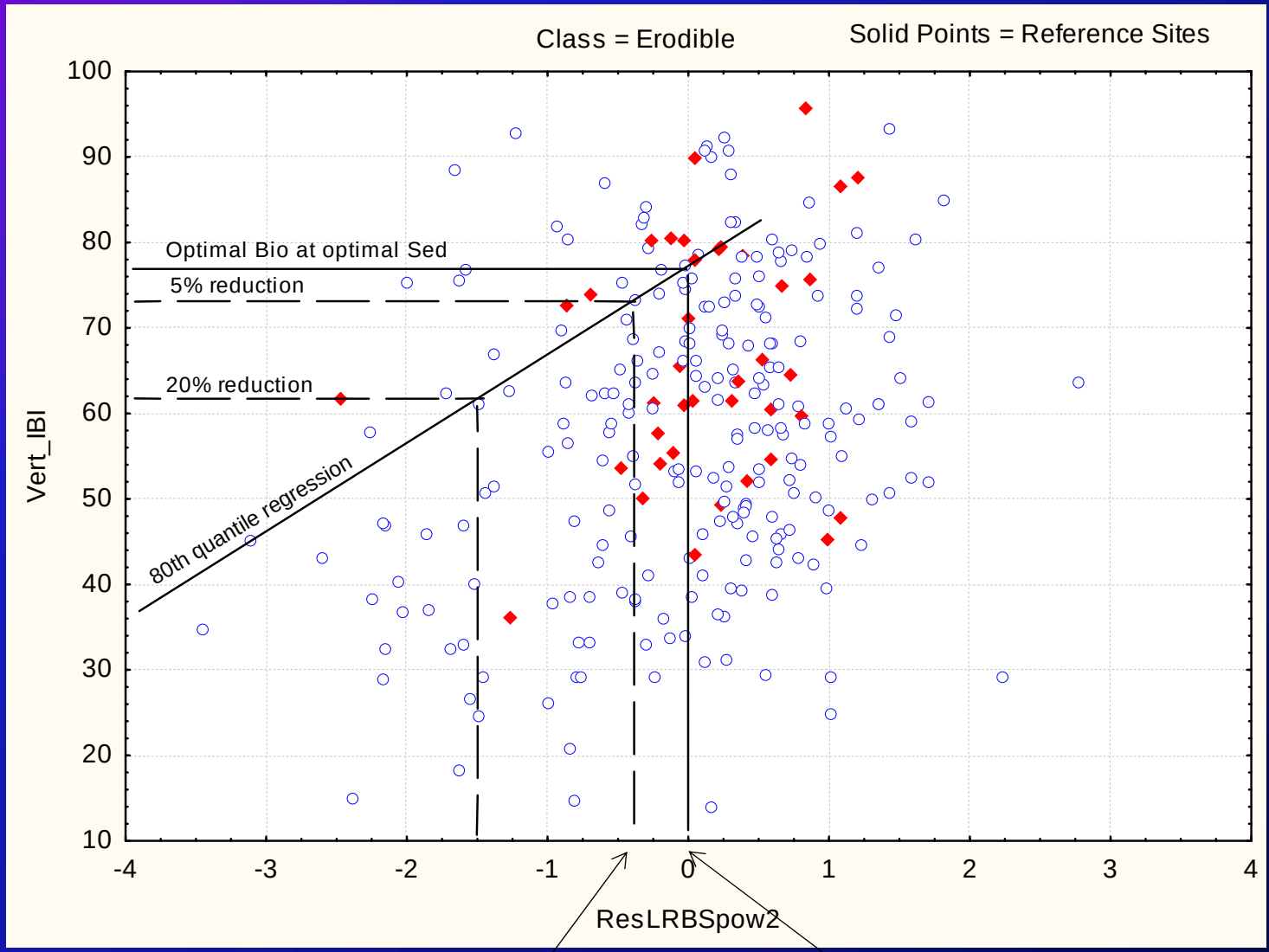


Potential Criterion

Quantile Regression – Effective Slope



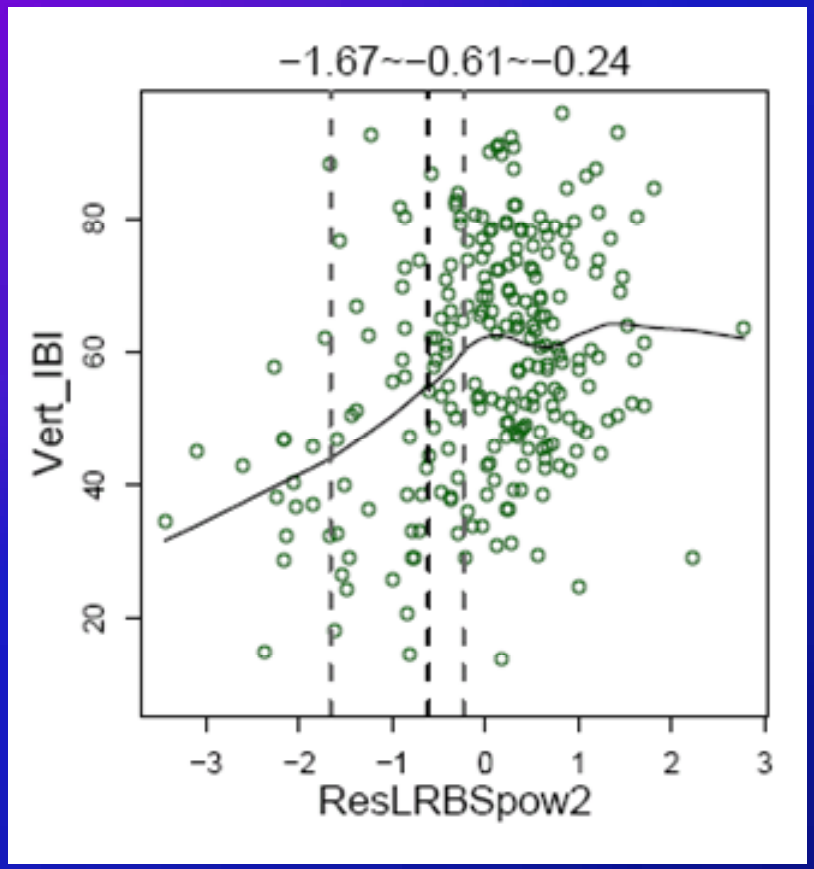
Quantile Regression – Lost Resource

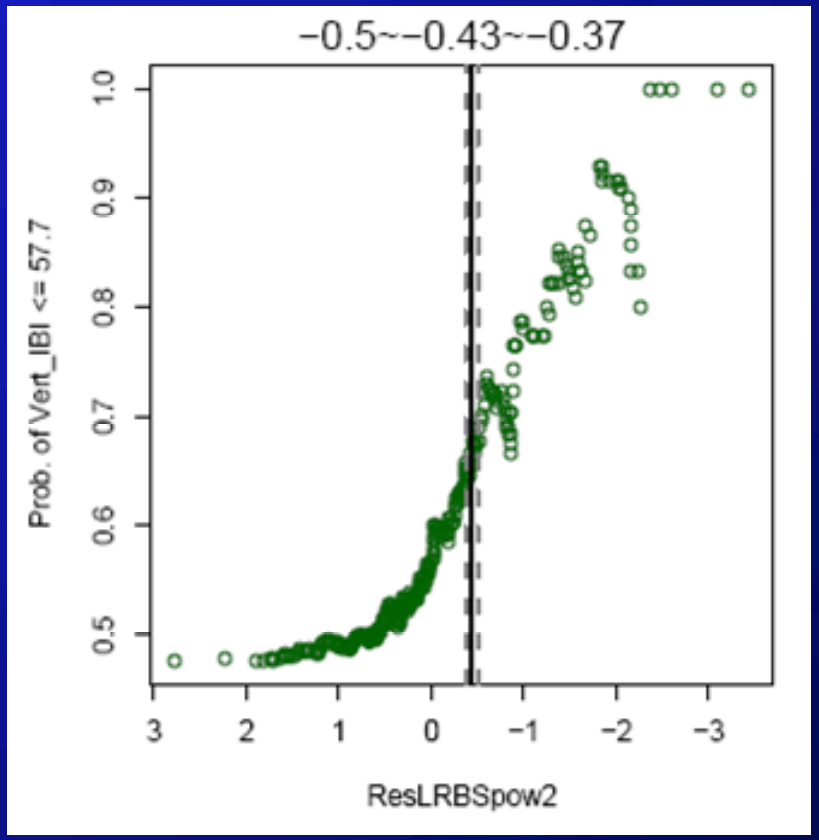


Potential Criterion

"Optimal" sediment condition

Conditional Probability



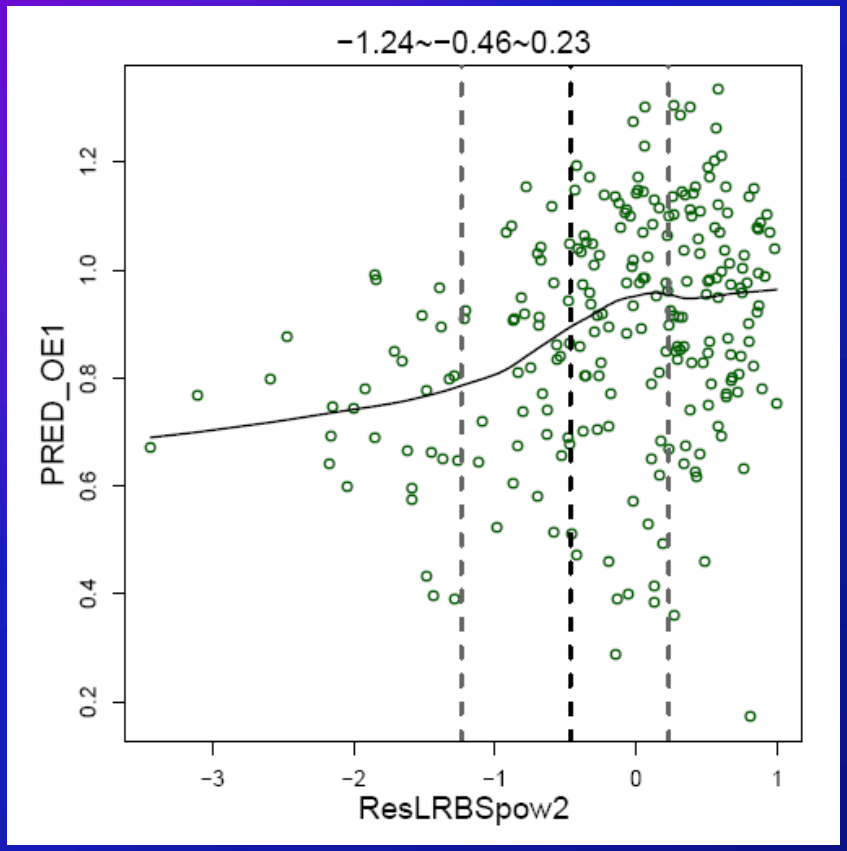


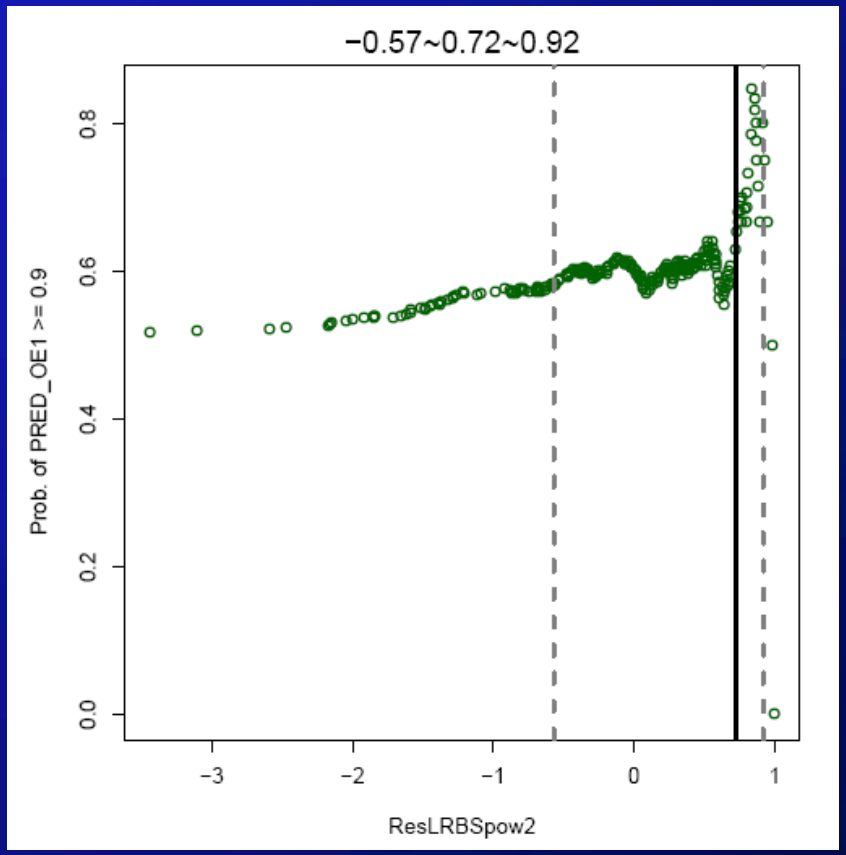
Raw Data with Loess regression

Probability Plot

Deviance reduction technique for finding the changepoint

CPA from the fat end of the wedge



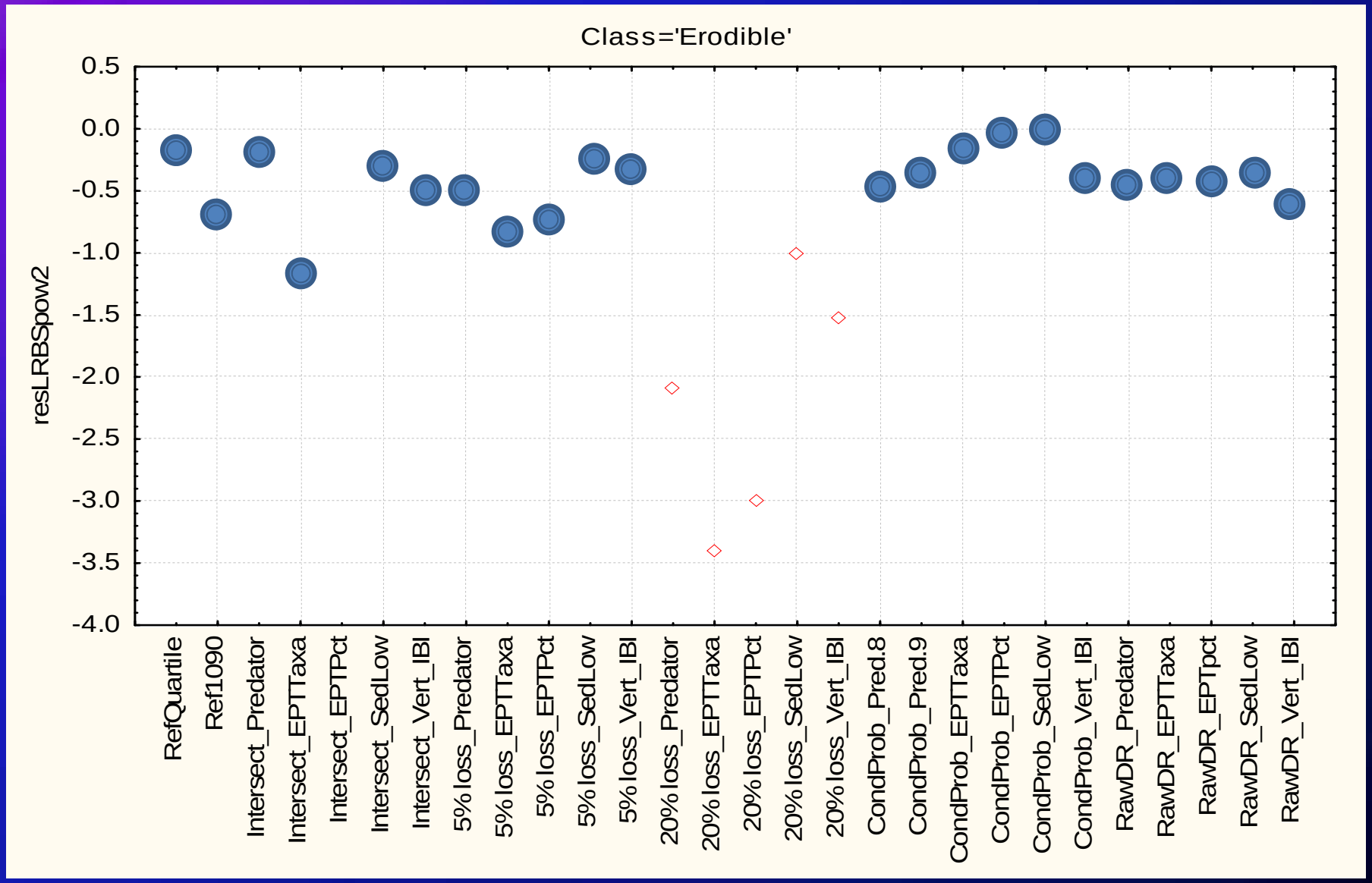


Is it more protective to assess when the probability of passing a threshold decreases? Or is it a misguided application of the technique?

Step 7: Describe decisions

- Weight of evidence
  - Central tendency
  - Discount outliers
- Preferred approaches
  - Stakeholder interests
  - Protective implications
  - Adaptive biological shifts

Potential Benchmarks



Selection Rationale

- resLRBSpow2 < 0.5 (possible range: 0.0 - -1.0)
- Between the 25th and 10th percentile of reference
- In line with the central tendency of all reasonable approaches
- Near 5% loss in optimal biological resources
- Far less than 20% loss in biological resources
- The sediment indicator is responsive to the stressor gradient
- Roughly half of the highly stressed sites would be below the benchmark

Sediment Benchmarks

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