Investigation of the Influence of Naturally Elevated Total Dissolved Solids on Macroinvertebrate Communities in the Southern California Region

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Project Purpose

- Investigate the influence of natural TDS concentrations and related ions (e.g., calcium, sodium, chloride, sulfate, etc.) on local macroinvertebrates
- Difficult to tease apart impacts in an urban influenced region with multiple ubiquitous stressors
- Some local streams contain naturally elevated TDS
- Field Study
  - Macroinvertebrates collected from reference streams across a broad range of TDS concentrations
  - Look at changes in the community
- Mesocosm Laboratory Study

Elevated Stream TDS Concentrations Were Documented Over 140 Years Ago

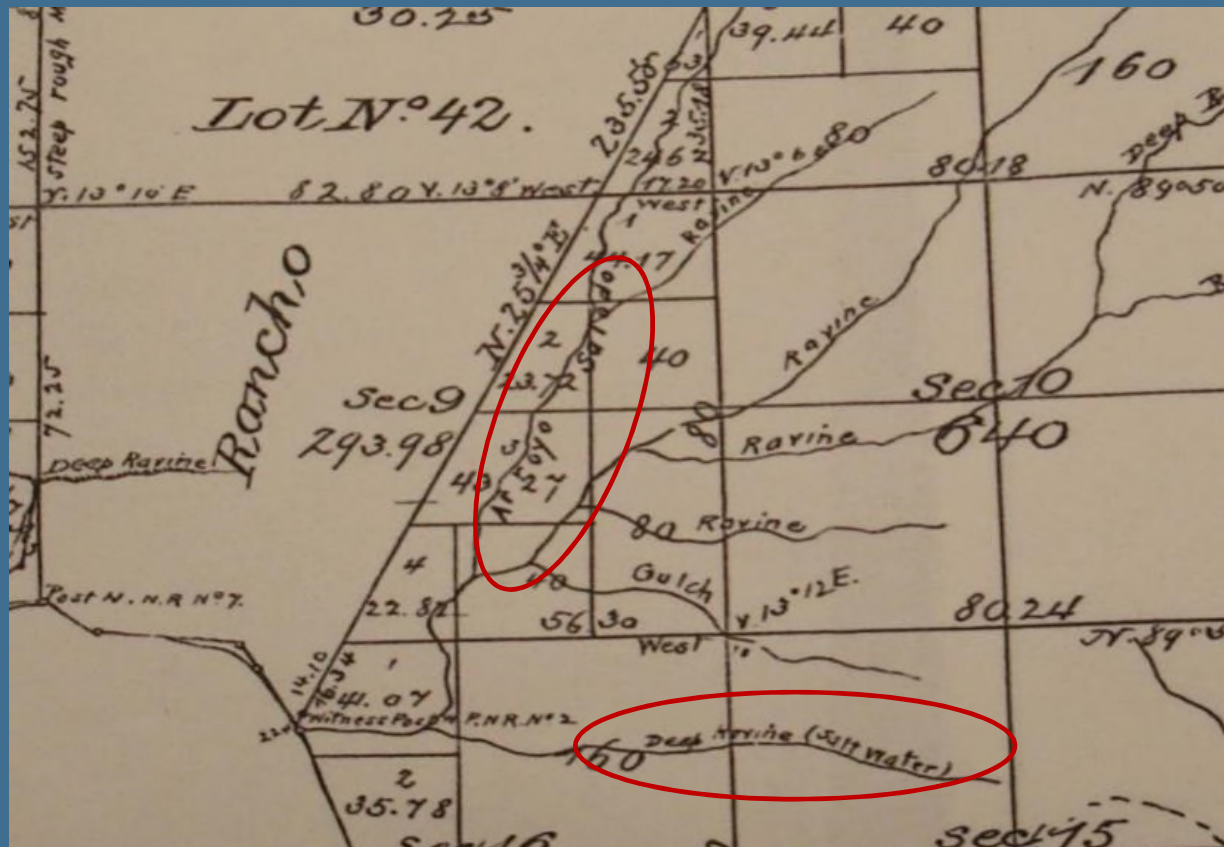
USGS Water Supply Paper, 1919.

Soledad Canyon.

"...Well K18, which is 1 mile above Sorrento or 3 miles above the marsh, yields water which is said to be saline and of very poor quality."

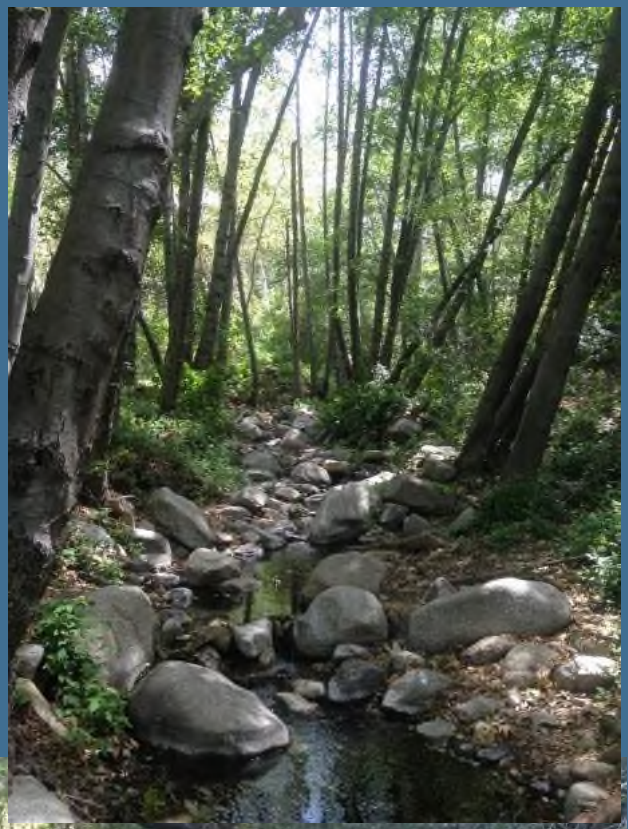
Dana Point, California, 1878. Egan Map Series. UC Archives. Salt Creek Watershed

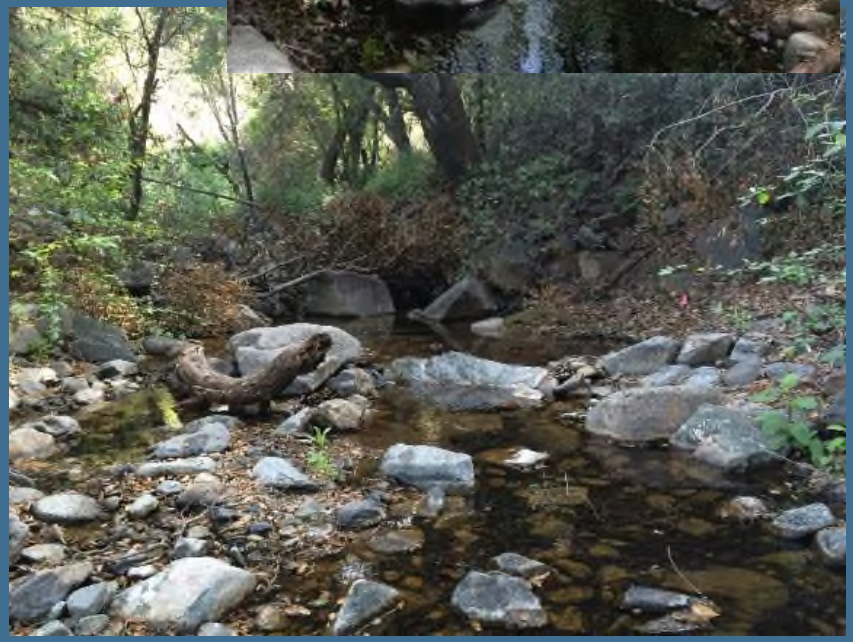
"Arroyo Salado" translates as "Salt Creek", and a second deep ravine is listed as containing "salt water".

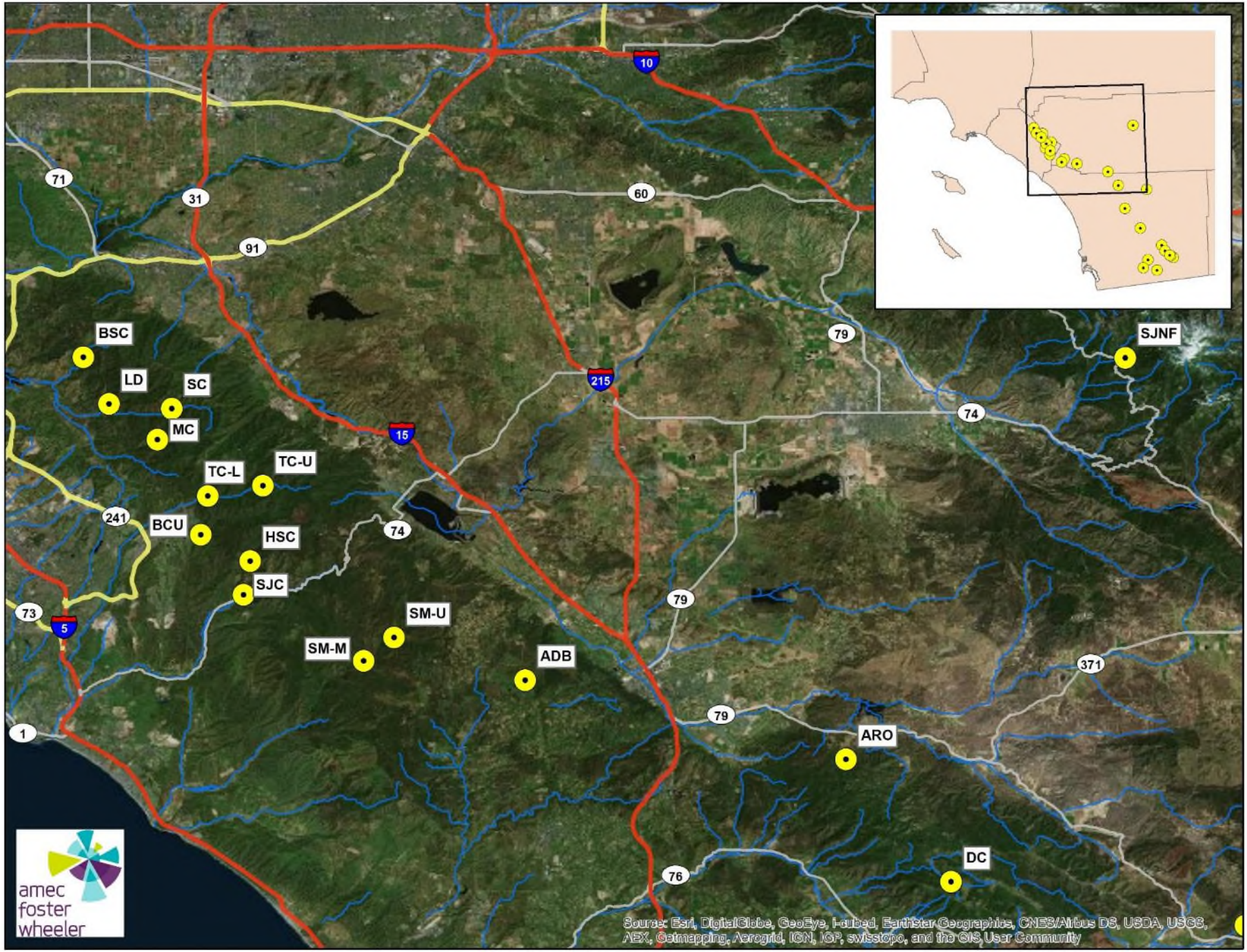


TDS Influence on BMI Methods – Field Study

- Collected BMI and physical habitat data at 29 reference streams
- Field in-situ conductivity, pH, temp, DO, turbidity
- Analytical TDS and associated ions



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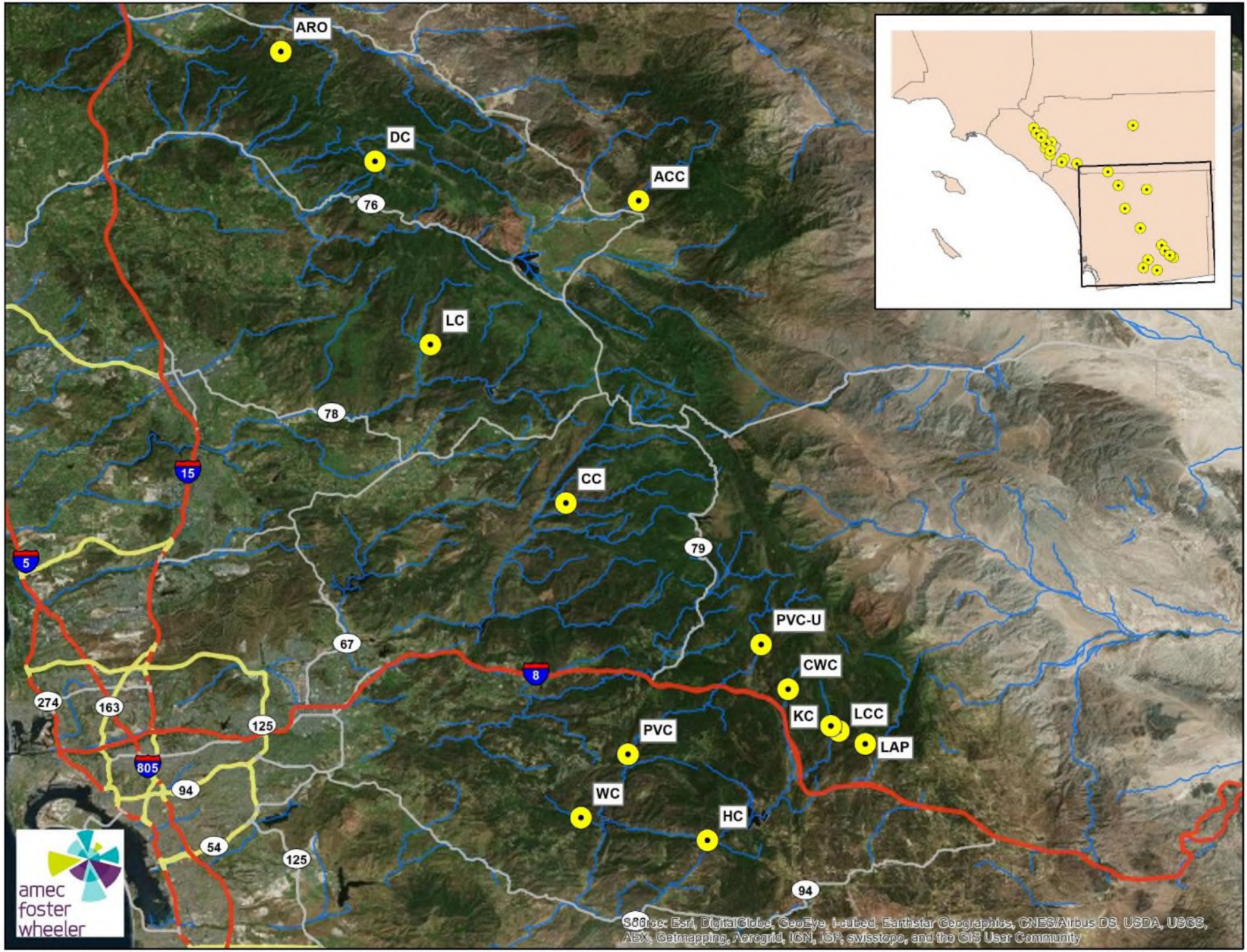
amec foster wheeler
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community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Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
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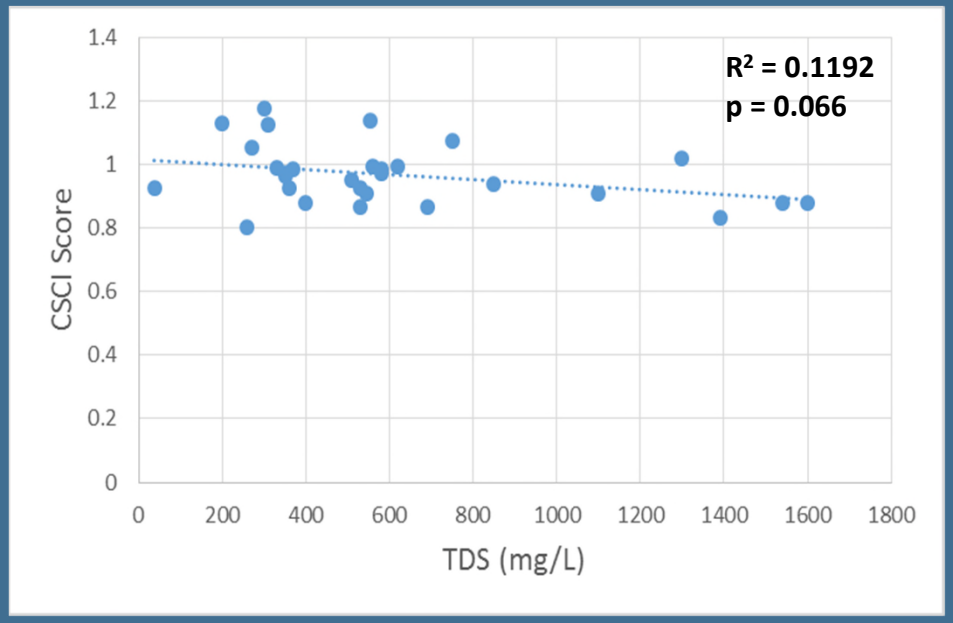
Macroinvertebrate and TDS Results

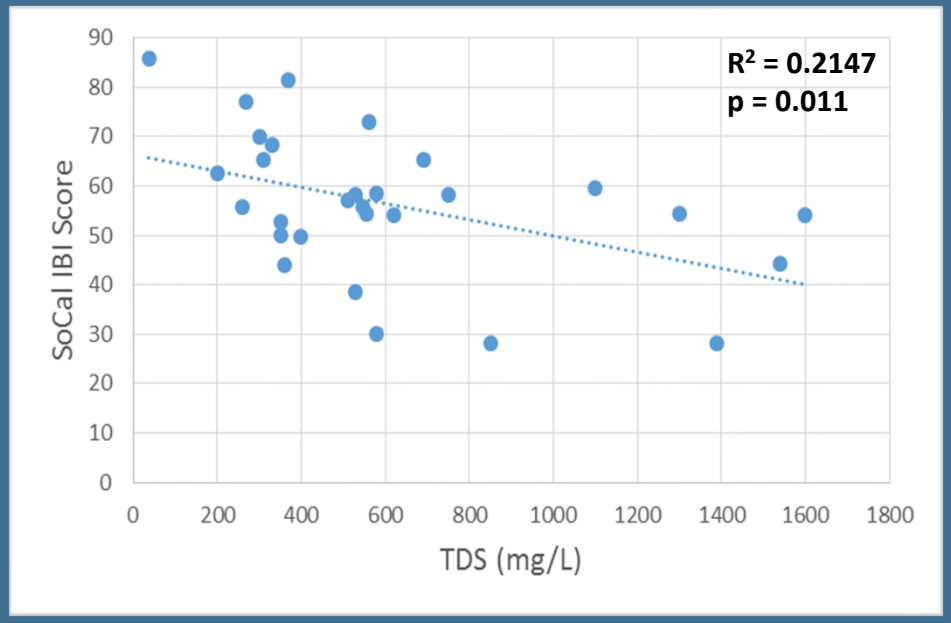
- Taxa richness 33 to 73
- Sensitive taxa
  - EPT taxa richness: 4 to 20
  - % EPT taxa: 6 to 36%
  - Mean HBI: 4.35 to 6.78
  - % Highly sensitive (HBI TV=0): up to 7.3%
- Overall Community
  - Mean CSCI Score: 0.97 (0.80-1.18)
  - Mean SoCal IBI Score: 56.4 (28-86)
- TDS Conc. range 38 – 1600 mg/L
- Conductivity range 56 – 1942 µS/cm

Relationship TDS with MMIs

CSCI

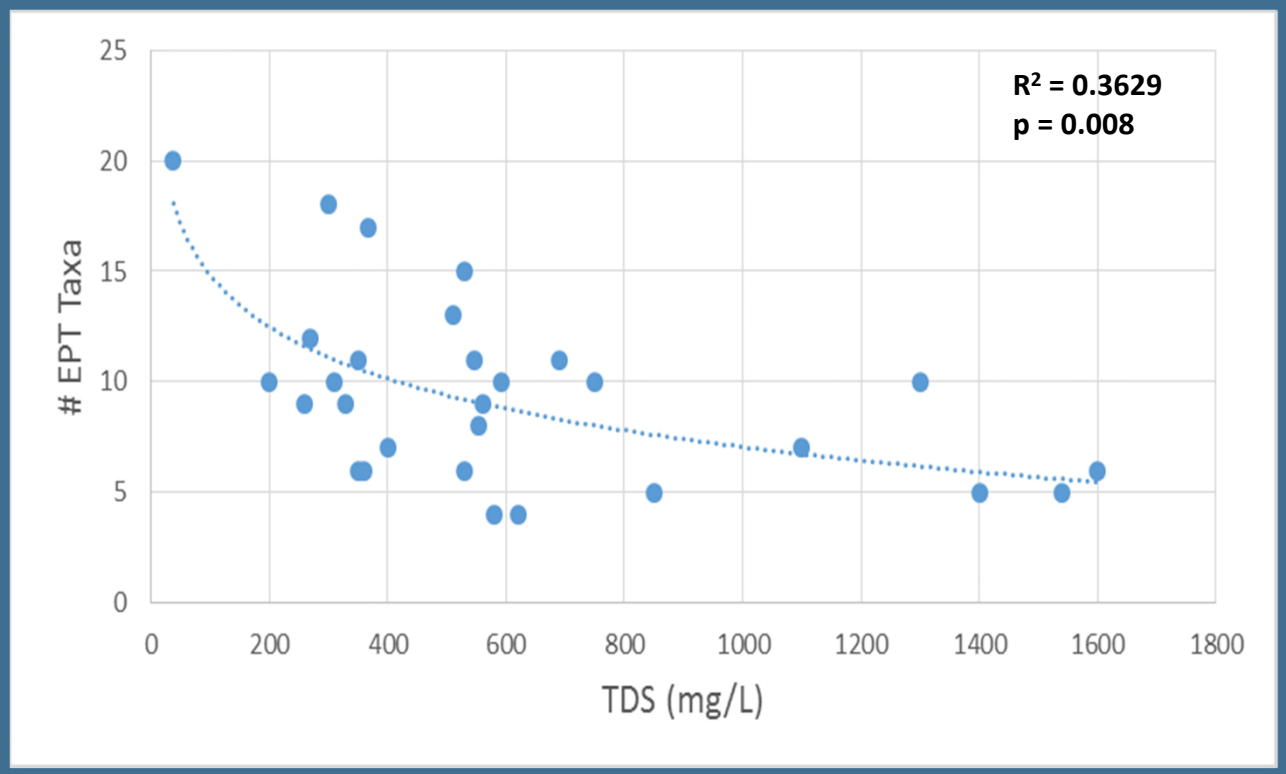


SoCal IBI



- CSCI maybe slight downward trend, but just above significance
- SoCal IBI distinct downward trend and significant
- Exhibits utility of the newly developed CSCI

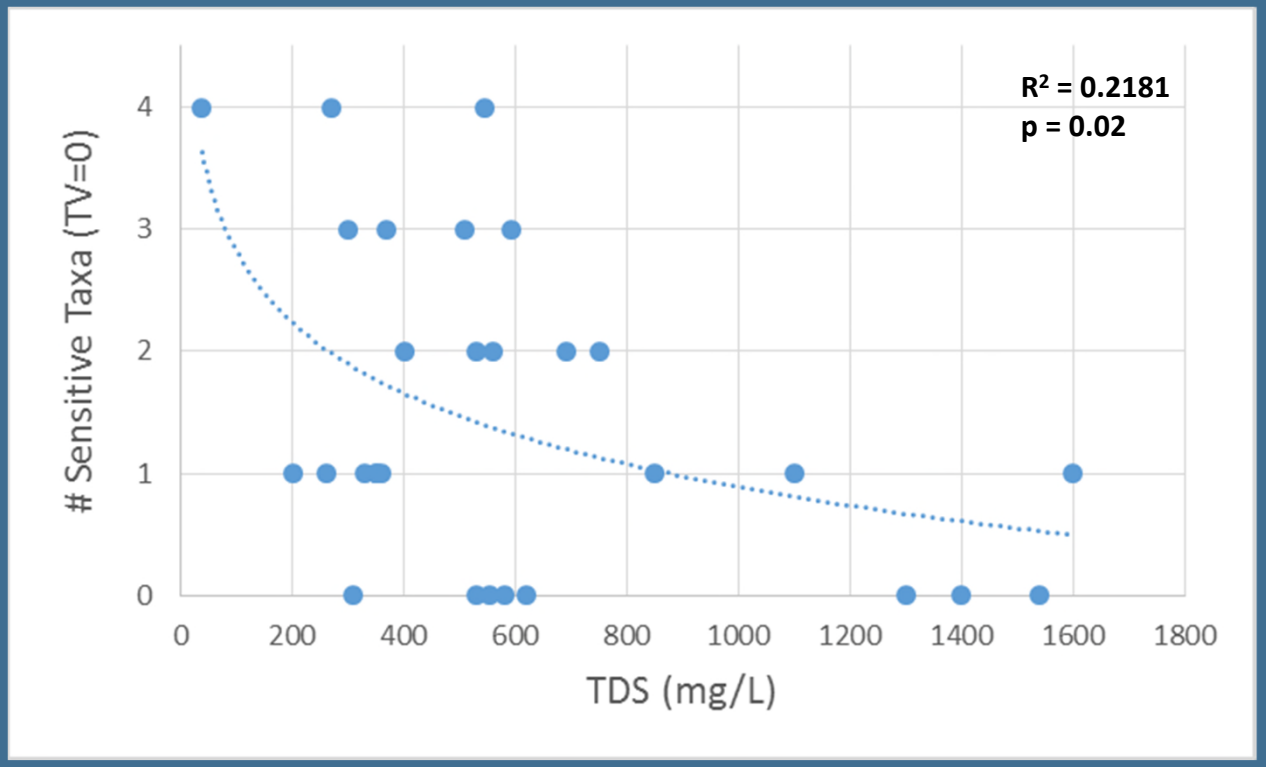
Relationship TDS with Submetrics



- But TDS does exhibit clear trends with submetrics

Relationship TDS with Submetrics

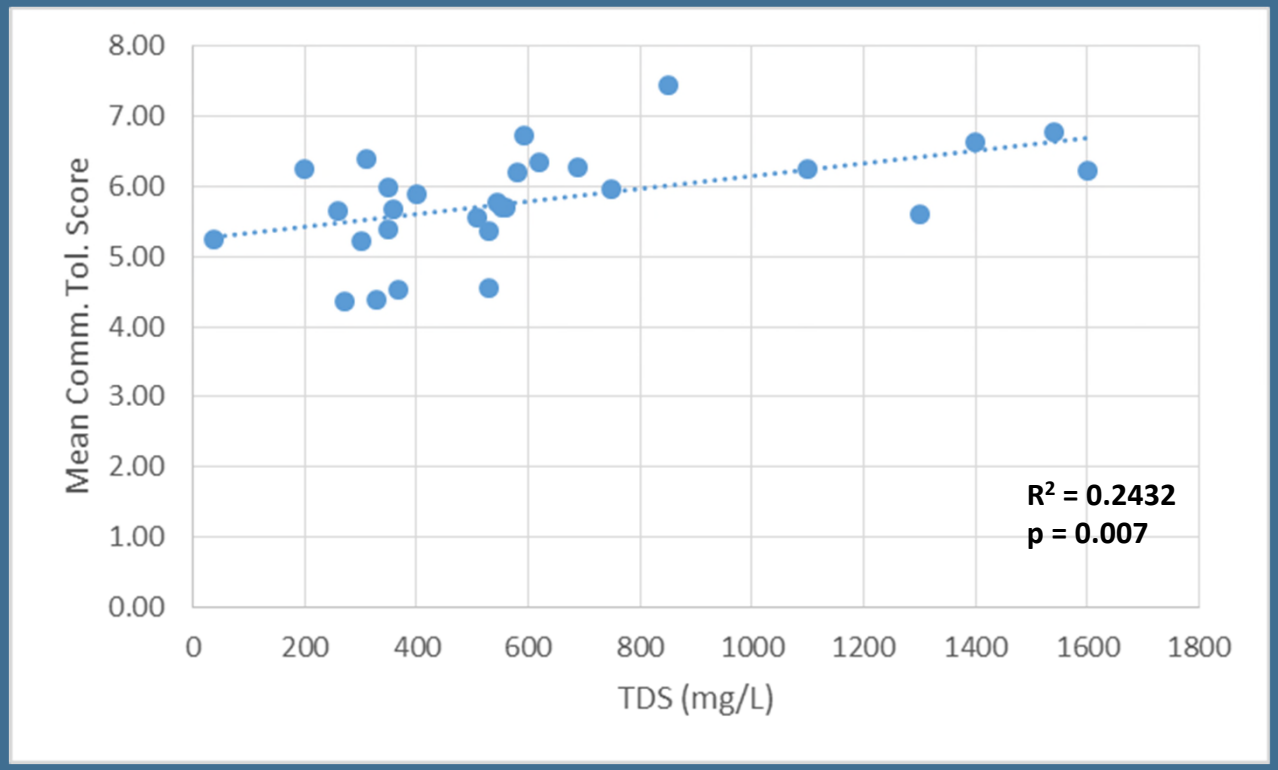
Highly Sensitive Taxa (TV=0)



- But TDS does exhibit clear trends with submetrics

Relationship TDS with Submetrics

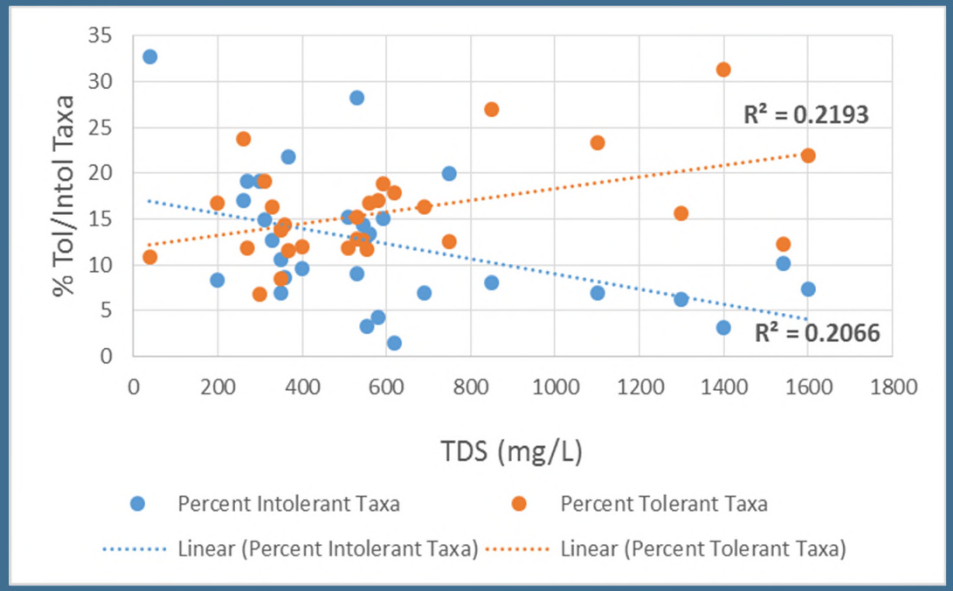
Mean Community Tolerance Value (MCTV)



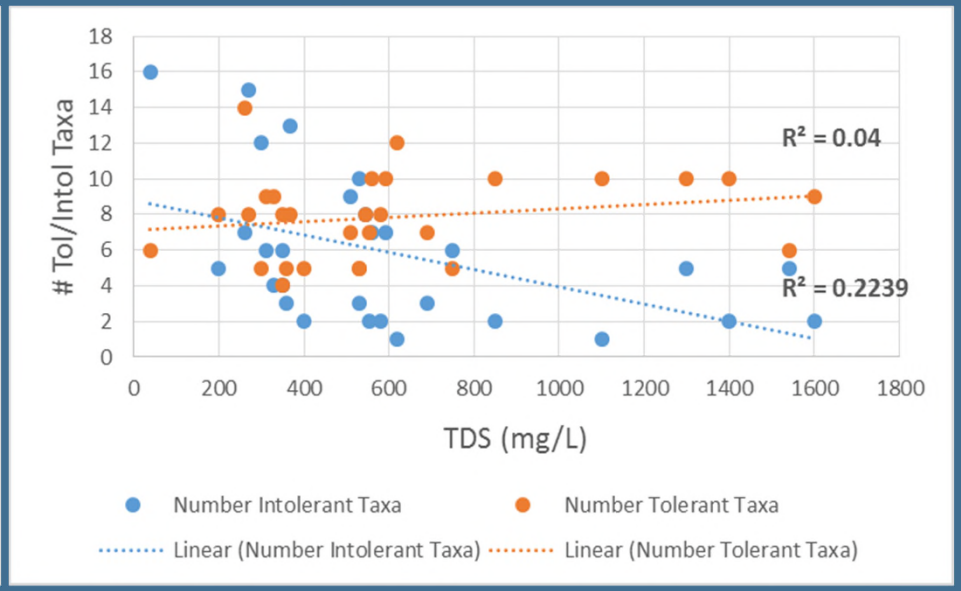
- But TDS does exhibit clear trends with submetrics

Relationship TDS with Submetrics

% Tol / Intol Taxa

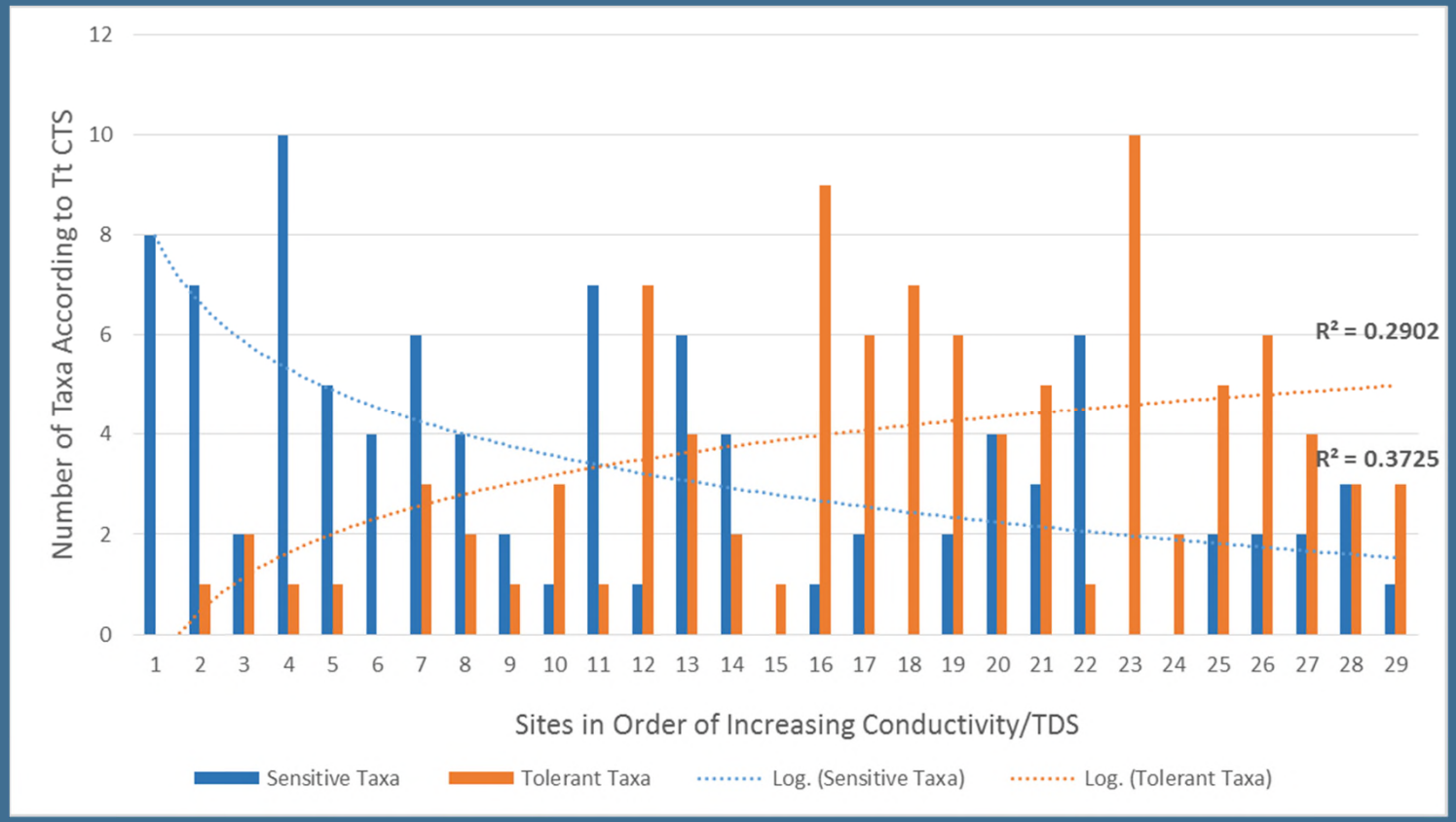


Tol / Intol Taxa



- Trends at both ends of the Tolerance Value spectrum
- Might expect ↑ in % Tol Taxa as % Intol ↓, but also true for # Taxa

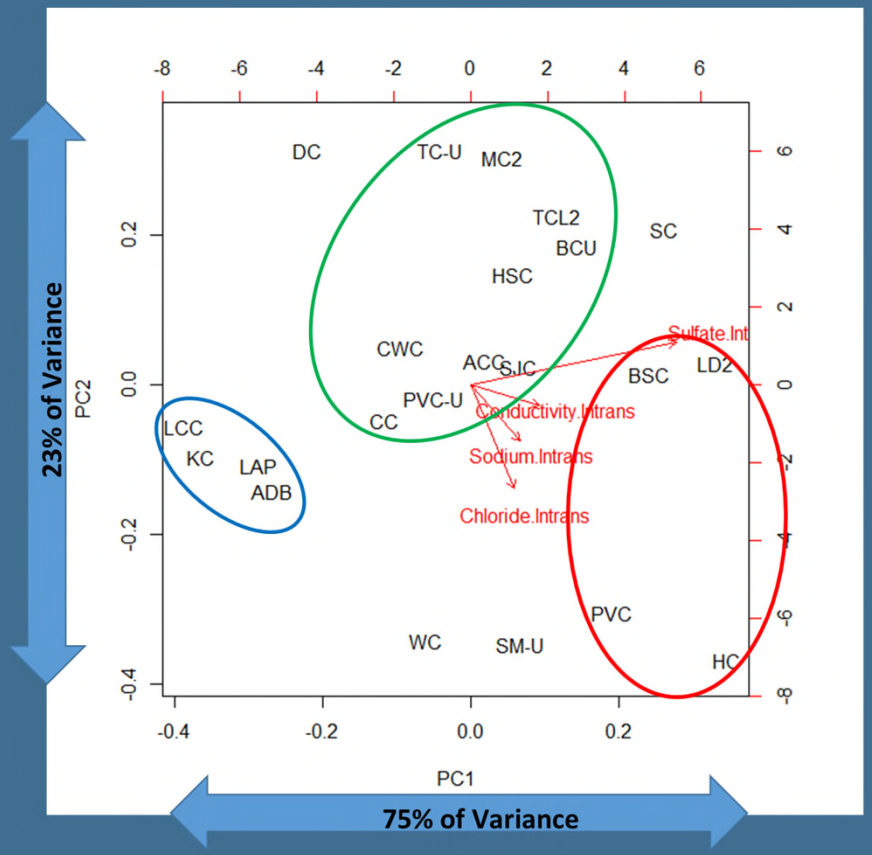
Conductivity Tolerance Scores (CTS) – Tetra Tech (2014)



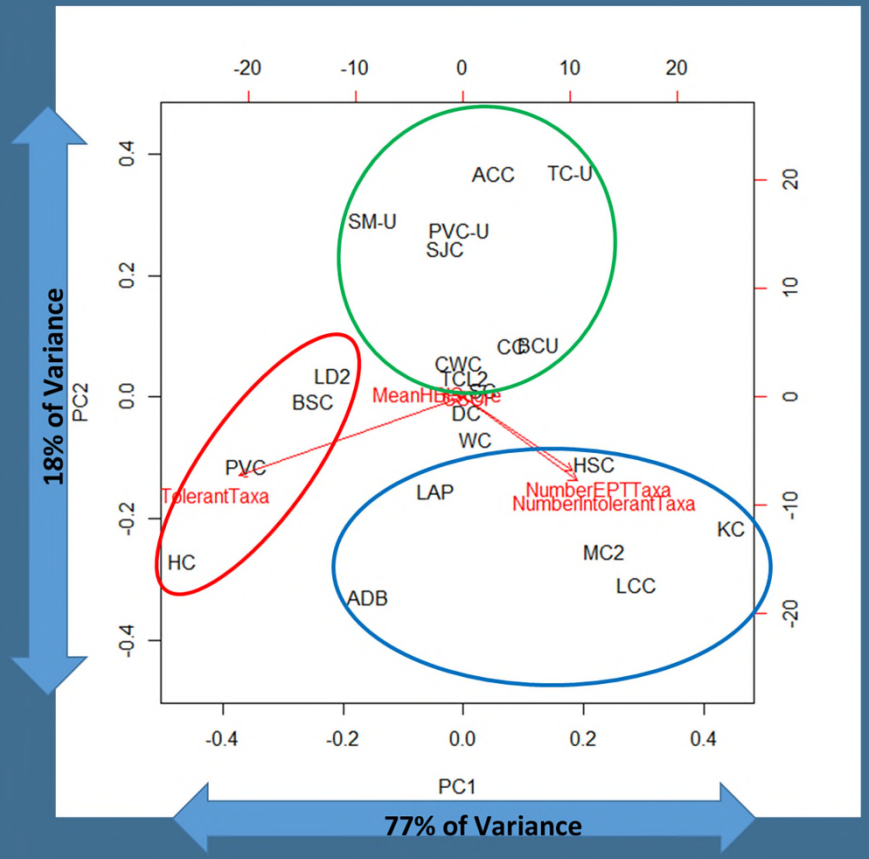
- Clear trend in # Tol/Intol taxa with Conductivity Tolerance Score

PCA Analyses

Water Chemistry

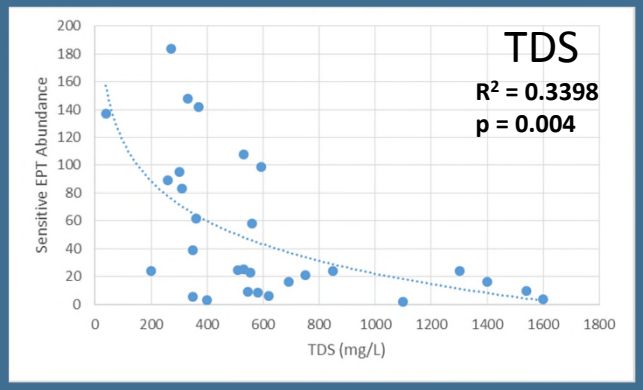


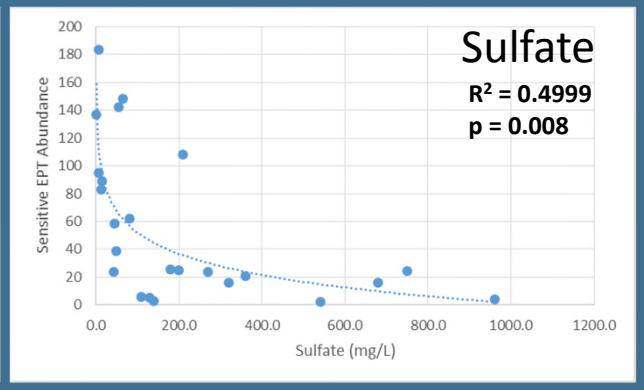
Biological Metrics

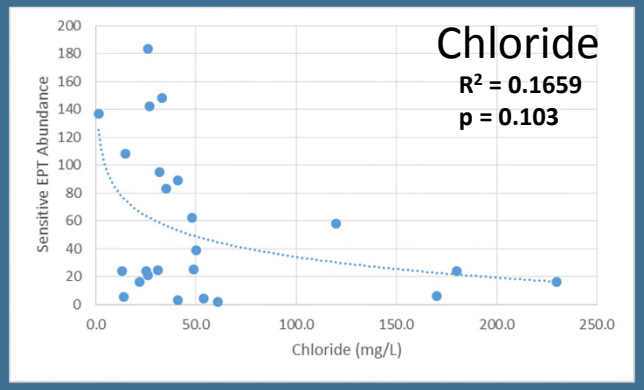


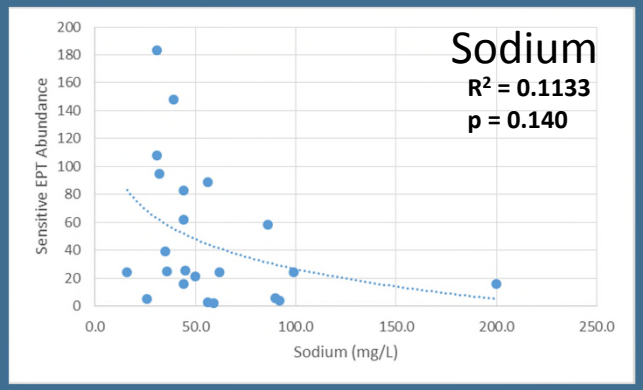
- Sulfate driver of water chemistry variance
- % Tolerant and # Intolerant/EPT drivers of biology variance
- Some similarity in site clustering based on chemistry and biology

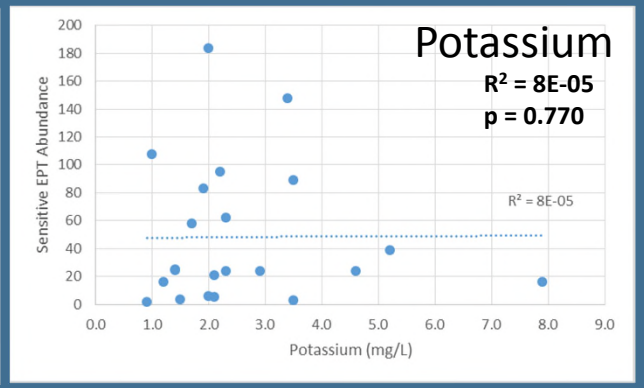
Further Examination Ions and Sensitive EPT

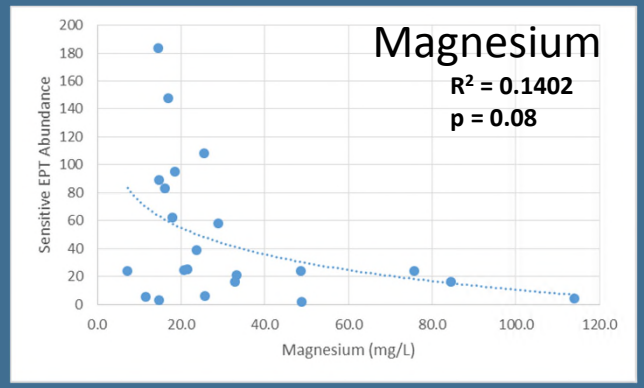






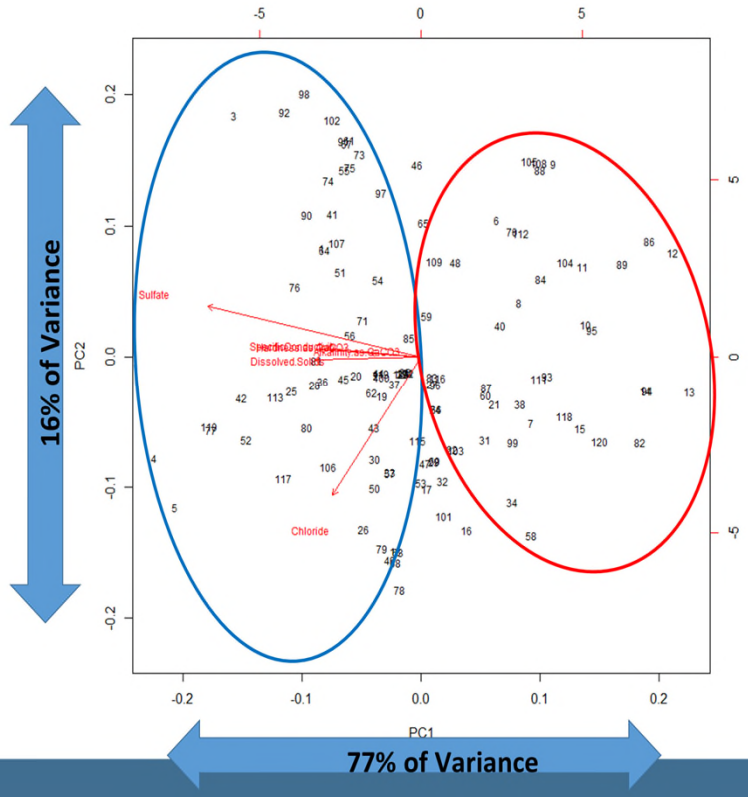




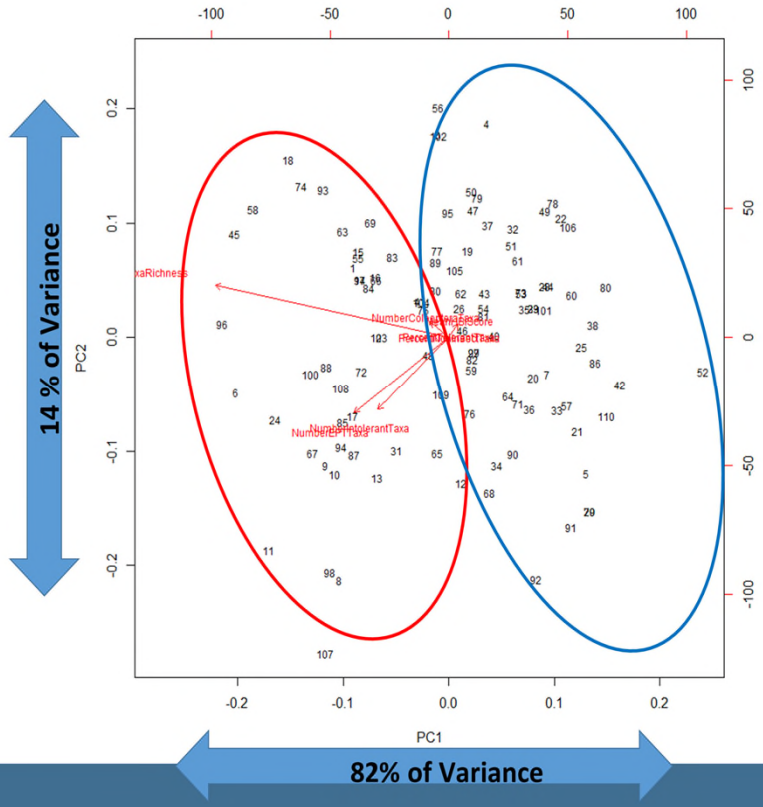


Other Regional Data - PCA Analyses

Water Chemistry

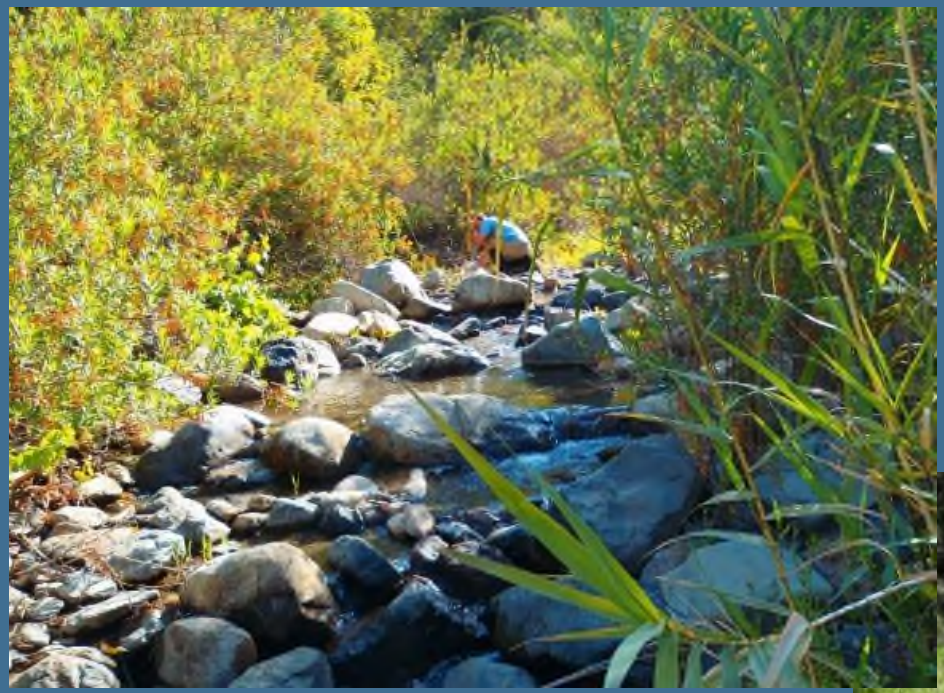


Biological Metrics



- Sulfate and Chloride drivers of water chemistry variance
- Taxa Richness and # Intolerant/EPT drivers of biology variance
- Similarity in site clustering based on chemistry and biology

Conclusions

- Natural levels of TDS and associated ions can influence the BMI community
  - High natural TDS concentrations can limit some MMIs, depending on how they were derived
  - Close and significant relationships with various submetrics
- Sulfate, and potentially chloride, likely the drivers of TDS effects observed
- A 5-year regional monitoring report (2015) ranked TDS as its highest priority stressor, affecting 76% of stream-miles region-wide (50% of natural streams)
- Important diagnostic implications when conducting Causal Assessments and restoration
- Presence/Absence of taxa could help diagnose. Sensitive to TDS, but tolerant of other stressors

Questions?