



Assessing Changes in Fish Traits and Water Quality in a Large Great Plains River



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Introduction

- Reliable and affordable water supply needed
- Protection of biological integrity of streams
- Environmental flows
- Assessments focused mostly on mitigation of water extraction
- Recent considerations seek to integrate water quality



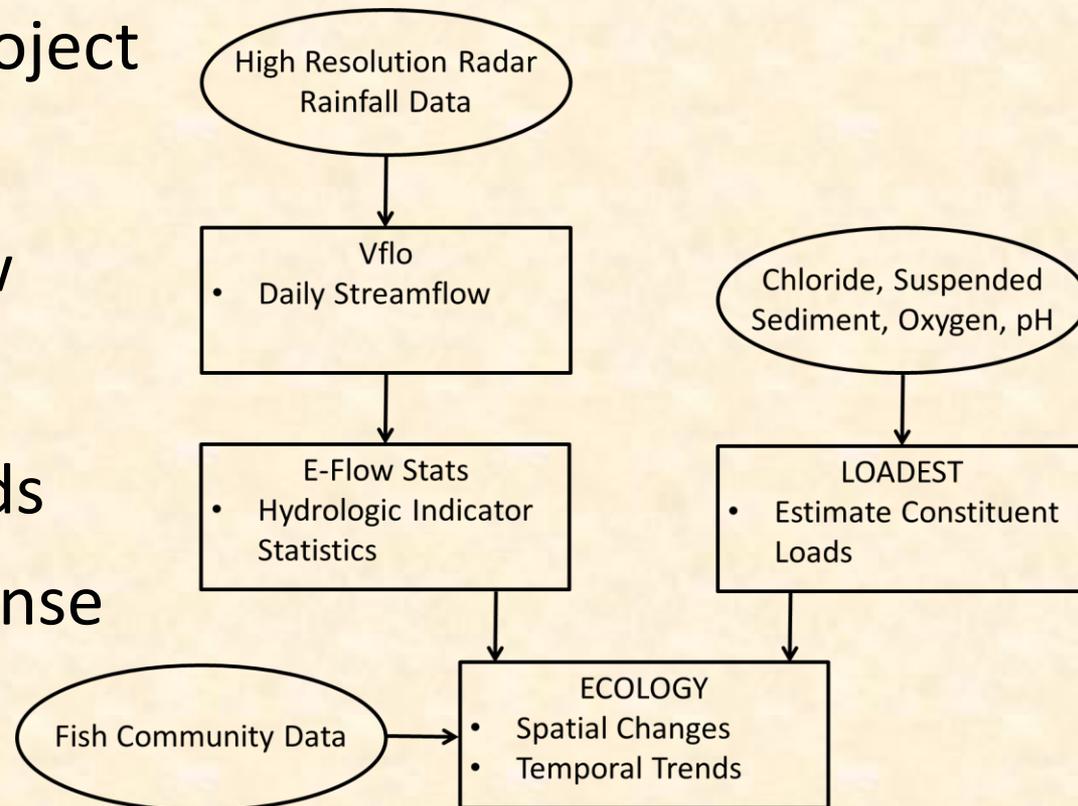
Introduction

- Fish as a tool in biological monitoring
 - Key position in ecological processes
 - Economic & recreational value, ESA
- Focus on key species, fish community, diversity
- Often, studies are of short duration



Background

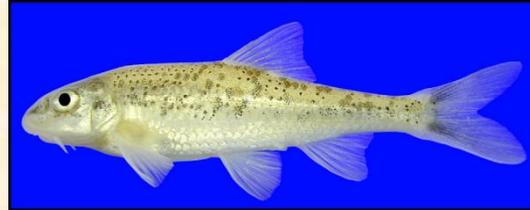
- Objective: Determine appropriate flows to support biological integrity
- Multidisciplinary Project
- Outputs
 - Daily Streamflow
 - E-Flow Stats
 - Constituent Loads
 - Ecological Response



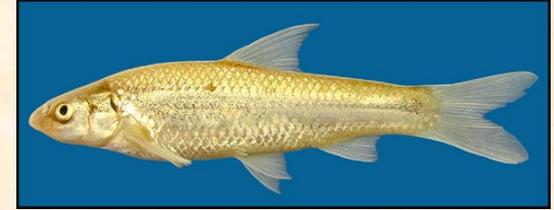
Canadian River Fishes



Arkansas River Shiner

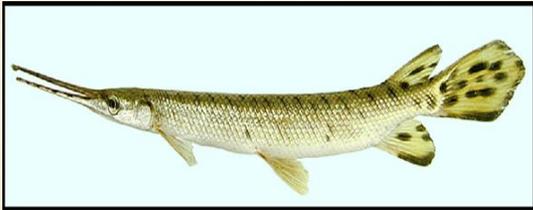


Speckled Chub



Plains Minnow

- Pelagic-broadcast spawning cyprinids.
- Several species of conservation concern.



Longnose Gar



Red Shiner



Plains Killifish

- Community change in relation to water quality.
- Species traits used to describe the community.

Species Traits

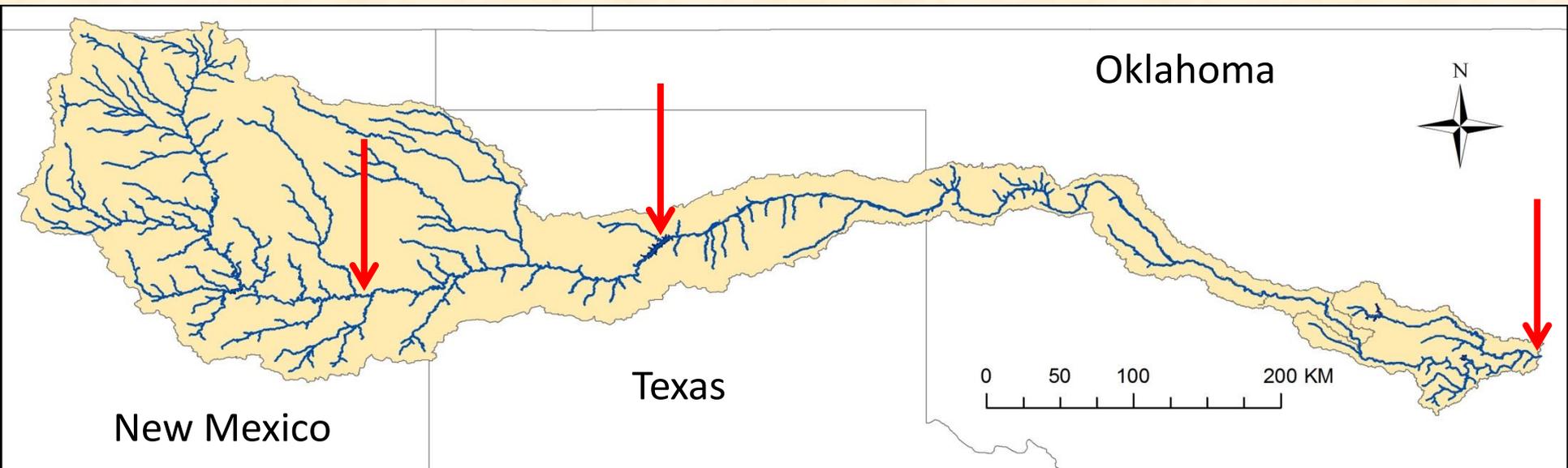
- Physiological, ecomorphological, and life-history characteristics
- Advantages
 - Better to understand adaptations (causal mechanisms)
 - Allow multiple species/regional comparisons
 - Insight into rare and invasive species



Credit: B. Brown

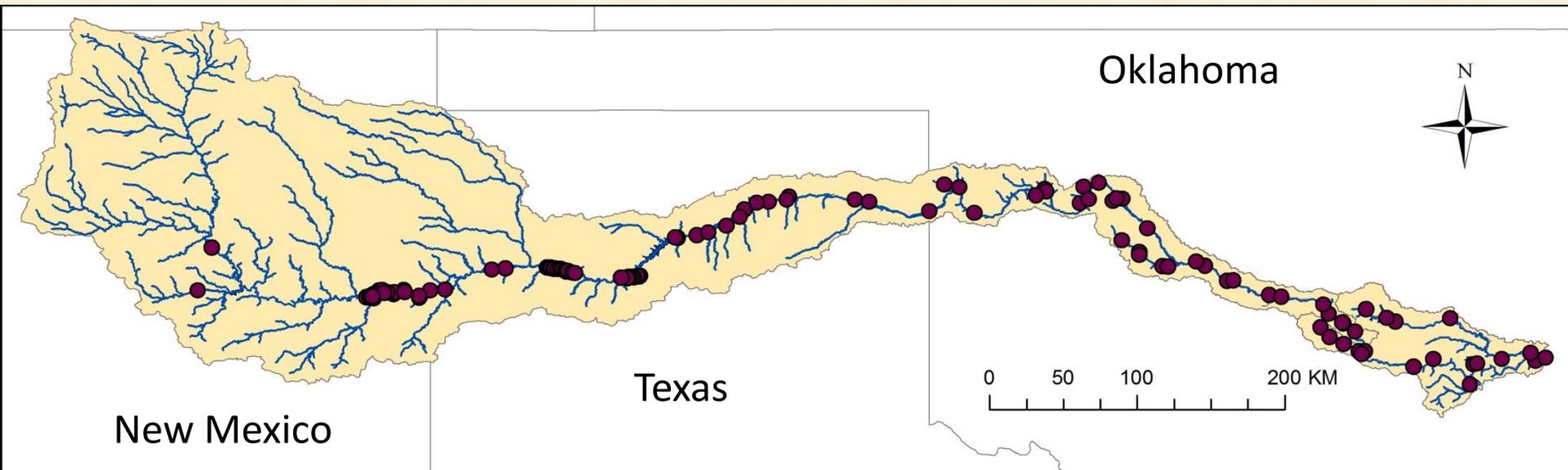
Methods

- Canadian River Basin
 - Ute Lake to Lake Eufaula



Methods

- Canadian River Basin
 - Ute Lake to Lake Eufaula
- Fish-community data from OK, TX and NM
 - 783 samples
 - 121 locations



Methods

- Species Richness
- Fish Traits
 - Feeding Range
 - Length
 - Age at Maturity
 - Maximum Age
 - Fecundity
 - Reproductive Season
 - % Benthic Feeders
 - % Non-guarding Fish

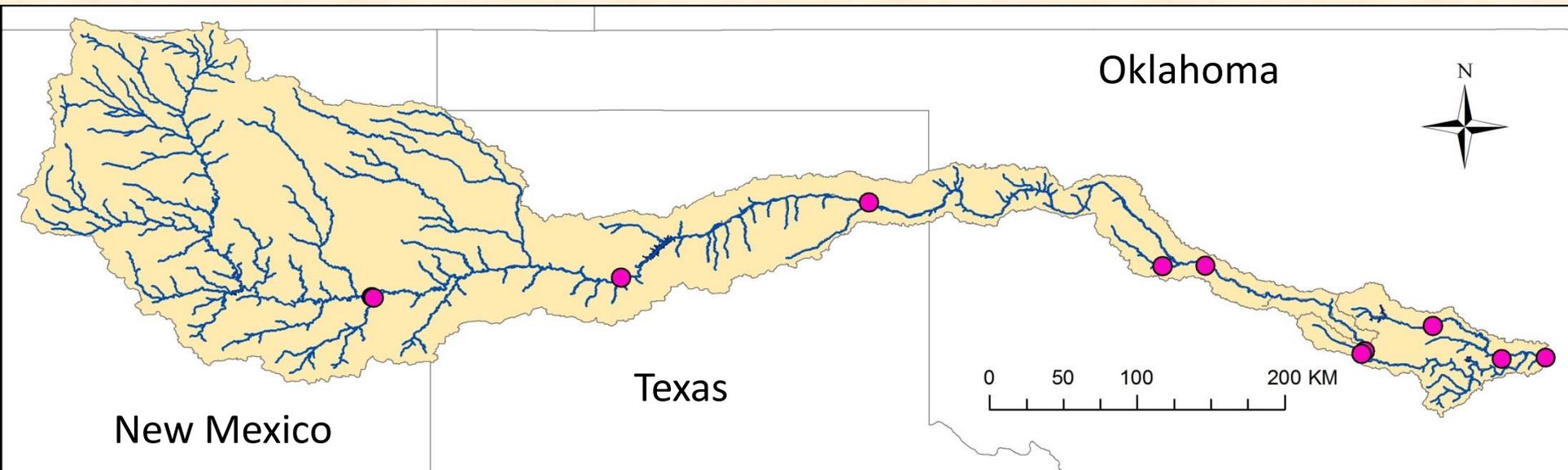
Desert streams



8 cm
Tolerate 4°- 45°C, high salinities
Omnivore
Sexually mature at 6 weeks

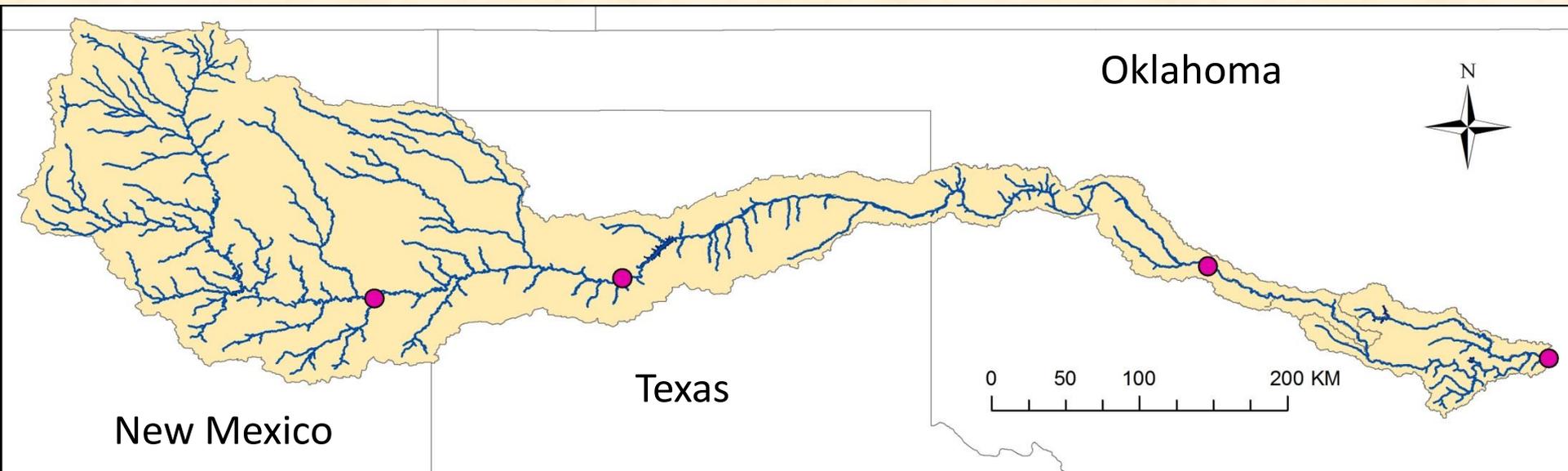
Methods

- The USGS S-LOADEST program used to estimate constituent loads
 - 11 sites with long-term data, temporally variable
 - Dissolved chloride, dissolved oxygen, suspended sediment (temperature, pH - missing values)

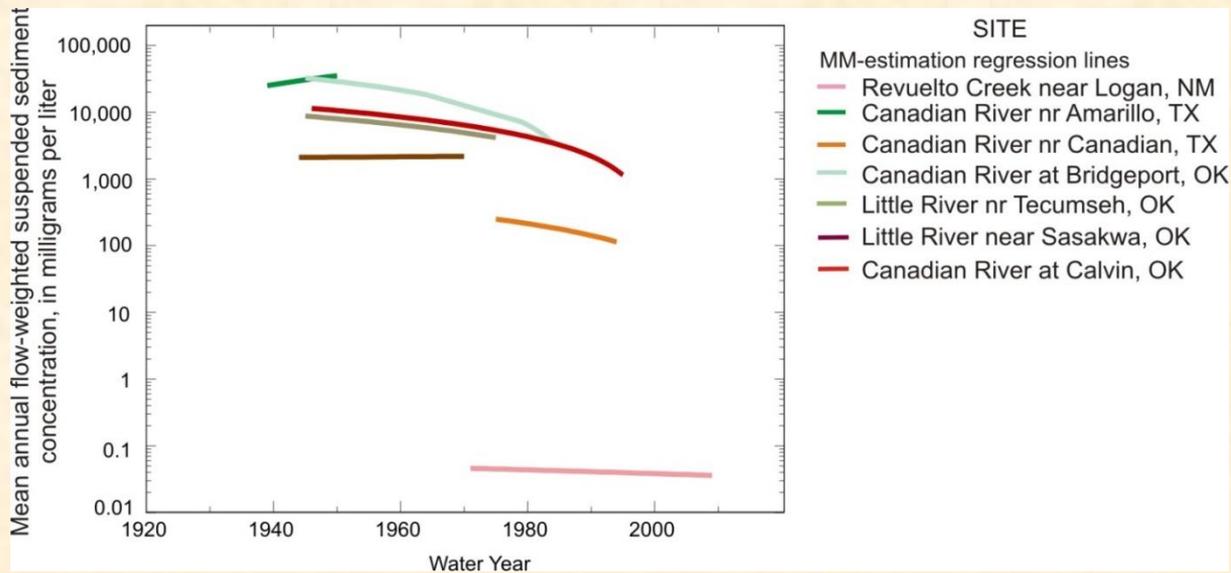
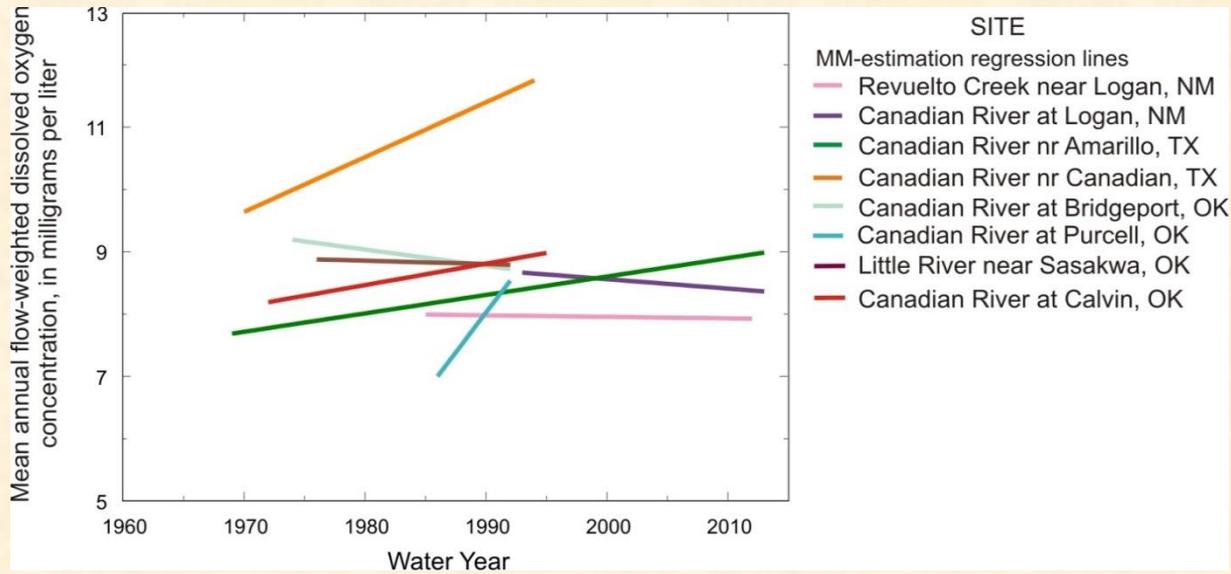


Methods

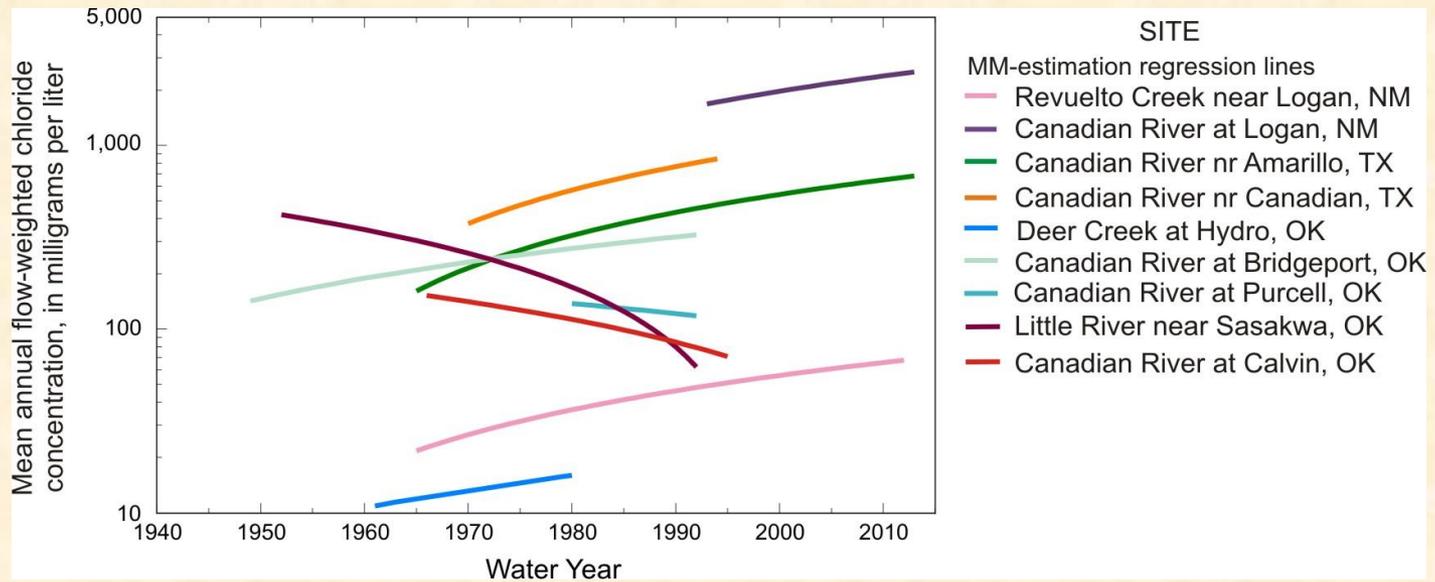
- S-LOADEST water-quality modeling
 - Only 4 sites match ecology data >5 years
 - Suspended sediment data too intermittent
 - Dissolved chloride and dissolved oxygen highly correlated, $r > 0.85$



Results

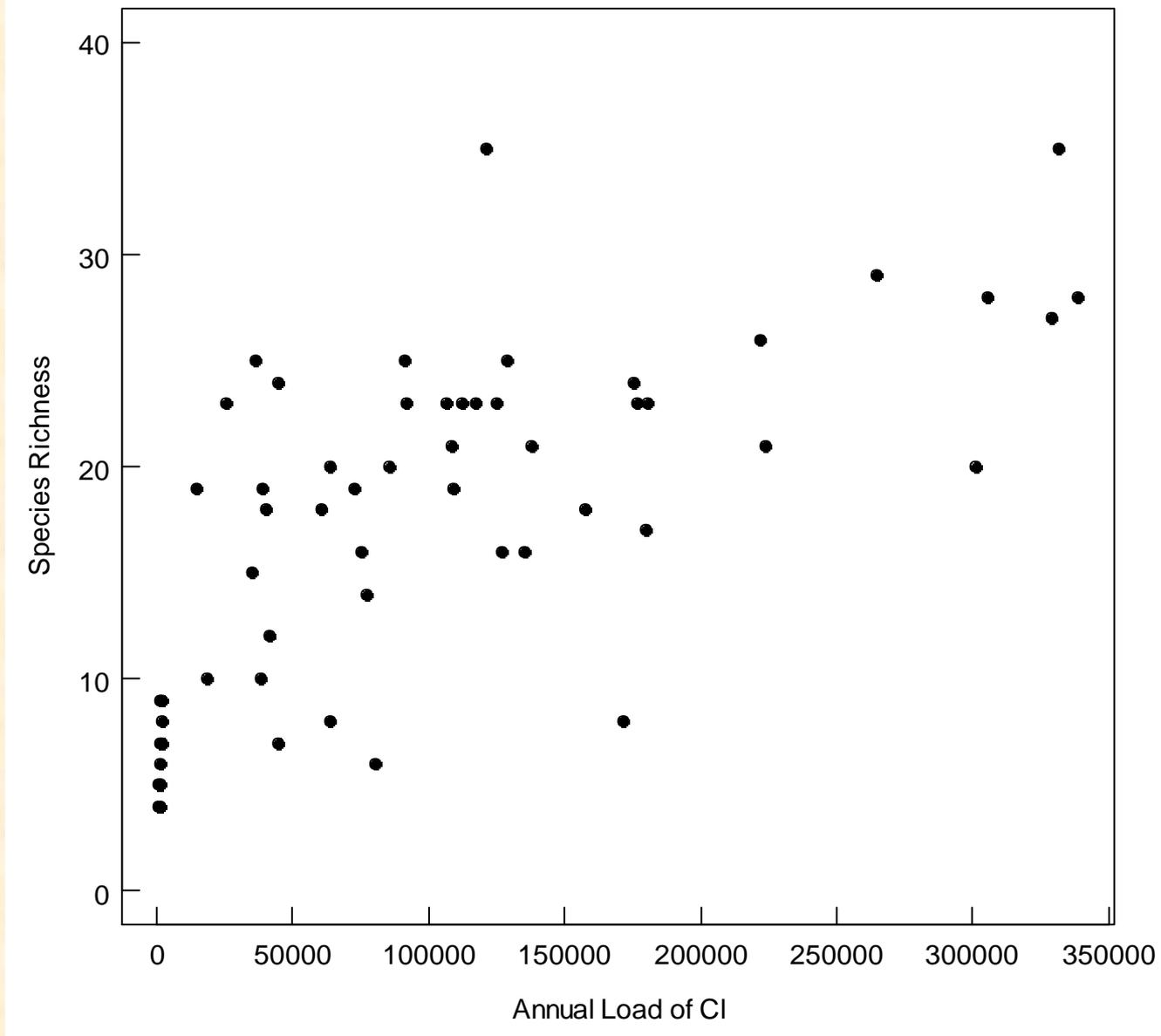


Results

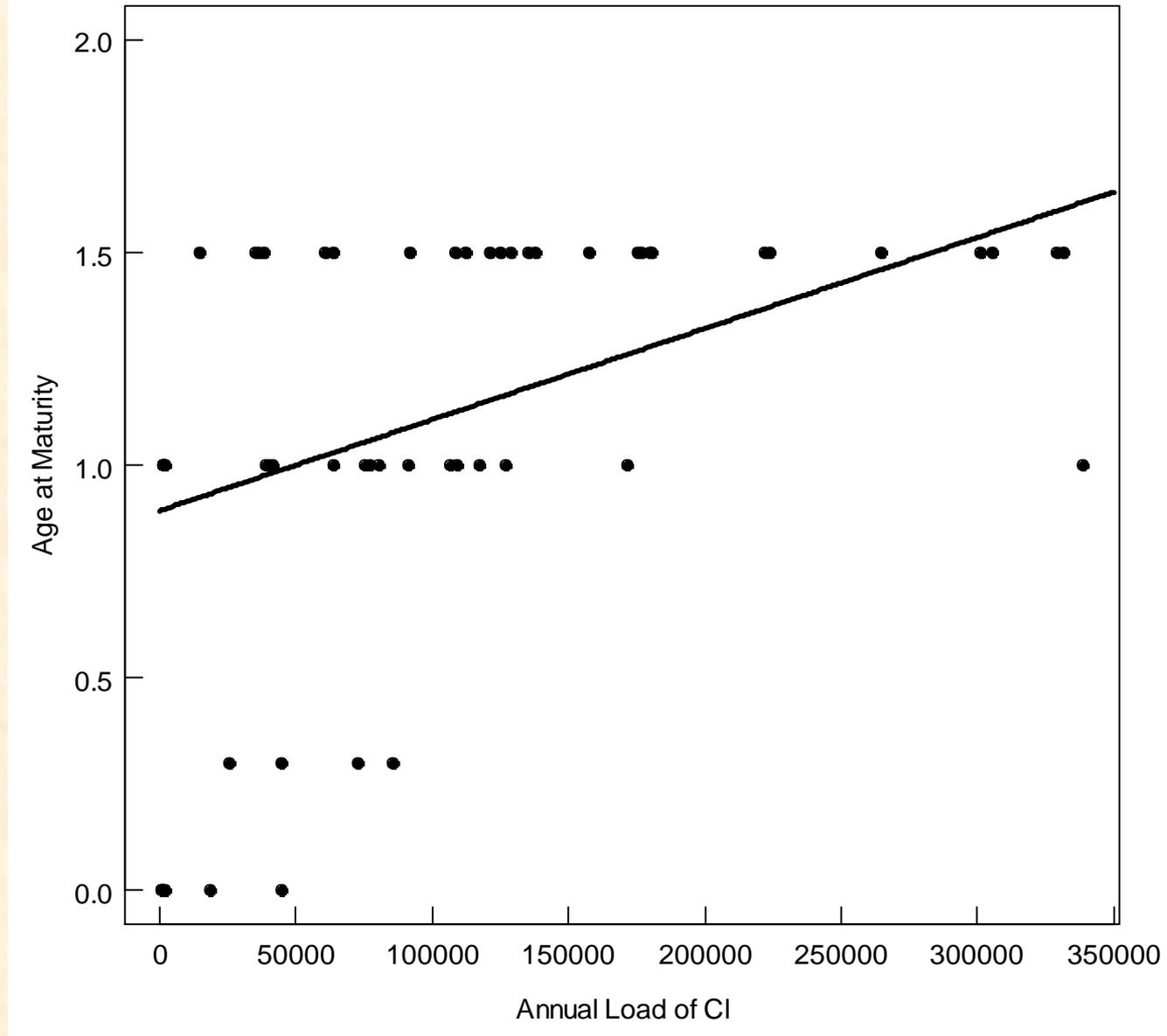


Results

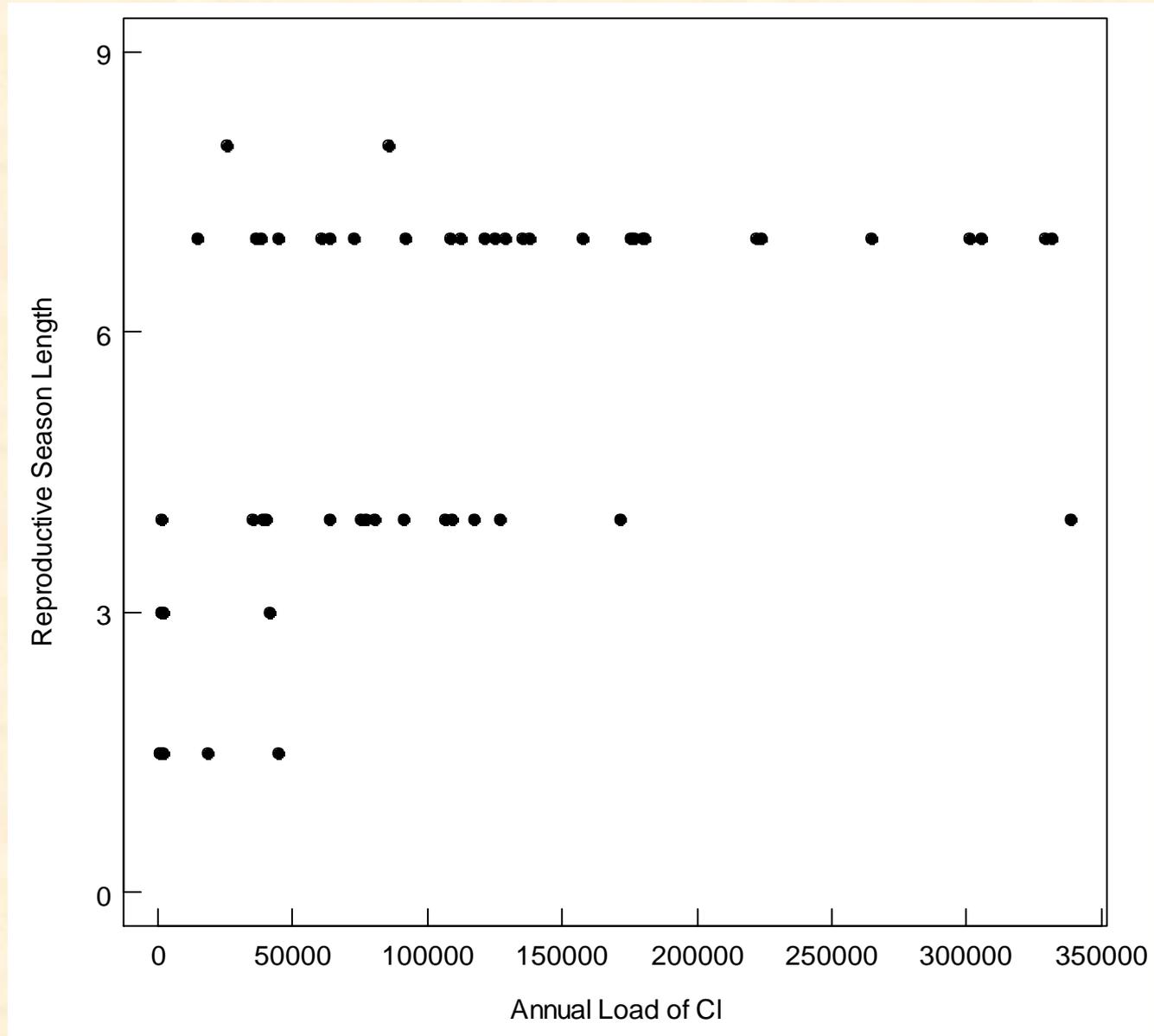
- Dissolved chloride increased over time, higher loads downstream
- Species richness - increased downstream
 - Upstream dominated by
 - ARS, Red Shiner, Plains Minnow, Plains Killifish
 - Downstream dominated by
 - Plains Minnow, Red Shiner, Mosquitofish
 - Lots of species in low numbers
- Median age-at-maturity increased downstream
 - Addition of more species increased range of ages



- Random effect of sampling site significant
- Dissolved Chloride: $z = 2.06$, $p = 0.039$



- Random effect of sampling site not significant
- Dissolved Chloride: $t_{2, 55} = 4.04, p < 0.001$



- Appearance of a trend, however strong impact of random effect of site

Conclusions

- Species richness increased with increased chloride
 - Salinity an important determinant of Great Plains fish-assemblage composition
- Changes in composition resulted in greater range of age-at-maturity
- Analysis limited due to data availability
 - Mismatch in ecology/ water-quality collections
 - Spatially and temporally irregular
 - Samples collected for specific program objectives
- Limits the scale of questions addressed

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(MARIS)

