

# An Empirical Analysis of Freshwater Mussel Abundance and Pollutant Abatement in Minnesota Rivers

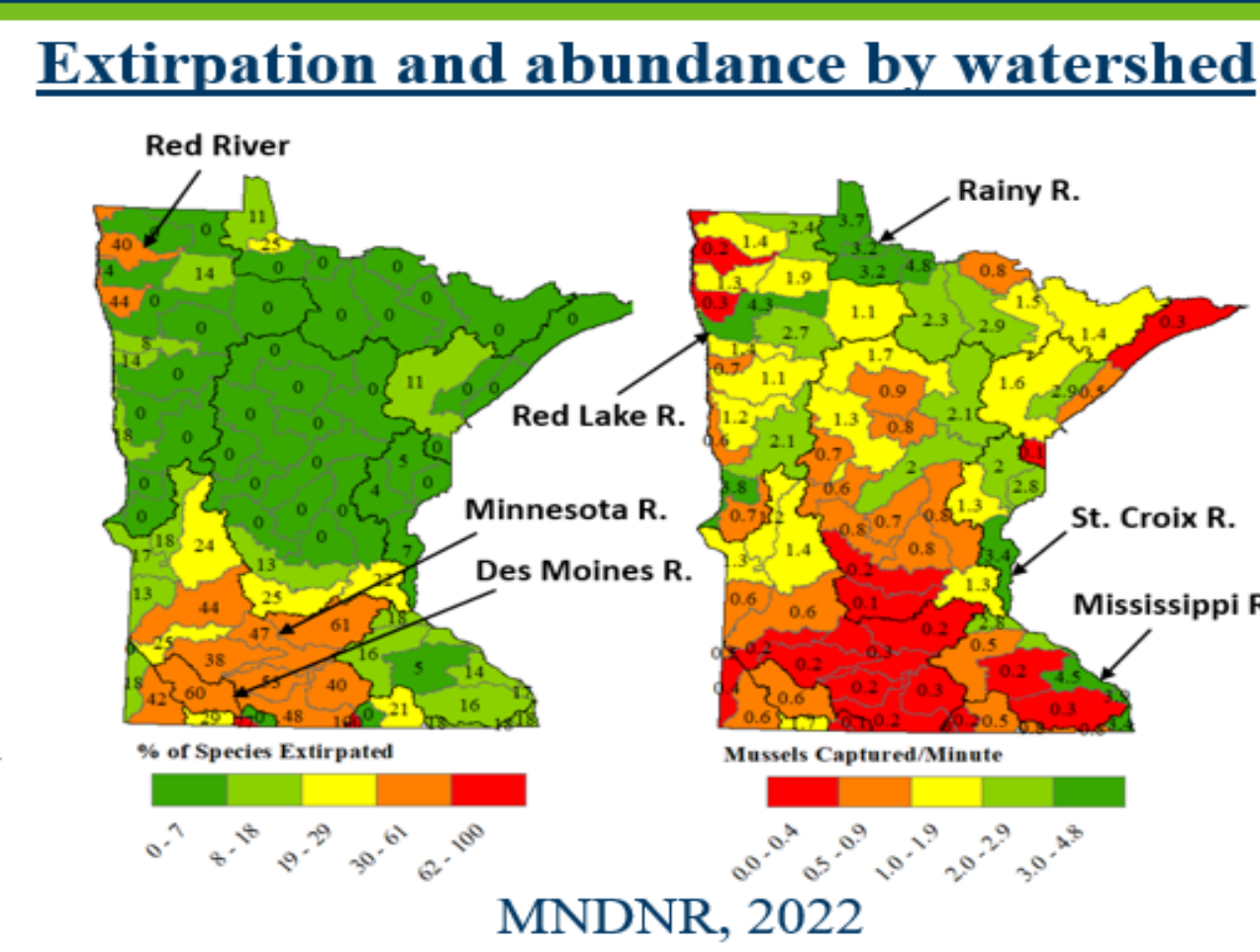
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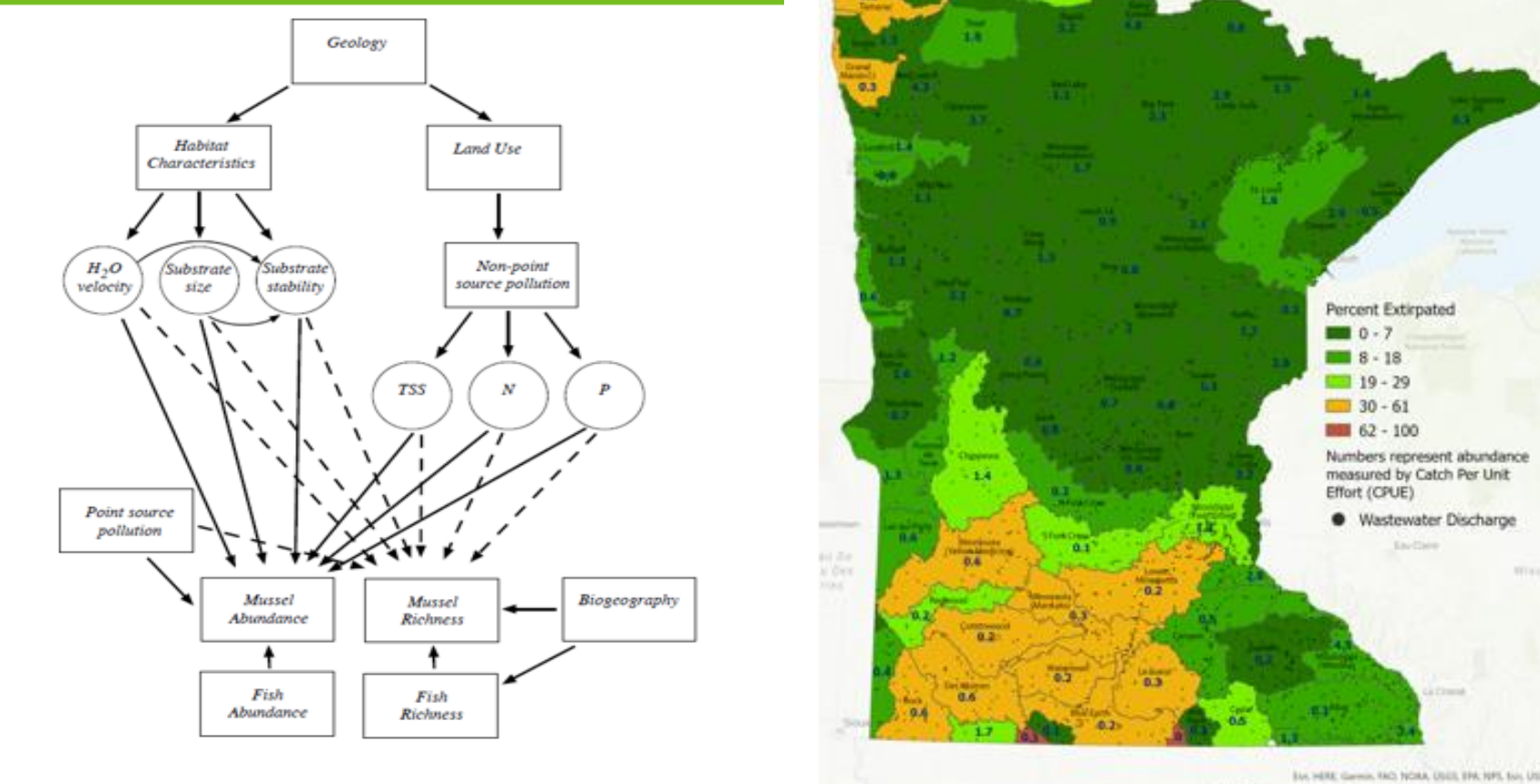


## Freshwater mussels are imperiled

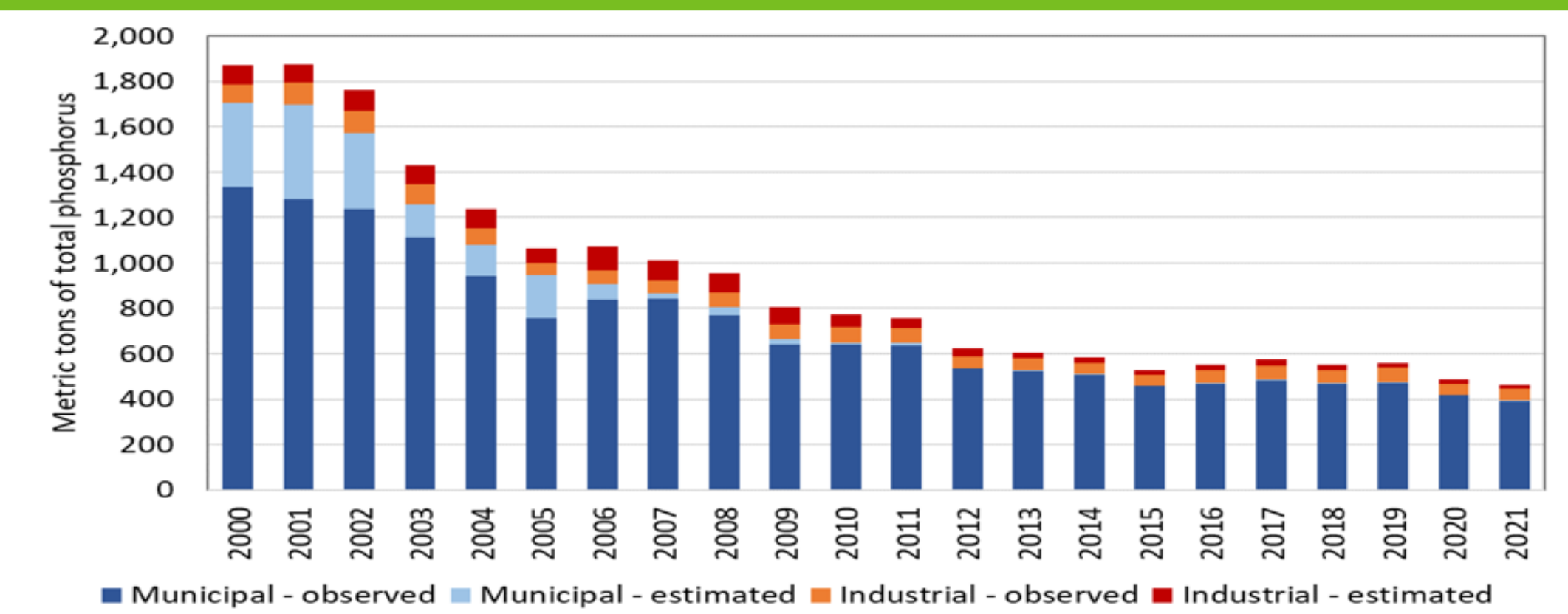
- North America**
- 302 species
  - 30 taxa extinct-last 100 years
  - 74% En, T, Vu
- Minnesota**
- 51 species
  - 8% extinct
  - 63% En, T, Vu
  - 23 of 40 species still present in Minnesota River basin.



## Many Threats

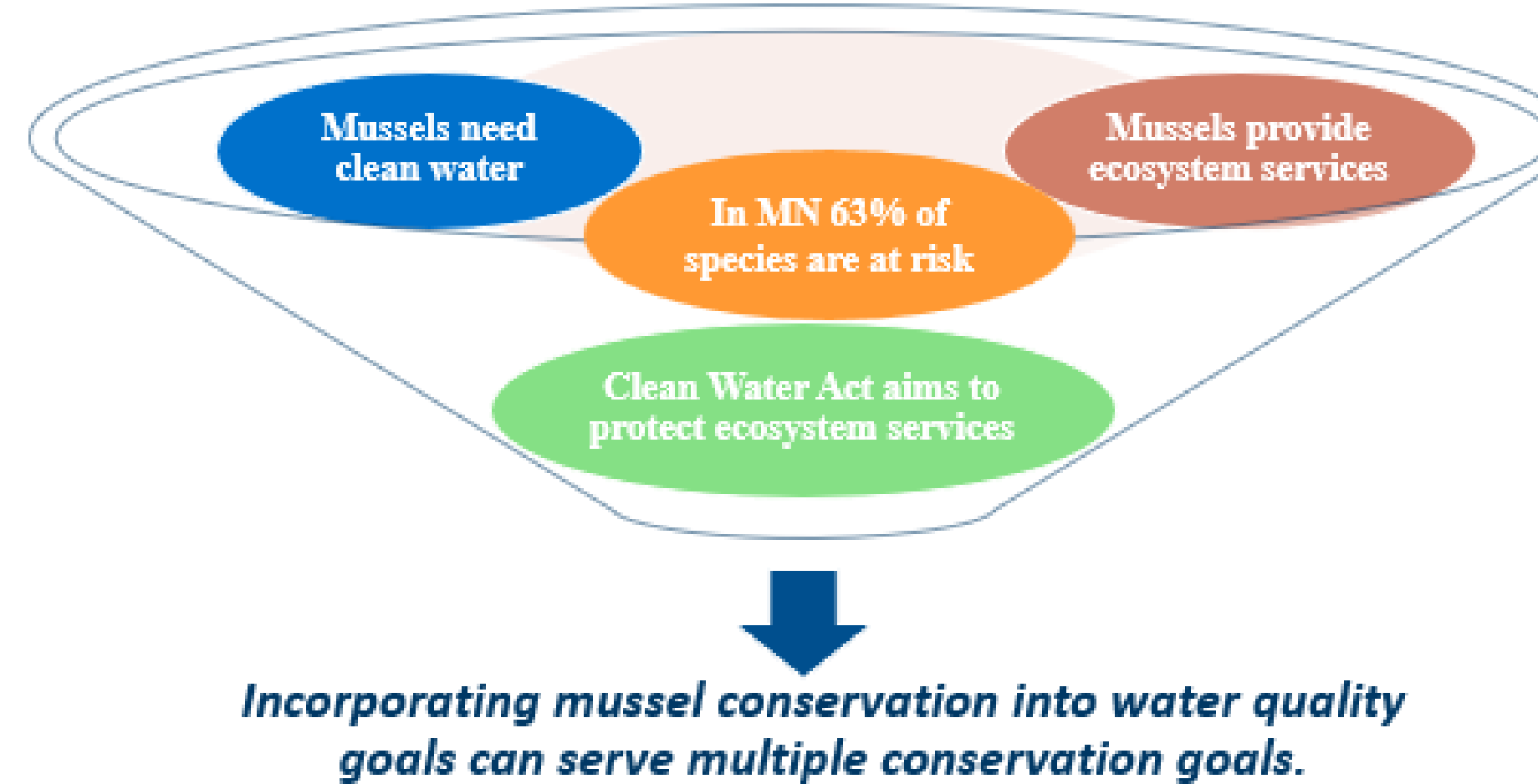


## Water quality improvements are costly and time-intensive



## Mussels are sensitive to pollution

Pollutant	Mussel tolerance values	Source
Ammonia (TAN)	1.45 mg TAN/L	Wang et al., 2007
Chloride	113-1430 mg/L	Gillis, 2011
Phosphorus	0.05 mg/L	Morris et al., 2008
Nitrate and nitrite	3 mg/L	Morris et al., 2008
DO	>2-6 mg/L	Chen et al., 2001; 2011
CECs-Atrazine	0.003 mg/L	Bringolf et al., 2007
Copper	0.002-0.012 mg/L	Jorge et al., 2013



## Empirical Analysis

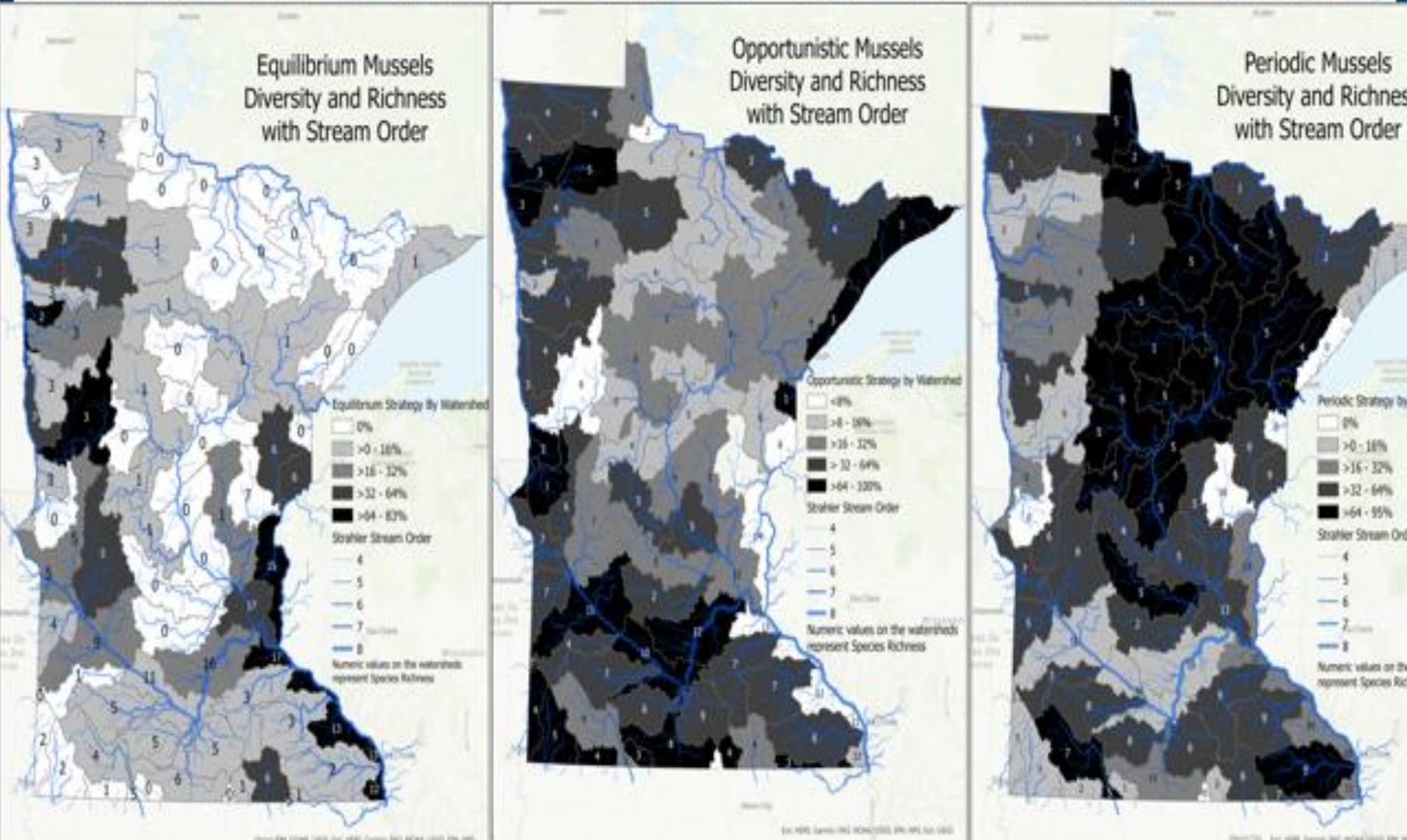
### Mussel metrics analyzed

- Proportion extirpated
- Catch per unit effort (CPUE)
- Biotic Index

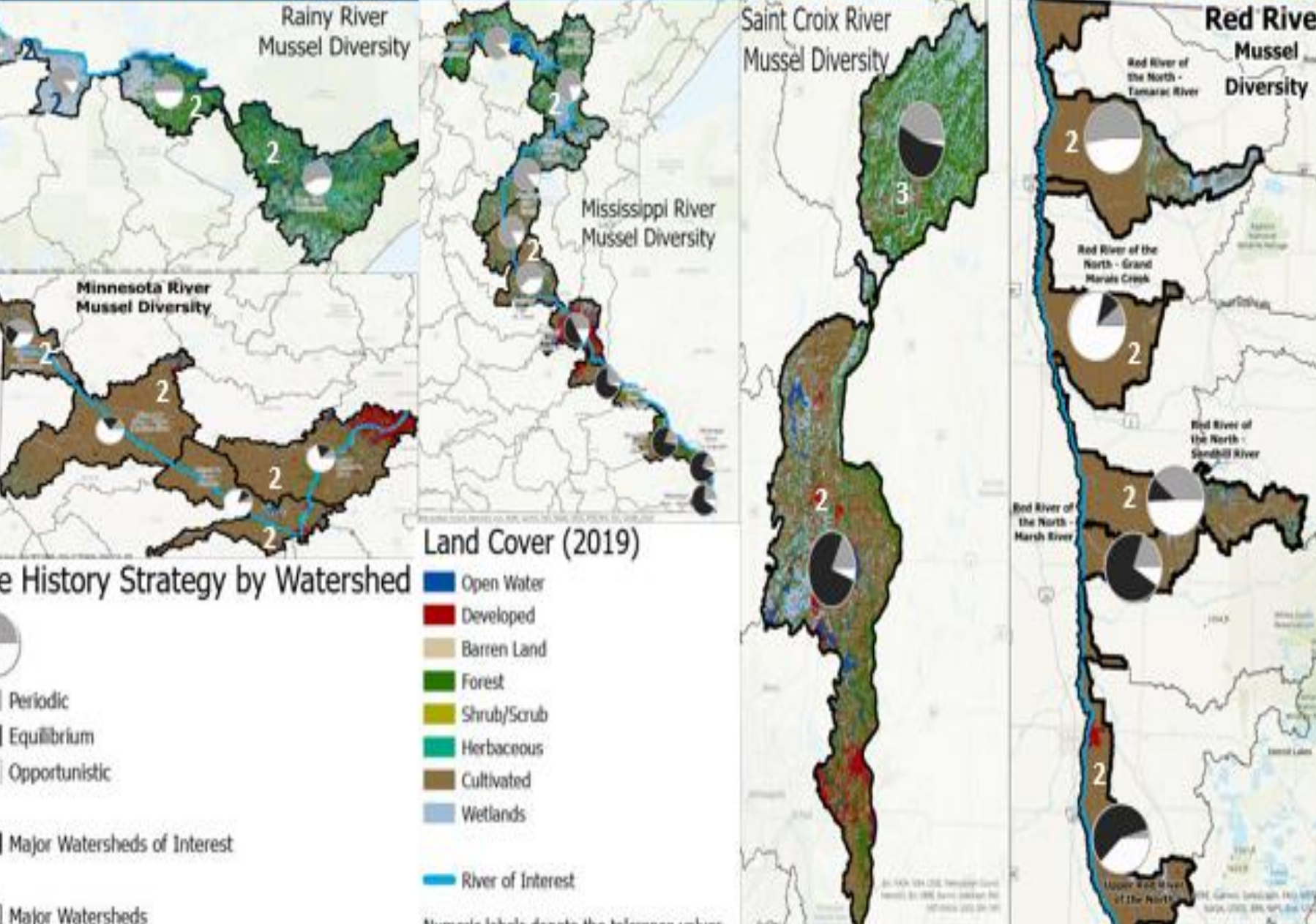
### Analysis type

- **Spatial:** Life history traits, diversity, tolerance values
- **Exploratory:** Correlation analysis, Scatterplots with loess and quantile regressions
- **General:** determine factors (water quality, fish richness) that influence mussel distributions
  - Generalized additive models
  - Multiple logistic regression models

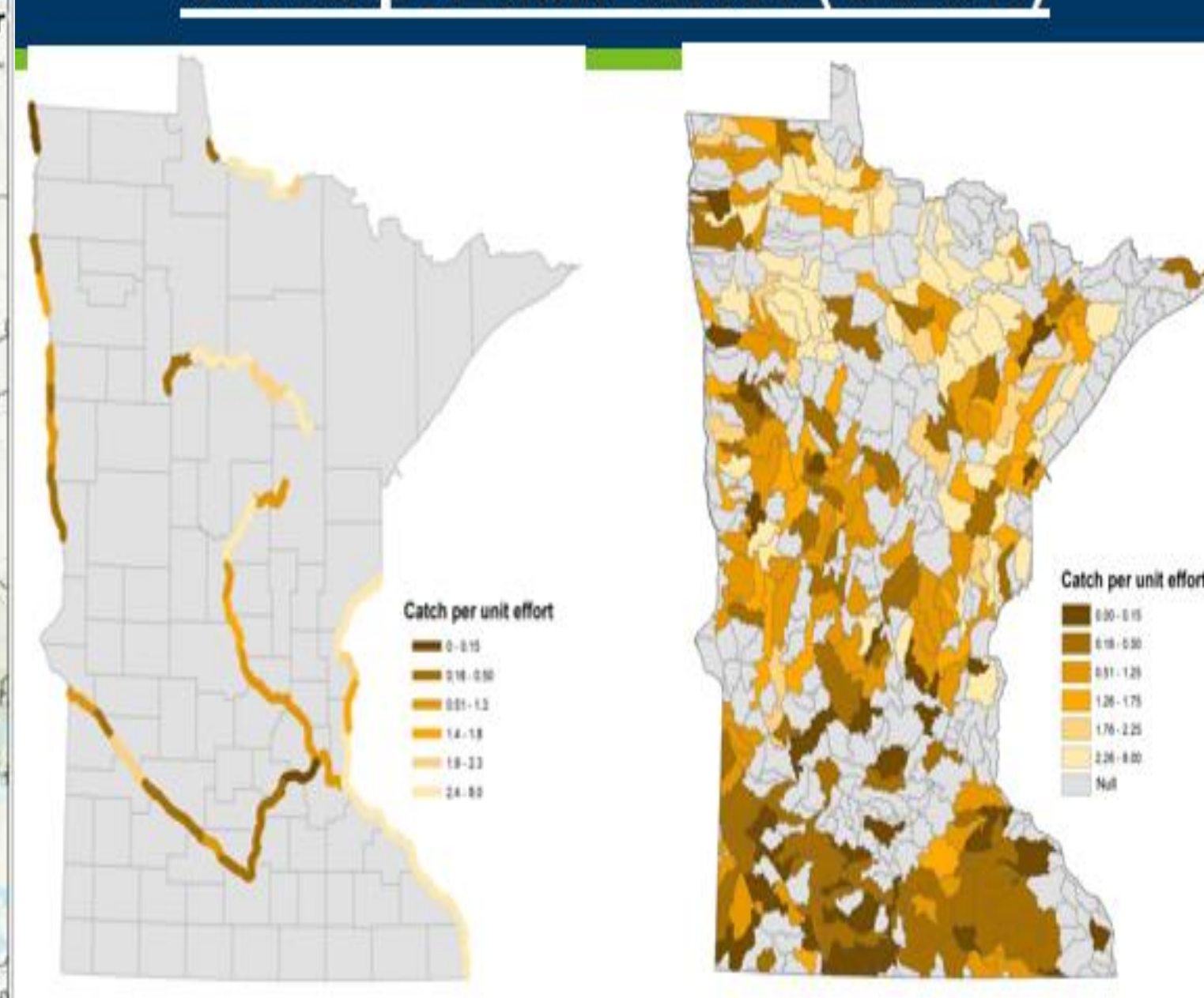
## Relative abundance based on life history choices



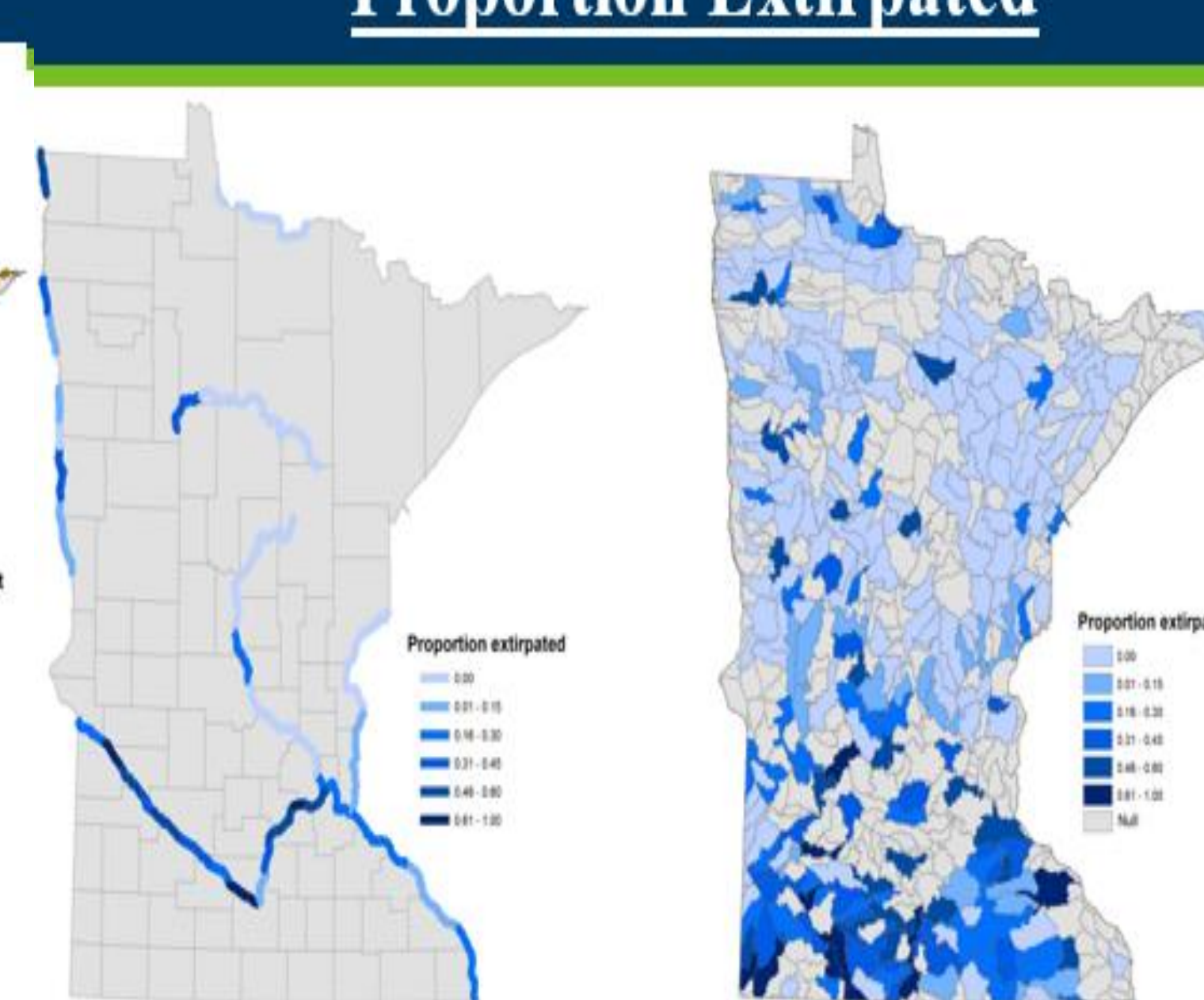
## Relative diversity, land use, and tolerance value



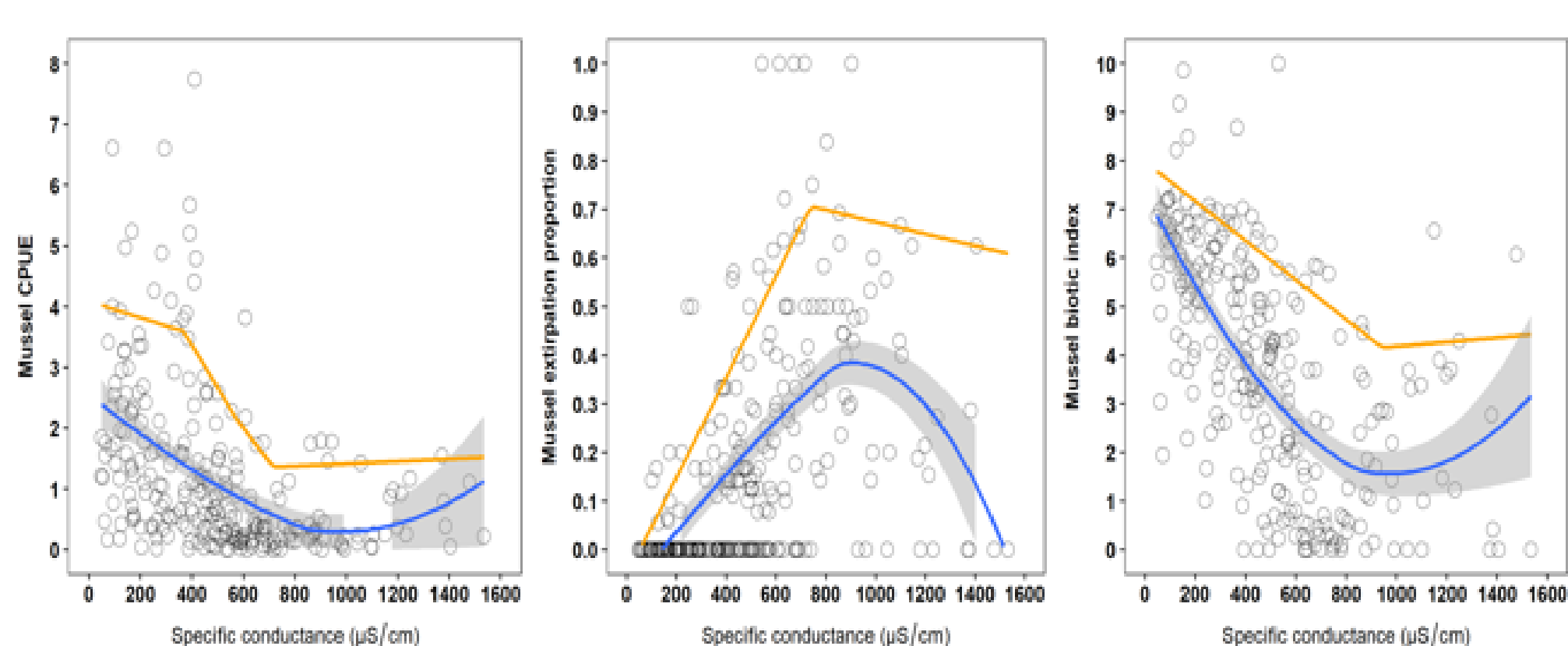
## Catch per unit effort (CPUE)



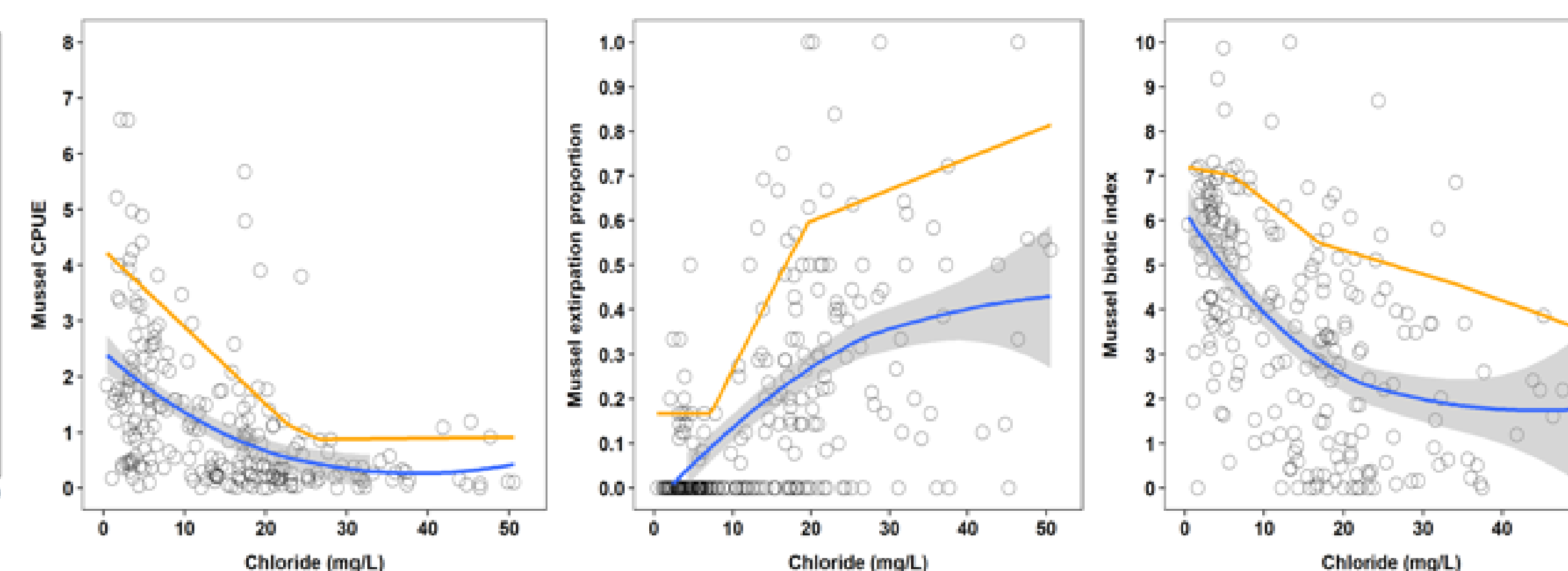
## Proportion Extirpated



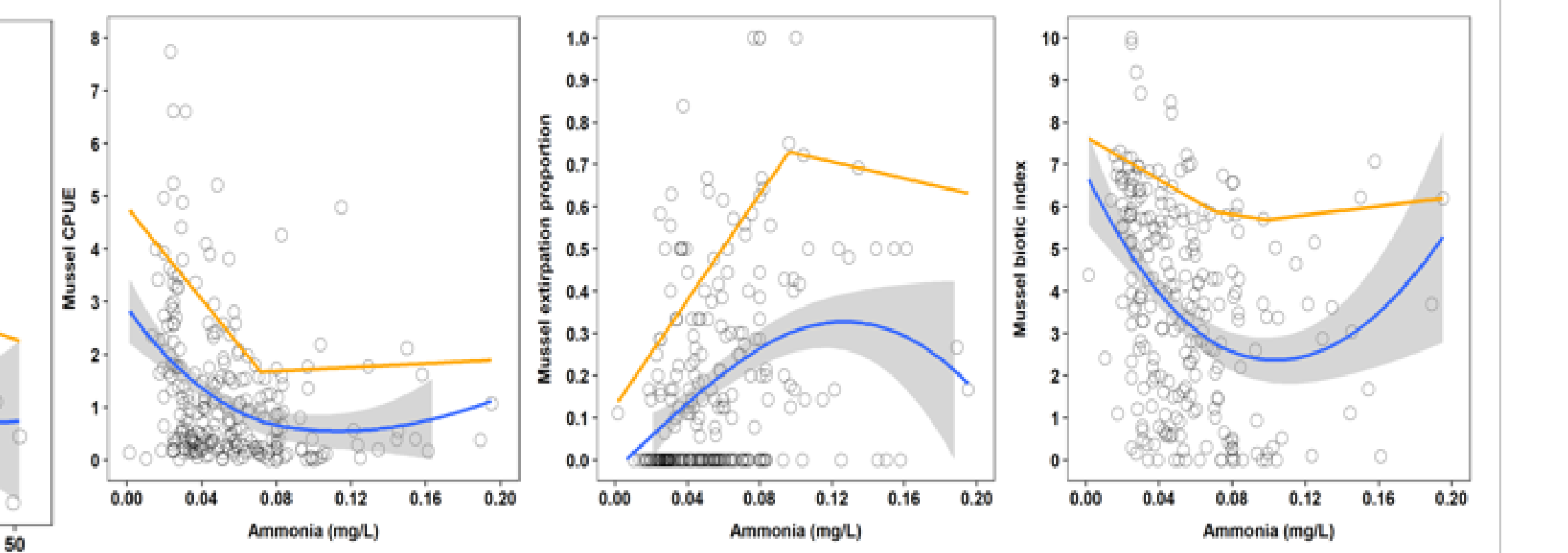
## Specific conductance



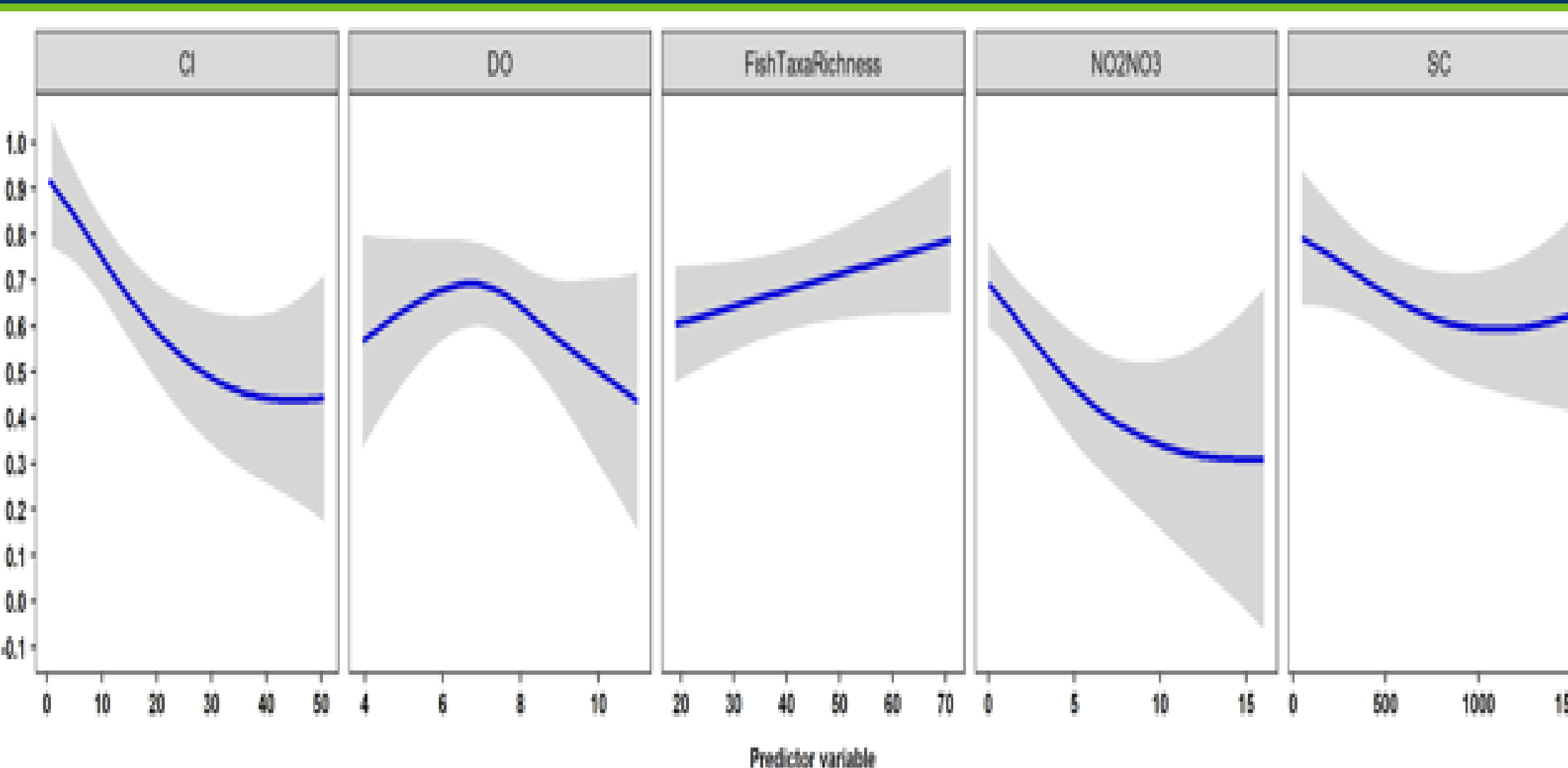
## Chloride



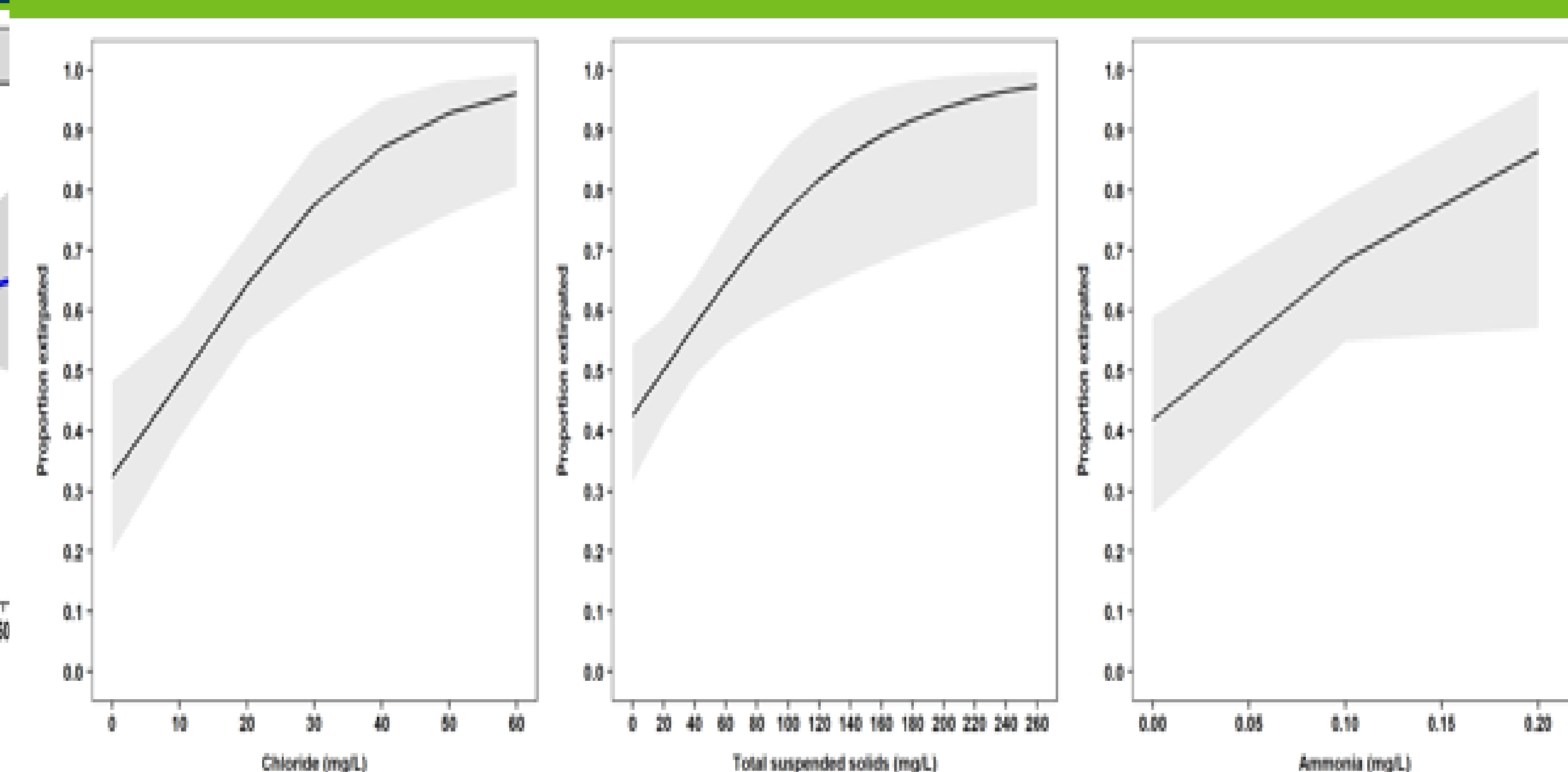
## Ammonia



## Generalized additive model: CPUE



## Multiple logistic regression: Proportion extirpated



## Takeaways

- Mussels are sensitive to land use, stream type, life history traits and pollution sources
- Mussels have significant associations with water quality parameters
  - Chloride, Ammonia, TSS, Nitrate-Nitrite, Specific conductivity
- Can prioritize specific pollutants for mussel conservation

**Significant:** Chloride, Nitrate/Nitrite, Specific Conductance, Fish taxa richness, DO

**Significant:** Chloride, TSS, Ammonia