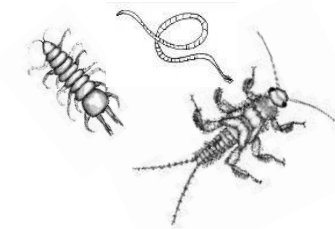


Identifying stressor risk to biological health in western Washington streams

Elene Dorfmeier ¹, Leska Fore ²

¹ *King County Seattle, WA*

² *Statistical Design, Seattle, WA*



Benthic Monitoring EPA Grant Advisory Board meeting
February 27, 2014



Identifying stressors of ecological importance

Utilize monitoring data to:

1. Identify sources of environmental impairment to watershed systems
2. Analyze relationships among environmental factors and biological indices of impairment



Assessing Stressor Risk

EPA definition: An ERA evaluates “the likelihood that adverse ecological effects may occur as a result of exposure to one or more stressors.”

→ Identify, characterize, and prioritize risks for resource management

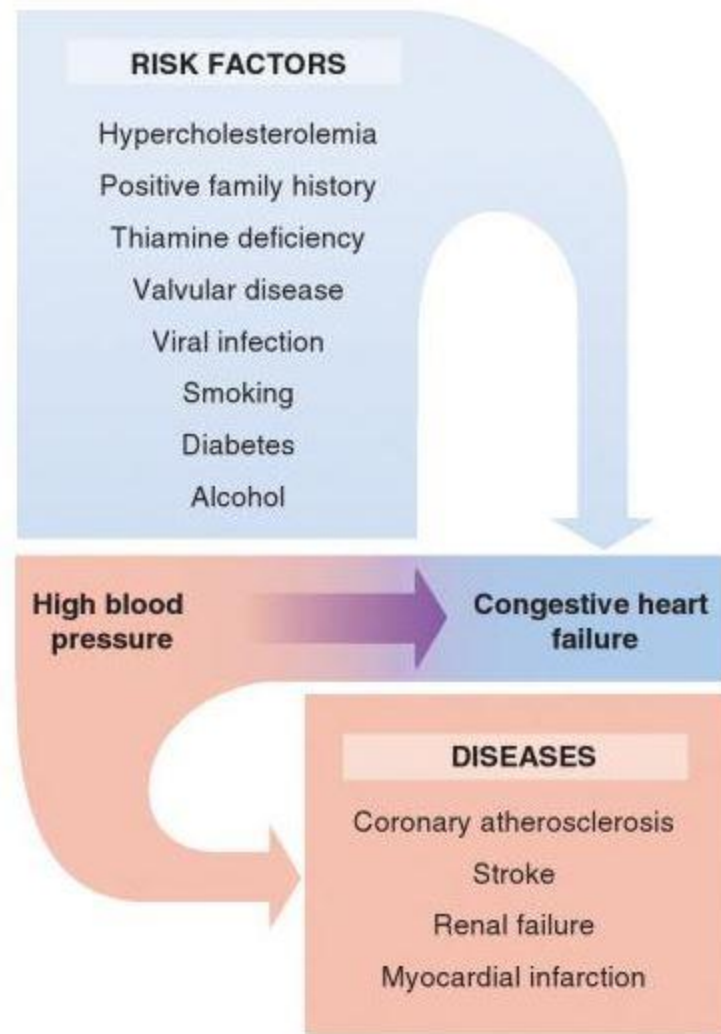
Relative Risk Assessment for Resource Management

(Paulsen et al. 2008; Van Sickle and Paulsen 2008; Van Sickle 2006; 2013)

- Identify regionally important stressors
- Summarize impact of stressor on study population
- Describe association between poor stressor condition and poor biological conditions
- Derive the potential biological benefits of stressor management

Relative Risk

Originally an epidemiological measure that determines strength of the relationship between a variable (health, environment, genetics...) to disease.



Relative Risk: Ecoepidemiology




Relative Risk Measures


1. Extent
2. Relative Risk
3. Attributable Risk



1. Population Extent

How wide-spread is the problem?


 Proportion of total stream length in poor biological condition per stressor

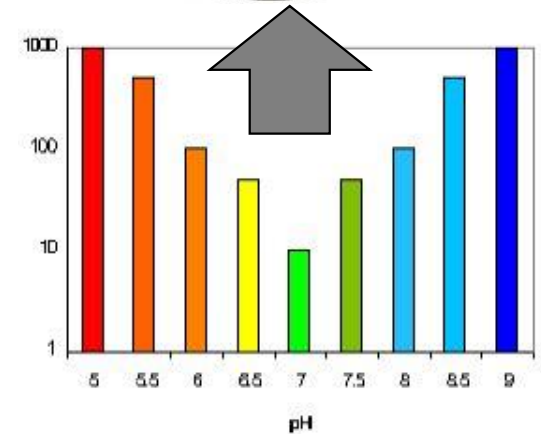
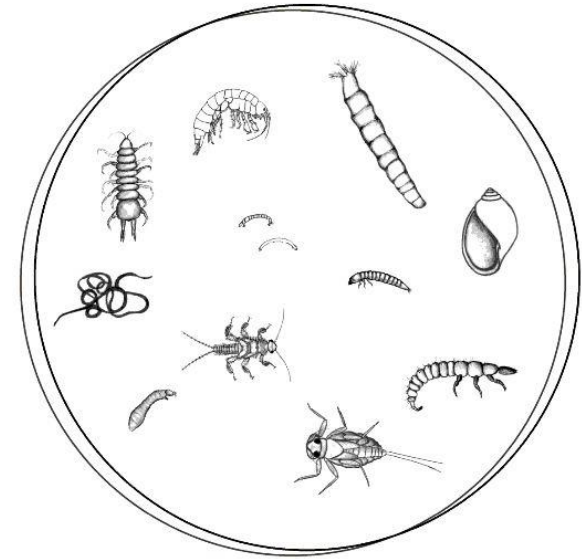
 The probability of finding a poor stressor condition in a randomly selected stream



2. Relative Risk

What is the impact of the stressor when present?

 Measures strength of association between good/bad stressor levels and poor biological condition



3. Population attributable risk

How much does a risk factor contribute to indicators of overall stream health?

1. Combines severity and impact into a single measure of overall stressor impact to a population
2. Estimates the reduction in poor biological condition that would result from eliminating stressor

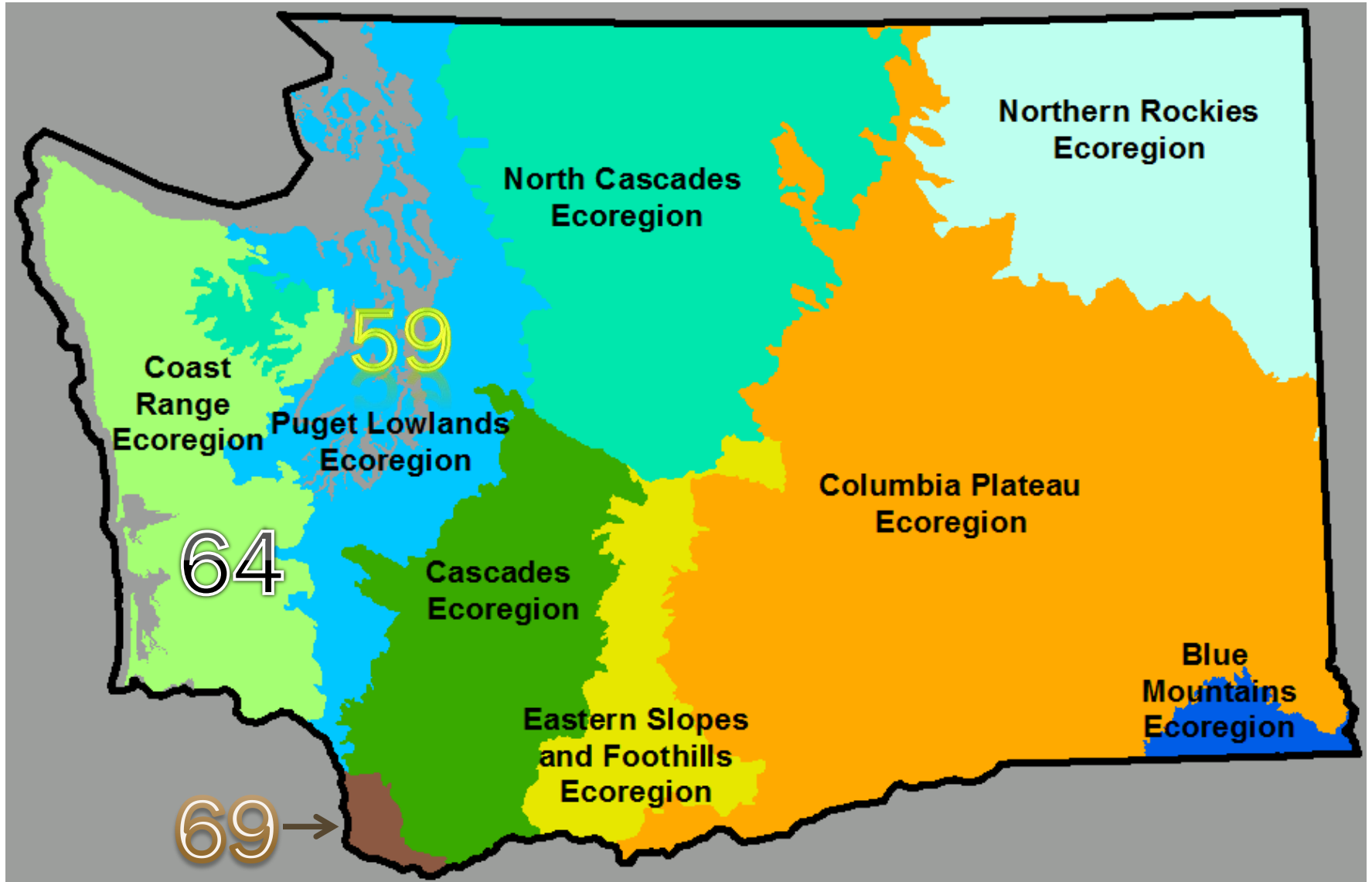
Risk Analysis

- ✂ Assumes causality
- ✂ Assumes reversibility
- ✂ Assumes independence
- ✂ Detangling confounding variables

Methods

- WA Dept of Status and Trends Monitoring for Watershed Health (n = 146)
 - Puget Sound Basin (n = 47)
 - Coastal (n = 49)
 - Lower Columbia (n = 50)
- Data: Habitat assessment (EMAP), water quality, sediment chemistry, B-IBI
- Stressor conditions and response split into classes of “Poor” or “Not Poor”
- Response variable = B-IBI score and individual metrics

B-IBI Overall Scores



Results

1. Regional Extent
2. Relative Risk
3. Attributable Risk

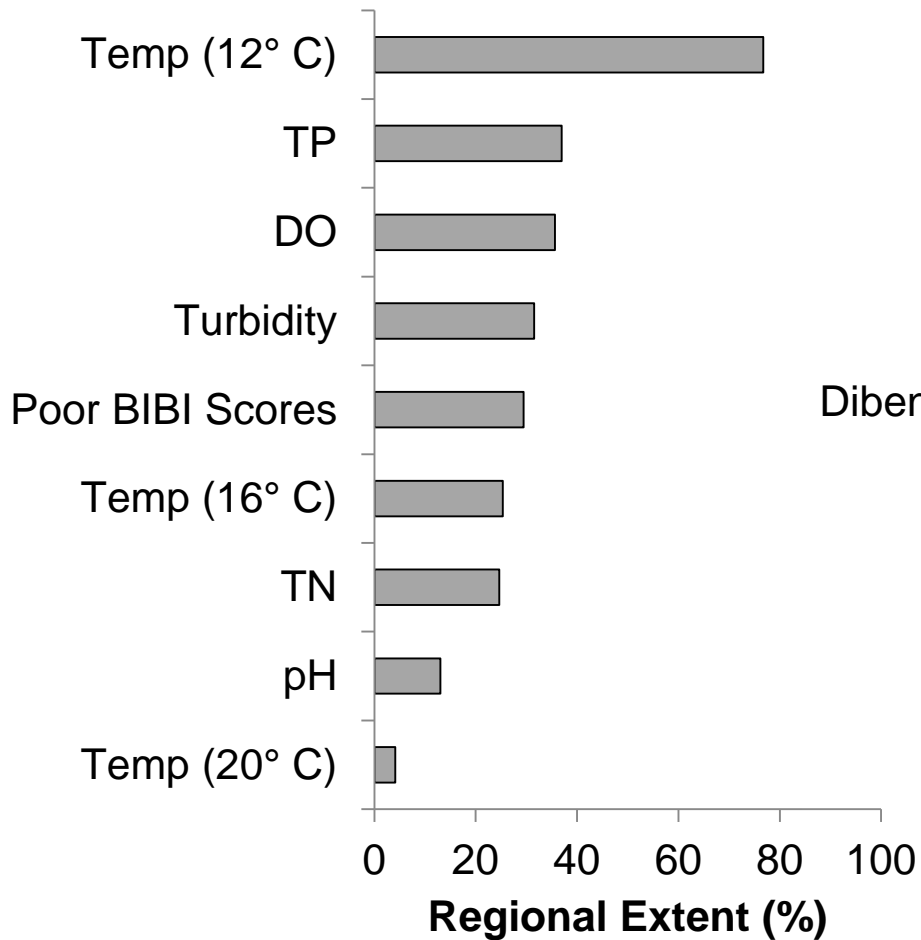
Results

1. Water Quality
2. Sediment Chemistry
3. Habitat Assessment

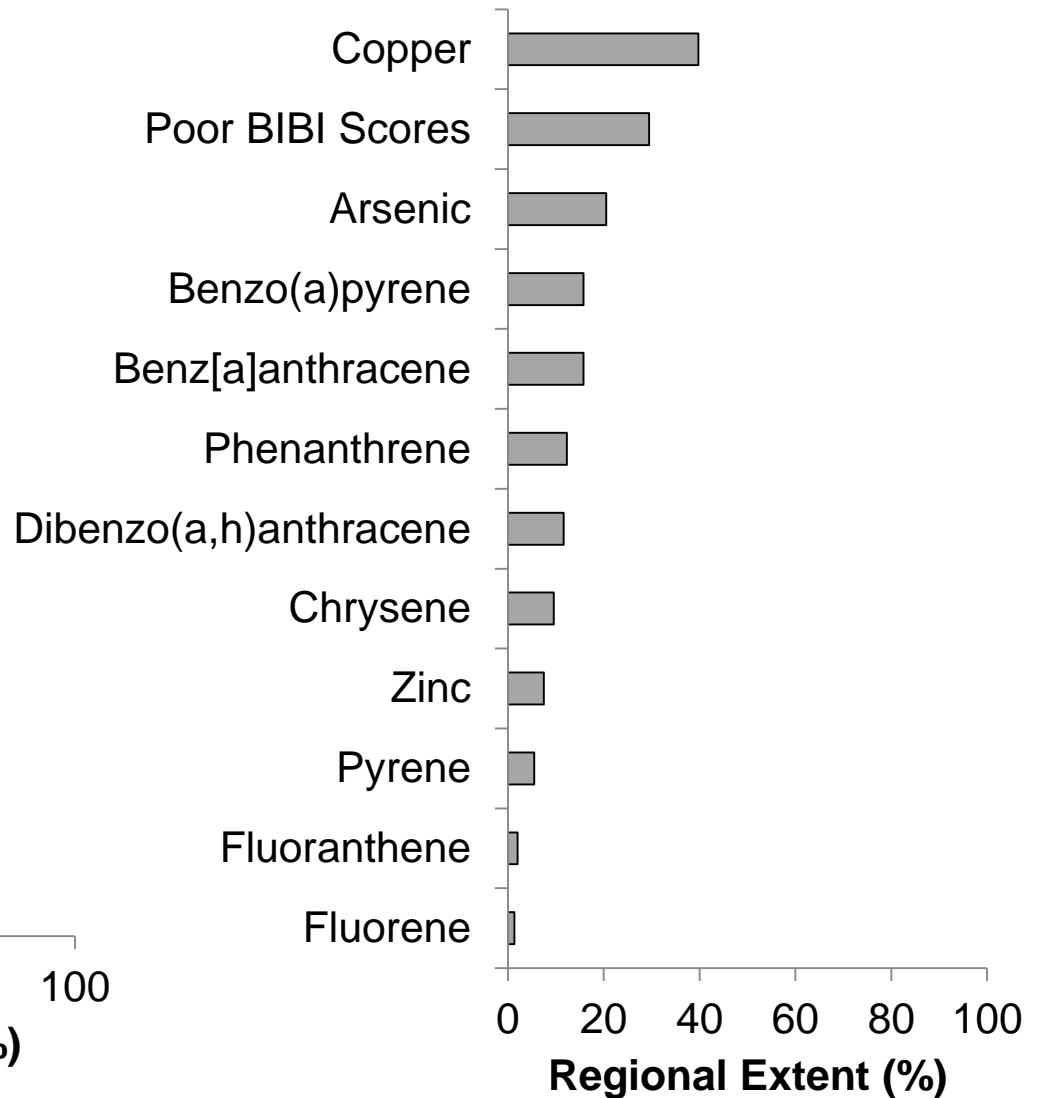
Results

1. Regional Extent
2. Relative Risk
3. Attributable Risk

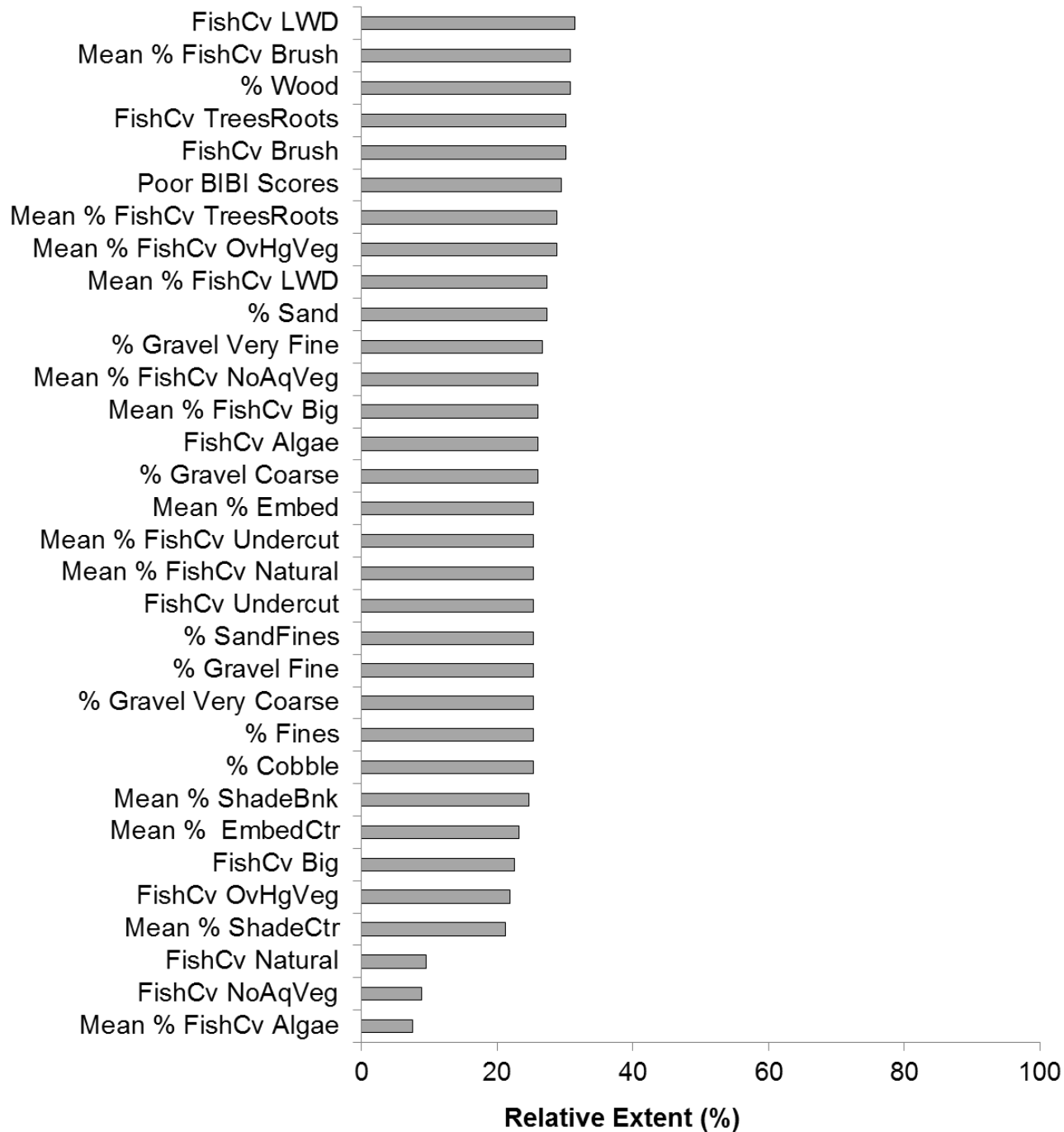
Water Quality



Sediment



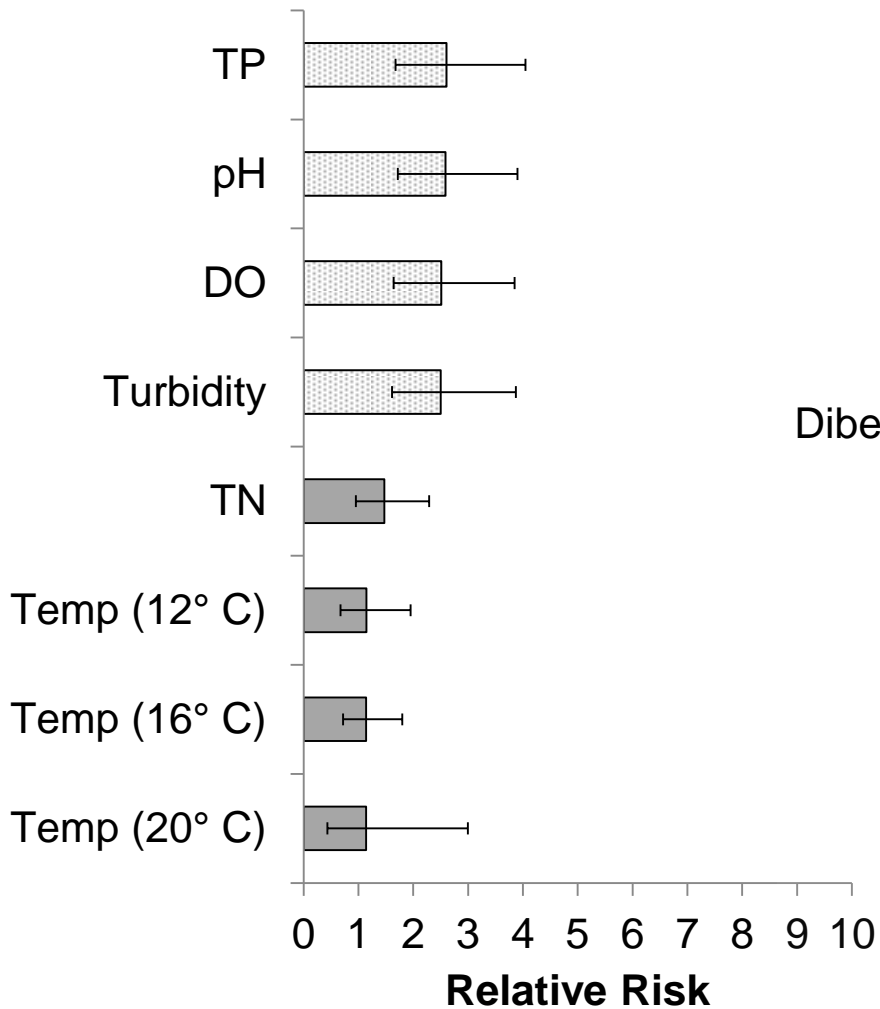
Habitat: Extent



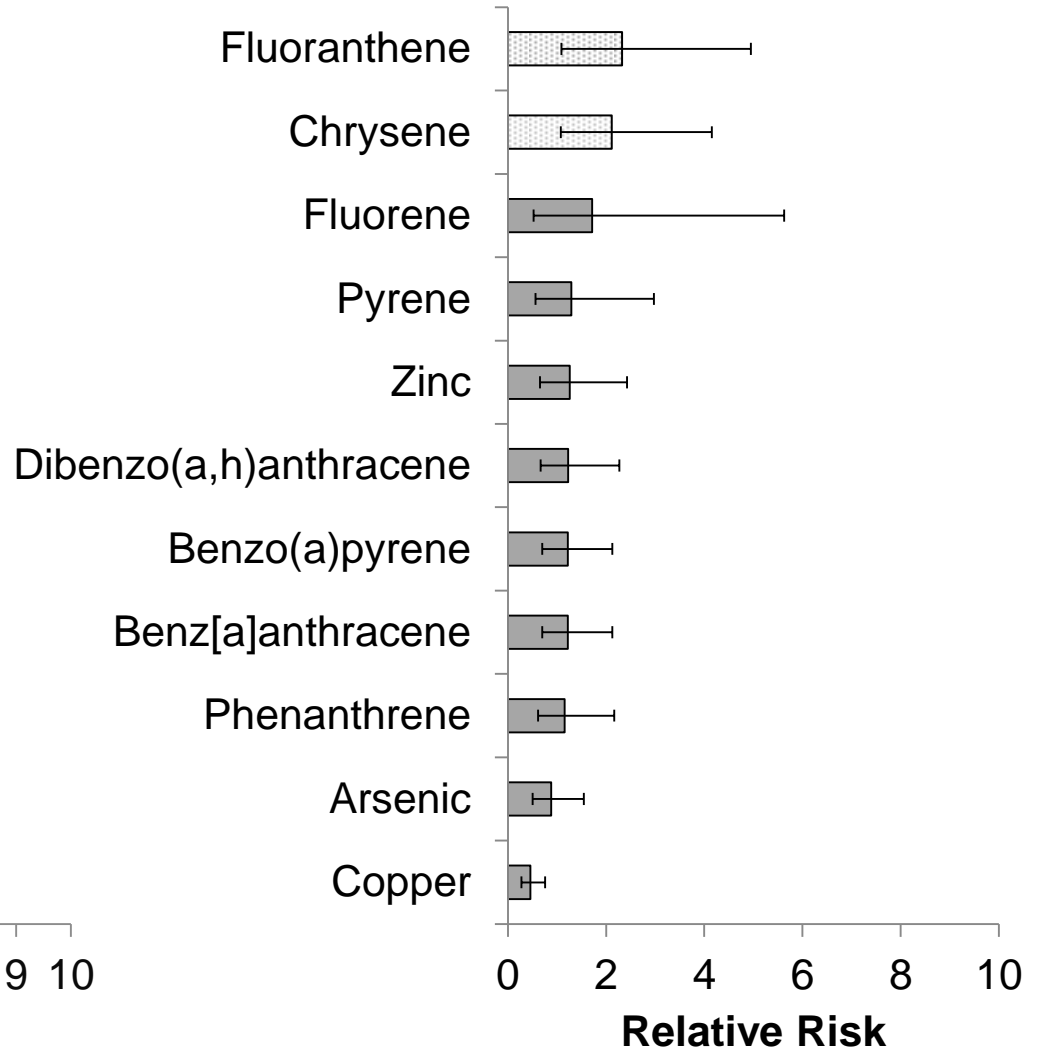
Results

1. Regional Extent
2. Relative Risk
3. Attributable Risk

Water Quality

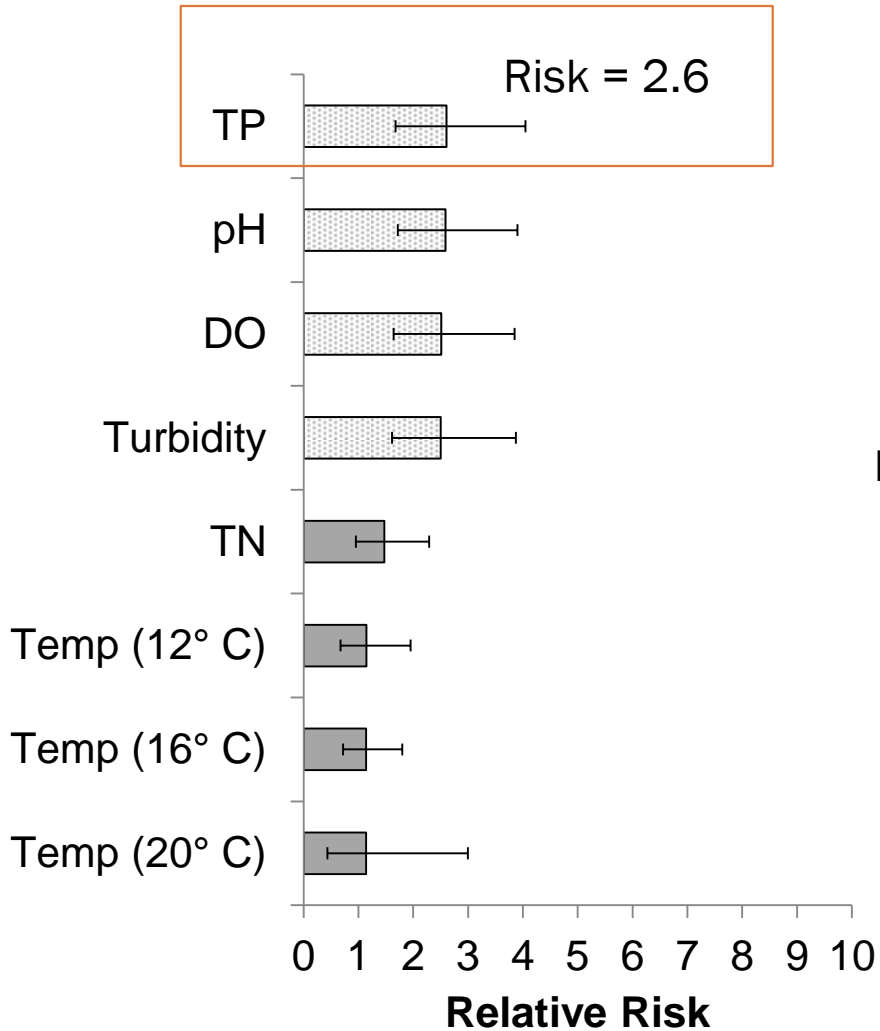


Sediment

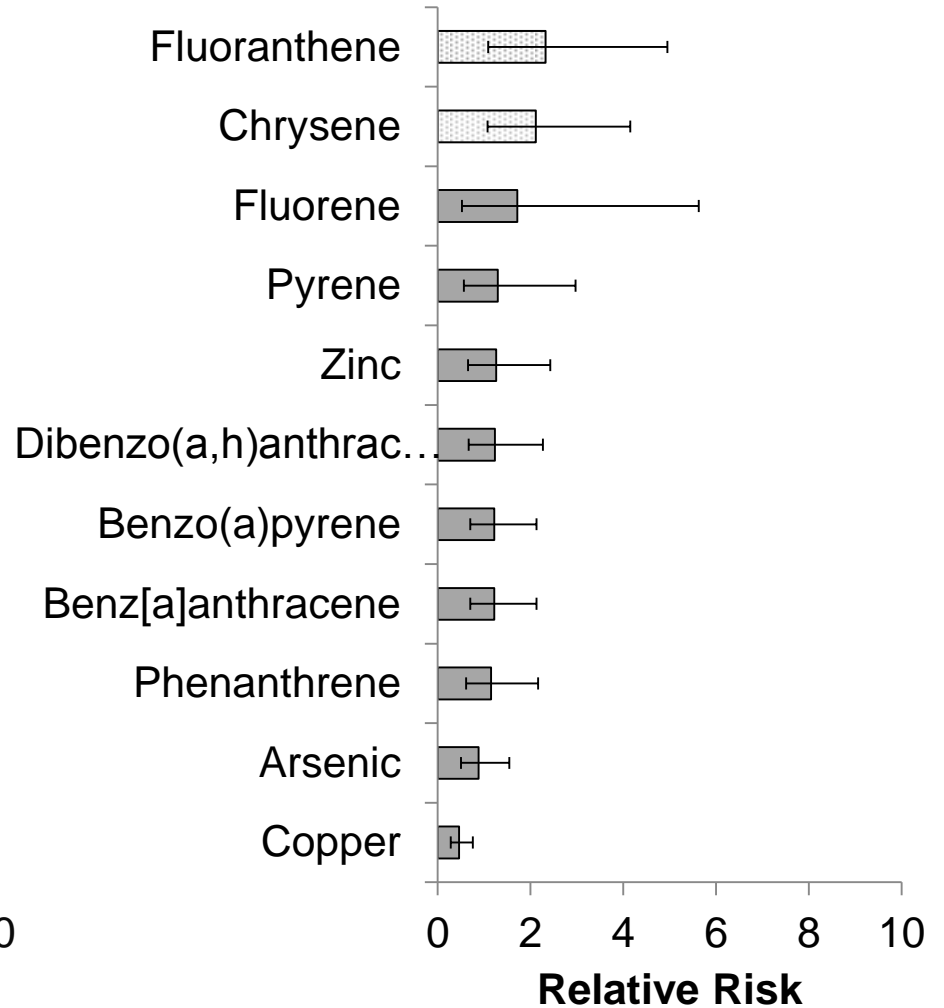


Error Bars = 95% CI

Water Quality

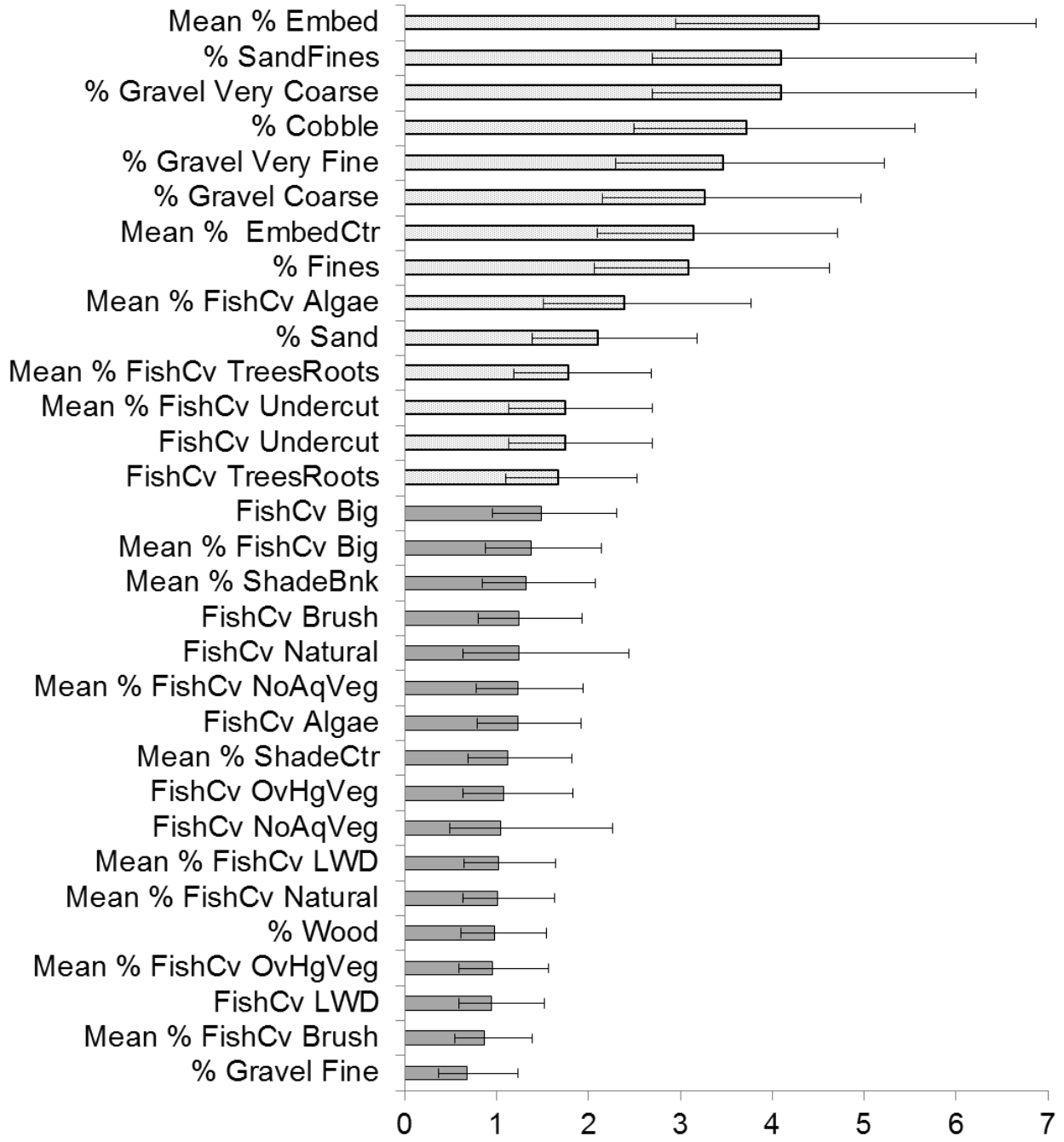


Sediment



Error Bars = 95% CI

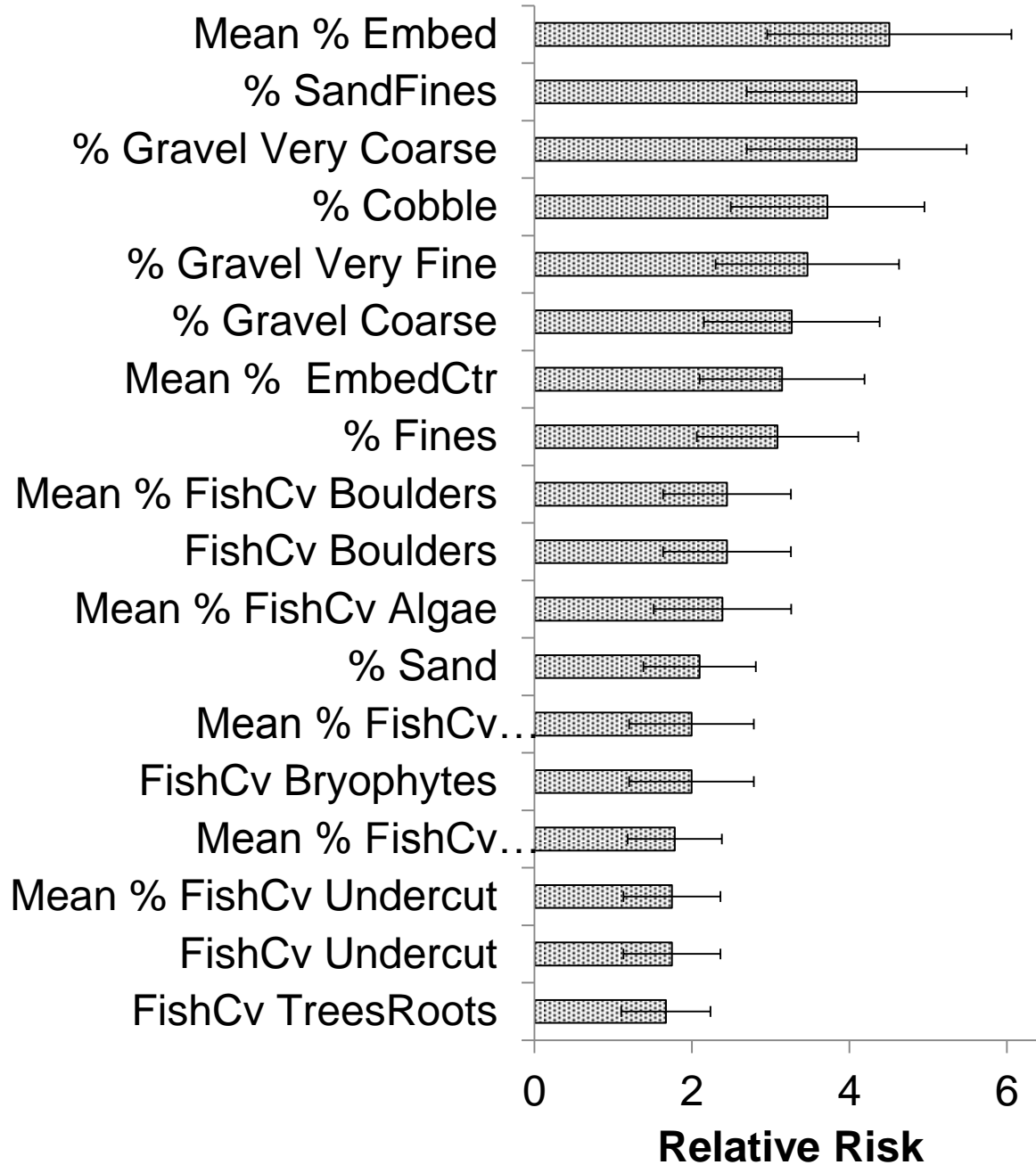
Habitat: Relative Risk



Error Bars = 95% CI

Relative Risk

Habitat: Relative Risk



Results

1. Regional Extent
2. Relative Risk
3. **Attributable Risk**

Attributable Risk: Review

1. Single measure of stressor severity and impact
2. Estimates the reduction in poor condition that would result from eliminating stressor

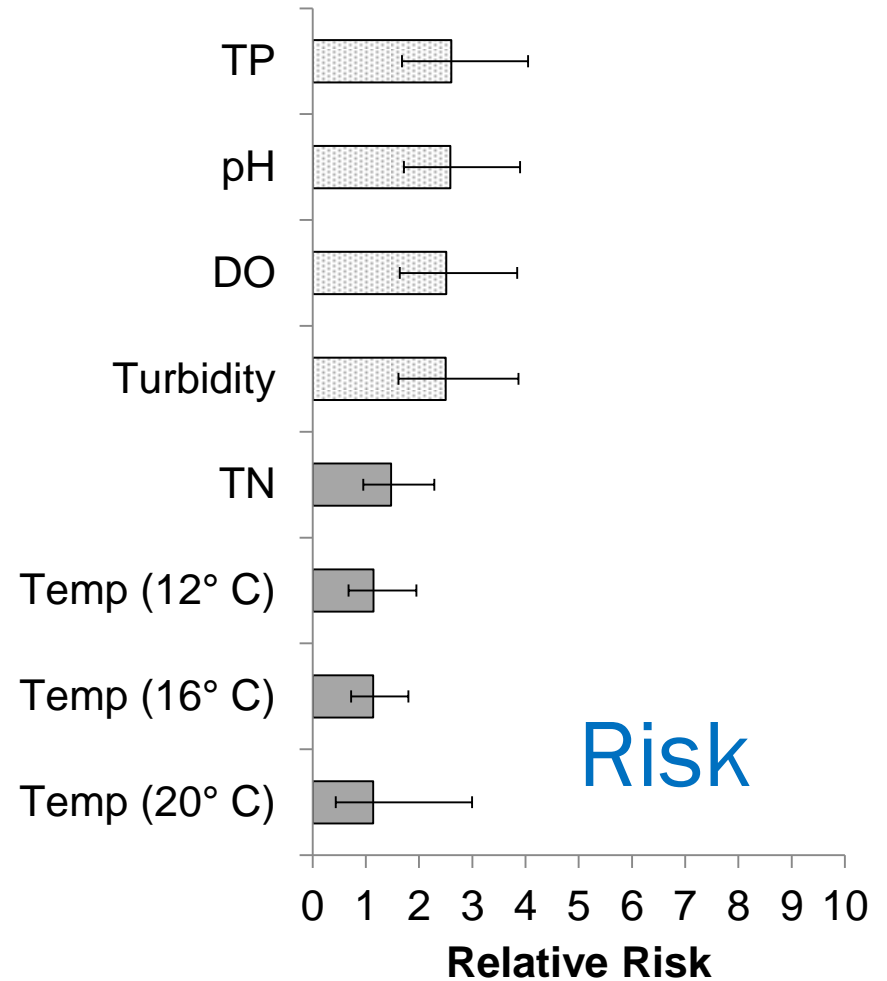
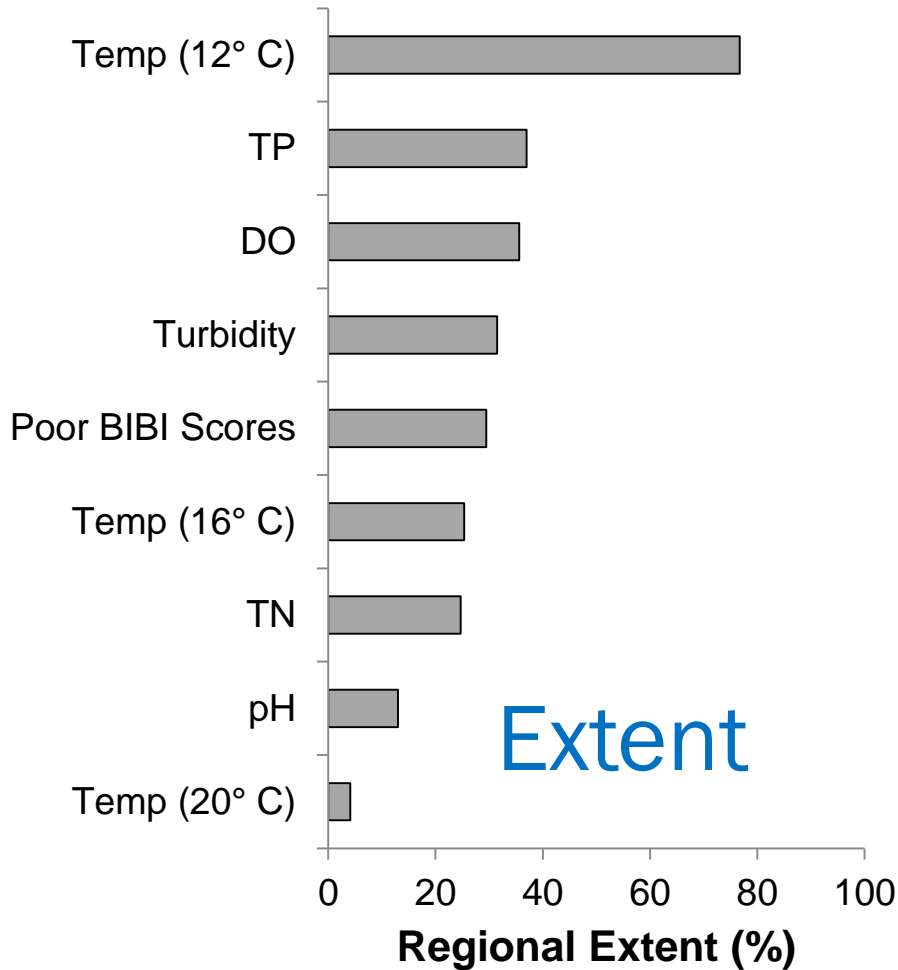
→ Rank stressor risk

→ Estimate impact to biology

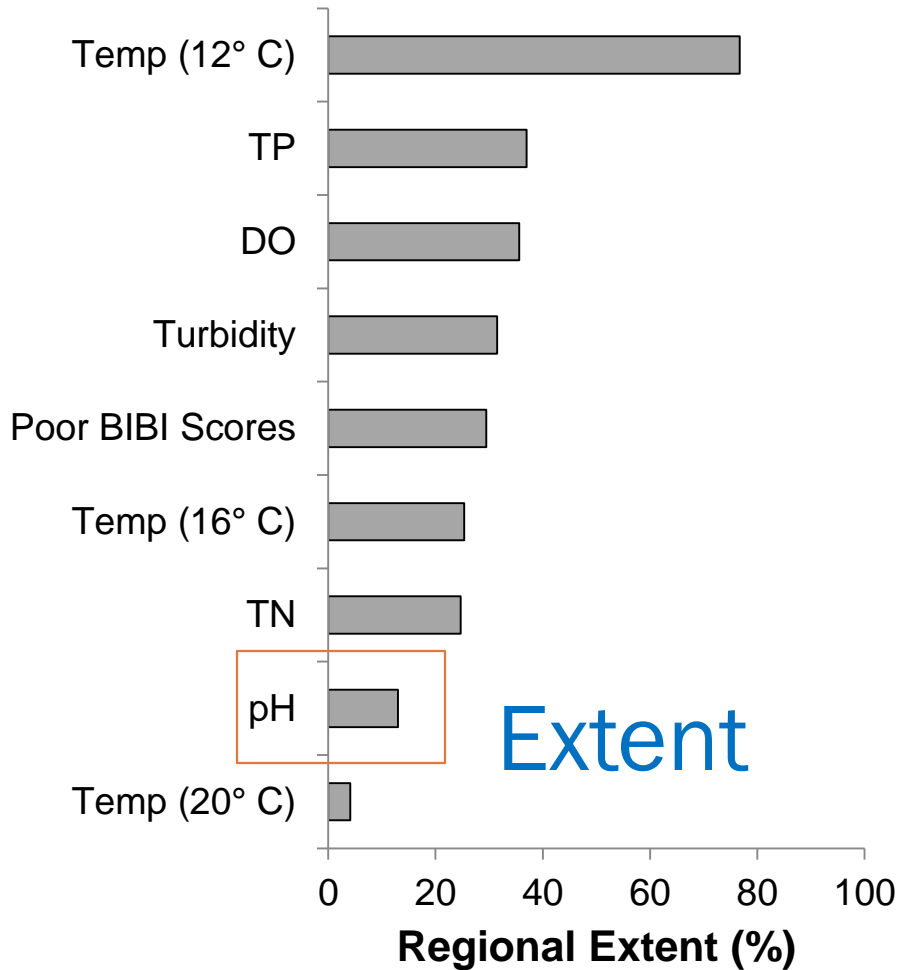
Attributable Risk: Review

1. Single measure of stressor severity and impact
2. Estimates the reduction in poor condition that would result from eliminating stressor

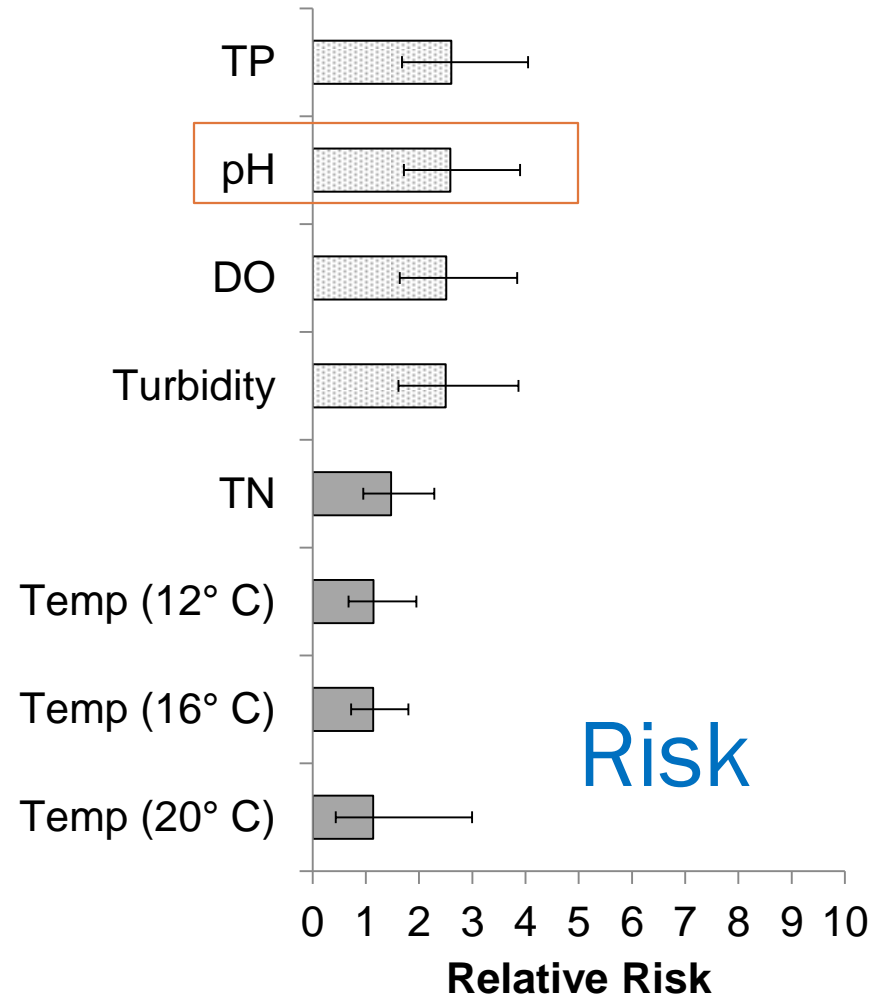
Water Quality: Extent and Risk



Water Quality: Extent and Risk

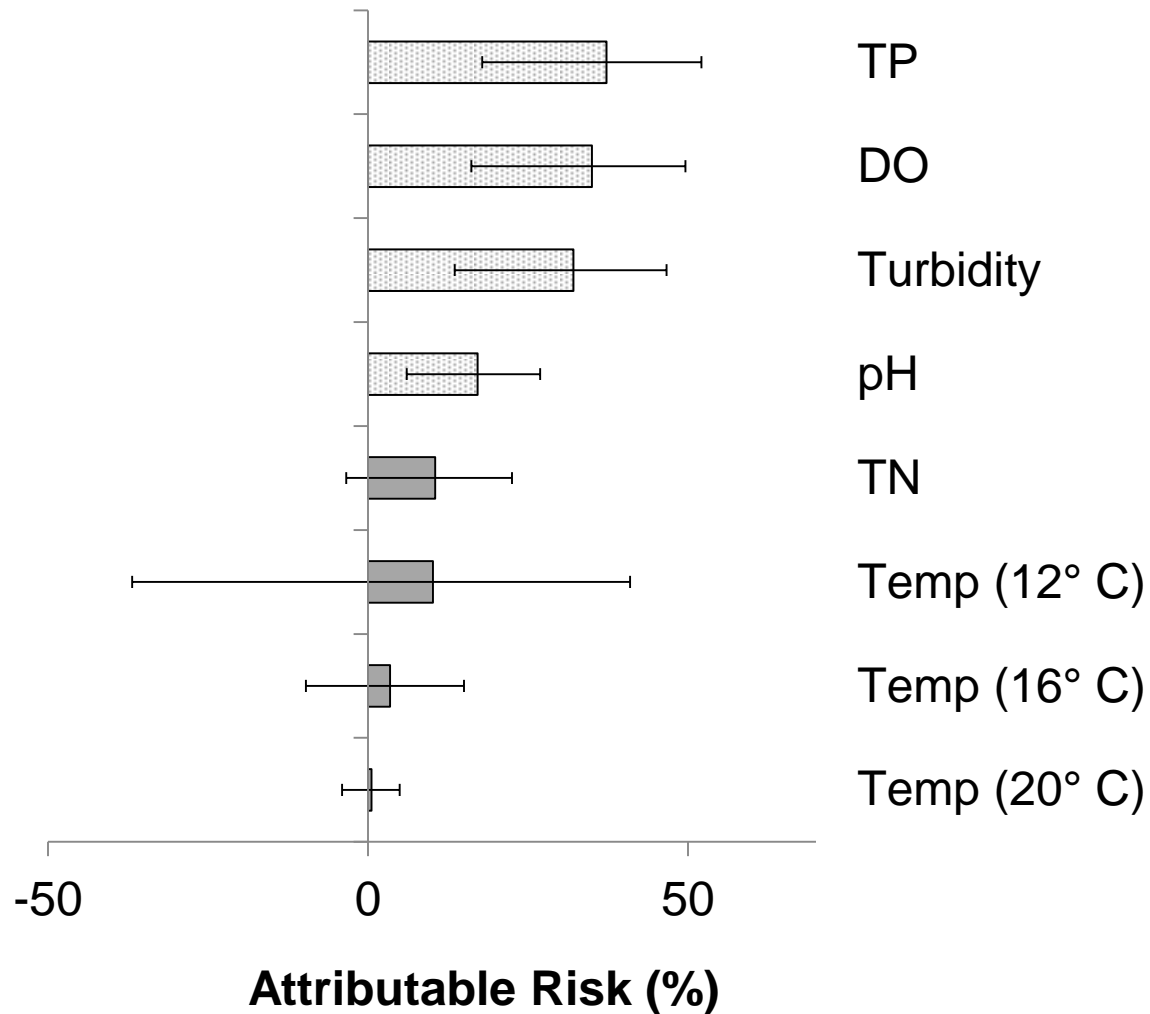


Extent



Risk

Attributable Risk: Water Quality

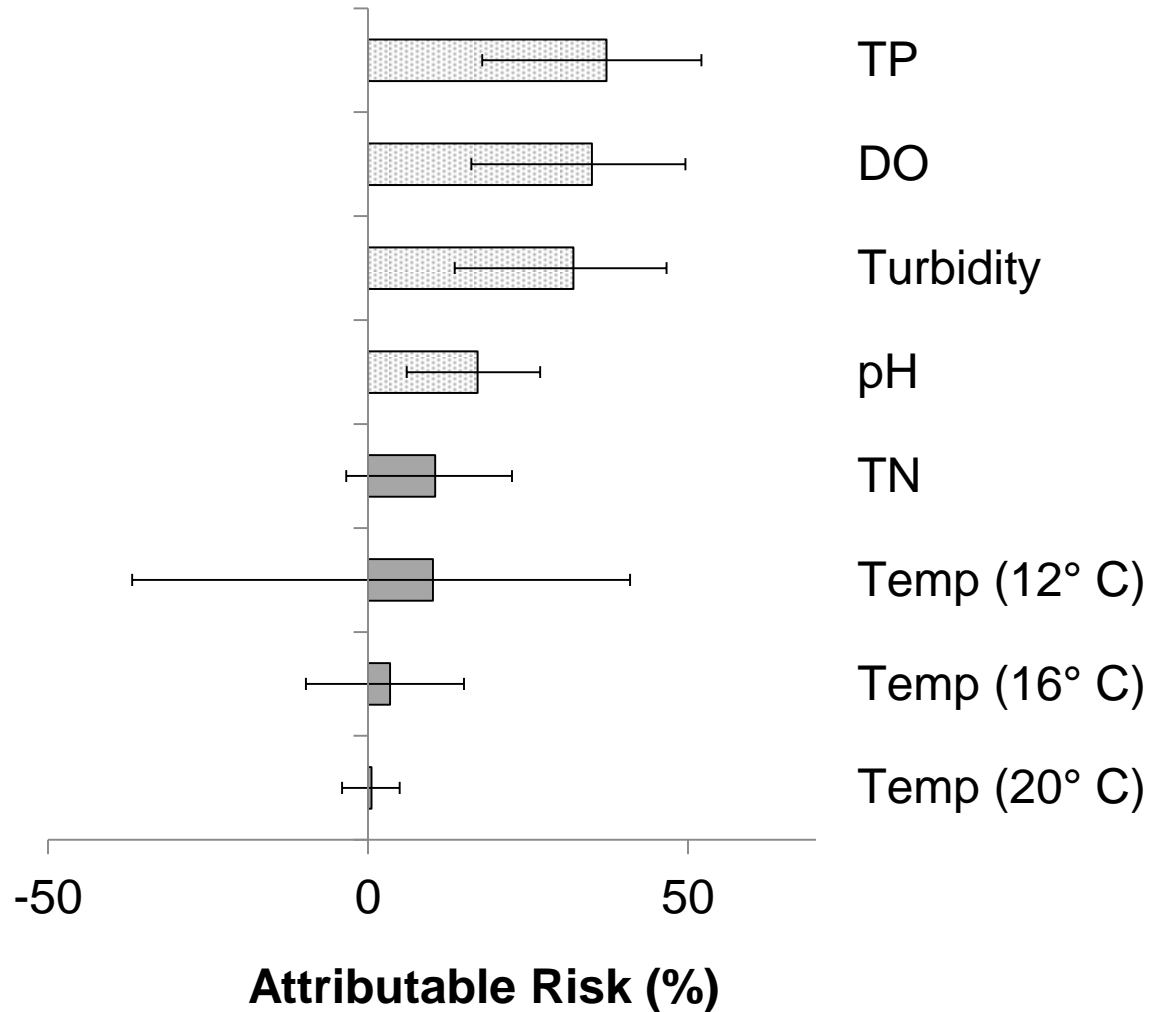


Error Bars = 95% CI

Attributable Risk: Review

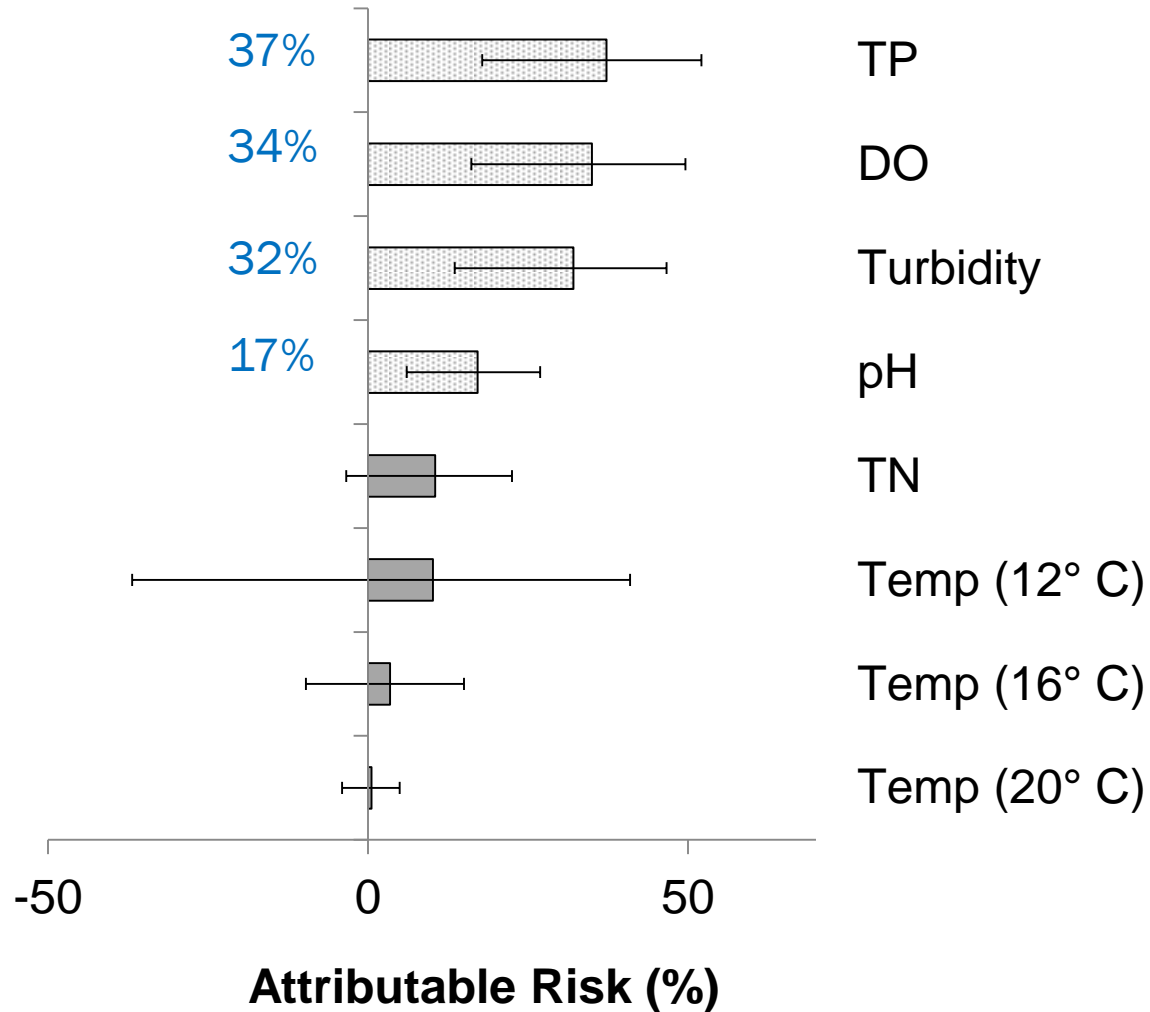
1. Single measure of stressor severity and impact
2. Estimates the reduction in poor condition that would result from eliminating stressor

Attributable Risk: Water Quality



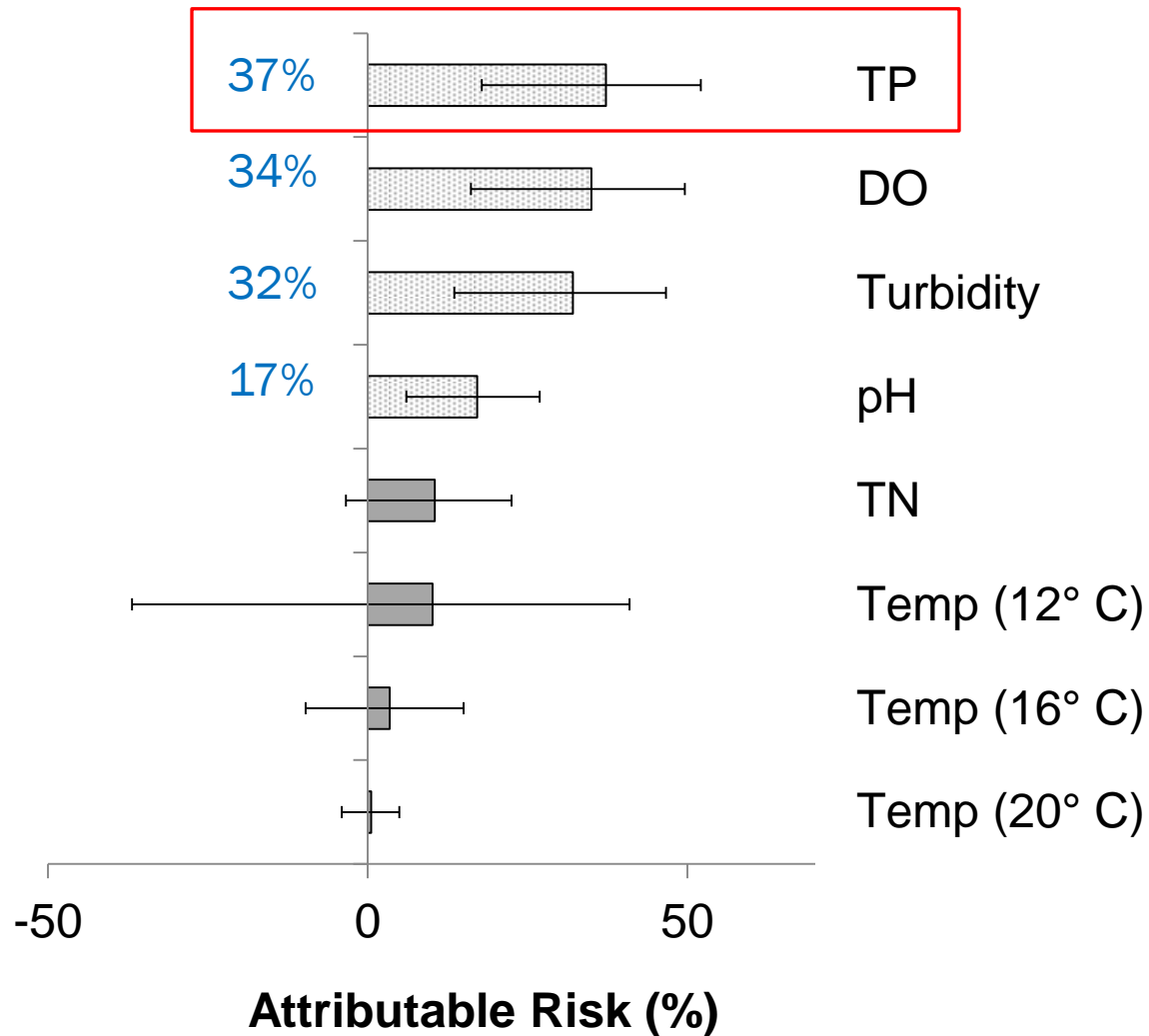
Error Bars = 95% CI

Attributable Risk: Water Quality



Error Bars = 95% CI

Attributable Risk: Water Quality



Error Bars = 95% CI

Attributable Risk: Water Quality

37% proportional
reduction of poor scores

Before stressor
management
Poor sites = 30%
Good/fair sites = 70%

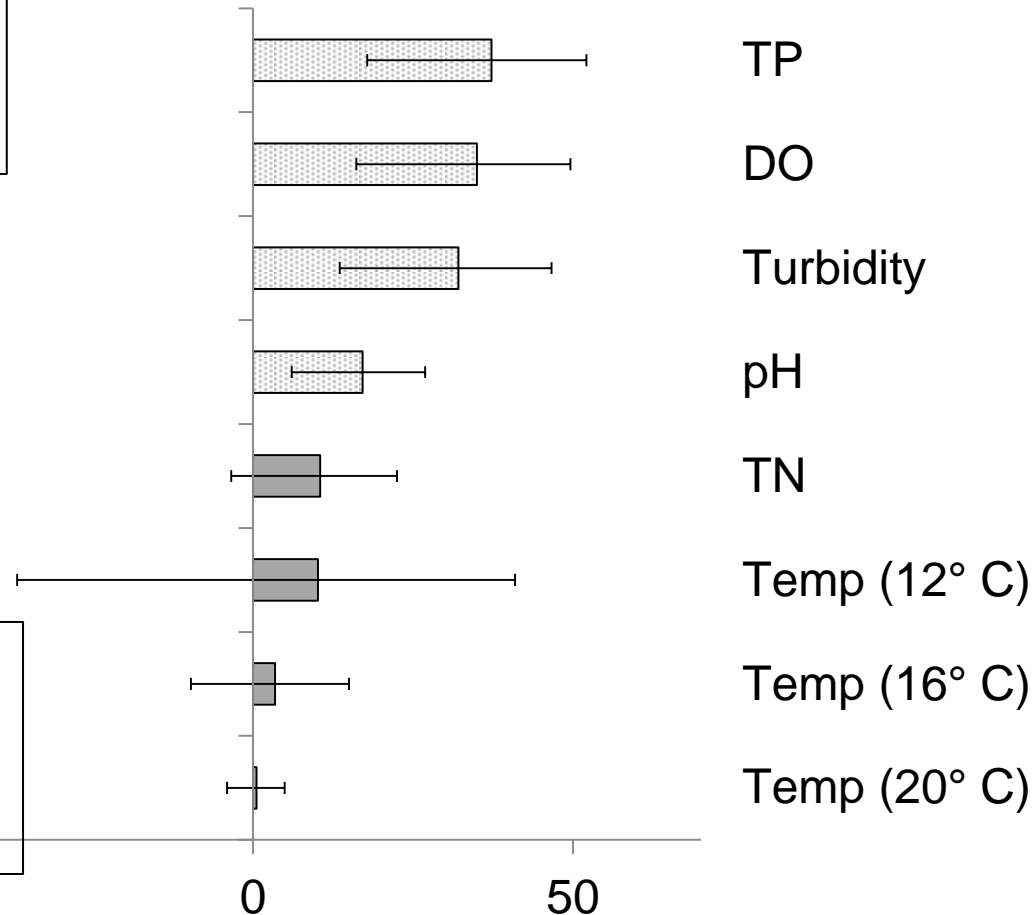


Eliminate risk:
Phosphorous



After stressor
management:
Poor sites = 19%
Good/fair sites = 81%

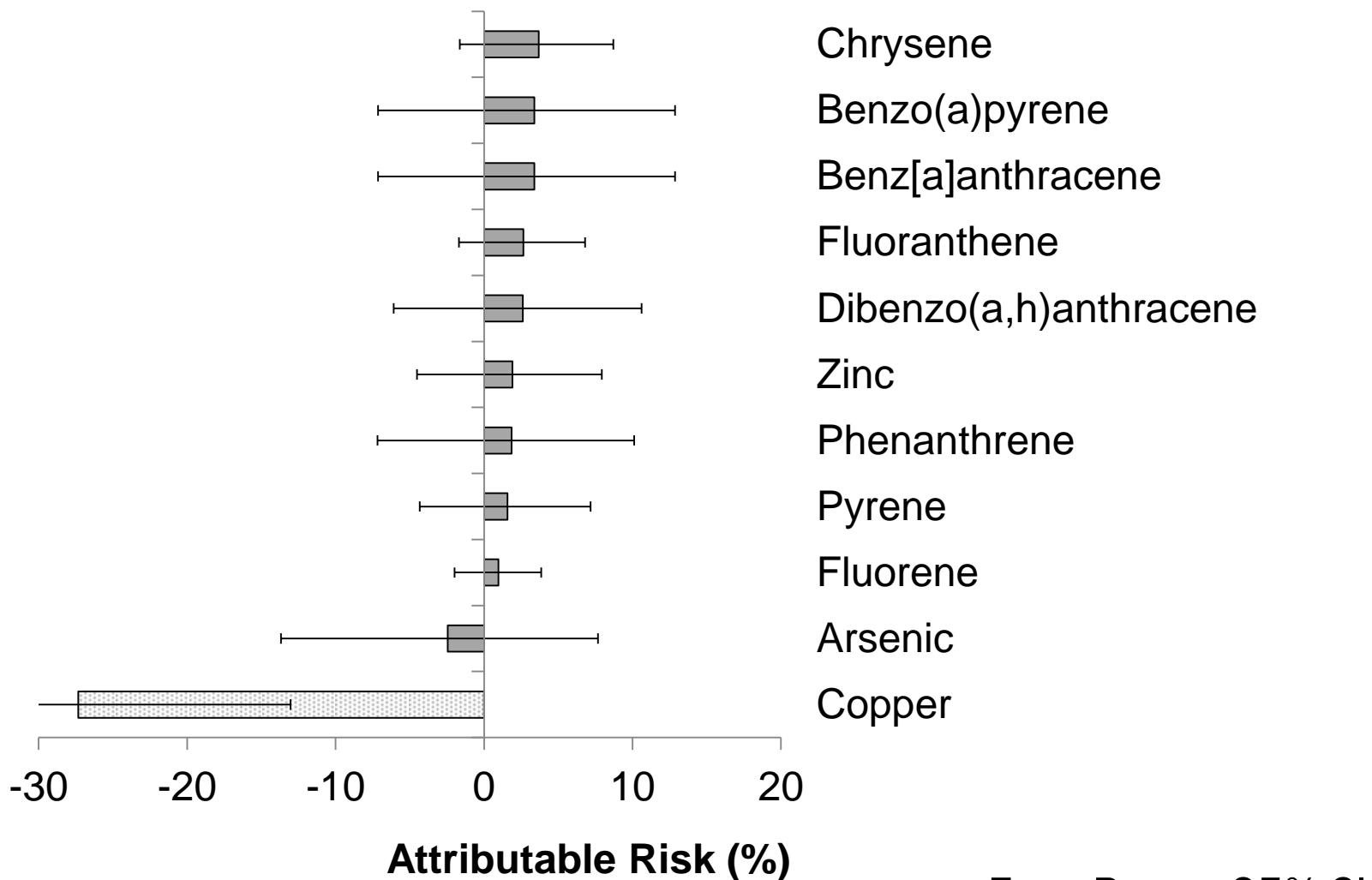
-50



Attributable Risk (%)

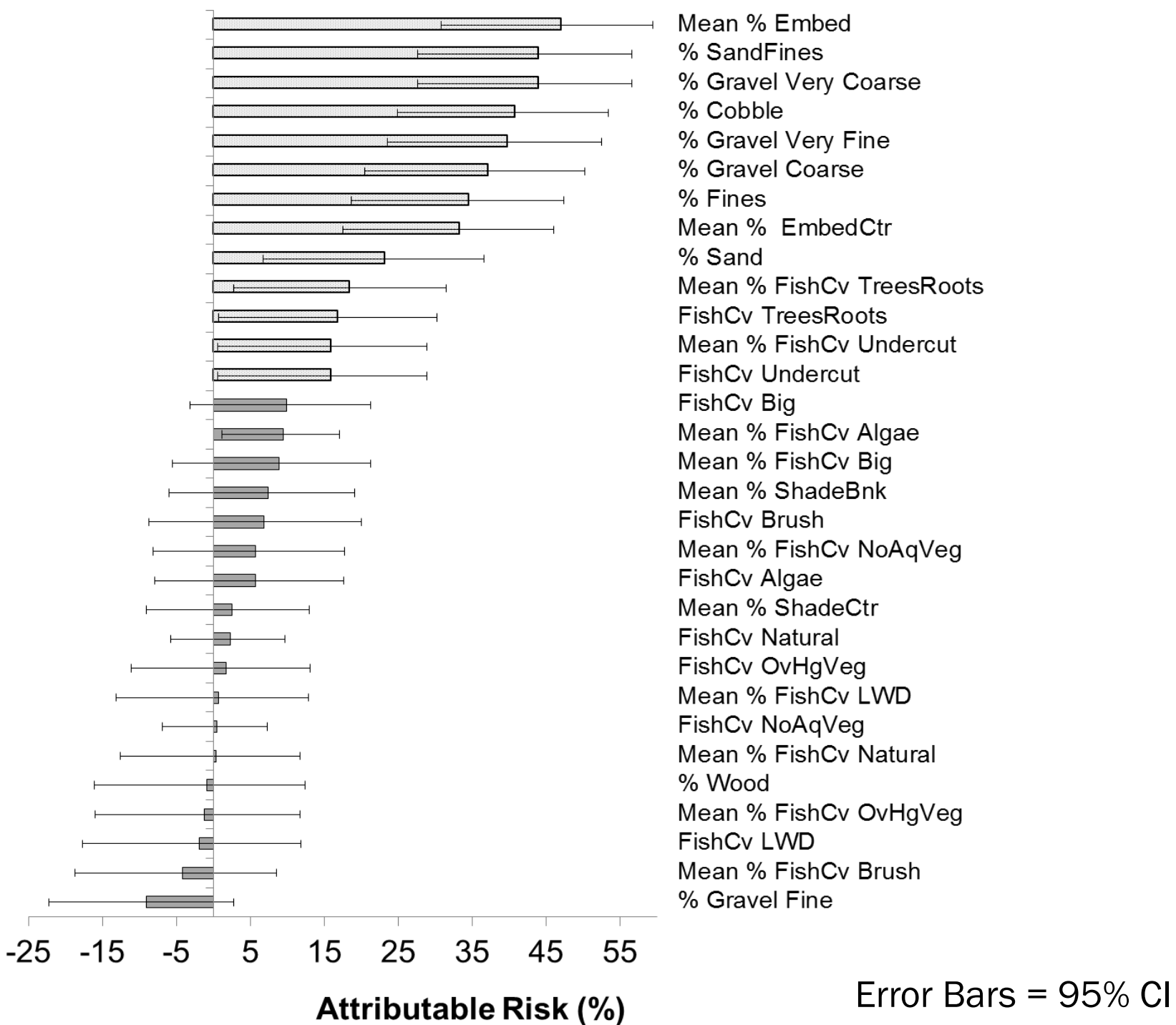
Error Bars = 95% CI

Attributable Risk: Sediment Chemistry



Error Bars = 95% CI

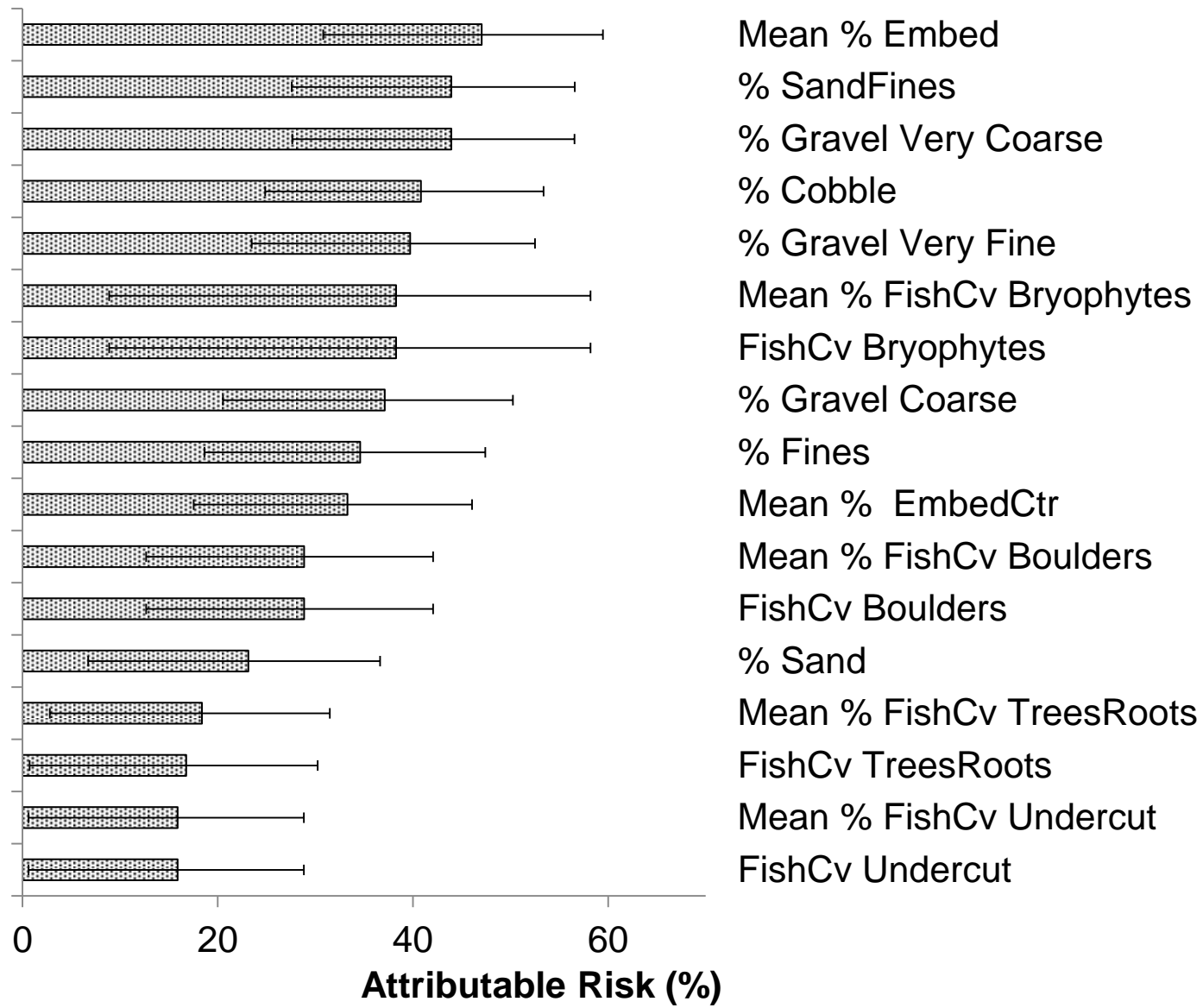
Attributable Risk: Habitat



Error Bars = 95% CI

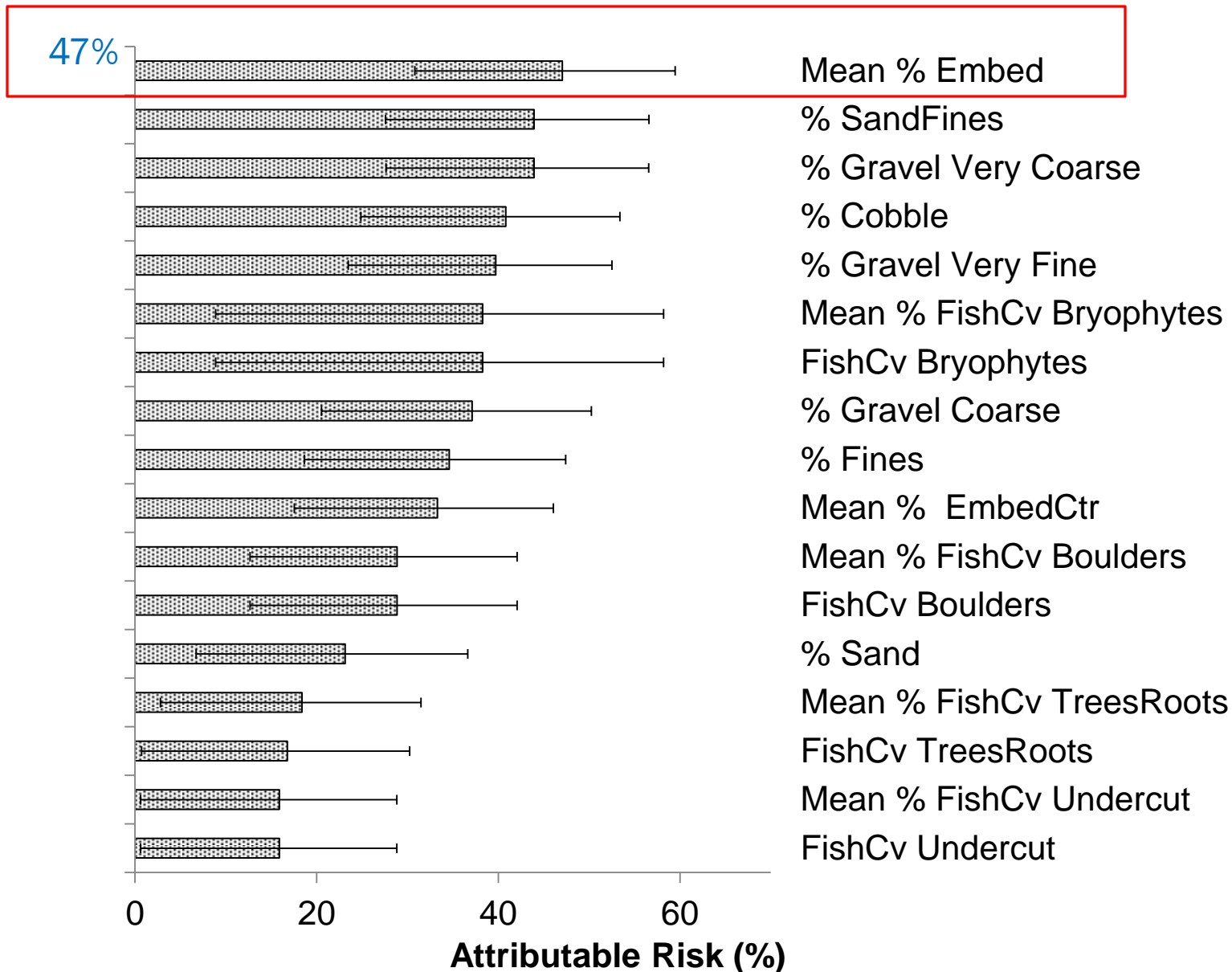
Habitat: Attributable Risk

→ Substrate
→ Fish Cover



Error Bars = 95% CI

Habitat: Attributable Risk



Error Bars = 95% CI

47% proportional reduction of poor scores

Habitat: Attributable Risk

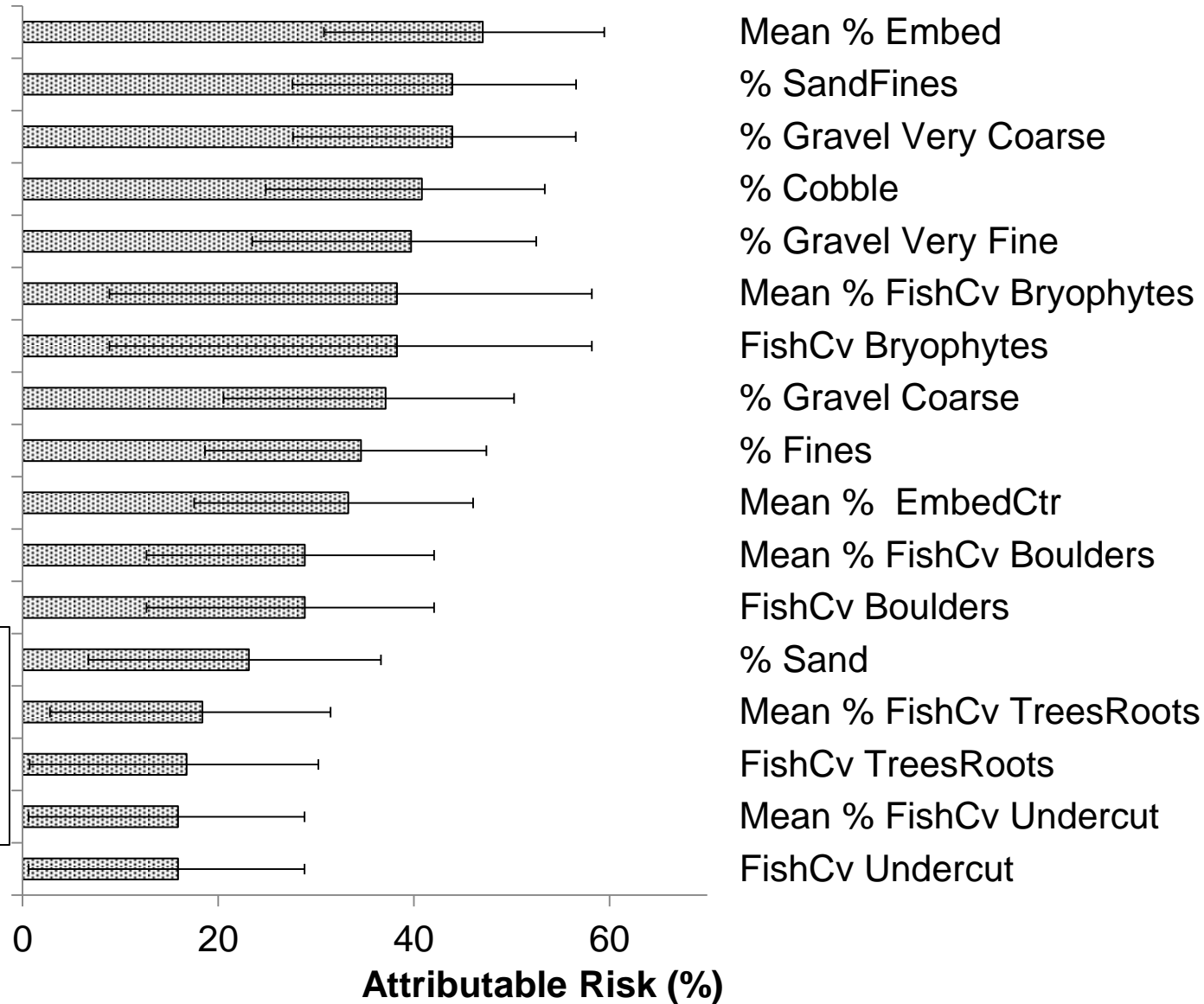
Before stressor management
Poor sites = 30%
Good/fair sites = 70%



Eliminate risk: Embeddedness



After stressor management:
Poor sites = 16%
Good/fair sites = 84%



Error Bars = 95% CI

Risk Summary

- Substrate composition is important to B-IBI and metrics
- B-IBI and metrics are sensitive to surface water quality parameters – Phosphorous, Turbidity, DO, pH
- Target restoration: physical habitat
 - Rebuilding riparian buffers
 - Eliminating sedimentation sources
- Management and continued monitoring of water quality characteristics should be prioritized
- Valuable analysis tool to help prioritize watershed restoration decisions



Future Risk Analyses

- Weighted analysis
- Reference site data for threshold determination
- Grouping/scaling down variables
- Updated habitat metrics with hydrology
- Expanding analysis other biological data



Acknowledgements

EPA

John Van Sickle, Gretchen Hayslip

King County

Deb Lester, Jo Wilhelm

WA Dept. of Ecology

Glenn Merritt



Thank you!

