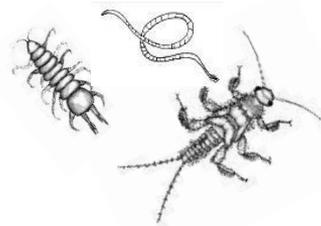


Assessing stressor risk to biological indicators of watershed health in western Washington

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Causation of environmental impairment

Utilize monitoring data to:

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



Ecological Risk Assessment

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

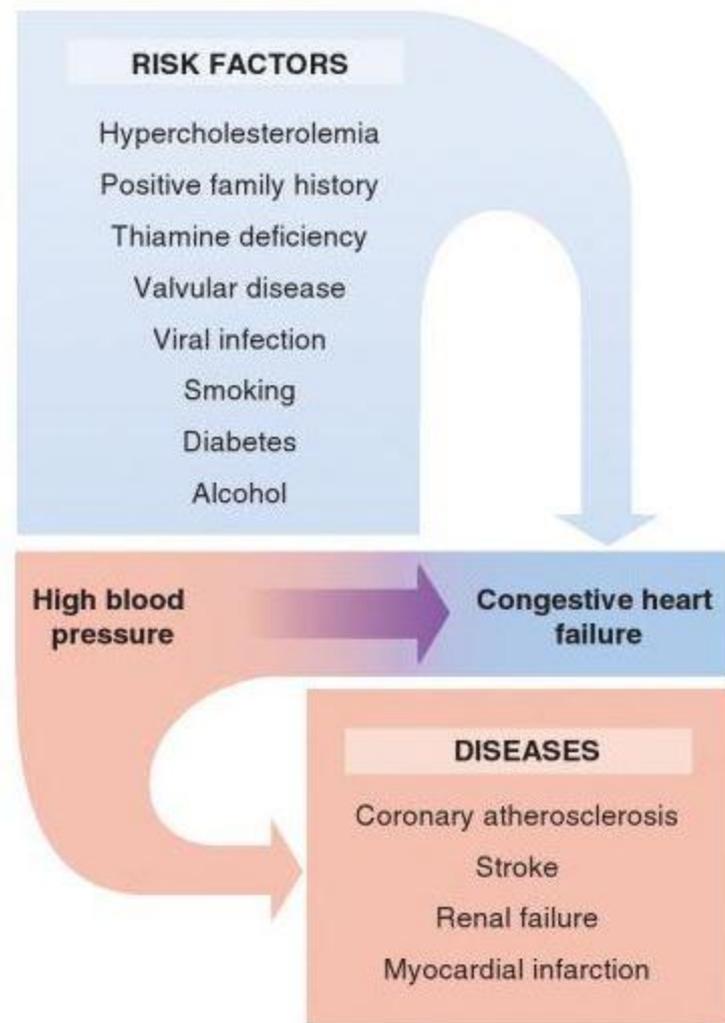
Relative Risk Assessment for Resource Management

(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

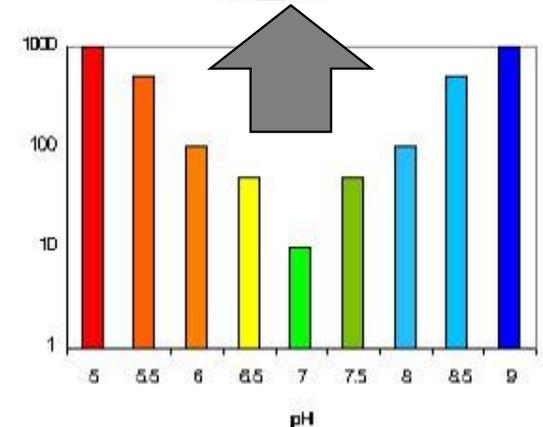
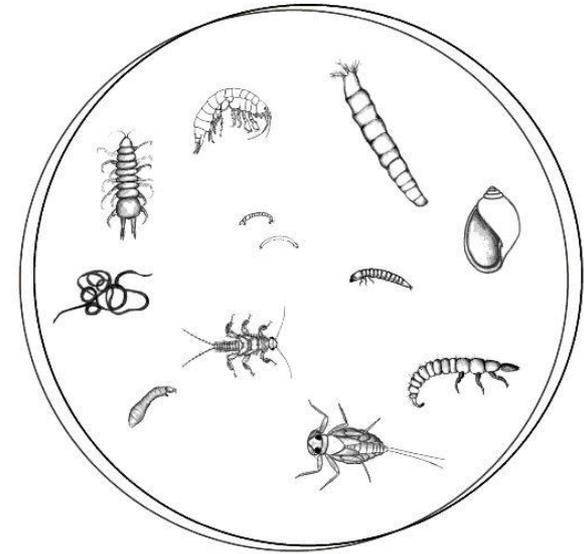
 The probability of finding a poor stressor condition in a randomly selected stream



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 regional extent of poor biological condition that would result from eliminating stressor

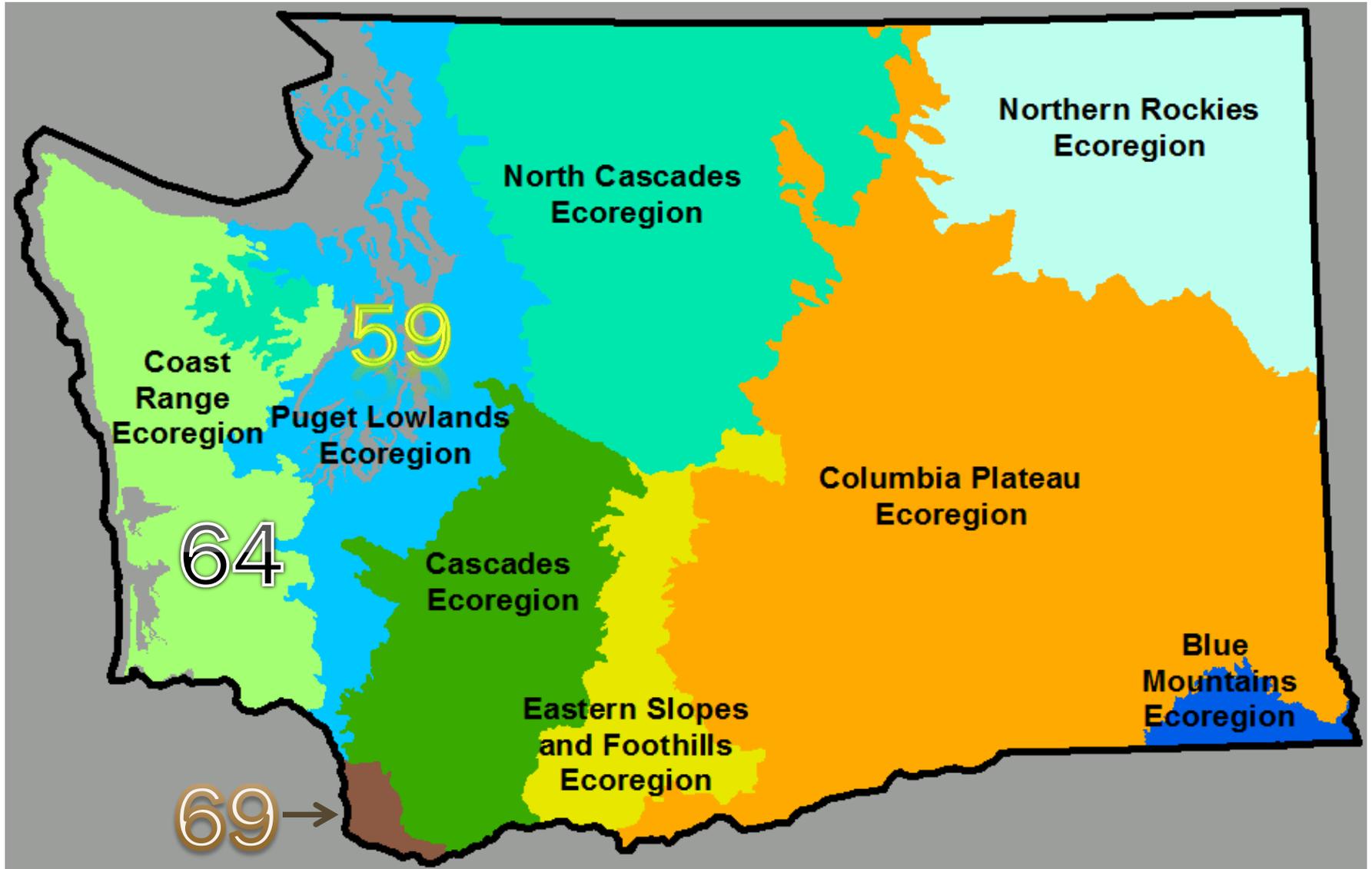
Relative Risk

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

Methods

- WA Dept of Ecology's Status and Trends monitoring sites (n = 146)
 - Puget Sound Basin (n = 47)
 - Coastal (n = 49)
 - Lower Columbia (n = 50)
- Data: Habitat (EMAP), water quality, sediment chemistry, fish abundance, 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



Preliminary Results: Relative Risk

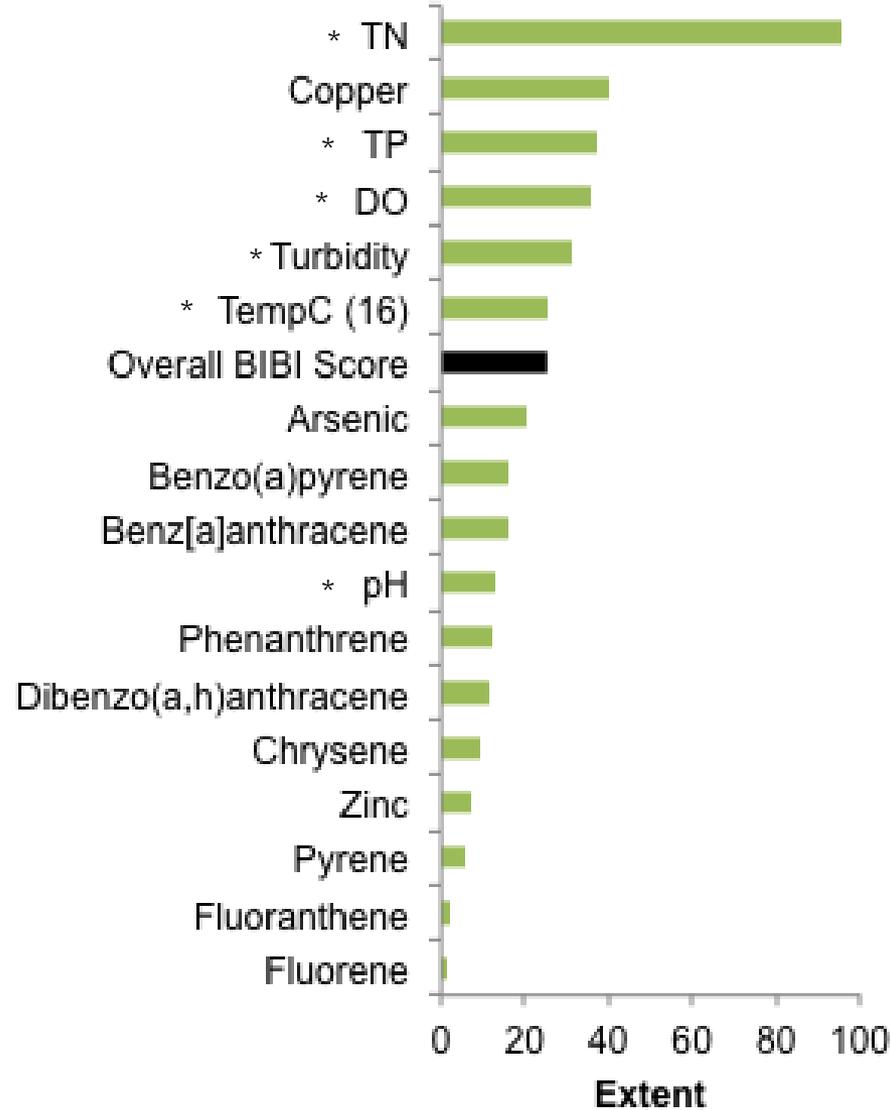
1. Water Quality and Sediment Chemistry
2. Habitat

Preliminary Results: Relative Risk

1. Water Quality and Sediment Chemistry

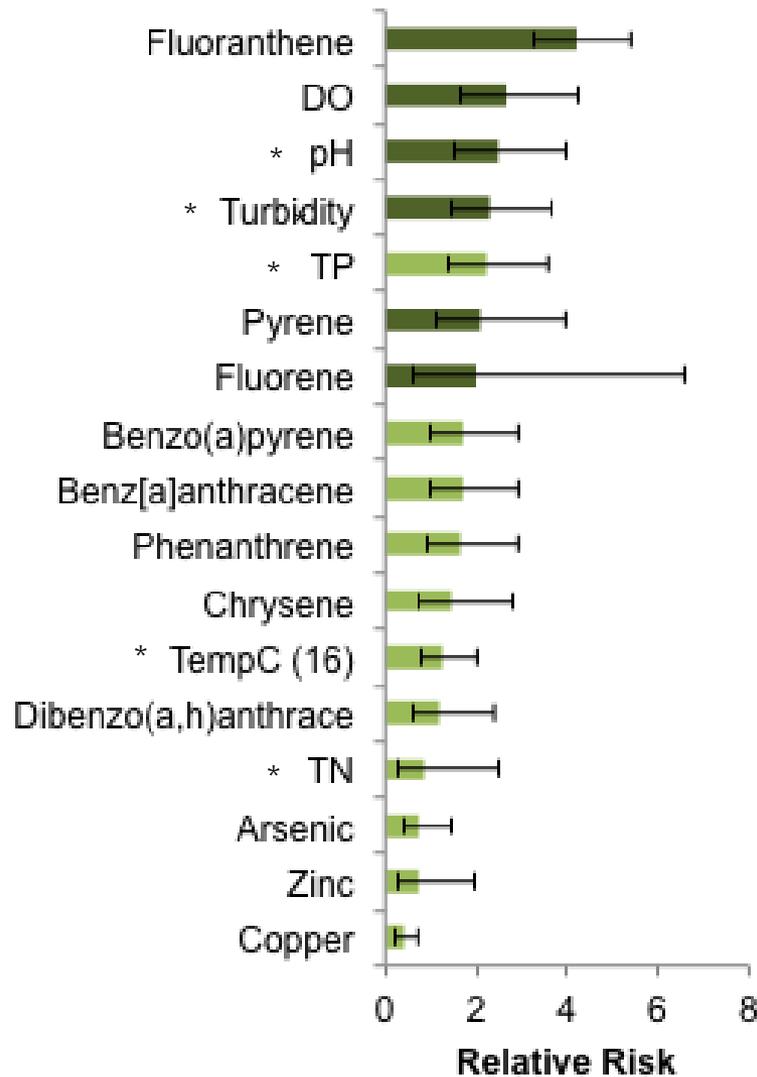
2. Habitat

Extent of Poor variable condition: WQ, SC



* denote Water Quality Results

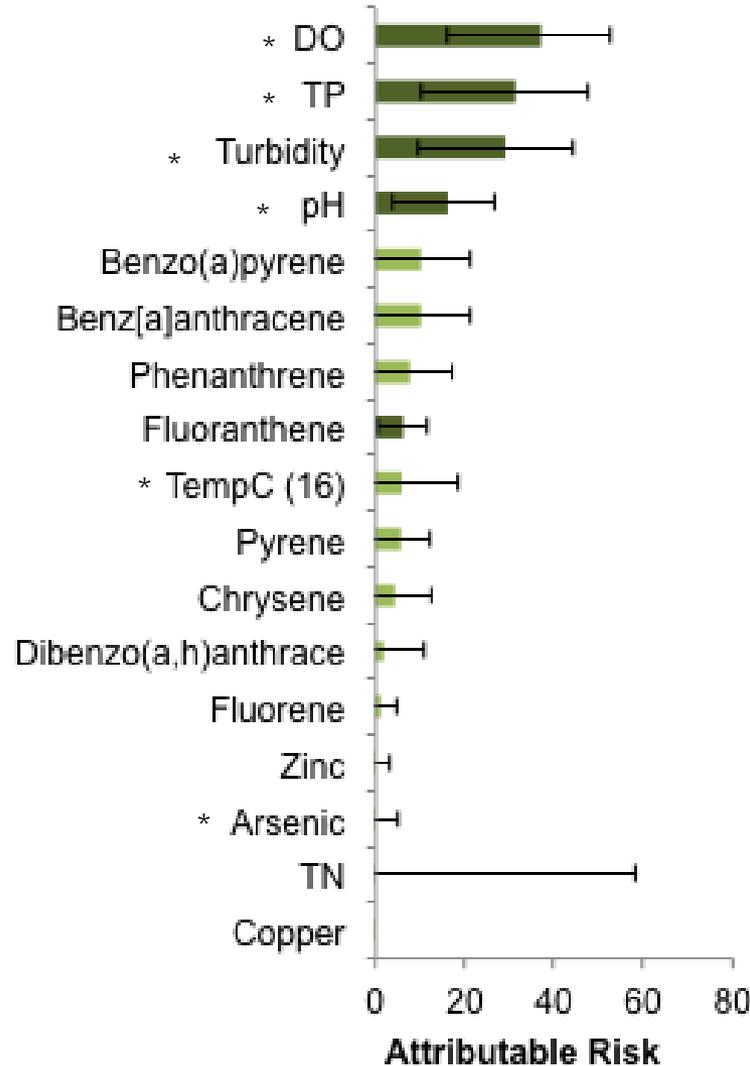
Relative Risk: WQ, Sediment Chemistry



* denote Water Quality Results

Error Bars = 95% CI

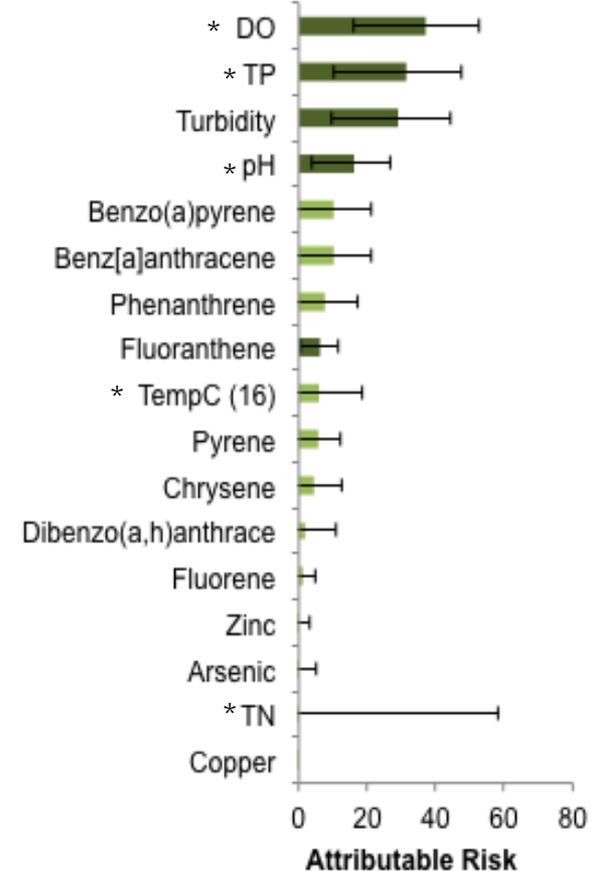
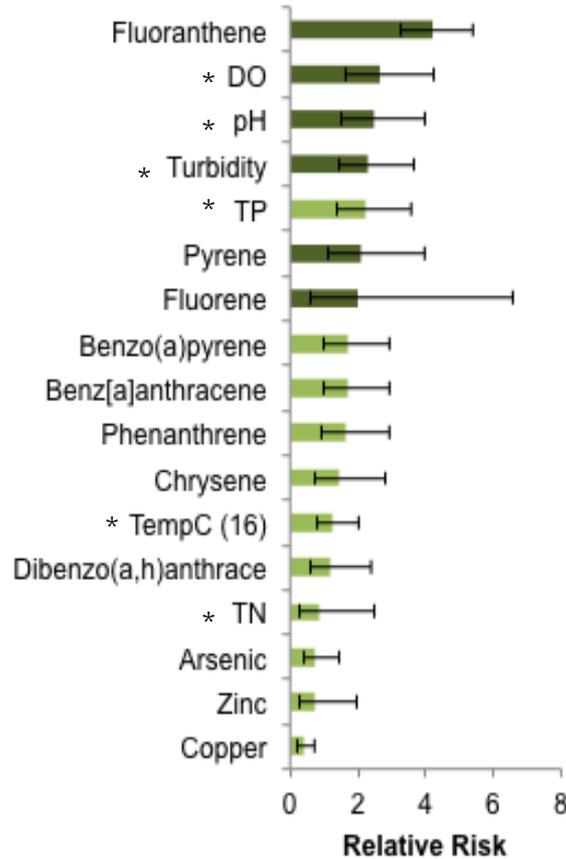
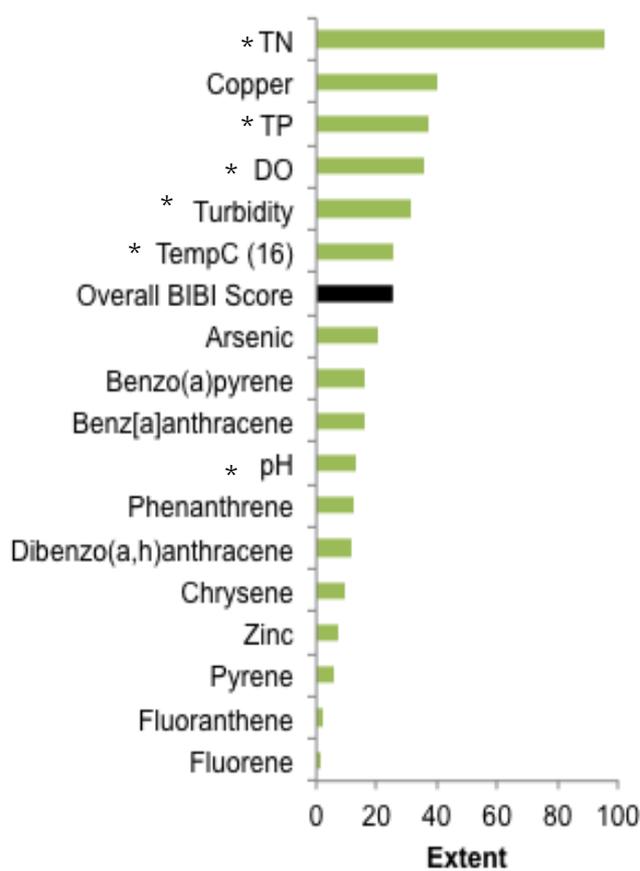
Attributable Risk: WQ, Sediment Chemistry



* denote Water Quality Results

Error Bars = 95% CI

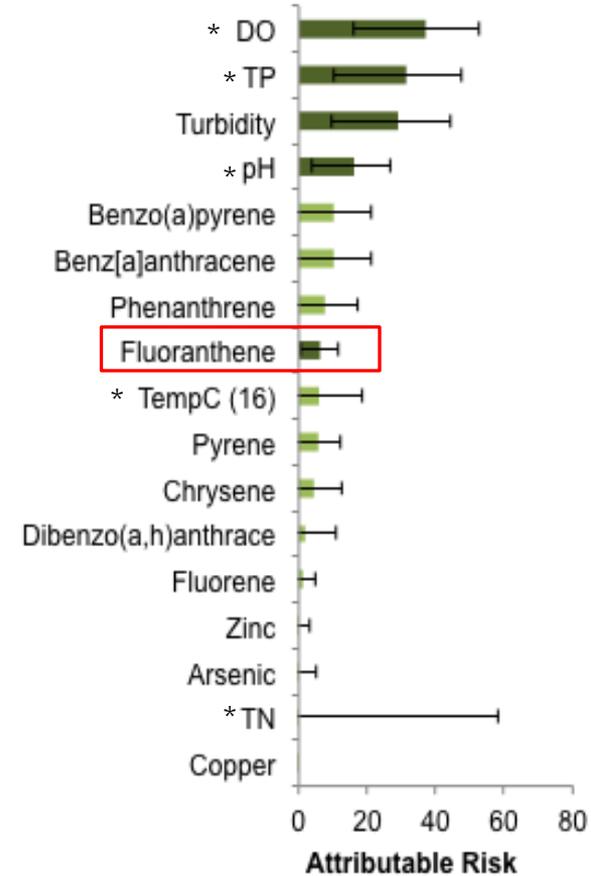
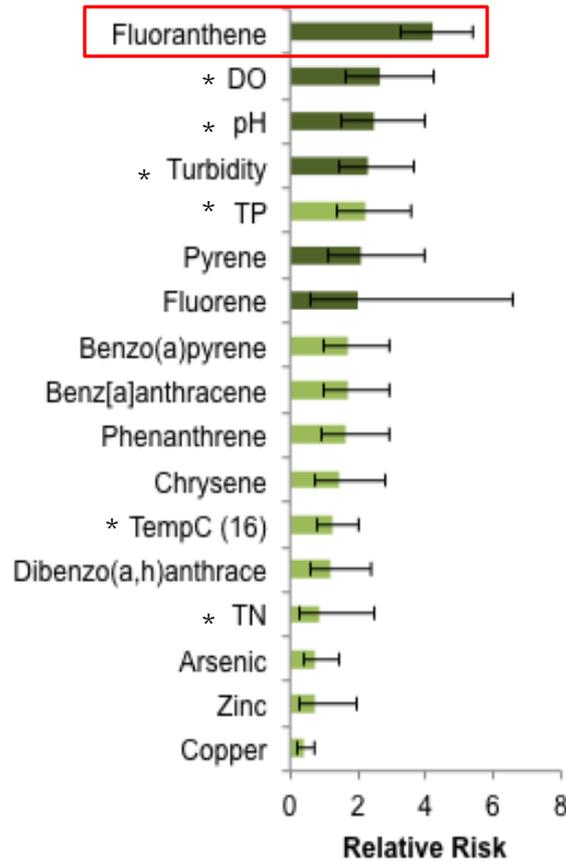
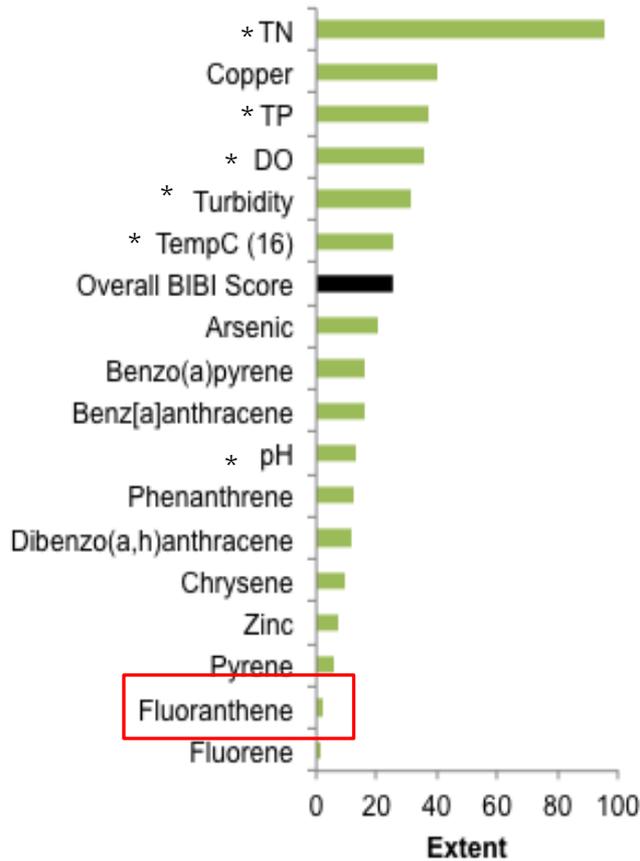
Relative Risk: WQ, Sediment Chemistry



* denote Water Quality Results

Error Bars = 95% CI

Relative Risk: WQ, Sediment Chemistry

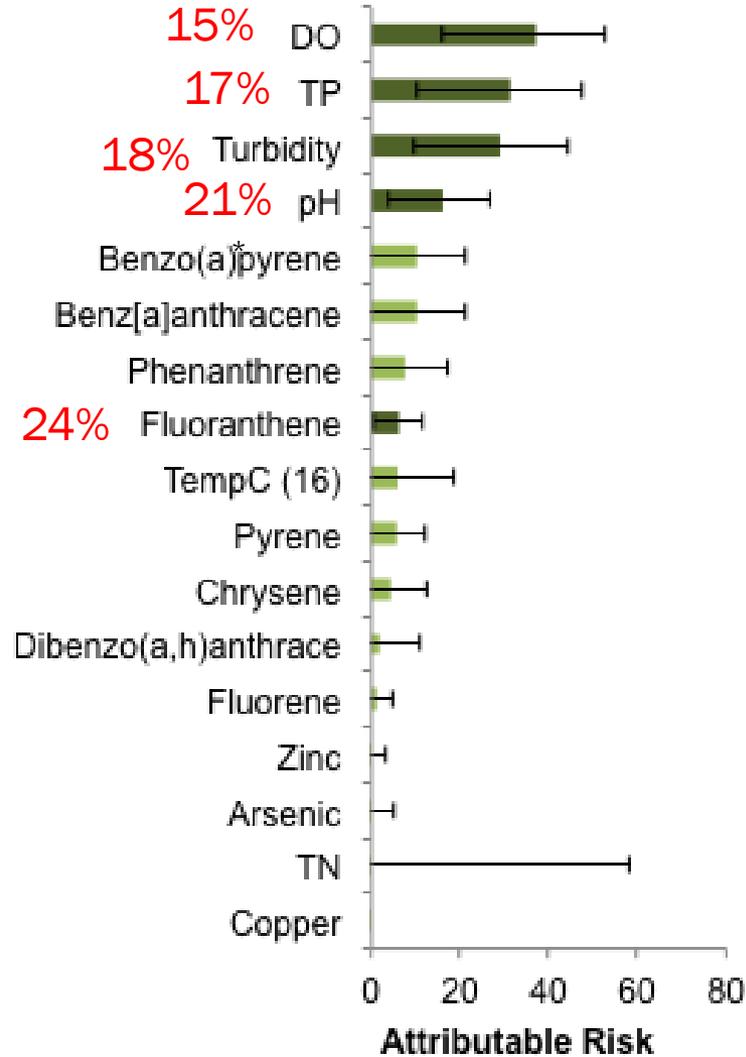


* denote Water Quality Results

Error Bars = 95% CI

Attributable Risk: Impact to B-IBI

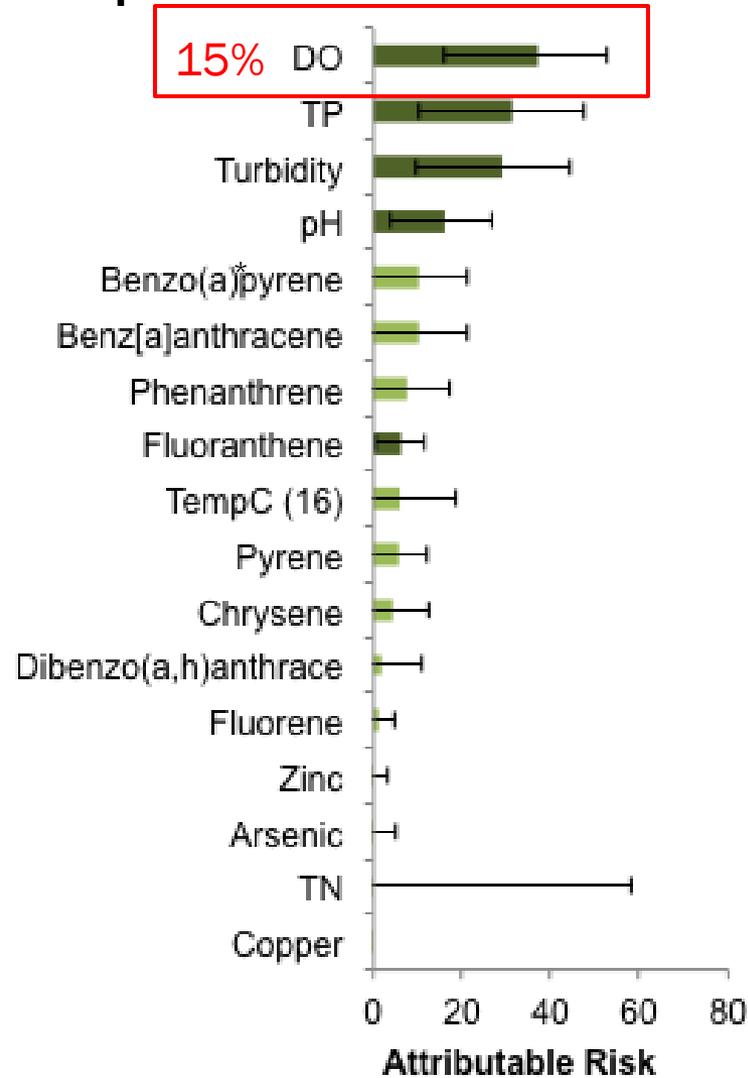
Proportion of B-IBI scores in poor condition (extent) = 25%



Error Bars = 95% CI

Attributable Risk: Impact to B-IBI

Proportion of B-IBI scores in poor condition (extent) = 25%



Error Bars = 95% CI

Attributable Risk: Impact to B-IBI

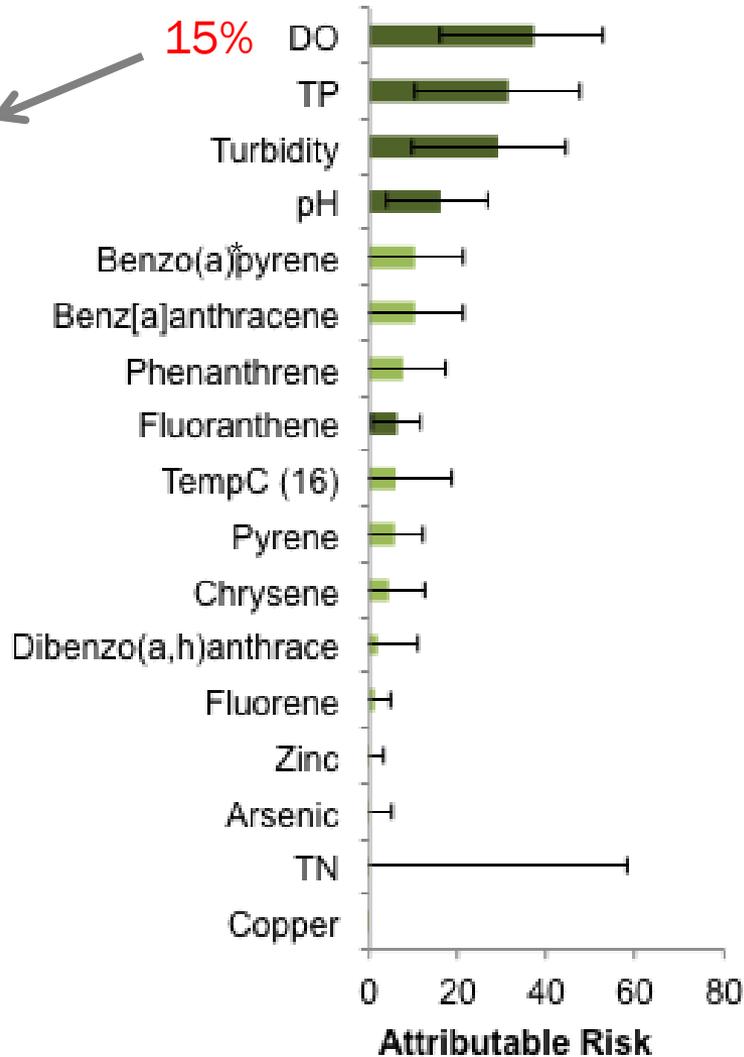
Before stressor management
 Poor sites = 25%
 Good/fair sites = 75%



Eliminate risk:
 DO conditions



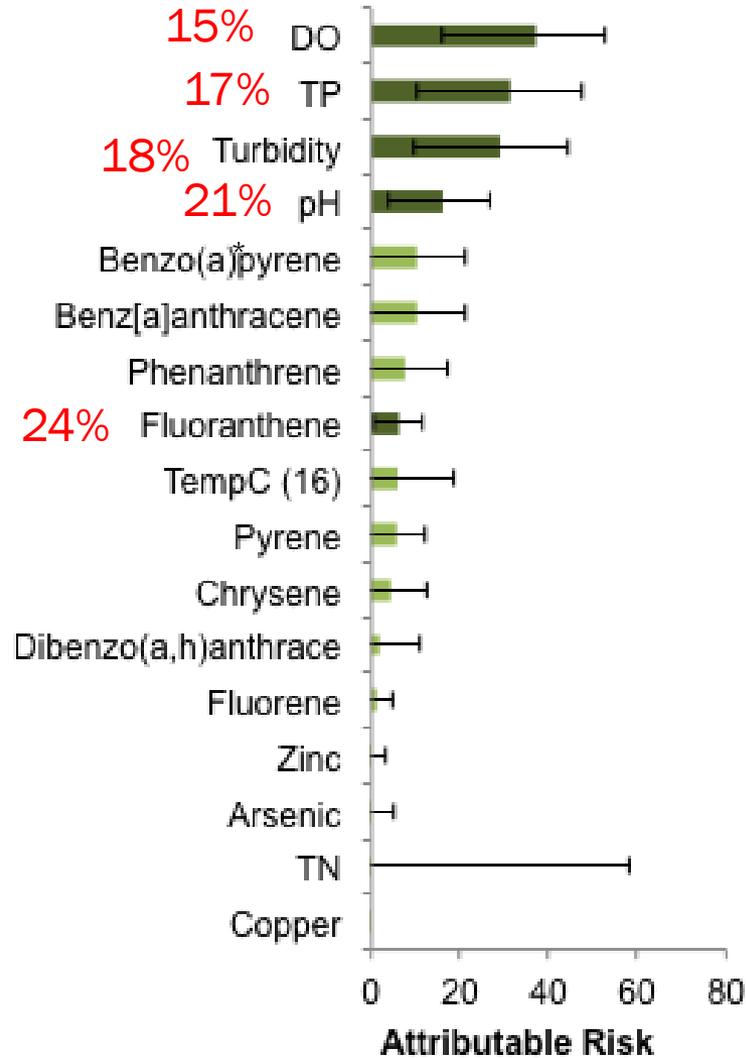
After stressor management:
 Poor sites = 15%
 Good/fair sites = 85%



Error Bars = 95% CI

Attributable Risk: Impact to B-IBI

Proportion of B-IBI scores in poor condition (extent) = 25%



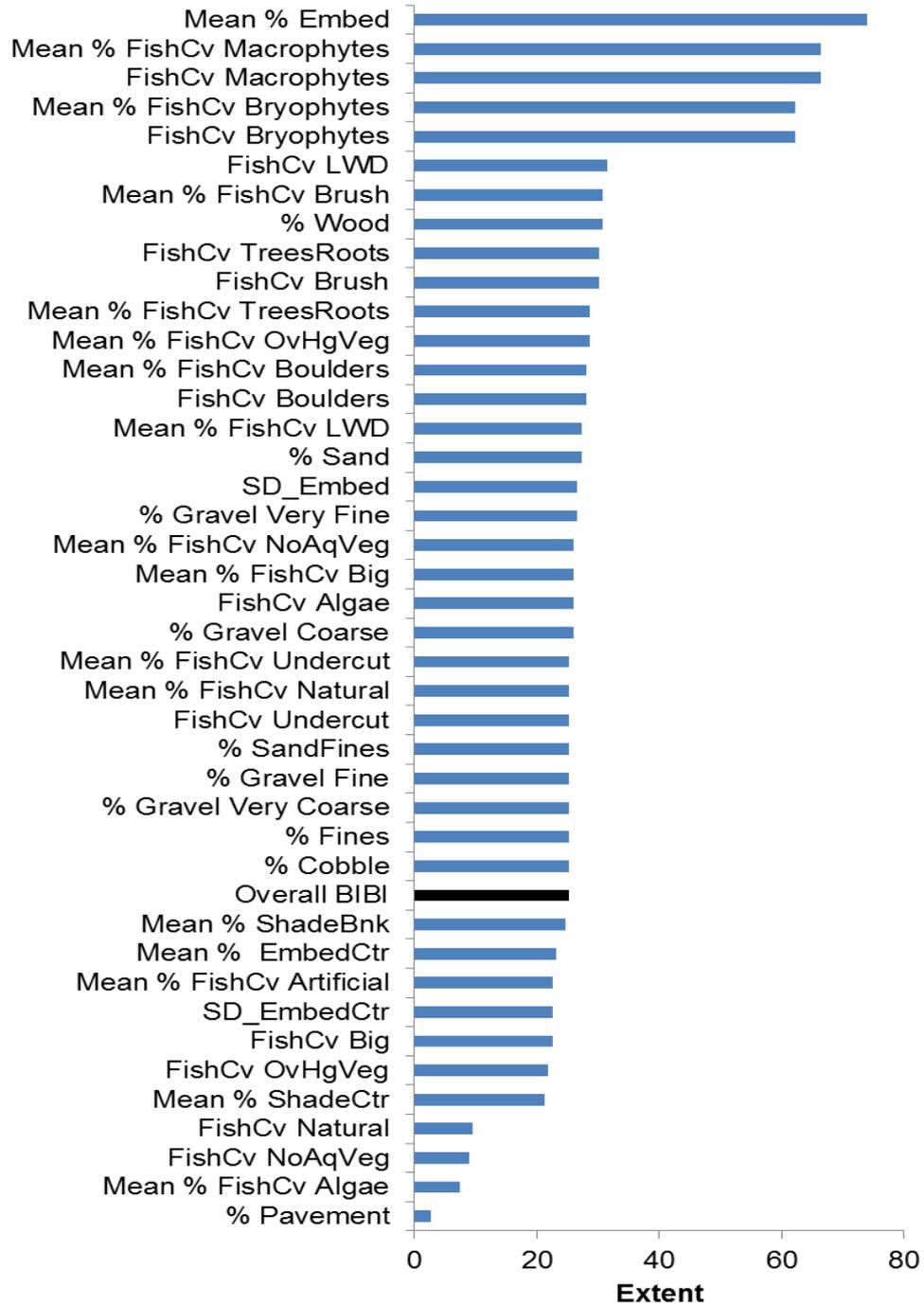
Error Bars = 95% CI

Preliminary Results: Relative Risk

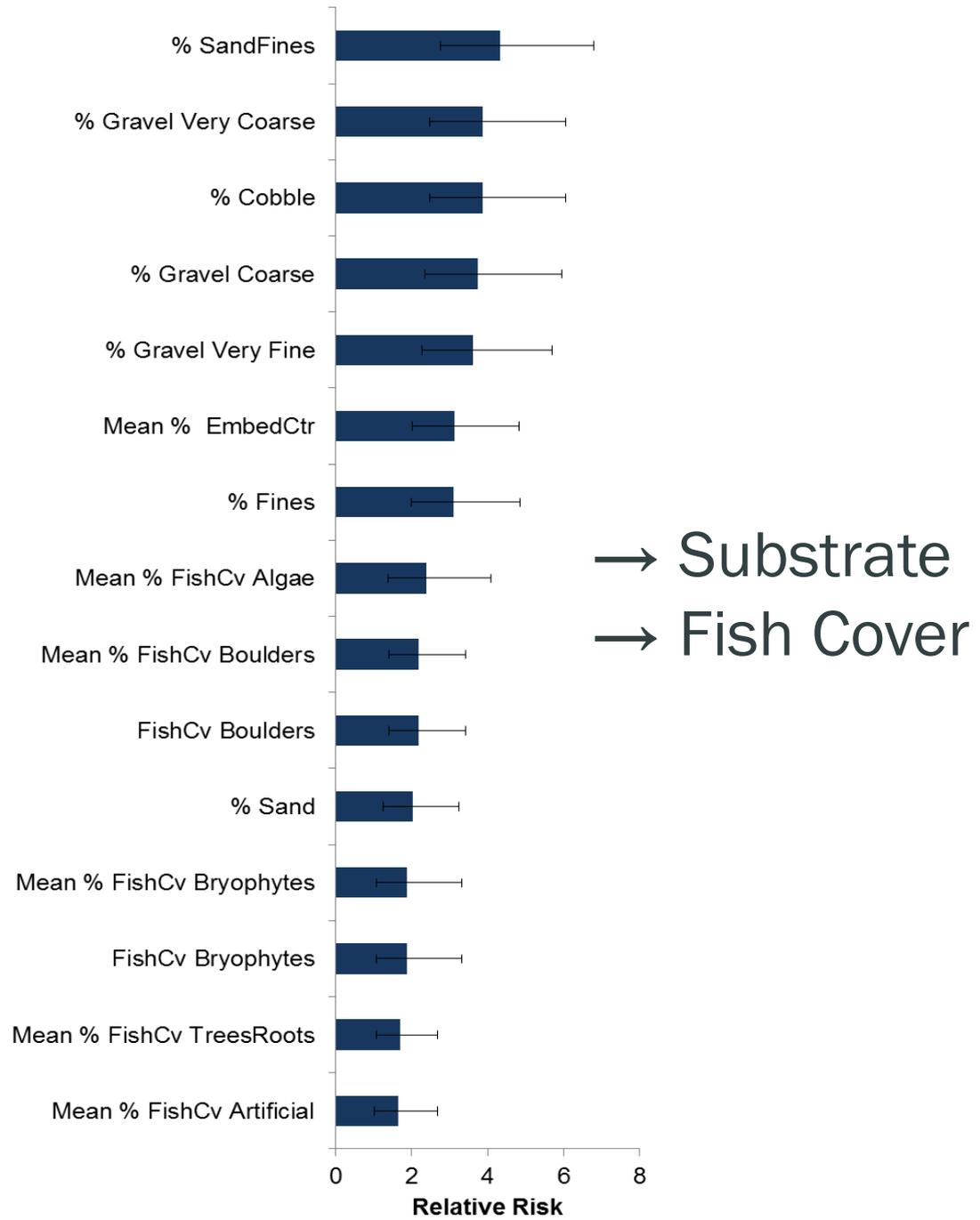
1. Water Quality and
Sediment Chemistry

2. Habitat

Poor Habitat Extent



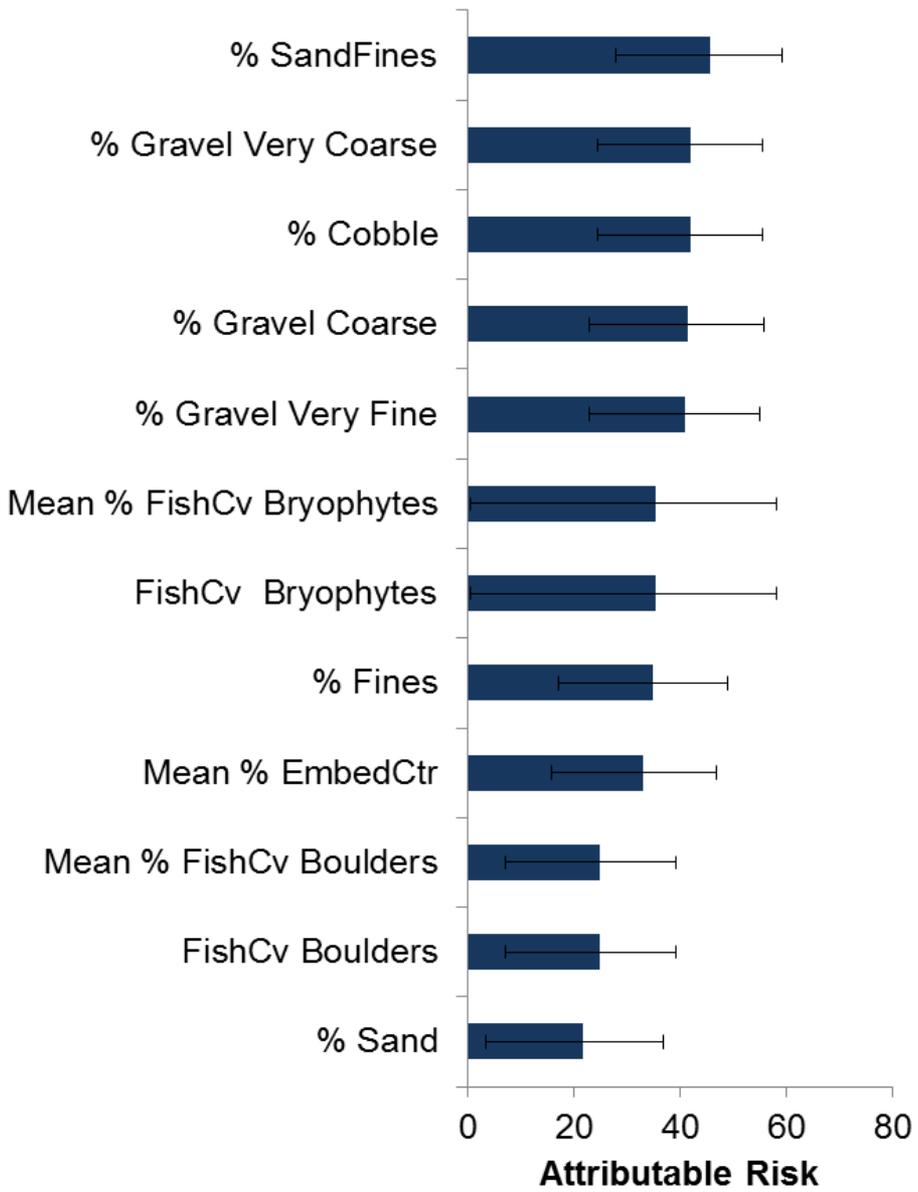
Relative Risk: Habitat



Error Bars = 95% CI

Attributable Risk: Impact to B-IBI

→ Substrate
→ Fish Cover

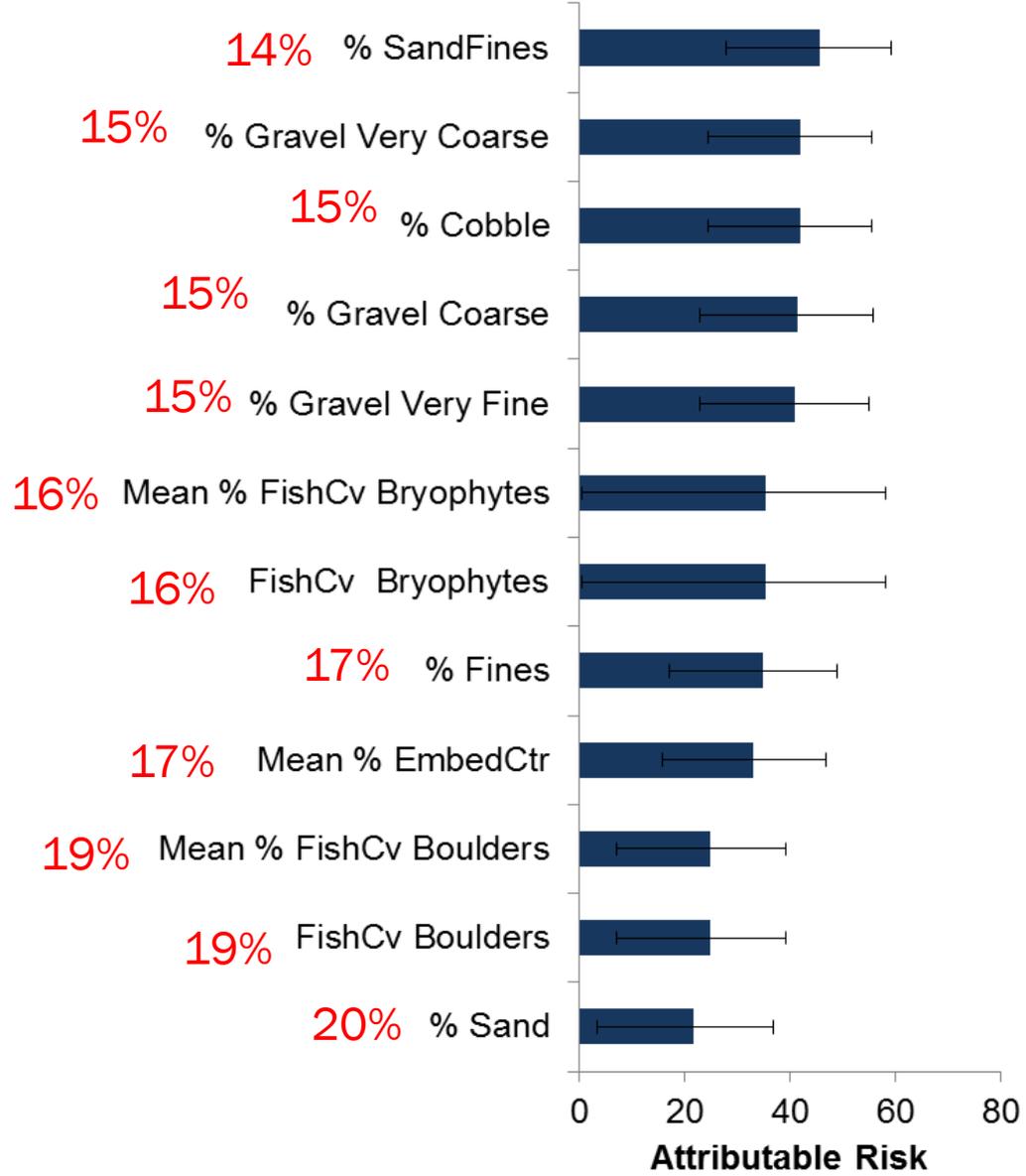


Error Bars = 95% CI

Attributable Risk: Impact to B-IBI

Proportion of B-IBI scores in poor condition (extent) = 25%

→ Substrate
→ Fish Cover



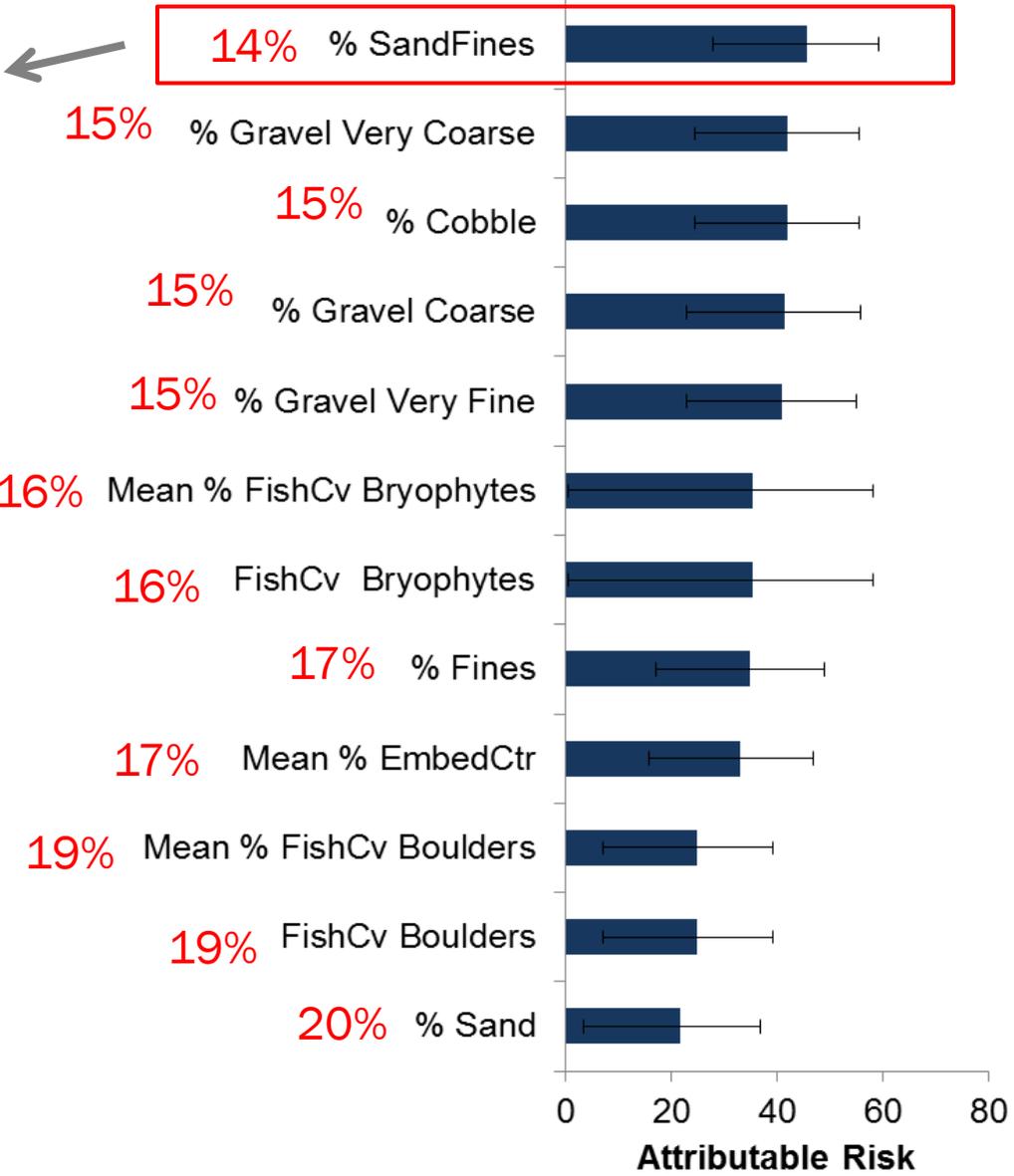
Error Bars = 95% CI

Attributable Risk: Impact to B-IBI

Before stressor management
 Poor sites = 25%
 Good/fair sites = 75%

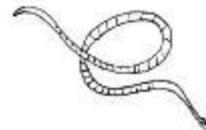
Eliminate risk:
 Sand / Fine
 Substrate

After stressor management:
 Poor sites = 14%
 Good/fair sites = 86%



Relative Risk Summary

- ✈ Substrate composition is important to B-IBI scores and metrics. Sites dominated by a single substrate tend to have lower B-IBI scores.
- ✈ Benthic macroinvertebrates sensitive to surface water quality parameters – DO, pH, P
- ✈ Working on adding more water and sediment chemistry variables needed for more robust picture
- ✈ Valuable analysis tool to help prioritize watershed restoration decisions



Acknowledgements

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Thank you!

