Relative Risk
What is it? How do I calculate it?

John Van Sickle

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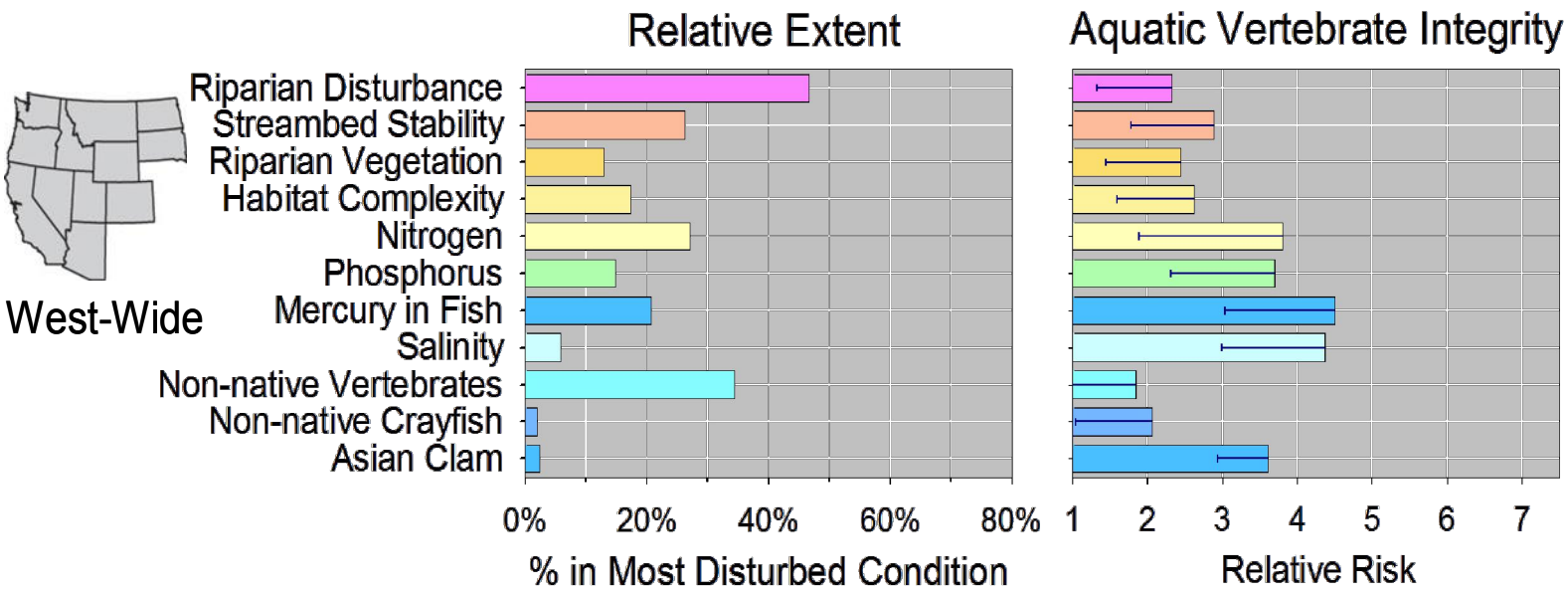
Relative risk and relative extent estimates for EMAP-West



Relative risk and relative extent

1) **Select desired stressor and response variables**

2) **Define condition classes for each stressor and each response**

-- Example: Total nitrogen stressor (NTL) for EMAP-West.

In 'Mountains' aggregate region (see handout),
NTL > 200 defines "Poor" condition ("Most-disturbed").
125 < NTL ≤ 200 defines "Fair" condition.
NTL ≤ 125 defines "Good" condition ("Least disturbed").

3) Calculate the condition classes of each sampled site, separately for each stressor and each response.

Table B-1. Thresholds used in this Assessment to separate condition classes, and the approximate percentage of the reference site distribution they represent. Thresholds were estimated separately for each climatic region; Habitat Complexity and Streambed Stability thresholds were estimated separately at the ecoregion level in the Mountain climatic region. Names in parentheses are variable names from the EMAP West database.

"POOR" "GOOD"

Mountains	Most-Disturbed		Least-Disturbed	
	Threshold	%	Threshold	%
Aquatic Vertebrate IBI (MMI_VERT)	<37	5th	≥82	25th
Macroinvertebrate IBI (MMI_BUG)	<57	5th	≥71	25th
O/E Index (OE_BEST)	<0.5	[a]	≥0.8	[a]
Phosphorus (PTL)	>40 µg/L	5th	≤10 µg/L	25th
Nitrogen (NTL)	>200 µg/L	5th	≤125 µg/L	25th
Salinity (COND)	>1000 µS/cm	5th	≤500 µS/cm	25th
Mercury	>0.1 µg/g	[b]	≤0.1 µg/g	[b]

4) Relative extent – Definition and calculation

Relative extent of Poor condition for a variable is the percent of stream length estimated to be in Poor condition for that variable.

$$\text{Relative extent} = 100 * \frac{\text{sum(weights of sites in Poor condition)}}{\text{sum(weights of all sites)}}$$

5) Relative risk – Concept

Relative risk measures the likelihood that Poor biological condition and Poor stressor condition co-occur in streams.

6) Relative risk example: Fish MMI (biological response) versus NTL (stressor, Total Nitrogen)

Proportion of stream length

	NTL GOOD	NTL POOR
Fish MMI GOOD	0.598	0.275
Fish MMI POOR	0.070	0.056
Total	0.668	0.331

(Risk of **Poor** MMI, given **Poor** NTL) =
0.056/0.331 = 0.169

Also --
(Risk of **Poor** MMI, given **Good** NTL) =
0.07/0.668 = 0.105

Result: The risk of Poor MMI when NTL is Poor is higher than the risk when NTL is Good.

(Note – “Risk” is just another word for “Probability”)

6 cont.) Relative Risk (RR) is just the ratio of these 2 risks

$$RR = \frac{\Pr(\text{Poor MMI, given Poor NTL})}{\Pr(\text{Poor MMI, given Good NTL})} = \frac{0.169}{0.105} = 1.61$$

So: **"The risk of Poor MMI is 1.61 times greater in streams with Poor NTL than in streams with Good NTL."**

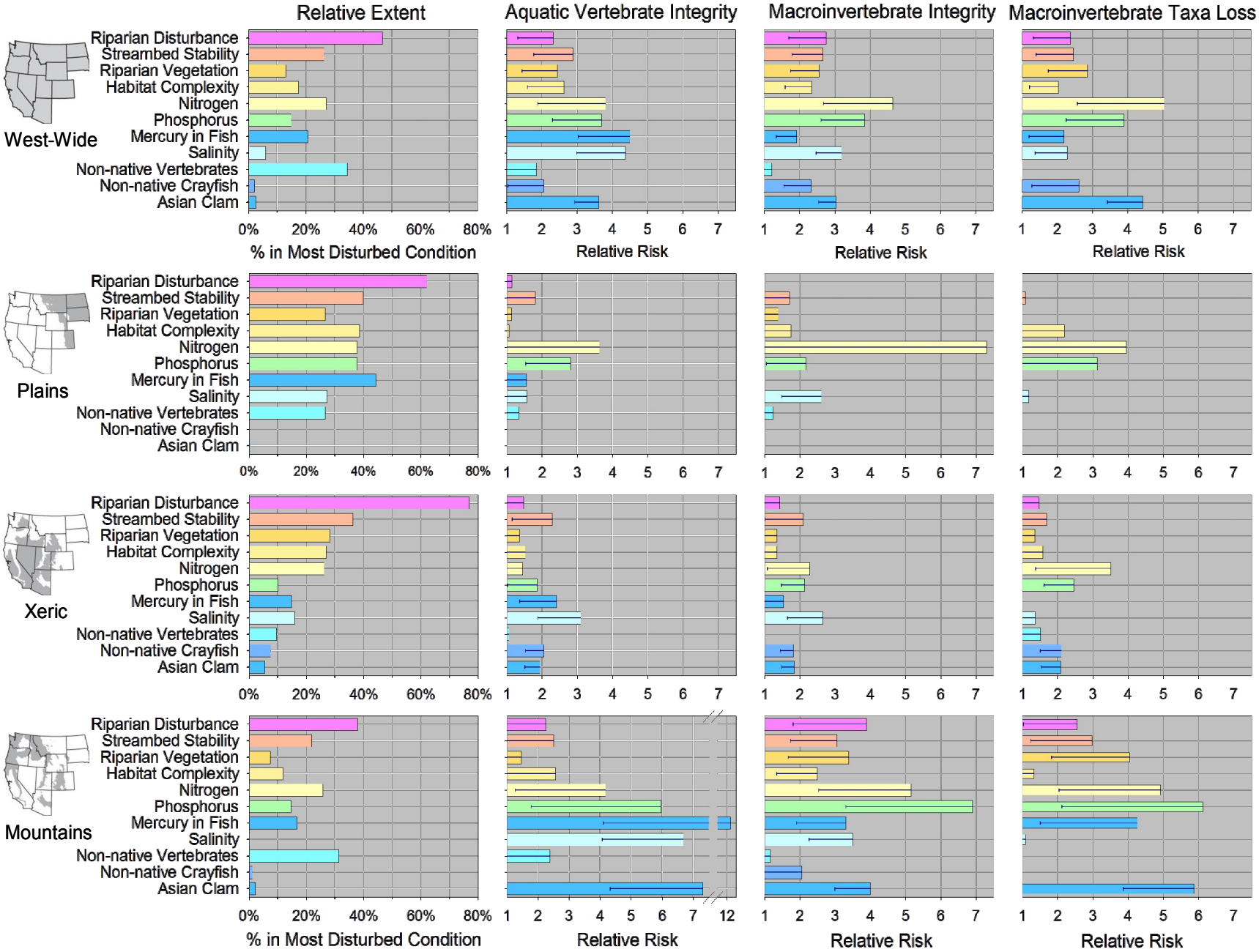
Notes –

-- If stressor has no effect then RR = 1.

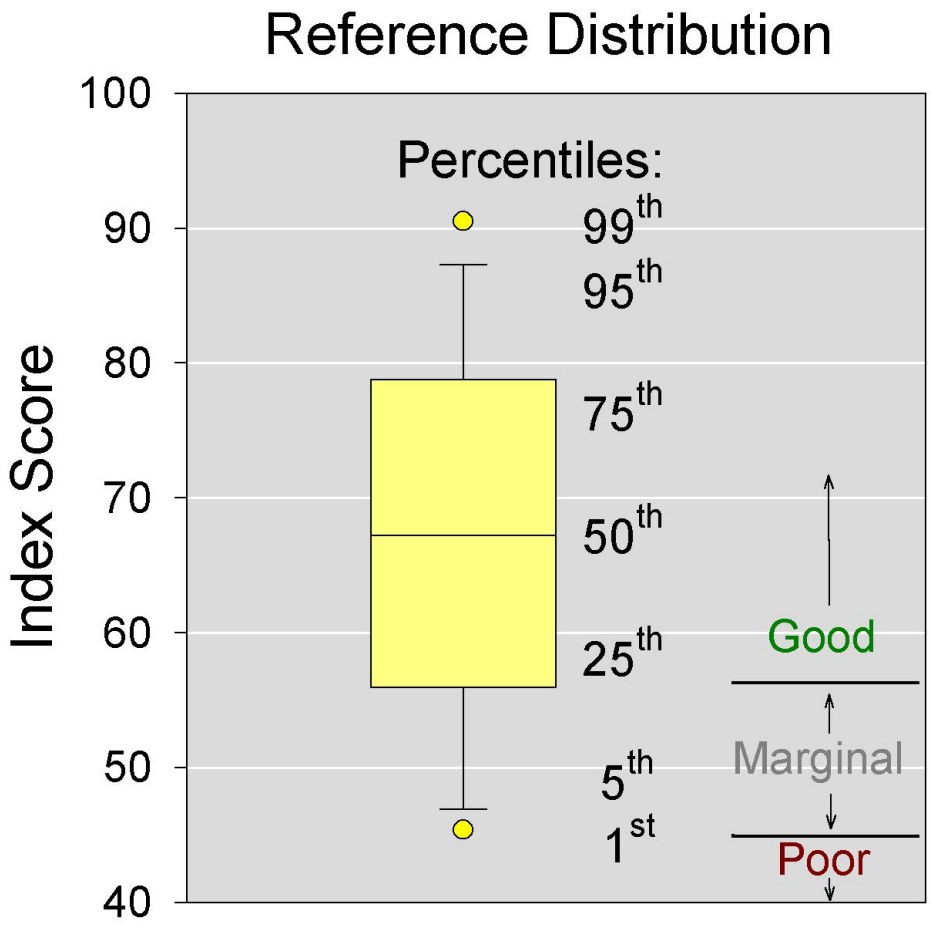
-- Can use a confidence interval to express uncertainty in the estimate of RR.

End – spare slides follow.

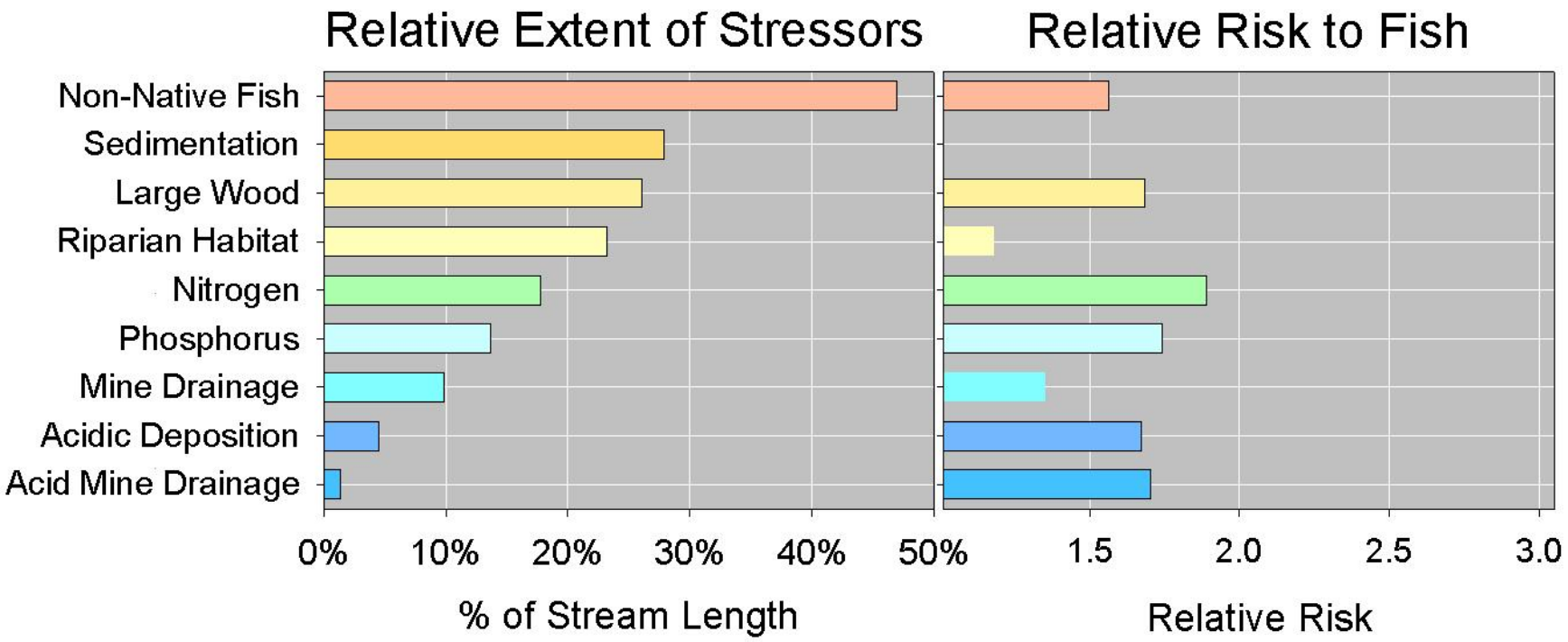
Relative risk and relative extent estimates for EMAP-West



Step 1 -- Define classes of "Good" and "Poor" condition for fish IBI and for each stressor, based on their continuous scores observed at reference sites.



MAIA: Relative extents of Poor conditions for 9 stressors and their relative risks for Poor fish IBI



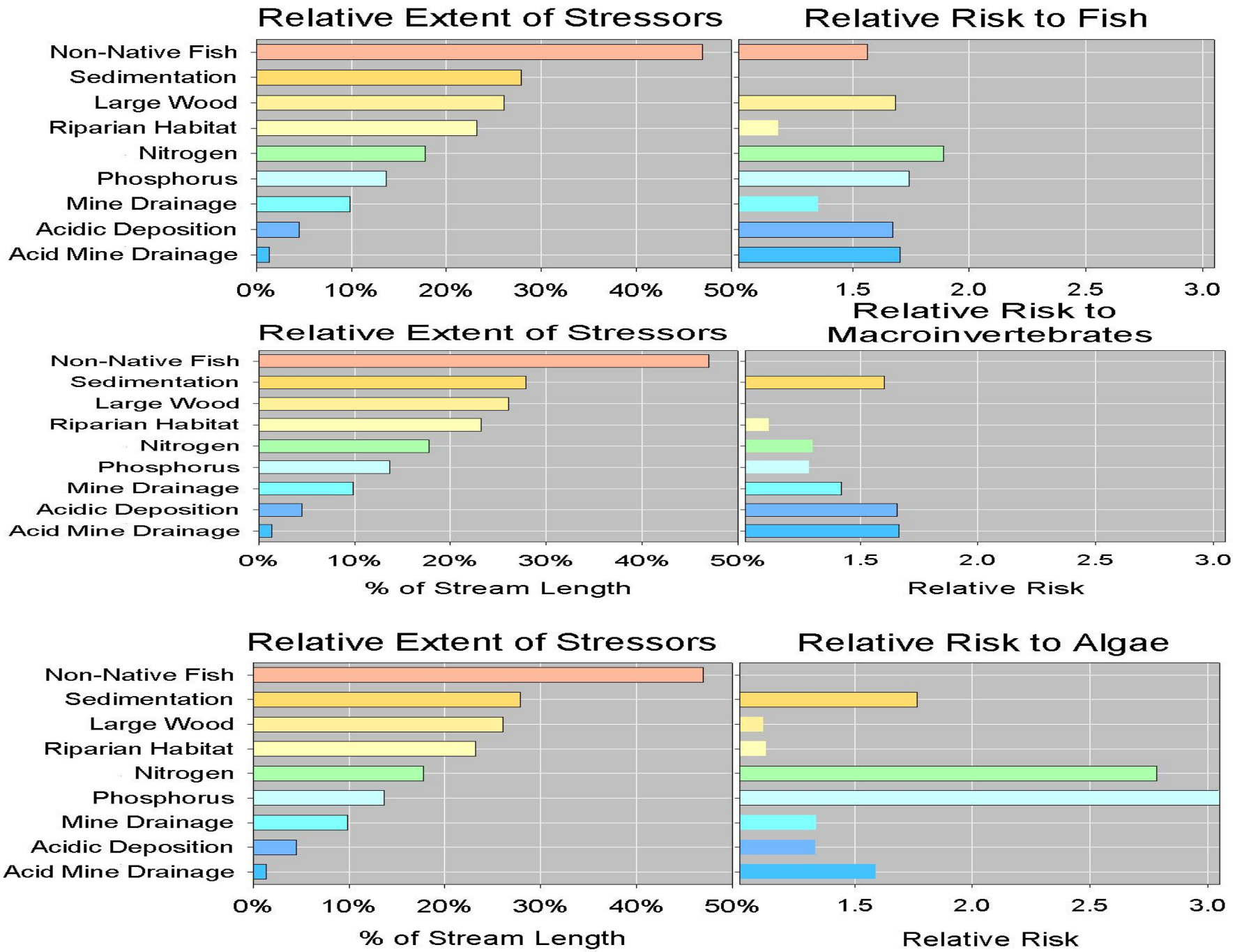
Summary

Challenges in using relative risk to help assess stressors–

--- Does not model joint effects of correlated stressors.
--- Employs condition classes (‘Poor’ vs. ‘Good’).

Advantages –

-- Familiar to general public because of human health applications.
-- Employs condition classes (‘Poor’ vs. ‘Good’).
-- Works together with stressor extent to give an overall picture of the relative importances of multiple stressors.


Relative Extent of Stressors
Relative Risk to Fish
Non-Native Fish
Sedimentation
Large Wood
Riparian Habitat
Nitrogen
Phosphorus
Mine Drainage
Acidic Deposition
Acid Mine Drainage
0%
10%
20%
30%
40%
50%
1.5
2.0
2.5
3.0
Relative Extent of Stressors
Relative Risk to Macroinvertebrates
% of Stream Length
Relative Risk
Relative Extent of Stressors
Relative Risk to Algae
% of Stream Length
Relative Risk

Example of fish IBI versus the LWD stressor

Step 3: Construct two-way tables of “Good” and “Poor” condition, based on all sampled sites.

Number of sites

	LWD GOOD	LWD POOR
Fish IBI GOOD	56	15
Fish IBI POOR	46	23

Estimated stream length (km)

	LWD GOOD	LWD POOR
Fish IBI GOOD	24040	4470
Fish IBI POOR	20170	14750

Step 4

Relative Risks (MAIA assessment)