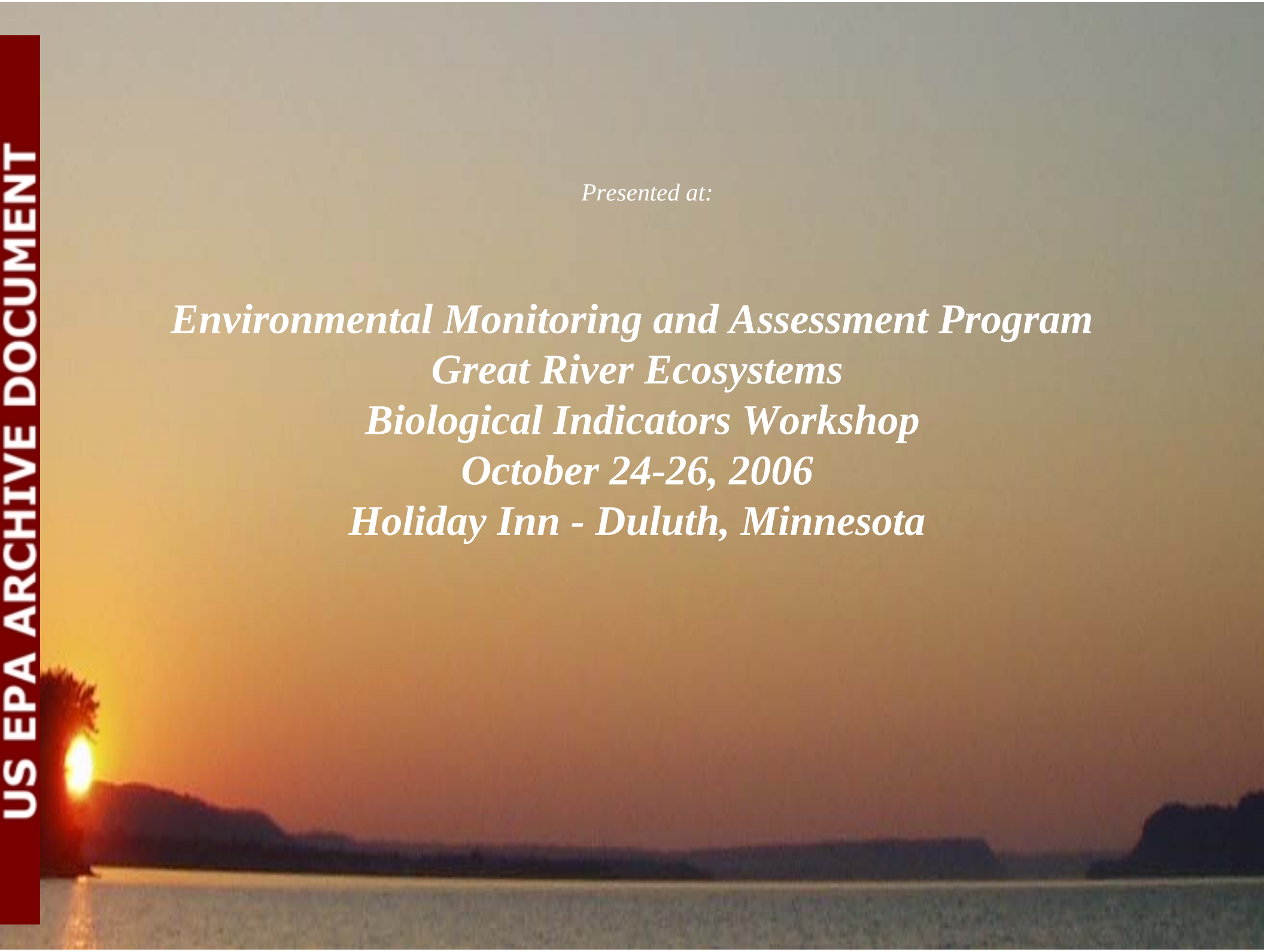

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Using Relative Risk for Regional-Scale Assessment of Stressor Effects

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How important is an aquatic stressor?

-- An important stressor has **broad extent**
(high percentage of river length has elevated stressor levels).

AND

-- At elevated levels, an important stressor **impacts biota**.

-- Cannot directly assess stressor impact from survey data.

-- Indirect assessment:

Relative risk measures the strength of association between elevated stressor levels and degraded biota.

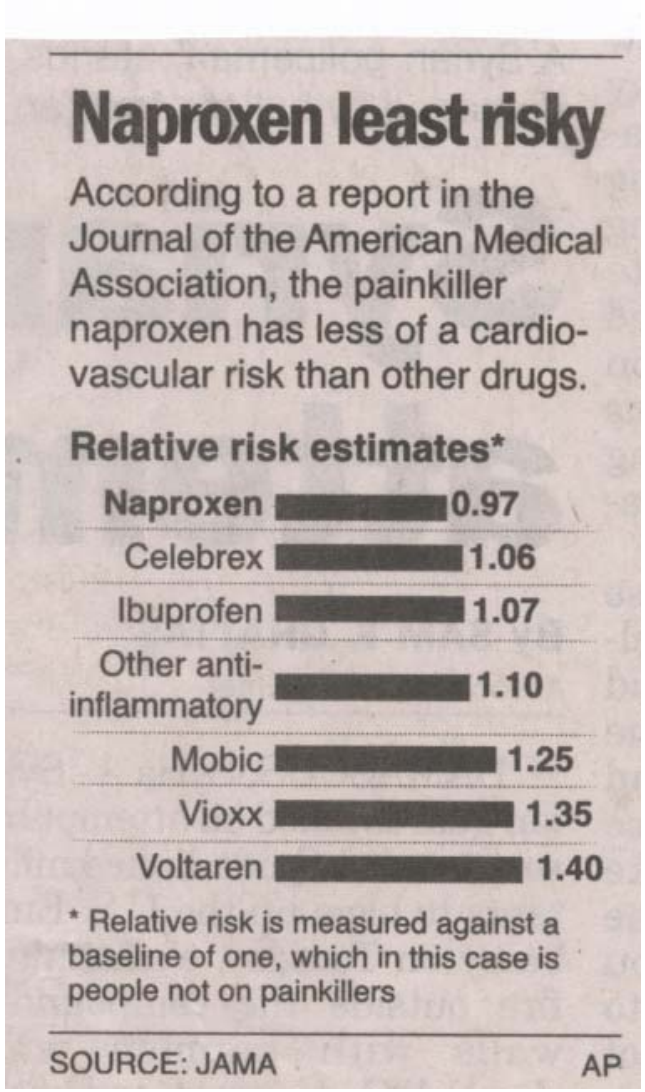
Why "relative risk"?

-- Widely used in human health assessment.

Relative risk setup:

Stressor: Painkilling drug.
Drug is either taken, or not taken.

Response: Cardiovascular event (stroke).
Stroke either occurs, or does not occur.



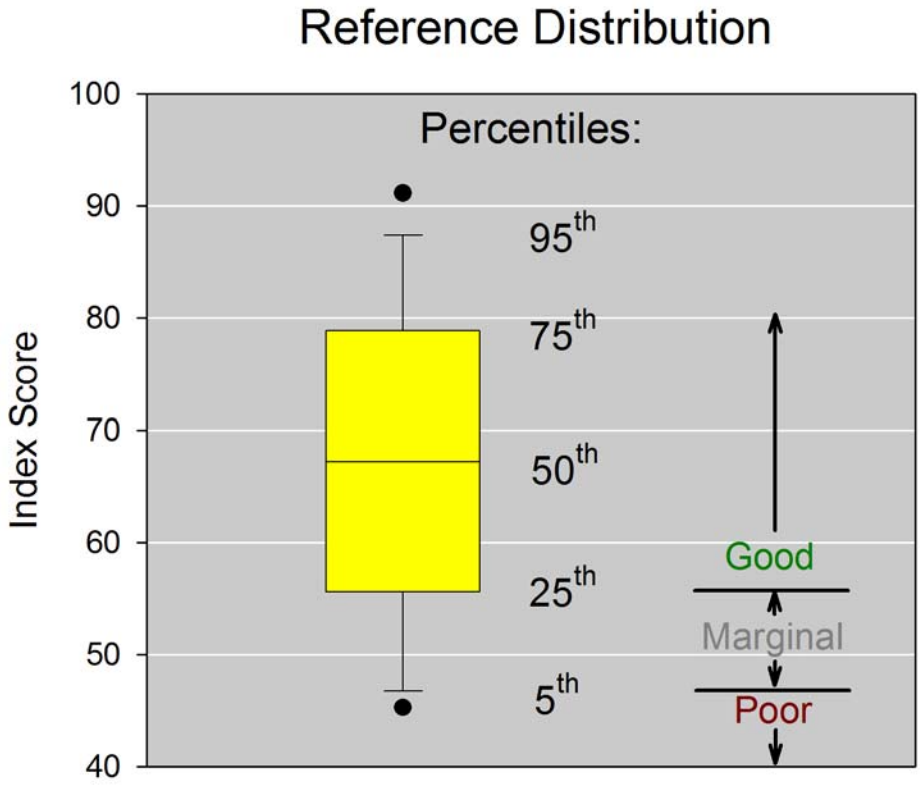
Corvallis, OR, "Gazette-Times", Sept. 13, 2006

Applying relative risk to rivers

-- For each sampled site, determine condition classes:
"Poor" (Most disturbed), "Marginal", or "Good" (Least disturbed)
(Assign condition classes independently for each stressor and response).

-- Estimate number of sites (or river miles) in various condition classes.

-- Note: Can use distributions of continuous stressor/response index scores at reference sites to define thresholds for "Good", "Marginal", "Poor".



Example: Relative risk of Poor macroinvertebrate IBI when the excess-sediment (ExSed) stressor is also Poor.

Percent of stream length

	ExSed GOOD	ExSed POOR
IBI GOOD	59	4
IBI POOR	18	19
Total	77	23

(Risk of **Poor** IBI, given **Poor** ExSed) =
19/23 = 0.83

Also --
(Risk of **Poor** IBI, given **Good** ExSed) =
18/77 = 0.23

Result: The risk of Poor IBI when ExSed is Poor is higher than the risk when ExSed is Good.

Relative Risk (RR) is the ratio of these 2 risks

$$RR = \frac{\Pr(\text{Poor IBI, given Poor ExSed})}{\Pr(\text{Poor IBI, given Good ExSed})} = \frac{0.83}{0.23} = 3.6$$

So: **"The risk of Poor IBI is 3.6 times greater in streams with Poor ExSed than in streams with Good ExSed."**

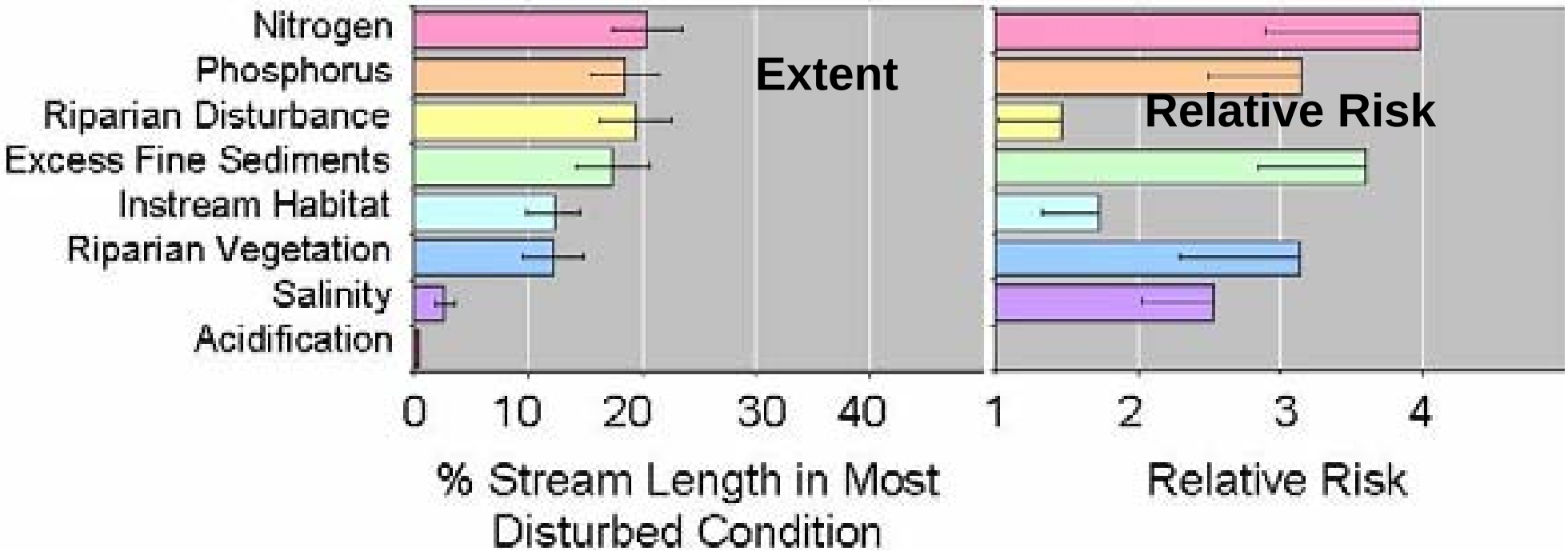
Notes –

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

-- Use a confidence interval to express uncertainty in RR.
(EMAP software for the R language calculates RR and its confidence interval. Free, at www.epa.gov/nheerl/arm/ . Also, see Van Sickle et al., Environmental Management, in press).

-- Sites in "Marginal" condition for either the stressor or the response were not included in RR estimate.

WSA Western region: Extent of Poor condition for 8 stressors, and relative risk of stressors for Poor macroinvertebrate IBI



% of Stream Length

Relative Risk ratio

Summary

Challenges in using relative risk –

--- May not capture joint effects of multiple, correlated stressors.

--- Employs condition classes (‘Poor’ vs. ‘Good’).

Advantages of using relative risk –

-- Familiar language for general public.

-- Employs condition classes (‘Poor’ vs. ‘Good’).

-- Together, RR and stressor extent can assess the relative importance of different stressors.