

US EPA ARCHIVE DOCUMENT

Notes that accompany risk_wrk_shp.pdf

Slide 1.

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

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Slide 2.

Shows westside relative extents of 11 stressors, and their relative risks for 1 bio indicator, aquatic vert MMI.

The extent barplot shows how widespread are Poor conditions for the various stressors.

The righthand barplots show how severe are the effects of Poor stressor conditions, on Aquatic vertebrate MMI, in those streams where Poor stressor conditions do occur.

In our example, we are going to estimate the relative extent & relative risk for Total N. Our example will get different results from those shown here, because it applies to Region 10 only, not to entire EMAP-West sample region.

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Three initial steps. We use things like bug, fish MMI, or bug O/E as bio response variables..

-- Will not walk through all the R mechanics of doing these initial steps.

They can be done in R, in SAS, or in spreadsheets.

However, will give you an example of R code for assigning condition classes to each site;

-- We will assume that you have already constructed a data set with condition classes assigned for

each site and each variable. I will use words like Good and Poor condition, although we were more euphemistic in EMAP-W (least and most-disturbed).

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Definition and calculation of relative extent.

Concept of relative risk.

Slide 6.

Example of calculating relative risk, where LWD is the stressor. Data is from a different study (MAIA)

Fish IBI is the endpoint of concern (ie, response variable).

We construct a 2 x 2 contingency table containing estimates of the percent of stream miles in each class of the combo of Good and Poor for stressor and IBI. Each cell entry is the sum of EMAP weights across all sites in that class, expressed as a percent of the total of the 4 cells.

Note that sites in Fair condition for either MMI or LWD are not included.

So we are contrasting the 2 extreme classes of condition.

We chose to do this because we were most confident that those 2 classes really do represent distinctly different conditions.

But you can set up the RR analysis using any 2 classes of stressor vs response.

Based on this table, we estimate 2 risks (ie, probabilities).
The first is the risk of Poor IBI, for those streams having Poor LWD.
But it is hard to interpret this risk without comparing it to a baseline.
As a baseline, we estimate the second risk, which is the risk of finding Poor IBI in those streams where LWD is in Good condition.

As you can see, there is a much higher risk of Poor IBI when LWD is Poor than when it is Good.

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Finally, relative risk is just a single number representing the ratio of these 2 risks. Can interpret it as shown.

All calcs in this and previous slide are done by psurvey.analysis, -- just want you to see what you are getting.

Note that a stressor has no effect if $RR=1.0$. That is, you are equally likely to find Poor IBI in streams with Poor LWD as in streams with Good LWD.

Can construct a CI for RR. If the CI does not include 1.0, than can conclude that RR is “significant”.

No time to discuss confidence intervals further here.

Read about them in MAIA report.

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Relative risk and relative extent results for Western EMAP.
Shows relative extents of 11 stressors, and their relative risks for 3 indicators of biological condition.

Too small to see here, but the point is that relative extent and relative for many cases can be compactly displayed, very useful for assessments.

Next slide zooms in to upper left corner.

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Optional slide – Info on how we define thresholds of poor or good condition for stressors or IBI’s that are continuous variables.

Method requires identification of Reference sites – no time to go into how, just assume you can do it.

-- Note that some sites are called “marginal”, and we omitted these from our severity assessment.

-- For RR to work, need to define classes in such a way that neither "Good" nor "Poor" conditions are rare.

-- For some stressors, we could not define reference conditions and had to use expert judgment to set thresholds.

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Here are relative extents relative risks to fish IBI for the 9 stressors.
Assess stressor importance by interpreting them jointly.

For example, of the 4 most widespread stressors, only 2 of them (Introduced fish, LWD) have any significant relative risk for Poor fish IBI condition.

Elevated N and P conditions have a strong association with Poor fish IBI, but these stressors are not as widespread, occurring in 18% or fewer streams.

Poor conditions of acidification (ANC < 0) also had high relative risks for fish where they did occur, but they occurred in fewer than 5% of stream miles.

Overall, most important stressors are probably introduced fish and large wood.

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Challenges –

RR estimates stressor associations one at a time. Does not necessarily reflect the joint effects of several correlated stressors.

There are some regression/correlation methods that can partly decompose joint effects, but no general solution to this problem.

Our current research is working on the problem.

From a strict science standpoint, the use of condition classes (Good vs Poor) is undesirable because info may be lost and class thresholds may appear arbitrary.

Advantages:

RR measure may be better understood by general public than, say, a regression slope, because RR widely used in human health reporting.

From standpoint of communicating with the general public, condition classes have an advantage over continuous measures of stressor and biological condition.

Finally, The EMAP group likes RR because of how it compliments standard EMAP reporting of stressor extent (percent of stream miles in Poor condition). RR uses the same condition classes and the same language (RR is derived from percents of stream miles in various combos of stressor and IBI condition).

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RR is based on a set of prevalence estimates. We count the number of sampled sites in each of the combos of good and Poor for stressor and endpoint, put result in 2-way table.

- If all your sites are sampled with equal probability, can use this table to compute RR
 - If unequal probability, then construct another 2 way table by summing up the sample weights for sites in each class, to estimate total stream length.

Note that these lengths do not add up to total length, because we have omitted all sites that are “marginal” for either sediment or bug IBI.

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Here are RR estimates for 9 stressors and 3 biological endpoints.

Yellow bars denote RR values w/ confidence intervals that do not include 1.0 (no effect).

These are ‘statistically significant’.

Note that different endpoints seem to be responding to different stressors.