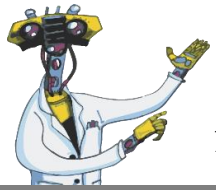

Meta-analysis

Tutorial: The Meta-analysis video tutorial can be found on the MEDDLE for Multiple Drivers Research YouTube channel.

Speaker: Kristy Kroeker, University of California, Santa Cruz

Video: Christina McGraw, University of Otago, New Zealand

Transcripts: Rebecca Zitoun, University of Otago, New Zealand

Resources: The complete resources for the *Best Practice Guide for Multiple Drivers Marine Research* are available on the MEDDLE website.

0:00 - *Introduction*

We are going to talk a little bit about meta-analysis now and why you might want to consider meta-analysis, or synthesis, before you start your own experiment.

Text (0:14): A meta-analysis is a quantitative way of summarising the results of multiple experiments or studies.

Meta-analysis is really just a quantitative way of summarising the literature. So it is *not* a review. In fact, there are well developed statistical techniques that people use to actually quantitatively summarise the results of other experiments or studies, or multiple experiments of your own.

It is a research endeavour in and of itself. It takes a lot of time to collate the data and do the analysis for these, but they can be incredibly useful especially for policy makers and non-specialists, who want to understand the lay of the land, or understand what we know, and generalities that they can start to glean from the scientific community that might be useful for decision making.

Text (0:44): Meta-analysis are especially useful for policy makers and non-specialists.

0:59 – *How can we compare the results from different studies?*

Some of the things that are really important to know about meta-analysis is that, when you are doing a meta-analysis it is kind of like trying to compare apples and oranges. We do a number of things to try to make results as comparable as we possibly can, so that it is more like comparing tangerines to oranges than apples to oranges, the example I started with.

Text (1:12): The challenge is to male results from different studies comparable

We will comb through the data to try to increase our sample size and really capture the entire literature and the number of experiments that have been done on a particular subject.

1:33 – *Ensure the data from your study is accessible*

So if you want your data included, it is best that you actually make your data accessible. One way that you can do this is making sure that you put your data in an online data repository when you are done with your research or make it accessible in a paper.

Text (1:37): Tip 1 – Make your data available in an online repository

1:50 – *Clearly indicate your error estimates*

Another thing you might want to consider if you want your data included in meta-analytic efforts is to make sure that your error estimates are very clear.

Text (1:59): Tip 2 – Make sure your error estimates are VERY clear

When we calculate a mean or an effect size for a particular question, what we often do is we weight by the error or the replication in a study.

Text (2:12): In a mate-analysis, studies are weighted by their error or replication

So it is really critical - it seems so simple, but you will be surprised how often it doesn't happen - but it is so critical, that you actually report what your error bars are. Are those standard deviations? Is it standard error of the mean? Is it a 95 % confidence interval?

Text (2:23): Clearly define all error bars in your manuscript

That [definition of error bars] needs to go onto every Figure in your paper, very clearly in the legend. It is a simple rule, but it would make it so much easier to actually include that data in these synthesis efforts.

2:44 – *Clearly explain your experimental design*

Another thing you might consider, is really clearly explaining your experimental design and what I mean here is actually the 'n' [or 'experimental unit] that you use in your statistical analysis.

Text (2:47): Tip 3 – Clearly state the number of experimental units (n) at the level being measured. (See the Data Analysis video tutorial for more information)

So when we work on multiple stressors, we often have these really complicated experimental designs with tanks nested in tanks nested in tanks, but we need that 'n' to actually weight the effect size when we are doing our analysis. So if you can report that ['n'] in your study that would be really helpful.

Text (3:13): Tip 4 – Report the location and conditions of your sample collection

In addition, you might want to report where your organism were collected and the background conditions that those organisms come from. This is going to help us interpret the results or why some results might be quite different from others.

Text (3:28): Consider making your treatment levels comparable with other studies.

And then the last thing you might consider is any way that you can make your treatment values more comparable to others. So for example, in a multi-stressor experiment you might want to look at the effect of two different factors on a large response surface on organismal performance. If you are looking at global change drivers you might consider something like the year 2100 as one of your treatment levels, or our projections for that year, just so we can compare with other studies that often use those values. So you don't want it to drive your design, but if there are ways to work it into your design, so that you can be compared to other studies, it just increases the chances that your work will contribute to really our broader knowledge on this subject and then hopefully to inform policy makers, decision makers and other users of the research.

To learn more about meta-analyses and multiple driver research, please see Global Change Biology 19 (6), 1884-1896 (2013) and Ecological Letters, 11, 1305-1315 (2008).