**Methods planning document**

Latest update: 3/15/2022

The purpose of this document is to help you think through the entire process associated with developing methods to address your research questions. A side benefit is that completion of this planning document should make writing the methods section for your work much easier. This outline should be applicable to almost all studies we conduct, but there are inevitably exceptions to every rule. If you are working through this outline and find yourself struggling to fit your study in the prompts, try some more and then reach out to someone for suggestions.

1. What is/are your research question(s)?
2. What are the variables you will be measuring? What are the units for each? How is each variable measured or defined (if calculated)?
   1. Dependent/response
   2. Independent/explanatory
3. For each variable: what do you expect your data to look like?
   1. What type of data will it be: continuous, counts, proportions, percentages, categories?
   2. What general range of values do you anticipate?
   3. Do you expect many outliers?
   4. Do you expect a lot of values to be ‘0’ or ‘below detection’?
   5. Can you reasonably expect the values to be normally distributed? (If not, that’s okay.)

1. What is the sampling design, and why is the study set up this way? A diagram and/or map can help communicate this. Consider:
   1. How many stations do you have (and where)?
   2. What are you sampling at each station (and why)?
   3. How frequently are you sampling for each variable (and why)?
   4. What are your replicates?
   5. How are your data points related to each other? Think about relationships in both space and time – do you expect sites closer to each other to be more similar? Do you expect to see seasonality?
2. How will you summarize your data and any patterns/results you find?
   1. Summary statistics: will you want to show mean, standard deviation, range, sample size, etc. for each variable, perhaps by group? Consider making an empty table here, into which you can insert those values when you get them. (Does this work to communicate about your data overall, or to help you understand what you’re dealing with?)
   2. Figures: sketch out, conceptually, the main figures you envision making. What will they look like? What will you communicate through them?
3. What will you want to test statistically?

Now it’s time to start thinking about what you want to test statistically. Refer back to your responses to the questions above to help with this exercise. Are you wanting to determine if size distributions of organisms change over time? Are you wanting to determine if wave energy/erosion/plants/animals are different in one area vs. another? Get very specific here for each variable you think you should test statistically!

Because statistical tests ultimately involve math (done in the background by your computer program), each research question needs to be thought of like an equation, and each piece of the equation (variable) must be clearly definable as a number or matrix. Imagine someone asking “what do you mean by that, exactly?” for each variable – especially your response variable(s) – until you have a very specific definition for each piece of your data that will go into a statistical test.

* 1. If you are testing a difference between groups:
     1. What are your groups? How are they defined (think about spatial and temporal relationships described above)?
     2. How many samples do you have per group?
     3. What are you expecting to be different between groups?
     4. What procedure is typically used to test for this type of difference in your field?
     5. If you have more than two groups, what sort of analysis will you do to figure out, and show, which groups are different from which others? How will you control for the fact that you’re performing multiple comparisons? [LINK TO SOME RESOURCE ABOUT THIS]
  2. If you want to look for relationships between variables:
     1. Are all of your data points independent, or might they be related (in space and/or time)?
     2. Do you want to include more than one potential explanatory variable?
     3. Are you most interested in describing the direction and strength of a relationship, or in finding the best way to predict your response variable from your explanatory variable(s) in a new situation?
     4. Are there other variables that could impact the relationship you want to examine? How will you account for these? Can you measure them as part of your project?
  3. If you are looking at some sort of community:
     1. How are you defining “community” to represent it in tabular form: what are your rows (samples), and what are your columns (species: counts/relative abundances/presence-absence)?
     2. Will you calculate richness and/or diversity metrics?
     3. What are you expecting to be different between groups, and on what scale (spatially, temporally)?
     4. What type of community analysis do you anticipate using?

1. What are the statistical results you will present? What is commonly presented (or *should be* presented) for someone to understand the output of your intended statistical test?
   1. See also question 5, as your data summaries and patterns will likely tie in with what you display here.
   2. This will be ***more than just a p-value*** and likely belongs in a table. Think: sample size, degrees of freedom, test statistic, confidence intervals, slope and R^2 (for regression-type analyses), etc.