Chapter 4

Biodiversity: measuring biological integrity

4.1 Background information

Quantifying biodiversity is an active area of research for ecologists and conservationists. Organisms have evolved alongside each other, and developed adaptations that allow them to thrive in different niches. The interactions between these organisms, and between these organisms and their environment can be incredibly complex. How diverse communities are, and how diversity changes area to area, can tell us a lot about a system. How do we even measure diversity? Or how similar 2 areas are? Alpha-diversity is a measure of biodiversity at a single location, while gamma-diversity is the cumulative diversity in a particular region of interest. Beta-diversity links the two, and is a measure of variable the subsets of gamma-diversity are (Fig. 4.1).

Scientists have been arguing for years about the best way to measure biodiversity, but at its heart all biodiversity metrics are a way to compress complex information into an interpretable number. A coarse analogy would be the Body Mass Index (BMI) score. Humans are comprised of assemblages of cells and organ systems, and we could measure the health of a single individual in thousands of different ways. The BMI score is a simple way to compress that information into a single number that we can use to assess relative 'health'. We can do something similar for biodiversity! I do not want you to conflate 'health' with 'biodiversity', but it is a useful starting point.

Benthic macroinvertebrates (Fig. 4.2) are a useful group of study organisms because they are incredibly diverse, and are important ecological indicators of the physical and chemical characteristics of their ecosystem. Some are incredibly sensitive to changes in dissolved oxygen or pH, or will struggle if sediment loads into the stream from the surrounding landscape is too high. Stream ecosystems are linked to the areas around them (their watershed). Think of some ways that humans influence the landscape - then Google how those changes influence aquatic environments (most anthropogenic impacts are very well studied).

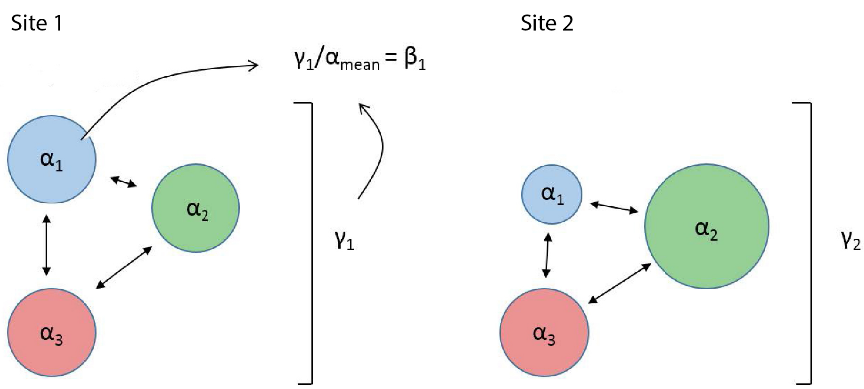

Figure 4.1: Schematic representation of how alpha (sample level), gamma (region level), and beta (sample variability) diversities are related. For each stream you have multiple measures of alpha-diversity (taxa richness), with one measure of gamma and beta-diversity per stream.

Figure 4.2: Example macroinvertebrate (Order: Trichoptera) that you will collect in the field and identify under a dissecting microscope. Caddisflies frequently have elaborate shells built from materials around them in the stream.

4.2 Objectives

We collected macroinvertebrates from 2 sites in central Texas that differed in anthropogenic impact using 1 m^2 kick-screens. Neils Creek is a relatively unimpacted site, with some pasture, farmland, and forrest in its watershed, while Harris Creek is surrounded by heavy farming activity and neighborhoods. Actually, the Fall 2017 class collected the Harris Creek data for you, but you get the idea. You will use this data to answer the following questions:

1. Does anthropogenic impact influence biodiversity?
    - Assess this question by calculating alpha, gamma, and beta-diversity for the 2 sites.
2. Does anthropogenic impact influence the EPT taxa in a stream?
    - Assess this question by calculating the %EPT in each sample.

4.3 Lab report specifics

1. Introduction
    - Why is biodiversity important?
    - How is biodiversity measured?
    - Why are macroinvertebrates useful?
    - Objectives
    - Hypotheses
2. Methods
    - Experimental design and field work
    - laboratory work
    - Calculations / statistics
3. Results
    - Question 1 (text **AND** graph)
    - Question 2 (text **AND** graph)
4. Discussion
    - Hypotheses rejected/supported
    - Provide a coherent explanation/interpretation of your results