Task 4

Part1 – Biodiversity of ant communities along an elevational gradient

Dataset: dat4_ants_elevation.xlsx

Description of the data set:

This data set includes samples of ant communities along an elevational gradient. The sampling used a hierarchically nested design. The basic sampling unit are $1m^2$ plots for which abundance counts for all species are available.

Sites ranged in elevation from 379-1828 m and were in relatively undisturbed deciduous forest sites, away from trails. At each site, there is one randomly placed 50 × 50 m plot, from which 16 1-m^2 quadrats were arranged in a nested design: 10 x 10 m subplots were placed in the corners of each 50 x 50 m plot, and 1-m^2 quadrats were placed in the corners of each 10 x 10 m subplot, for a total of 16 1-m^2 quadrats per site. Ants were sampled by collecting all the leaflitter within each quadrat and sifting through it with a coarse mesh screen (1-cm grid) to remove the largest fragments and concentrate the fine litter. Concentrated litter from each quadrat was then put in its own mini-Winkler sacks for 2 days in the lab. After 2 days, all worker ants were extracted and enumerated.

The main question is now, how ant diversity at different scales (alpha, gamma, and beta) changes along the elevational gradient

Tasks:

- How many samples (1m2 plots) were taken at each elevation?
- Provide appropriate measures of alpha ($1m^2$) and gamma-diversity (16 x 1 m^2 plot) for each elevation.
- Apply standardized biodiversity comparisons for species richness along the elevational gradient using:
    - Equal sampling effort (i.e. equal no. of samples)
    - Equal no. of individuals (i.e. individual-based rarefaction)
    - Equal coverage (i.e. coverage-based rarefaction)
- Calculate beta-diversity for each elevation and its partitioning into turnover and nestedness components.
    - Use multisite measure of beta-diversity NOT pair-wise measures
- Visualise the relationship of all biodiversity indices with elevation

Part 2 – Taxonomic composition of arthropods along plant diversity gradient in the Jena Experiment

Datasets:

- JenaExp_arthropod_taxa.csv
- JenaExp_treatments.csv

Description of the data set:

The Jena Experiment (https://the-jena-experiment.de) is the largest and the longest grassland biodiversity experiment in Europe. It is located in city Jena in Germany. On 80 experimental plots (each of 20 x 20 m in size) the number of plant species and the presence of four different plant functional groups (legumes, grasses, tall herbs and short herbs) were experimentally manipulated. In 2010 the arthropod communities were sampled on each plot. The dataset called **JenaExp_arthropod_taxa.csv** includes community composition for each plot (called "plotecode") of arthropods with the arthropod taxa and their abundances. The dataset called **JenaExp_treatments.csv** includes the treatment variables of the Jena Experiment:

"Plant_SR" – species richness (number of species) of plants sawn on the plot: 1, 2, 4, 8, 16, 60 species

"Grasses" – presence of grasses (0-absent, 1-present);

"Legumes" – presence of legumes (0-absent, 1-present);

"Short.Herbs" – presence of short herbs (0-absent, 1-present);

"Tall.Herbs" – presence of tall herbs (0-absent, 1-present);

Main questions:

- **Are there patterns in the taxonomic composition of arthropods along the plant diversity gradient?**
- **What are the effects of plant species richness and of the presence of each plant functional groups on the taxonomic composition of arthropod communities?**

Tasks:

- Explore if there are patterns in the taxa composition of arthropods across the plant diversity gradient. Create an ordination diagram of taxa and plots for the first two ordination axes. Colour the plots based on the level of plant species richness of each plot. Investigate any patterns in the taxonomic composition of arthropods.
- Post-hoc, analyse the effects of the plant-diversity treatments (i.e., plant species richness, presence of grasses, legumes, small herbs and tall herbs) on the community composition of arthropods. Add vectors representing these effects to the ordination diagram.
- Describe the results of the ordination and of the post-hoc analysis:
    - Identify the plant-diversity treatments with the strongest effect.

- Determine which drivers have similar and different effects on community composition.
- Identify the arthropod taxa that occur most frequently and least frequently at high and low plant diversity levels.
- Identify the arthropod taxa that associate most with grasses.