Diversity Analysis Results – Interpretation Guide

Findings from the Analyses

Alpha Diversity (within-site diversity)

1. Mean species richness: 21.6 species per site
    a. Range 3-42 species
    b. Mean Shannon Diversity 10.8
    c. Mean Simpson Diversity 7.1
2. Interpretation
    a. Most sites have moderate diversity
    b. Difference between Shannon and Simpson means that while sites may have many species, a few dominant taxa make up most of the abundance
    c. Range between sites is highly variable

Gamma Diversity (Regional Diversity)

1. Example year 2010
    a. Total regional diversity was 29
    b. Average site diversity was 19.3
    c. So each site has about 2/3 of the regional species pool
2. Pattern across years
    a. Low years 7-12 species (90s)
    b. High years 17+ (2003)

Beta Diversity (Between-Site Diversity)

<u>Hill Numbers (β = γ/α)</u>

1. Key Results:
    a. Years with **β ≈ 1**: One 1 site sampled, so no turnover
    b. Years with **β = 1.2-1.6**: Low turnover, sites are fairly similar
    c. Years with **β = 1.6-1.9**: Moderate-High turnover, sites differ
2. Pattern Observation:
    a. Most years show beta_q0 > beta_q1 > beta_q2
        i. Rare species create more turnover than common species
        ii. Common/dominant species are shared across sites
        iii. Site differences are driven by which rare species are present
    b. Example year: 1997
        i. β_q0 = 1.875

        1. Species composition changes ~2 times across sites
    ii. β_q1 = 1.906
        1. Similar pattern when accounting for abundance
    iii. β_q2 = 1.937
        1. Even the common species are showing turnover

Jaccard Index (presence/absence)

1. Key Results:
    a. Mean Jaccard dissimilarity ranges from 0.36-0.75
    b. Most years are between 0.5 and 0.7 (moderate to high dissimilarity)
2. Interpretation
    a. 0 = identical communities, 1 = completely different
    b. Sites typically share 30-50% of their species
    c. High Jaccard values indicate strong compositional differences
3. Interesting Finding (2010)
    a. Mean Jaccard was 0.70
        i. 15 pairwise comparisons
        ii. Relatively high turnover even within this one year

Bray-Curtis (abundance based)

1. Key Results:
    a. Mean Bray-Curtis ranges from 034-0.85
    b. Most years between 0.5 and 0.8
2. Interpretation
    a.
3. Comparing with Jaccard
    a. Similar or slightly higher in Bray-Curtis than Jaccard
        i. Abundance differences contribute to this dissimilarity
        ii. Sites differ in species present and in their abundances

Results Interpretation

Alpha Diversity

Alpha diversity across sites averaged 21.6 ± 8.9 taxa (range: 3-42, n = 141 sites). Hill-Shannon diversity (q=1) averaged 10.8, while Hill-Simpson diversity (q=2) averaged 7.1, indicating that while sites contained moderate species richness, communities were typically dominated by a few abundant taxa.

Beta Diversity

Beta diversity, calculated as γ/α following Jost (2007), ranged from 1.2 to 1.9 across years (q=0), indicating moderate community turnover. The pattern β_q0 > β_q1 > β_q2 observed in most years suggests that rare taxa drove community differentiation, while common taxa were more uniformly distributed across sites. Jaccard dissimilarity averaged 0.58 ± 0.15, and Bray-Curtis dissimilarity averaged 0.65 ± 0.16, indicating moderate to high compositional differences among sites. The similarity between presence/absence (Jaccard) and abundance-based (Bray-Curtis) metrics suggests both species composition and relative abundances contributed to community differentiation.

Gamma Diversity

Regional gamma diversity ranged from 7 to 29 taxa per year (mean = 12.3), with individual sites capturing an average of 65% of the regional species pool.

Common Questions about Results

Why is beta_q2 sometimes less than 1?

This can occur with very small sample sizes (2 sites) due to rounding or when common species are MORE evenly distributed than expected. Check years where this occurs - they likely have only 2 sites.

Why do some years have NA for Jaccard of Bray-Curtis?

These years (1994, 2002, 2003, 2006, 2008) had only 1 site sampled, so pairwise dissimilarity cannot be calculated (need at least 2 sites).

What's a 'good' beta diversity value?

It depends on your system:

- *β ≈ 1: Sites are essentially the same (low heterogeneity)*
- *β = 1.5-2: Moderate heterogeneity (typical for streams with environmental gradients)*
- *β > 3: High heterogeneity (strong environmental gradients or barriers to dispersal)*

Should I use Jaccard or Bray-Curtis if I have abundance data?

They answer different questions:

- *Jaccard: "Do sites have different species?"*
- *Bray-Curtis: "Do sites have different species AND different abundances?"*
- *If they're similar → compositional differences dominate*
- *If Bray-Curtis >> Jaccard → abundance differences are important*