ABUNDANCE & DIVERSITY OF SPECIES

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AUTECOLOGY & SYNECOLOGY

- Aut- (itself), Syn- (together)

- Populations (autecology)
  - One species
  - One location
  - One time

- Communities (synecology)
  - Assemblage of species
  - One location
  - One time
SPECIES ABUNDANCE

- Rare
- Common
- Abundant

Community assemblages
- Many common
- Few rare
- Few abundant
SPECIES RICHNESS

- Total number of species in each community
- Both communities have 4 species
  - Species richness is equal for both communities
SPECIES RICHNESS

- \( D = \frac{s}{\sqrt{N}} \)
- \( S = \) number of species present in sample
- \( N = \) total number of individual organisms
SPECIES RICHNESS

- Community A
  - 14 total individuals (N)
  - 4 species present (s)
  - \( D = \frac{4}{\sqrt{14}} = \frac{4}{3.74} = 1.07 \)

- Community B
  - 14 total individuals (N)
  - 4 species present (s)
  - \( D = \frac{4}{\sqrt{14}} = \frac{4}{3.74} = 1.07 \)

Species richness is the same in both communities!
SPECIES EVENNESS

- Relative abundance of each species to others
  - In other words, how equal are the numbers of each species
  - One abundant species can reduce diversity of the community
SPECIES DIVERSITY

- How many species are present?
- How evenly represented is each species?
  - Does one population dominate the community?

- To answer this, we have to calculate richness but include evenness

- Shannon-Weiner Index
  \[ H' = \sum (p_i)(|\ln p_i|) \]
  - \( p_i \) = proportion of individuals of a species to all individuals
  - \(|\ln(p_i)| = absolute\ value\ of\ natural\ log\ of\ p_i \)
SHANNON INDEX

- $H' = \sum (p_i)(\ln p_i)$
Community A
14 individuals total (N)

4, so \( p_i = \frac{4}{14} = 0.29 \), thus \( \ln p_i = \ln 0.29 = 1.24 \), and \( 0.29 \times 1.24 = 0.36 \)

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3, so \( p_i = \frac{3}{14} = 0.21 \), thus \( \ln p_i = \ln 0.21 = 1.56 \), and \( 0.21 \times 1.56 = 0.33 \)

3, so \( p_i = \frac{3}{14} = 0.21 \), thus \( \ln p_i = \ln 0.21 = 1.56 \), and \( 0.21 \times 1.56 = 0.33 \)

And finally, \( H' = 0.36 + 0.36 + 0.33 + 0.33 = 1.38 \)

The Shannon Index of Community A is 1.38
Community B
14 individuals total (N)

2, so \( p_i = \frac{2}{14} = 0.14 \), thus \( \ln p_i = |\ln 0.14| = 1.97 \), and \( 0.14 \times 1.97 = 0.28 \)

9, so \( p_i = \frac{9}{14} = 0.64 \), thus \( \ln p_i = |\ln 0.64| = 0.45 \), and \( 0.64 \times 0.45 = 0.29 \)

1, so \( p_i = \frac{1}{14} = 0.07 \), thus \( \ln p_i = |\ln 0.07| = 2.66 \), and \( 0.07 \times 2.66 = 0.19 \)

2, so \( p_i = \frac{2}{14} = 0.14 \), thus \( \ln p_i = |\ln 0.14| = 1.97 \), and \( 0.14 \times 1.97 = 0.28 \)

And finally, \( H' = 0.28 + 0.29 + 0.19 + 0.28 = 1.04 \)

The Shannon Index of Community A is 1.04
SHANNON INDEX

- So, Community A (1.38) > Community B (1.04)

- Community A has a higher diversity
  - Each species has an even amount on individuals

- Community B has a lower diversity
  - One species is abundant, while the others are rare