More than a species count

Biodiversity is the variety of life. Assess it at genetic, species and ecosystem levels; one measurement cannot describe every aspect of that variety.

1. GENETIC DIVERSITY

Variation in alleles within a species or population. It provides the raw material for evolutionary responses to changing conditions. A large population of genetically similar individuals need not have high genetic diversity.

2. SPECIES DIVERSITY

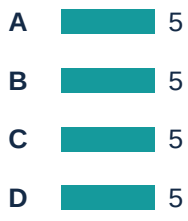
Species richness is the number of species present. Species evenness describes how evenly individuals are distributed among those species. Both contribute to species diversity; abundance is not the same as richness.

3. ECOSYSTEM DIVERSITY

The number and range of ecosystems and habitats in an area, such as woodland, grassland and ponds. Ecosystems include interacting organisms and their physical environment, not just lists of species.

4. SAME RICHNESS, DIFFERENT EVENNESS

Sample X: 5, 5, 5, 5



Sample Y: 17, 1, 1, 1



Each sample contains 20 individuals and 4 species (A-D). X has greater evenness and a higher Simpson diversity value. The counts are illustrative; bar length represents number of individuals.

Genetic, species and ecosystem levels: OpenStax, Biology 2e 47.1.
Richness and relative abundance: Field Studies Council, Calculating Biodiversity.
Website lesson numbering; Cambridge scope: 18.2.2-3 and 18.2.6.
Cambridge 9700 syllabus: pp. 45-46; Simpson formula: p. 65.

Calculate Simpson's diversity

Use the Cambridge form shown below: find the proportion belonging to each species, square each proportion, add the squares, then subtract the total from 1.

1. KNOW THE SYMBOLS

$$D = 1 - \sum \left(\frac{n}{N}\right)^2$$

n = individuals of one species

N = individuals of all species

Σ = add the term for every species

2. WORK THROUGH SAMPLE Y

Species	n	n / N	(n / N) squared
A	17	0.85	0.7225
B	1	0.05	0.0025
C	1	0.05	0.0025
D	1	0.05	0.0025
Totals	**20**	**1.00**	**0.7300**

D = 1 - 0.7300 = 0.2700

3. COMPARE WITH THE EVEN SAMPLE X

Each species has proportion 5/20 = 0.25. The sum of squared proportions is 4 times 0.0625 = 0.25, so D = 0.75. X is more diverse by this index, despite having the same richness and total abundance as Y.

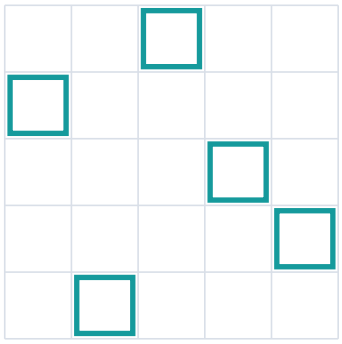
Do not square the sum of the proportions: that sum is 1. Square each species' proportion first, then add. Keep unrounded values until the final answer.

Formula and symbol definitions: Cambridge Biology 9700, p. 65.
Worked counts and calculations: original illustrative examples.
Website lesson numbering; Cambridge scope: 18.2.2-3 and 18.2.6.
Cambridge 9700 syllabus: pp. 45-46; Simpson formula: p. 65.

Make the comparison meaningful

A diversity index is only as informative as the sample behind it. Standardise collection and identification before interpreting a numerical difference between sites.

1. CHOOSE LOCATIONS WITHOUT PERSONAL BIAS



Define the study area and use random coordinate pairs to locate quadrats. Every eligible location should have an equal chance of selection. Do not choose only species-rich patches or simply throw the quadrat.

Schematic grid: outlined cells show example sample locations, not species counts.

2. KEEP THE SAMPLING EFFORT COMPARABLE

Use suitable quadrat sizes, adequate repeats and the same identification rules. Compare equivalent areas and similar sampling times or seasons. Record the abundance of each species consistently. Rare or difficult-to-detect species may be missed, so observed richness is an estimate.

3. READ D IN THE CORRECT DIRECTION

For this formula, D = 0 when all individuals belong to one species; larger values indicate greater diversity. With S equally abundant species, D = 1 - 1/S. Thus 4 equally abundant species give 0.75, not 1. The index has no units.

A higher D does not automatically mean a healthier habitat or prove a significant difference. It does not identify which species are present or measure genetic diversity. Compare like-for-like data and report sampling limitations.

Random sampling and survey design: Field Studies Council, Sampling - The Basics.
Quadrat placement and abundance measures: Science & Plants for Schools.
Website lesson numbering; Cambridge scope: 18.2.2-3 and 18.2.6.
Cambridge 9700 syllabus: pp. 45-46; Simpson formula: p. 65.