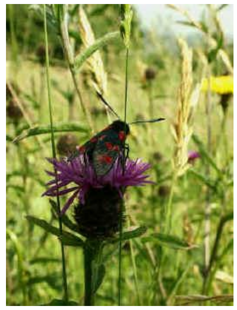
# Simpson's Diversity Index



Simpson's Diversity Index is a measure of diversity. In ecology, it is often used to quantify the biodiversity of a habitat. It takes into account the number of species present, as well as the abundance of each species. Before looking at Simpson's Diversity Index in more detail, it is important to understand the basic concepts outlined below.

**Biological Diversity -** the great variety of life

Biological diversity can be quantified in many different ways. The two main factors taken into account when measuring diversity are richness and evenness.

**1. Richness**

Richness is a measure of the number of different kinds of organisms present in a particular area. For example, species richness is the total number of different species present in a community. Some communities may be simple enough to allow complete species counts to determine species richness. However, this is often impossible, especially when dealing with insects and other invertebrates, in which case some form of sampling has to be used to estimate species richness.

**2. Evenness**

Evenness is a measure of the relative abundance of the different species making up the richness of an area.

*A community dominated by one or two species is considered to be less diverse than one in which several different species have a similar abundance.*

As species richness and evenness increase, so diversity increases. Simpson's Diversity Index is a measure of diversity which takes into account both richness and evenness.

**Simpson's Index** (**D**) measures the probability that two individuals randomly selected from a sample will belong to the same species (or some category other than species).

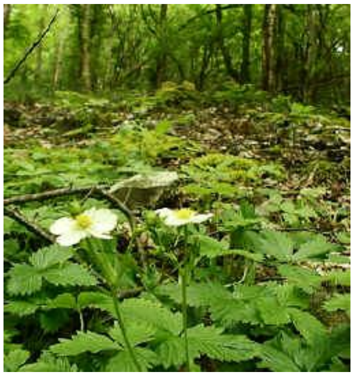
$$D = \frac{\Sigma\, n(n-1)}{N(N-1)}$$

The value of **D** ranges between 0 and 1

With this index, 0 represents infinite diversity and 1, no diversity. That is, the bigger the value of D, the lower the diversity.

**Simpson's Index of Diversity** 1-D

The value of this index also ranges between 0 and almost 1, but now, the greater the value, the greater the sample diversity. This makes more sense. In this case, the index represents the probability that two individuals randomly selected from a sample will belong to different species.



To calculate Simpson's Index for a particular area, the area must first be sampled. The number of individuals of each species present in the samples must be noted.
For example, the diversity of the ground flora in a woodland area might be tested by sampling random quadrats. The number of plant species within each quadrat, as well as the number of individuals of each species is noted. There is no necessity to be able to identify all the species, provided they can be distinguished from each other.

As an example, let us work out the value of **D** for a single quadrat sample of ground vegetation in a woodland. Of course, sampling only one quadrat would not give you a reliable estimate of the diversity of the ground flora in the wood. Several samples would have to be taken and the data pooled to give a better estimate of overall diversity.

| **Species** | **Number (n)** | **n(n-1)** |
|---|---|---|
| Woodrush | 2 | 2 |
| Holly (seedlings) | 8 | 56 |
| Bramble | 1 | 0 |
| Yorkshire Fog | 1 | 0 |
| Sedge | 3 | 6 |
| Total (**N**) | **15** | |
| **Σ n(n-1)** | | **64** |

Putting the figures into the formula for Simpson's Index

$$D = \frac{\Sigma\, n(n-1)}{N(N-1)}$$

$$D = \frac{64}{15(14)}$$

$$D = \frac{64}{210}$$

D = 0.3 **(Simpson's Index)**

**Then:**

**Simpson's Index of Diversity 1 - D = 0.7**

Simpson's Index gives more weight to the more abundant species in a sample. The addition of rare species to a sample causes only small changes in the value of **D**.

## Calculating Biodiversity

The diversity of species present in an ecosystem can be used as one gauge of the health of an ecosystem, but how can we measure the biodiversity of en ecosystem? One way is to use a biodiversity index, a mathematical formula that takes into account species richness and species evenness. Species richness refers to the number of different species present in an ecosystem, while species evenness measures the relative abundance of the various species.

In this activity we will use the Simpson Index to compare the species diversity (different makes of cars) of two ecosystems (parking lots). The formula for Simpson's Index is:

| | |
|---|---|
| $D = \dfrac{\Sigma\, n(n-1)}{N(N-1)}$ | **Simpson's Index of Diversity 1 – D** |
| **n = the total number of organisms of a particular species**<br>**N = the total number of organisms of all species** | |

The value of **D** ranges between 0 and 1, with 0 being the most diverse and 1 the least diverse. Since this is counterintuitive, you can use Simpson's Index of Diversity, 1 – D, or Simpson's Reciprocal Index, 1/D. For this activity use Simpson's Index is of diversity.

**Procedure:**

1. Answer the Pre-Lab Questions
2. Organize your team so that you collect your data as quickly as possible. Count at least **30 cars** in the lot.
3. Calculate the total number of different species in the parking lot.
4. Calculate the Simpson Diversity Index for the parking lot.
5. Answer all the conclusion questions.

**Name:________________________________**

**Simpson's Diversity Index**

**Pre Lab:**

1. What is the Simpson's Index?
2. What is the difference between species richness and species evenness?
3. What is the formula for the Simpson's Diversity index?
4. What does each of the letters represent?
5. What does a value of 0 represent compared to a value of 1?

**Data Table – Parking Lot Data**

| Species | Number (n) | n(n-1) |
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| **TOTAL (N)** | | |

**Calculations:**

**Questions:**

1. List the single most abundant species in each set of data. Why might this species be the most abundant?

2. If you conducted this survey at a mall parking lot, would the Diversity Index be high or low?

3. If you conducted this lab at a new car dealership, predict whether the Simpson Diversity Index would be high or low, and how it would compare to the school parking lots?

4. Explain the species richness of the parking lot.

5. Explain the species abundance of the parking lot.