**How do we measure biodiversity?**

When we study natural populations, one statistic we want to know is how many individuals of a species occur in a given study area. We can get at this number through various techniques that include mark-recapture, repetitive mark-recapture, transect analysis, and quadrat analysis. However, it is also important to know how many species occur in a given study area and how the community of interacting populations is structured. Species richness is the total number of species of a given taxon (e.g. birds, orthopterans) or group (e.g. macroinvertebrates, trees) in a given unit area. However, species richness does not take into account that the individuals of one or two species may be dominant in proportion to all the other individuals of other species. For example, we may discover that the entirety of a given small forest patch supports 12 species of wood warbler (birds in the family Parulidae) in the summer. Yet, when we consider how many individuals of each species are contributing to the total of wood warblers, we may find that Yellow-rumped Warblers are by far the dominant species. We then survey the same size area in a much larger forest for wood warbler species richness. Again, we find that the forest is composed of 12 warbler species. However, each species contributes nearly the same number of individuals to the total number of wood warblers.

Are the two sampled areas equal with respect to species diversity? Which forest can we conclude is more diverse with wood warblers?

We need a diversity measure or diversity index that measures species richness AND the number of individuals representing each species at the same time.

[Watch this video](https://www.youtube.com/watch?v=WbrMFtblAT4) about how to calculate the Simpson’s Biodiversity Index!

The Simpson’s Index of Biodiversity is an equation that takes both into account. The index essentially measures the probability that two randomly selected individuals from a sample will be the same. The formula for calculating the value of the index (𝐷) is

*D* = diversity index

*N* = total number of organisms of all species found

Σ = the sum of

*n* = number of individuals of a particular species

**Here is an example of a problem:**

It is a good idea to tabulate the findings. Here, the different species seen at two sand dune sites are compared.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Location 1** |  | **Location 2** |  |  |
| **Species** | n (# of individuals) | n-1 | n(n-1) | n (# of individuals) | n-1 | n(n-1) |
| sea crouch grass | 21 | 20 | 420 | 18 | 17 | 306 |
| sea twitch grass | 1 | 0 | 0 | 11 | 10 | 110 |
| sea rocket | 8 | 7 | 56 | 8 | 7 | 56 |
| prickly saltwort | 1 | 0 | 0 | 3 | 2 | 6 |
| lyme grass | 12 | 11 | 132 | 7 | 6 | 42 |
| **N** (total # of individuals) | 43 |   |   | 47 |   |   |
|  |  | **∑ =** | 608 |  | **∑ =** | 520 |

For Location **A**: 𝐷 = 1 - 608 𝐷 = 1 - 608 𝐷 = 1 – 0.337 **𝐷 = 0.663**

 43x42 1806

For Location **B**: 𝐷 = 1 - 520 𝐷 = 1 – 520 𝐷 = 1 – 0.241 **𝐷 = 0.759**

47x46 2162

The higher value at Location B shows that Location B appears to be more diverse in species than Location A.

**Ecologists**, such as those working for the Environmental Agency, are interested in species diversity. This is because diversity is usually proportional to the stability of the ecosystem: the greater the diversity the greater the stability. The most stable communities have large numbers of species which are fairly evenly distributed in good-sized populations. Pollution often reduces diversity by favoring a few dominant species. Diversity is therefore a factor in successful conservation management. A diversity index takes into account the number of species present, as well as the abundance of each species. Species diversity should not be confused with species richness. The number of species per sample, e.g. plants in a 1m2 quadrat, can be used as a measure of richness. Or a consolidated species list may be built up of all the species found in a habitat or ecosystem over a period of time. These are useful for comparing different areas, but just counting species will not allow comparison of diversity.

**Questions:**

1. What is the difference between species evenness and species richness?
2. How do the evenness and richness of a species tie into the diversity?
3. An African park contains 15 lions, 94 giraffes, 1000 wildebeests, 50 elephants, and 5 hyenas. Calculate the Diversity Index of the park.
4. A meadow contains 1532 chestnut oaks, 342 black cherry trees, 12 white ash trees, and 1022 yellow birches.
5. An area of the Black Forest in Germany contains 134 pitch pines, 24 douglas firs, and 53 red pines.
6. According to your calculated diversity values, which of the 3 communities appears to be more diverse?