5.9 BIODIVERSITY

What is biodiversity and how do we measure it?

The term **biodiversity** is used to describe the variety of life. In a specific area, we can try to measure how diverse the range of living organisms present is. A **habitat** is a place where an organism lives. It often provides sufficient conditions for the organisms there to survive, and most organisms tend to be well-adapted to their habitats. One **species** is a group of individuals which share anatomical, physiological and biochemical characteristics, look similar and can successfully interbreed to produce fertile offspring.

In chapter 5.8 Sampling, you learned about some of the different sampling methods available for sampling sessile and motile organisms. But why sample? Sampling can be used to *measure* biodiversity.

One key factor to measuring biodiversity is **species richness**. This is the number of different species found in a habitat. We say that the more species there are present in a habitat, the more species rich it is. The second key factor is **species evenness**. This is a measure of the relative numbers, or abundance, of individuals in each species. The best measures of biodiversity will combine a consideration of both of these two factors.

Estimating species richness tends to be fairly easy. This involves conducting a *qualitative* survey of a habitat to assess how many species there are in the area. Estimating species evenness, however, is generally more difficult. This needs a *quantitative* survey using some of the sampling methods from the previous chapter, which you know have their scientific drawbacks.

MEASURING SPECIES POPULATIONS

There is no easy way to accurately measure the population of a species in a habitat, but there are some fairly simple ways of *estimating* the population sizes. To estimate the number of individuals belonging to *one* species in a habitat, the **mark, release and recapture** technique may be used. Whilst for large animals, such as bears, population sizes can be counted by hand, small animals require the mark, release and recapture method to be used:

1. Using one of the methods for sampling animals covered in the previous chapter, an initial sample of animals is taken
2. Record how many individuals were captured in this first sample, and mark them all in some way
3. The batch of animals are then released back into the natural habitat
4. A second sample is taken, usually the following day
5. Record how many individuals have been captured in the second sample, and how many of those were already marked from the previous capture, and then release the sample of animals back into the wild

The formula below is used to calculate population size, based on N_1 being the number of individuals captured in the first sample, N_2 being the number of individuals captured in the second, and M_2 the number of individuals from the second sample who were already marked from having been in the first sample.

$$\text{population size} = \frac{N_1 \times N_2}{M_2}$$

SIMPSON'S DIVERSITY INDEX

Simpson's diversity index is a tool used to measure the biodiversity of a habitat. As was previously mentioned, a good measure of biodiversity will take into account both species richness and species evenness, as Simpson's index does.

The formula for the index is as below, where ***n*** is the number of individuals of given species and ***N*** is the total number of all individuals in a habitat.

$$D = 1 - \frac{\Sigma n^2}{N^2}$$

The table below displays some of the species found in habitats X and Y, and the number of individuals of each species.

	Habitat X		Habitat Y	
	n	***n^2***	***n***	***n^2***
Species A	1	1	2	4
Species B	30	900	60	3600
Species C	10	100	5	25
Species D	40	1600	2	4
Species E	12	144	1	1
Species F	7	49	30	900
	100	**2794**	**100**	**4534**

To calculate the diversity of habitat X using Simpson's diversity index, we need to know the values of *n* and *N*. We know *n* is the number of individuals in a given species, so for the formula we need to know Σn^2 which is the total of all n^2 values. The n^2 value for each species has been calculated for you in this table, and we can see the total number is **2794**. The value for *N* is simply the total number of individuals, which for habitat X is **100** as is shown. Using the index, then:

$$D = 1 - \frac{\Sigma n^2}{N^2} = \frac{2794}{100^2} = 0.7206 \approx 0.72 \text{ (to 2 d.p.)}$$

Question: Calculate the diversity of habitat Y using Simpson's diversity index

But what does the result show us? The formula will always provide you with an answer between 0 and 1. When the result is a high value, of around 0.8 or above, the habitat is said to be diverse. This means there is a wide range of species occupying the habitat, and the numbers of individuals in each species is fairly even.

When the number of the index is low, it generally means the habitat is not diverse. This means it will be largely dominated by a few species. This can be dangerous, because it means such a small change to the environment could have such a large impact on the habitat, such as a new predator or new disease.