ACTIVITY BRIEF

Ecology and Simpson's Diversity Index

The science at work

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 favouring 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 1 m^2 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.

Your brief

Environmental scientists use a variety of different methods to compare diversity in different ecosystems and to monitor the progress of conservation measures. One of the most popular methods is to use the relative abundance of different species to calculate Simpson's Index of Diversity.

You can investigate this by using ordinary playing cards as 'species' to generate data to calculate Simpson's Index, D.

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

where N = the total number of organisms of all species and

n = the total number of organisms of a particular species

from which Simpson's Diversity Index, 1 – D, is found.

Once you have an understanding of the method works you can obtain and analyse your own data.

Use:

- *Practical sheet: Using cards to investigate Simpson's Diversity Index*
- *Practical sheet: Finding Simpson's Diversity Index for an ecosystem*

PRACTICAL SHEET

Using cards to investigate Simpson's Diversity Index

You will need

- one pack of 52 standard playing cards

  The cards represent nine possible species:

Species A: all picture cards (jacks, queens and kings)	**Species B**: odd numbered clubs	**Species C**: odd numbered clubs
Species D: even numbered diamonds	**Species E**: even numbered diamonds	**Species F**: odd numbered hearts
Species G: even numbered hearts	**Species H**: odd numbered spades	**Species I**: even numbered spades

- copies of the recording sheet

Procedure

Work with a partner to investigate the following communities:

Community 1

Shuffle the cards. Count out 26 cards, this is your sample. Using the *Recording sheet*, note how many of each species (A to I) you have in your sample. Tally your results by putting an upright line in the appropriate box, /. Complete the table to calculate the Simpson index.

Note: you can make 'gates' //// with each fifth tally to make counting easier

Community 2

Remove seven jacks, queens or kings from the pack of 52 cards to leave five cards for every 'species'. Repeat as for Community 1.

Community 3

Remove the jacks, queens and kings and one of the suits from the pack of 52 cards to leave you with three suits and six 'species' with five cards each. Repeat as for Community 1.

Community 4

Make up a further community of your own to investigate. Use all of the 'species' but alter the relative numbers of cards to get the lowest diversity that you can.

Questions

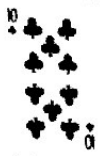
Make notes to answer these questions:

1 Why is 1 – D rather than D used as a measure of diversity?

2 Two factors affect diversity scores: (a) what are they? (b) what effect do they have?

3 How could you ensure reliability?

Recording sheet

Species		Tally	Total, n	n - 1	n(n - 1)
					
 clubs	Odds				
	Evens				
 diamonds	Odds				
	Evens				
 hearts	Odds				
	Evens				
 spades	Odds				
	Evens				
Totals		N =		$\Sigma n(n-1)$ =	
		N - 1 =	$D = \frac{\Sigma n(n-1)}{N(N-1)}$ =		
		N(N - 1) =	1 – D =		

PRACTICAL SHEET

Finding Simpson's Diversity Index for an ecosystem

If you have already sampled an area, you may be able to use the data to calculate Simpson's Diversity Index. All you need is the number of different species and the number of times each species was found (frequencies). If you are to compare ecosystems, you must use the same sampling method and compare the same organisms. So, you might look at diversity of the invertebrates in a clean and a polluted stream or the ground flora (vegetation) or insects in a woodland compared to a field.

If you already have suitable data (for example from a quadrat study or kick sampling in a stream), calculate Simpson's Diversity Index. Note that a single calculation is not much help, you need to be able to compare different areas sampled using the same technique.

If you need to collect data you will need further instructions from your teacher. One advantage of using this particular index is that you only need to be able to distinguish species, you do not need to identify them.

Representative sample

You may be restricted by time and only able to take a limited number of samples. If you have time to make a more serious study, you can use a simple technique to test that you have a sample that is truly representative of the area that you a studying. This is done by keeping a cumulative species total as each random sample is taken, i.e. the total number of different species that have been found to date. This is plotted against the sample number. After no more species have been found for three or four samples, you know that you are likely to have found them all.

Try this for practice

The following data were obtained for woodland vegetation using randomly placed 1 m^2 quadrats.

Trial number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Number of species	9	14	17	18	19	21	22	23	23	24	24	24	24	24	24

Plot the data and suggest the point at which sampling could stop.