LOOKING FOR PATTERNS

Purpose

- To carry out a study on the ecology of a habitat.
- To develop practical skills.

Observing patterns

Have you ever walked into a wood and noticed that the vegetation changes as you enter? Why do the bluebells only occur under the trees? Or have you been clambering over a rocky shore and spotted that the seaweeds grow in distinctive bands, and that you only find mussels when the tide is far out? What causes these patterns in plant and animal distribution? When ecologists study habitats they try to account for plant and animal distribution, correlating them to the abiotic and biotic factors that are affecting the habitat.

Abiotic means 'non-living' and examples of abiotic factors include light intensity, slope, humidity, wind exposure, edaphic (soil) characteristics, such as pH and soil moisture, and many more. Biotic means 'living' and examples of biotic factors include competition, grazing and predation. All species of plants and animals you encounter in the wild are very well adapted to the set of conditions encountered in their usual habitat. If they weren't they would either grow somewhere else or become extinct.

Studying patterns

Look around your local habitats and spot any patterns in distribution and abundance of organisms. You do not need to go far; you might notice something in your school grounds or the local park. You might have a look at the distribution of plants in trampled areas of the sports field or grass paths; are there any patterns that you could investigate?

1 Scientific questions and information research

- *State what you are going to investigate* – once you have identified a pattern and thought about why it might have come about, you should express this as a question to answer, a problem to investigate or a hypothesis to test.
- *Research relevant information* – once you have described the pattern, you need to use appropriate biological ideas to suggest an explanation for the pattern and to help you decide on the question or hypothesis you are going to investigate. You will also need to research how you will carry out the practical work and methods other people have used to investigate similar problems. Read the information on pages 2 and 3, which briefly mention some of the techniques that could be used. There is more detail in Practical Skills Support Sheet 6 – ecological sampling. You can also look at the weblinks that accompany this activity for more information about sampling techniques. SAPS and the Field Studies Council websites have online resources for students including detailed information on fieldwork techniques.

When you write up your plan remember to give full details of any information sources you use and comment on their reliability.

2 Planning and experimental design

- *Design an experiment that you can use to complete your investigation* – use the Developing Practical Skills Support on SNAB Online to help you plan a fieldwork investigation to test your idea.

When planning any investigation you need to:

- decide what data you are going to collect
- select a procedure that uses suitable apparatus and methods to test your question or problem
- say what measurements you will make, how they will be made, and the level of accuracy that you can expect in your measurements
- ensure you are going to collect valid data
- identify any variables that may affect the outcome of the experiment and, where possible, controls or allows for them
- identify any potential sources of error (systematic or random) and how errors can be minimised.
- decide how you will analyse the data once it has been collected
- complete a risk assessment and decide on steps to avoid or minimise any risks, including both risks to the organisms and environments being sampled (injury, death, discomfort, damage) and any risks for the researcher undertaking the investigation
- conduct a trial to inform your planning.

Have your plan checked by your teacher/lecturer before you start the fieldwork.

3 Carrying out practical work safely and ethically

Either use the plan you have created after it has been checked by your teacher/lecturer or use a method supplied by your teacher/lecturer. If unexpected ethical or safety issues arise deal with them sensibly, taking advice where needed and make a note of them. Note any possible errors.

4 Analysis and interpretation of data

When you have collected your data, you must present it in an appropriate way to help you to identify any patterns in the data. For transect data you can draw kite diagrams by hand or use a computer programme.

Analyse your data to reveal any patterns and explain the main relationships between species and abiotic factors, using scientific knowledge and statistics. Determine if your original hypothesis was correct. If you are comparing mean values for two sites you can determine if there are significant differences between the means by using a t-test. If you have suitable data, you can calculate correlation coefficients between your biotic and abiotic data. For example, you can see if there is a significant positive or negative correlation between the factor you think is responsible for the pattern and the distribution of the organisms you have recorded. Remember that correlations do not prove cause and effect.

For information on correlation coefficients, t-tests and other statistical techniques see the Maths and Stats Support.

5 Conclusion and evaluation

In your write-up, interpret your results using biological principles and concepts. Support any conclusions you make with results. Discuss the limitations of your results and conclusions based upon them, and suggest modifications that you could make to the procedure.

Some techniques for studying patterns

Completing a transect study

One of the easiest patterns to spot is zonation in vegetation and animal distribution – as you go from one place to another the vegetation and animal distribution changes. A zonation can often be explained by a gradual change (a gradient) in one or more physical or abiotic factors. A transect is often used to study zonation in vegetation or non-mobile animal distribution. A transect is a line along which systematic samples can be taken (Figure 1) usually using quadrats to determine the areas where the distribution and abundance of an organism will be sampled.

When planning a transect study you need to be sure you are collecting valid data that will test your hypothesis. You need to make the following decisions.

- The most appropriate sampling method to use (for example, random or systematic sampling).
- The position and length of any transect to use. You need to make sure your transect extends far enough to sample all the possible zones.
- The size and number of quadrats to use, and their positioning.
- The species of plants and animals you are to record. You can focus on those which would enable you to test the hypothesis under investigation (you may need to find out more about the species concerned using secondary sources).
- The method to use for measuring the abundance of each species.
- The abiotic factor(s) you are going to record. Although you may be investigating the correlation between, for example, soil moisture and the distribution of plant species, there may be other factors that could affect the distribution of organisms. It is not possible to control these variables, but you can measure them and take them into account when analysing your results.
- The appropriate method for measuring the abiotic factor(s).
- How the data will be analysed.
- How to avoid or minimise any risks when completing the fieldwork.

A pilot study in advance of the main data collection will help you make these decisions.

For details on sampling techniques, see Practical Skills Support 6 – ecological sampling – and the weblinks that accompany this activity for more detail on the use of quadrats and other sampling techniques.

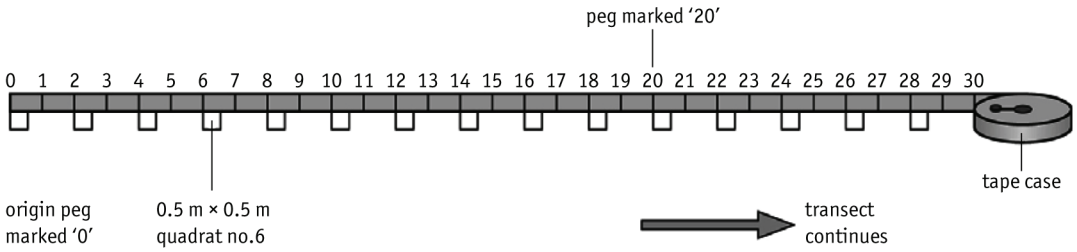

Figure 1 One way of laying out a tape measure for a transect study. Quadrats are laid down at regular intervals along the tape and the abundance of species within each quadrat is recorded.

Comparing two sites

Frequently, ecologists may notice a distinct pattern that does not show a gradual change and may be related to one or more factors at the two sites. For example, the vegetation in one area of a field may be very different to the rest of the field, or the species found upstream and downstream of an outflow pipe discharging into a river may seem to differ. A transect may not be the best method for this type of investigation; instead random sampling of each area may be more appropriate with comparison of the data collected for each area. Quadrats are frequently used to sample a larger area: information recorded from quadrats provides a representative sample of organisms' distribution and abundance for the whole area.

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The hazards will vary depending on the site chosen.

Risk assessments will minimise the risk.

Notes on the procedure

Students need to carry out a study on the ecology of a habitat to produce valid data, including the use of quadrats and transects to assess the abundance and distribution of organisms, and the measurement of abiotic factors. The Student Sheet outlines how to approach a fieldwork investigation. It briefly mentions some techniques that might be used. It does not attempt to provide detailed accounts of the techniques. Additional details are provided on Practical Skills Support Sheet 6 – ecological sampling on SNAB Online, on the SAPS website in post-16 Ecology resources and on the Field Studies Council website. The methods used will depend on the habitat and factors under investigation. Any suitable methods could be used that give students the opportunity to have first-hand experience of field data collection. The school/college grounds can be a valuable resource.

Activity 5.3 includes details of fieldwork to study succession. Other activities could be covered in a fieldwork context; for example, feeding relationships and the transfer of energy through ecosystems could be investigated through a specific habitat.

The interactive tutorial that accompanies this activity allows students to become familiar with sampling techniques before undertaking fieldwork themselves. A Microsoft Excel® spreadsheet which can be used to produce kite diagrams is included with the resources. Students could plan the investigation themselves, but then work cooperatively to collect data. At the planning stage encourage students to decide on the statistical analysis they will use. The Developing Skills Framework available in the Practical Skills Support will help when planning.

Select a site carefully

The site selected should show some clear relationships.

Some examples where transects can be used:

- *A playing field or grassy area* from an area of high trampling to an area of low trampling.
- *Woodland margin* – passing from a field or other example of grazed or mown grassland through brambles into a wood. The key gradient is likely to be light – but it may not be the only one.
- *A sand dune system* from the shore across dunes into grassland and scrub as you go further inland. In this case, the key factors could be soil moisture, soil stability and organic matter although succession is also involved here.
- *A rocky shore* from the low tide mark to the top of the beach. The key factor is the proportion of time a part of the shore is left exposed to the air and to desiccation when the tide is out.
- *A geological boundary* between two types of rock.

Some examples where two sites can be compared:

- grazed and ungrazed grassland
- mowed and unmowed grassland
- trampled and untrampled grassland
- fertilised and unfertilised lawns
- shaded and sunny sites
- fast- and slow-flowing streams
- chalk and sandy soil sites
- understories of beech and oak woodlands.

Identification – don't panic!

Identification is not as big a problem as you may think. The only species students need focus on are those that would support the hypothesis under investigation. Trying to identify each species in a quadrat down to the tiniest piece of moss can be a poor use of time and can actually prevent students from 'seeing the wood for the trees'.

A transect at a woodland margin could be successfully done recording only tree cover, grass, brambles, nettles, ivy, bare ground, wild garlic (with give-away smell) and bluebells, together with good light meter reading and soil pH (often showing no pattern), especially if you start to consider something like leaf surface area of brambles at the same time.

However, the principles are:

- Select a site where you can cope with the species identification.
- Before teaching students to identify another species ask yourself 'What is the ecological point of teaching this?'.
- Make use of expert help if available – this could include a Field Study Centre.

The Field Studies Council produce excellent laminated guides to aid with field identification in particular habitats.

The students will be relying on you for identification so careful preparation is important. You may wish to produce a record sheet which includes the species you want to focus on.

Class organisation

Students can work in groups. The smaller the group the more 'ownership' by individuals, whilst the larger the group the more quadrats can be recorded, and the bigger and statistically more meaningful the picture produced. A good size is six – working as three pairs. It helps if the whole group can have access to a computer as soon as possible after collecting the data and to a full set of equipment during data collection. Waiting to borrow equipment from other groups wastes a lot of time and loses momentum.

Pace is also important – it is possible to be too slow and nit-picking about accuracy, in which case the students become bored and lose sight of the bigger picture. It is also possible for the students to feel it is somehow 'efficient' to get the job done as quickly as possible: subsequently, data are produced that are so inaccurate and incomplete that they do not produce reliable results.

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The standard equipment required for carrying out an ecological study is detailed below. Additional items required to measure abiotic factors will depend on the site selected and type of study being undertaken.

Requirements per student or group of students	Notes
A 10–20 m tape measure	A piece of rope with 0.5 m intervals marked on it will also work.
A quadrat	Either square or point quadrats can be used. Square frame quadrats with subdivisions are useful. The 'standard' square frame quadrat is 50 cm × 50 cm, but smaller and larger ones can be used.
A clipboard	
A clear plastic bag large enough to get clipboard and hand with pencil in	So that students' notes are not damaged by rain.
Ranging poles	The geography department may have these already.
A clinometer	The geography department may have one already.
Small plastic vials or dishes	For holding invertebrates while identifying them on site or taking soil samples for later pH testing. Old camera film pots are ideal for soil samples.
A key to organisms likely to be found in the area	The Field Studies Council produces a range of excellent laminated identification guides.
Access to a compass	To describe the aspect.
Access to an OS map of the area	To accurately pinpoint the site and for background knowledge.
Small numbered pegs	At least 50.
Jam jars	For pitfall traps.
Pooter	
Sweep net	
Thermometer	For air and soil if possible.
Hygrometer	
Light meter	
Soil pin/old knitting needle	To measure soil depth.
30 cm ruler	To measure leaf/stem characteristics such as inter-nodal length etc.

For information on measuring abiotic factors see Practical Skills Support Sheet 6 – ecological sampling.