

## Core practical 16a: Investigate the effect of one abiotic factor on the distribution of one species

| Objectives  |   |
|---|---|
| <ul style="list-style-type: none"> <li>To investigate the effect of an abiotic factor on the distribution of a species</li> <li>To understand how to use transects to investigate the distribution of organisms</li> </ul>  |   |
| Safety  | Specification links   |
| <ul style="list-style-type: none"> <li>Do not throw quadrats.</li> <li>There is low risk of infection from plants or soil, which may be contaminated by animal faeces. Cover any cuts with a plaster and do not eat while working outdoors. Wash your hands using soap after fieldwork.</li> <li>There is a possibility of allergic reactions to substances such as pollen, plant sap or insect stings. Ensure students inform you immediately if they feel unwell.</li> <li>Dress appropriately for wet and cold weather. Wear sunscreen in summer months.</li> <li>If working near water, do not enter water and always work within sight of others.</li> </ul>   | <ul style="list-style-type: none"> <li>Practical techniques 5, 8, 11, 12</li> <li>CPAC 1a, 2a–2d, 4a, 4b</li> </ul>   |
| Procedure   | Notes on procedure  |
| <p>When investigating the difference between two environmentally distinct areas, random sampling within each area is appropriate. However, if we are interested in the changes in populations along an environmental gradient, a transect is a more appropriate method of sampling. Transect samples are taken systematically in a linear pattern. In this investigation you will use an interrupted belt transect to investigate the effect of one abiotic factor on the distribution of a single plant species. Light intensity is chosen as the abiotic factor in this example. An appropriate habitat to use might be a woodland area, a grassland area or a heath area.</p> <ol style="list-style-type: none"> <li>Choose a site within your study area where there is an obvious gradient in the abiotic factor, for example from a shaded area under a tree canopy or on the shaded side of a tall building to an area in full sunlight. Lay a 20 m tape or marked rope as a transect line with the 0 m mark in the full shade and the 20 m mark in full light.</li> </ol> | <ul style="list-style-type: none"> <li>Core practical 16 is to 'Investigate the effect of one abiotic factor on the distribution or morphology of one species taking into account the safe and ethical use of organisms'. This has been split into two parts. This practical investigates the effect of an abiotic factor on distribution, while Core practical 16b investigates the effect on morphology. Core practical 16a has more detailed instructions and will require less time to complete. Core practical 16b is designed to allow you to cover a wider range of skills. All CPAC criteria can be met using Core practical 16b. It would be helpful to students to complete both practicals, but this may depend on time constraints and individual students' needs for fulfilling the criteria for practical endorsement.</li> </ul> |

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| <ol style="list-style-type: none"><li>Walk along your transect. Do any species appear to change in abundance along the line? Choose which plant species you will study, then decide whether you will use percentage cover or counts of plants (density) as a measure of abundance. If you use counts, individual plants must be easy to distinguish and should not be too abundant to count easily. Write down your decisions as well as a hypothesis and null hypothesis for the relationship you are studying.</li><li>Begin at one end of the transect and lay the quadrat next to the 0 m mark of the tape. Record the abundance of your chosen species and measure the light intensity at ground level. Make sure that you do not shade the meter.</li><li>Move the quadrat 2 m along the tape and repeat.</li><li>Repeat steps 3 and 4 until you have 10 measurements along the transect.</li><li>Repeat steps 3 to 5 with the tape positioned along two more transects running from a shaded area to a lit area, so that you have repeats at each distance. Alternatively, share class data.</li></ol> | <ul style="list-style-type: none"><li>This investigation uses light as the abiotic factor. Measurement of soil moisture content along a transect from a damp area to a dry one would be a suitable alternative. The choice of habitat and abiotic factor will depend on what is available locally. While woodland or grassland habitats, as suggested here, tend to be more readily accessible, this investigation could also be carried out on a sand dune system or down a rocky shore, using the distance from the high water mark as the abiotic factor.</li><li>Measuring light intensity in a valid manner can be challenging. Make sure that students are aware of the issues at the start. If the light measurements prove to be very variable, with no obvious change from light to shade, then students could plot graphs and perform statistical analysis using the distance along the transect instead.</li></ul> |
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### Answers to questions

- Using an interrupted transect is quicker, or allows a greater distance to be covered in the same amount of time. Interpolation between quadrats can be used to estimate the overall trends.
- We can only conclude that there is a relationship, we cannot conclude that changes in light intensity cause the changes in distribution. Any patterns could be the result of other abiotic factors such as soil moisture content, or the result of biotic factors such as competition.
- Take all readings as close together in time as possible because light intensity can be very variable over short timescales, for example due to clouds passing over. It would be better to take multiple sets of readings throughout the day.

## Sample data

| Distance from north-facing wall of building/m | Light intensity/lux | Density of ribwort plantain/m <sup>-2</sup> |
|---|---------------------|---|
| 0   | 1500                | 120   |
| 2   | 1640                | 118   |
| 4   | 1460                | 76  |
| 6   | 2100                | 56  |
| 8   | 2520                | 89  |
| 10  | 3210                | 45  |
| 12  | 3290                | 23  |
| 14  | 4170                | 47  |
| 16  | 4030                | 67  |
| 18  | 4520                | 34  |
| 20  | 4250                | 35  |

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### Objectives

- To investigate the effect of an abiotic factor on the distribution of a species
- To understand how to use transects to investigate the distribution of organisms

### Safety

- Do not throw quadrats.
- There is low risk of infection from plants or soil, which may be contaminated by animal faeces. Cover any cuts with a plaster and do not eat while working outdoors. Wash your hands using soap after fieldwork.
- There is a possibility of allergic reactions to substances such as pollen, plant sap or insect stings. Inform your teacher immediately if you feel unwell.
- Dress appropriately for wet and cold weather. Wear sunscreen in summer months.
- If working near water, do not enter water and always work within sight of others.

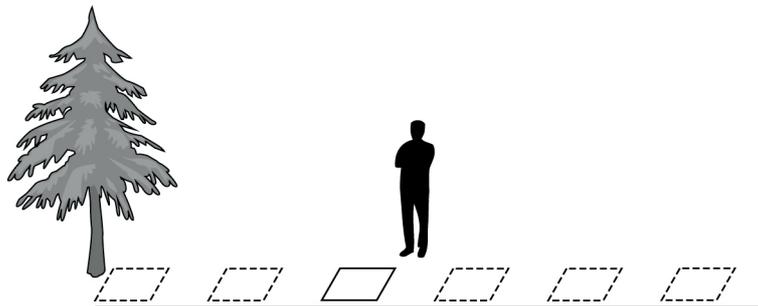
### All the maths you need

- Estimate results.
- Understand simple probability.
- Understand the principles of sampling as applied to scientific data.
- Use a scatter diagram to identify a correlation between two variables.
- Select and use a statistical test.
- Plot two variables from experimental or other data.

### Equipment

- 0.25 m<sup>2</sup> (0.5 m × 0.5 m) or 1 m<sup>2</sup> quadrat with grid
- 20 m tape measure or rope marked at 1 m intervals
- identification guide
- clipboard
- light meter or light sensor and datalogger

### Diagram



**fig A** An interrupted belt transect, showing quadrats laid at regular intervals along a tape.

**Procedure**

When investigating the difference between two environmentally distinct areas, random sampling within each area is appropriate. However, if we are interested in the changes in populations along an environmental gradient, a transect is a more appropriate method of sampling. Transect samples are taken systematically in a linear pattern. In this investigation you will use an interrupted belt transect to investigate the effect of one abiotic factor on the distribution of a single plant species. Light intensity is chosen as the abiotic factor in this example. An appropriate habitat to use might be a woodland area, a grassland area or a heath area.

1. Choose a site within your study area where there is an obvious gradient in the abiotic factor, for example from a shaded area under a tree canopy or on the shaded side of a tall building to an area in full sunlight. Lay a 20 m tape or marked rope as a transect line with the 0 m mark in the full shade and the 20 m mark in full light.
2. Walk along your transect. Do any species appear to change in abundance along the line? Choose which plant species you will study, then decide whether you will use percentage cover or counts of plants (density) as a measure of abundance. If you use counts, individual plants must be easy to distinguish and should not be too abundant to count easily. Write down your decisions as well as a hypothesis and null hypothesis for the relationship you are studying.
3. Begin at one end of the transect and lay the quadrat next to the 0 m mark of the tape. Record the abundance of your chosen species and measure the light intensity at ground level. Make sure that you do not shade the meter.
4. Move the quadrat 2 m along the tape and repeat.
5. Repeat steps 3 and 4 until you have 10 measurements along the transect.
6. Repeat steps 3 to 5 with the tape positioned along two more transects running from a shaded area to a lit area, so that you have repeats at each distance. Alternatively, share class data.

**Analysis of results**

1. Record your results in a suitable table.
2. Plot a scatter graph showing light intensity along the x-axis against plant abundance for individual quadrats (not the mean results of repeat measurements). Comment on any trends shown by the graph.
3. Carry out a Spearman's rank correlation coefficient test to determine whether there is any relationship between light intensity and abundance (as either percentage cover or individuals per square metre).
4. Comment on the strength and significance of the relationship you have investigated.

**Learning tip**

- Remember that the distribution of organisms is usually determined by a combination of a wide range of both abiotic and biotic factors. When we study the effect of one factor, all others should ideally be controlled. This is often not possible in field studies, so other factors are usually measured in order to take them into account.

**Questions**

1. What are the advantages of using an interrupted belt transect compared to a continuous belt transect?
2. If a significant correlation is found in this investigation, what can we conclude about the effect of light on distribution of the species?
3. Suggest improvements to the way in which you measured the abiotic factor of light. Explain your reasoning.

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### Equipment per student/group

### Notes on equipment

0.25 m<sup>2</sup> (0.5 m × 0.5 m) or 1 m<sup>2</sup> quadrat with grid

One per group. Gridded quadrats may be preferable if percentage cover is to be used.

20 m tape measure or rope marked at 1 m intervals

One per group

identification guide

Suitable to identify the main species in the area under study

clipboard

One per group

light meter or light sensor and datalogger

One per group. If light is not the abiotic factor that is being measured, this will need to be replaced with appropriate equipment.

### Notes