Fieldwork ideas: Ecosystems under stress

This resource is part of the toolkit that supports our AS and A-level Geography specifications (7036, 7037).

Ecosystem investigations

Geographers are concerned with examining the relationship between plant communities and their environment. Some of the factors leading to the establishment of different communities are climate, soil type, drainage, topography, aspect and geology. Fieldwork is likely to focus on one or more of these variables.

Links with the specification

"Nature of ecosystems – their structure, energy flows, trophic levels, food chains and food webs.

Concepts of succession: seral stages, climatic climax, sub-climax and plagioclimax.

The main characteristics of a distinctive local ecosystem (such as an area of heathland, managed parkland, pond, dune system).

Local factors in ecological development and change (such as agriculture, urban change, the planned and unplanned introduction of new species)"

Investigation ideas

- How is vegetation linked to soil type and gradient?
- How does microclimate vary within a woodland area?
- Are differences in vegetation linked to rock type?
- What is the link between vegetation type and variations in soil pH?
- How do different vegetation types affect organic matter content?
- How is vegetation influenced by aspect and height?
- How does position down a slope affect the type of vegetation?
- What is the effect of light on vegetation growth?
- How do deciduous and coniferous woodlands compare in age and density of vegetation, diversity of species, light intensity or soil type?
- Is there evidence of plant succession from mud flats to salt marsh (halosere) across a transect?

- How does plant species diversity across sand dunes change from shore to fixed dune?
- How does human activity affect plant cover and diversity in a sand dune environment?
- What effects do people have on a woodland area?
- What are the effects of trampling on plant species diversity?

Possible hypotheses

- Species diversity increases across sand dunes from the high water mark to the fixed dunes.
- There are significant differences in microclimate between coniferous and deciduous woodland.
- Slope, aspect and soil type influence the distribution of vegetation types.
- Changes in vegetation in a hydrosere are associated with changes in soil depth, organic matter and moisture content.
- Human activity in sand dune environments disrupts the natural process of plant succession.

Possible methods

- Point sampling and belt transects.
- Quadrat sampling of vegetation types.
- Measurement of light intensity using a light meter.
- Soil sampling-tests of soil acidity, texture and organic matter.
- Recording microclimatic data, including temperature, wind speed and relative humidity.
- Measuring the height of species, including trees (using clinometer and tape).

Sample investigation: sand dune ecosystems

Areas of consideration for interactions between the physical environment and the ecosystem could be height of dunes, gradient, aspect, soil depth and pH, salt content, moisture content, vegetation cover and microclimate features such as temperature and wind speed.

Areas for consideration for people and ecosystems could be the impacts of tourism, both positive and negative, or the management strategies employed in the dunes and their effectiveness.

Coastal sand dunes usually consist of dunes of differing ages, and a study of plant distribution on the dunes will therefore show vegetation change over time and space.

Hypothesis: Changes in vegetation across a sand dune from shore to fixed dune are associated with increased soil depth and moisture content.

The aim of the study is to examine the composition of vegetation species which exists in a sand dune ecosystem, and to investigate how this changes across a psammosere from the fore dunes through to the climax community.

Data Collection

Equipment

- 30 metre tape
- Compass
- Clinometer
- (Ranging poles)
- Quadrat
- Trowel
- Labelled plastic bags for samples
- Plant identification sheet
- (Moisture meter)
- (Thermometer, hygrometer, anemometer)

Methods

- Transects from the embryo dunes to fixed dunes or woodland, using tapes, ranging poles and clinometers.
- Sampling of vegetation cover using quadrats to identify percentage cover and the presence of specific species, or total number of species. Sampling could be systematic at equal distances from the beginning of the transect, or stratified, eg in each dune slack, or on each ridge or slope to allow coverage of different environments and microclimates.
- At each sampling point the following could also be measured: soil depth, soil colour, (an indication of organic matter), vegetation height, soil pH, wind speed, and temperature. Soil samples could be collected to be analysed later to calculate the moisture/salt content. Use sieves to see if shell content of the sand changes inland.
- Record microclimatic data. Light levels can be monitored with a lux-meter to record the amount of light reaching the vegetation canopy or the soil

surface. Wind direction can be determined with a compass, and wind speed recorded with an anemometer. Humidity can be monitored with the use of a whirling hygrometer or digital probes.

- Plant identification charts can be used to determine which species are present at specific points along the transect.
- Photographic evidence or field sketches to show changes along a transect in vegetation type, evidence of erosion from wind (blowouts for example) or footpaths and management techniques.
- Sketch map of the dune system, annotated with information including natural features, evidence of management and human impact, transect lines.

Encouraging independence during the planning and data collection phase

It is important to allow candidates to have the opportunity to demonstrate their independence in the following areas:

- planning the enquiry/posing enquiry questions and devising hypotheses
- selecting and implementing data collection techniques.

Processing the data

- To work out soil moisture, weigh a soil sample, dry in an oven for 12 hours then weigh again. To find the weight of organic matter, place the dried sample in an oven at 500 degrees C for two hours.
- Calculate % vegetation cover and type from quadrat data.

Presentation of data and statistical analysis

- Annotated dune transect profiles, showing changes in slope shape and vegetation type.
- Tables to show slope and vegetation recordings along the transect(s).
- Located bar/pie charts showing vegetation cover or type.
- Kite diagrams showing species distribution.
- Tables and bar graphs to show the depth soil/soil pH/wind speed/temperature/moisture/shell/salt content as it changes along the transect.
- Scattergraphs to show link between variables, eg distance inland vs number of plant species.
- Spearman rank correlation test to show association between selected variables, eg distance from the sea and organic content, or height of vegetation, or depth of soil.

- Use the Mann-Whitney U test and Chi-squared tests to compare two or more different areas of the dunes, eg comparing embryo with fixed dunes.
- Annotated or overlaid sketches and photographs.

Analysis

Moving inland you might expect to find greater vegetation cover, deeper soil, higher soil moisture content, and lower soil pH.

Does the type and amount of vegetation change inland? Is there a significant difference in the species diversity and composition at different areas of the dunes? Suggest possible explanations. How did the shape of the dunes change inland? Can this be linked to vegetation type? How did soil conditions and microclimate vary with vegetation across the dunes? Is there evidence of plant succession (disappearance of certain species, appearance of others)? How did other factors such as human activity affect the vegetation? Is it possible to describe the stages in the succession on the dunes?

Possible limitations

- It is important to keep the transect on a straight line across the sand dune system and to take a number of profiles across the width of the dunes for comparative purposes.
- The presence of some plant species may be dependent upon the season, and as a result the outcomes of the investigation may vary depending on the time of year.
- Human impact can considerably alter the features of the dune transect.

Extending the study

- Use Simpson's Diversity Index, which is a measure both of species richness (ie, the number of different species present) and species evenness (ie, how evenly distributed each species is).

  $D = N(N-1) / \Sigma n(n-1)$ where D = Simpson's Diversity Index n = the number of individuals of each species N = the total number of individuals.
- Investigate changes in dune shape with distance from the sea. Is there a correlation between slope angle and percentage plant cover?
- Focus on the effects of human activity on the dune, recording the impacts of footpath erosion and reduced vegetation cover caused by trampling. Comparisons could be made of intensively managed and relatively unmanaged areas.

In this type of study there is scope for many alternative investigations on the same theme. These can be carried out individually or extracted from the larger database collected by the group, such as:

- What effects do wind speed and humidity have on sand dunes and their vegetation?
- How do soil depth/moisture/humus vary across sand dunes?
- What soil and environmental factors influence dune vegetation type?
- Do psammoseres show clear ecological succession?
- What arresting factors prevent psammoseres reaching their climax community?
- An analysis of trampling and blowouts in sand dunes
- A comparison between grazed and ungrazed areas of sand dunes
- What has been the effect of planting woodland on the leeward side of dunes?

Sources of secondary data

- Use of aerial photos or Google Earth which can also be annotated for the purpose of the study.
- Use of old maps/photographs to compare past and present location of sand dunes and the nature of human activity.
- Field Studies Council section on sand dune fieldwork geography-fieldwork.org/ecology/sand-dunes.aspx
- RGS link to sand dune fieldwork: rgs.org/OurWork/Schools/Fieldwork+and+local+learning/Fieldwork+techniques/Ecosystems.htm
- Photos of every OS grid square: geograph.org.uk
- Natural England, the National Trust and English Nature all have useful resources on specific dune systems.
- DEFRA have released a series of reports of sand dune processes and management in England and Wales.