Sampling in a sand dune environment: Teacher guidance notes

This presentation develops some of the ideas introduced in the presentation about sampling strategies. It provides a specific context for sampling strategies that would be appropriate in a sand dune ecosystem.

Page 2

Sand dunes provide opportunities for students to investigate a number of theoretical contexts. These might include specialist concepts such as:

- causality
- equilibrium
- systems
- thresholds

Sand dune ecosystems also provide opportunities for students to investigate the concept of zonation and/or the ecological process of succession. Ecological zonation is the development, over time, of zones of vegetation that have similar characteristics. This basic understanding of zonation is needed before students can justify the selection of sampling strategies that are considered in the pages that follow.

Pages 3, 4 and 5

Environmental gradients can be seen where there is a correlation between distance (or altitude) and another variable. As such, the most effective way to investigate an environmental gradient is by sampling along a line (or transect).

In a sand dune ecosystem, the environmental gradients that are most commonly investigated are those that cut across the vegetation zones with increasing distance from the strand line at the top of the beach. Students can use a transect to investigate how both abiotic and biotic variables are affected by distance from the sea.

A key consideration will be where to start and end the transect. The ecosystem is considered to begin at the strand line, where debris on the beach causes turbulence in wind and deposition of sand, so the transect should start here. The decomposition of vegetable matter in the strand line provides enough nutrients for pioneer species such as sea holly or sea rocket to colonise the beach and form embryo dunes.

The transect should then proceed in the general direction of the prevailing wind, which will be roughly at right angles to the beach. The transect should continue until change in the abiotic and/or biotic variables is no longer significant – this would normally be in the dune slacks.

The sand dunes at Ynyslas near Borth on the Ceredigion coast are part of a National Nature Reserve and as such are managed. Wardens at the Reserve prefer students to set up transects along prescribed routes in order to prevent damage to sensitive areas. As such, key decisions about the start and end points of the transect are outside the control of the students.

Page 6 Review

Transect A is the least suitable. It is parallel to the beach so does not follow the same direction as the environmental gradients or cut across the vegetation zones.

Transect B does follow the same direction as the environmental gradient, but it is unsuitable because it starts too late and ends too soon to be useful.

Transect C is suitable. It starts in the right place – in the embryo dunes. It is also aligned in the correct direction as it is at right angles to the beach and roughly parallel to the prevailing wind. As such, it will be capable of detecting small scale variations in wind speed, soil colour and vegetation cover that occur at the beginning of the environmental gradient. However, the transect is too short as it stops in the fixed dunes before the development of the dune slacks. As such, any variations in wind speed, soil conditions or vegetation that occur in the last part of the environmental gradient will not be sampled.

Transect D is the most suitable. It does not necessarily follow the direction of the prevailing wind, but because of the curve in the spit, it is roughly at right angles to the sea. It starts in the embryo dunes and cuts across each of the vegetation zones. It is long enough to reach the dune slacks where variations in wind speed, soil colour, soil pH will be no longer significant.

Pages 7, 8 and 9

Vegetation cover is usually sampled using a square frame or quadrat in which case data is sampled from areas. This strategy is considered in more detail on pages 13 and 14. Most other factors (such as wind speed and direction, soil colour, moisture or pH) are sampled from discrete points along the transect. The key considerations here are:

- whether to use systematic, random or stratified sampling strategies
- the frequency of the points

A larger sample size/greater frequency should give a more representative sample. However, as we have seen, in a random sample every potential sampling point has an equal chance of being selected. If the sample size is sufficient, it should give a representative sample. The drawback is that using random numbers to generate sample points along a long transect is likely to be more time-consuming than working systematically along the transect. However, the limitation with systematic sampling is that not every point has an equal chance of being sampled.

So, if systematic sampling is used, the researcher needs to have sufficient frequency of sample points to be able to detect change in the environmental gradient where change occurs over short distances.

Pages 8 and 9 illustrate two points about systematic sampling in a sand dune ecosystem:

1. The frequency of sample points needs to reflect the rate at which data varies along the line. If the frequency is low, then significant changes in environmental gradient will be missed.
2. If the transect is very long, as is likely in study of zonation, sample size may need to be very large in order for the frequency of points to be positioned at sensible distances apart.

Page 10

Stratified sampling is not really an alternative to random or systematic sampling. Rather it is a more sophisticated way of organising the sampling strategy so that sample data represents significant proportions or ratios that are apparent in the whole population. In this case, stratified sampling could be used to ensure that sufficient proportions of sample points occur within significant sectors of the dunes. In this case, the 'sectors' are the vegetation zones.

The researcher has used a pilot survey to estimate the proportion of embryo dunes, yellow dunes, mobile dunes and dune slacks. Sample points have been selected according to these proportions, so:

- 10 percent of sample points are in the embryo dunes
- 30 percent of sample points are in the mobile dunes
- 40 percent of sample points are in the fixed dunes
- 20 percent of sample points are in the dune slacks.

If stratified sampling is selected:

1. It will be necessary to conduct some research before primary data can be collected so that the proportions can be estimated.

This could be achieved through the use of secondary data. Alternatively, it may be necessary to conduct a pilot survey of the fieldwork location.

2. The sample points within each sub-group of the population will still need to be selected using random or systematic methods.

Page 11

This page illustrates that some sort of pilot survey is needed if a stratified sampling strategy is going to be used. The pilot survey could involve a site visit. Alternatively, if a suitable map or aerial photo is available, as in this case, it may be possible to estimate the proportion of each vegetation zone within the fieldwork study area.

Page 12

This page illustrates an alternative approach to a stratified sampling strategy. In this example, the student wants to investigate the difference between windward facing dune slopes and leeward facing dune slopes. She makes a reasonable assumption that 50% of dunes face into the wind so makes sure that 50% of sample points (W1, W2 and W3) are windward facing.

This illustrates that the sampling strategy that is designed should suit the data and requirements of the investigation.

Pages 13 and 14

The final two pages illustrate area sampling along a line. This strategy is commonly used to sample vegetation cover. The square frames (quadrats) can be of any size. Larger quadrats can be made from pegs and line and be in the order of 5 metres across. These large quadrats are suitable for larger vegetation such as shrubs. Smaller wire quadrats (usually 50 cms across) are suitable for smaller plants such as those found in most zones of a sand dune.

The use of quadrats along a sample line is known as a **belt transect**.

As with point sampling, the frequency of area sampling along a line needs to be carefully considered. A continuous belt transect will give the highest possible frequency and the highest likelihood of a representative sample. However, continuous belt transects are time-consuming, so they are usually only possible in short transect. A continuous belt transect is a practical strategy in an investigation across a small feature such as:

- an embryo dune

- a footpath
- a blow out

An interrupted belt transect is a more pragmatic solution over a longer transect. If the transect passes through all the zones of a sand dune ecosystem, then the frequency of the sampling will be a trade-off between time/effort and the possibility that significant changes in the vegetation along the environmental gradient could be missed.

Page 15 Review

The best place to start this transect is at B in the strand line.

Page 16 Review

The most appropriate strategy is option C. The transect is short (it will only need to be about 5 to 8 metres long), so a continuous belt transect will be possible and it will represent any change in vegetation cover along the environmental gradient.