5.8 Sampling

Different sampling techniques for plants and animals for measuring biodiversity

Sampling is done so that we can measure the **biodiversity** of a **habitat**. In most habitats, it is unrealistic to record every individual present, which is why the need to take a **sample** exists. A sample can be extrapolated to the rest of the habitat.

A sample needs to be large enough to include the majority of the species present, and needs to be small enough to be practical. It must also be *representative* of the whole community (i.e. it should not be biased towards one particular species or one collective group of organisms).

Biodiversity - the diversity of life; the range of organisms found in an area to be found

Habitat - an area where organisms live

Sampling of plants: methods of sampling **sessile** (something rooted to one spot) organisms

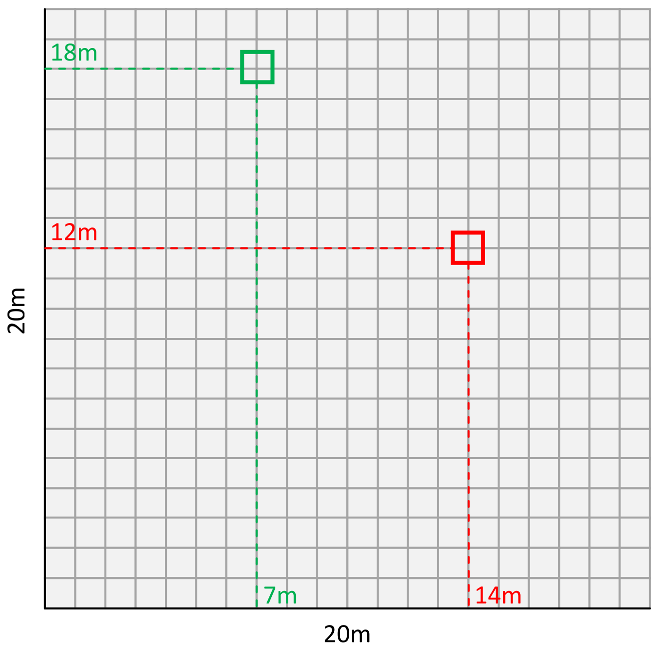
Random sampling

Generally, random sampling is the best way to ensure a representative sample is obtained. The sample area is defined usually by a **quadrat**. This is a square frame divided into multiple sections which can be used to measure percentage coverage of different sessile organisms, or also the amount present in a given area. Quadrats are normally $1m^2$ in area. Quadrats are placed in a number of locations within the testing area to be studied, and only the organisms which are within the quadrat are recorded.

The term 'random' means, mathematically, that every opportunity has an equal chance of being chosen. Usually, therefore, this sampling method is done using a divided grid.

Example

If the size of the habitat was 20m x 20m, a grid like the one below might be drawn.



To decide where the quadrat will be placed in order to get a truly random sample, a *random number generator* can be used. This can be done on the calculator using the Ran# function. For our habitat, we can type into the calculator 20Ran# and a random number between 0 and 20 (of 3 significant figures) will be generated. We do this in pairs to get two numbers to work with, e.g. -

20RAN# = 14.4
20RAN# = 12.6

We round these numbers, but not using traditional rounding. We always round *downwards*, so our numbers will be 14 and 12. This is because if we round to the nearest whole number, 0 and 20 would have an unfair chance of being generated.

We can use our numbers 14 and 12 to place our first quadrat. We go 14m along the *x*-axis and 12m up the *y*-axis and plot the location of our first quadrat, as shown. Then we go back to our random number generator on our calculators:

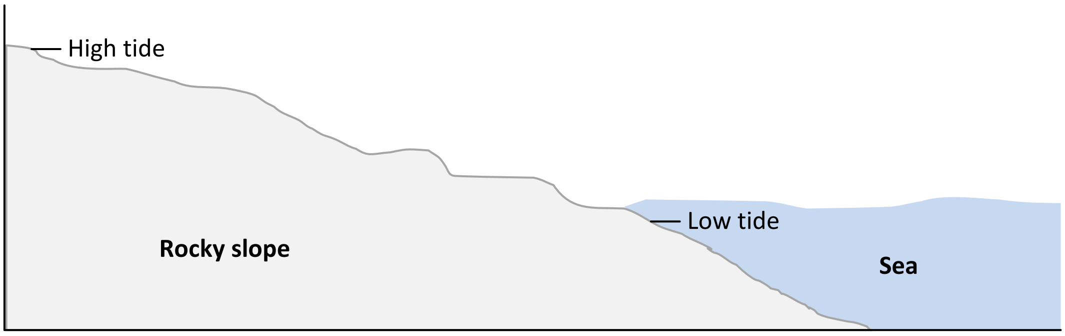
20RAN# = 7.4
20RAN# = 18.1

The calculator has presented us with 7.4 and 18.1 so we use the numbers 7 and 18. Once again we use the first number along the *x*-axis, and the second number along the *y*-axis.

This process is repeated a number of times until a *representative sample* has been generated. A **pilot study** may be necessary to decide how many quadrats to be used.

Transects

A **transect** involves recording individuals at exact intervals along a line, e.g. every metre. A long rope or tape measure may be stretched across the habitat in one straight line, and samples taken at each interval.



Suppose you wanted to sample the distribution of organisms along this rocky cliff face. Obviously, random sampling would not be appropriate, as that does not guarantee the entire range of areas will be selected (for this type of environment, you would want to have samples at, for example, 5m from the shore, 10m from the shore, 15m from the shore and so on). The samples should include the high tide region as well as the low tide region, in addition to frequent points in between the two areas.

One option available is the **line transect**. This would involve recording the types and quantities of sessile organism found touching the line at exact intervals. With a line transect, the plants must be touching the line, and the samples are only taken at regular intervals (so not every plant touching the line is recorded).

A second option is the **belt transect**. This involves recording all individuals within a set distance of your tape. A quadrat will be used in this transect. You should set up your tape and then the quadrat is gradually moved up the tapeline recording all plants along the line. A distance will be set, for example, 1 metre, which means you record all organisms which are up to 1m either side of the line using the quadrat.

The third option is to use an **interrupted belt transect**. This combines the use of a line and belt transect. The interrupted belt transect is similar to a belt transect, except it involves placing a quadrat at regular intervals along the line, rather than recording the organisms found along the entire belt.

Point frames

Becoming increasingly popular is the **point frame**. This is not a separate method of sampling, as a point frame is just an alternative to a quadrat (or it can be used as a combination with the quadrat). A point frame is placed along the sample region. It contains ten spikes. It is usually placed inside a quadrat ten times along the width of the quadrat, and ten times along the length of the quadrat, thereby obtaining 100 samples. The type of plant touching the needle is recorded and is said to have 1% cover of that $1m^2$ (although it is possible that multiple plants touch one needle, so you can have a percentage cover of up to around 400% sometimes).

When sampling plants, you are looking to measure their **abundance** in a certain area. A simple scale can be used to rate the abundance of plants in a region, using the data obtained from your various methods of sampling. The scale is, however, quite subjective. It is known as the **ACFOR scale**:

Abundant, **C**ommon, **F**requent, **O**ccasional, **R**are

Question: Which type of sampling (random sampling, line transect, belt transect, interrupted belt transect) to use?

- Measuring the distribution of coral species in relation to distance from the shoreline
- Measuring species diversity in a meadow
- Measuring percentage cover of barnacles as you move up a rocky beach
- Measuring distribution of tree species found on a hillside

Sampling of animals: methods of sampling **motile** (opposite of *sessile*) organisms

Animals that move are tricky to sample. There are many problems with sampling animals:

- a risk of counting the same animal twice as it moves around
- a risk of not counting all the animals if they are moving about
- some animals may be active at different times of the day (unlike sessile plants where this has no effect)
- animals may run away or hide from you as you approach them to sample them
- you cannot be certain if an animal actually belongs to the habitat your are sampling

Tree beating

The easiest method of collecting from trees is to use a large stick and knock the branches of a tree to dislodge any small animals which may be in there causing them to fall down. For this method, you will need to hold a white sheet under the area you are beating the tree with so that you catch the animals as they fall and can see them clearly to record the information. You need to be quick though as they will run away quickly.

Sweep netting

This method involves walking through the habitat with a sweep netter, and running the net through the vegetation on the ground several times to collect any of the small animals which may be residents there. Again, the contents of the net are emptied onto a white sheet to make counting the insects and other small animals easier, but speed is key. To prevent some of the smaller insects from flying or crawling away, a **pooter** may be used. This is a small container with two tubes coming out of it. You aim the end of one tube at the insect(s) and suck in from the end of the other tube, which sucks the insect(s) into the container to where they cannot escape from. This makes counting them easier.

Pitfall trap

This is a small trap embedded into the soil designed to trap small animals. A small container is buried into the soil so its rim lies just below the surface of the soil. Any animal crawling through the vegetation should fall into the **pitfall trap**. The bottom of the trap should be lined with a thin layer of water or some scrunched up paper to prevent them from crawling back out. Sometimes, a bath of water or alcohol is at the bottom to kill the insects, although this presents certain ethical issues. There should be a lid protecting the trap to prevent larger animals from falling in and to stop the build-up of rainwater inside the container.

Light trapping

A **light trap** can be used to collect flying insects overnight. It consists of an ultraviolet light that attracts the insects. Under the light is a collecting vessel containing alcohol. Moths and other insects attracted to the light eventually fall into the pool of alcohol, killing them.

A Tullgren funnel

A Tullgren funnel is a device for collecting small animals from leaf litter. You place the leaf litter in a funnel. A light above the litter drives the animals downwards as the litter dries out and warms up. They fall through the mesh screen into a collecting jar just underneath the funnel.

There are various drawbacks to sampling motile animals. These include:

- × some of the above methods involve killing the animals
- × may be biased towards the more active individuals
- × the methods can be difficult to standardise (e.g. with sweep netting, it has to be replicable, so to standardise, you must make note of how you recorded the data – for example, using a random sample area and then sweeping exactly 5m of vegetation with a speed of around 5mph)
- × many of the methods are often non-random