**Environmental change and the distribution of organisms**

**Summary**

Living organisms form communities, and we need to understand the relationships within and between these communities. These relationships are affected by external influences.

**Non-living (abiotic) factors**

Physical factors that may affect organisms are:

* **Temperature**:
  + Temperature affects the rate of an organism’s metabolism.
  + Some organisms cannot maintain a constant high body temperature.
  + They cannot tolerate extreme temperatures.
  + Organisms that can maintain a constant high body temperature may also struggle to survive in extreme temperatures.
* availability of **nutrients**:
  + Nutrients such as nitrates are essential for the growth of plants and microorganisms.
  + If there is a low concentration of these nutrients, these organisms struggle to grow and survive.
* amount of **light**:
  + Plants require light as an energy source for photosynthesis.
  + In low light intensities plants grow very slowly.
* availability of **water**:
  + All organisms require water.
  + It is essential because chemical reactions that occur inside and outside cells occur in solution in water.
  + In the absence of water, cells, and therefore organisms, die
* availability of **oxygen**:
  + Oxygen is essential for aerobic respiration.
  + It can become limited in the soil, so plant roots cannot grow and absorb mineral ions and water.
  + It can also become limited in water, so aquatic organisms struggle to respire and survive.
* availability of **carbon dioxide**:
  + Carbon dioxide is essential for photosynthesis.
  + This can become limited in an environment where there are many plants.
  + This will reduce the rate of growth of plants.

**Living (biotic) factors**

Biotic factors that may also affect organisms are:

* availability of **nesting sites/shelter**
  + eg, woodpeckers need trees to provide both a nesting site and supply of food
  + animals are unable to breed unless they have appropriate shelter
* Changes in number/type of **predator/competitor**
  + New predator or loss of a predator will have direct and indirect effects on the food web
  + Same is true for the introduction of a new primary consumer which could compete more efficiently for the vegetation than existing organisms

**Collection of quantitative data**

**Sampling:**

* To study the distribution of a species you need to find out:
  + The size of the area being studied.
  + The number of organisms living there.
  + Where those organisms live.
* However, it would be very time consuming to count every individual organism:
  + They may move
  + There may be too many.
* Therefore, a sample of the organisms is counted.
* The techniques chosen should enable this sample to be representative of the whole area.
* It should provide valid data.
* The sample can be used to estimate the total population.
* The technique should be reproducible; if it is carried out again the estimated population should be the same size.

**Quadrats**

* These are square frames, used to mark off specific areas of ground.
* Typically 0.5m X 0.5m with a grid of 10cm X 10 cm
* They can be used to survey:
  + which species are present,
  + numbers of each species, or
  + percentage cover of a species.

**Random Sampling:**

* Construct a regular grid using tape across the area.
* Generate random numbers using a calculator or computer.
* Use these to determine coordinates.
* This ensures that there is no bias by the investigator.
* It ensures the results are valid.
* Investigate the population of the species in the quadrat.
* Repeat many times.

**Transects**

Use when:

* + - * There are changes in the distribution of a population of an organism.
      * There are two neighbouring habitats, eg grassland to woodland
      * Or, if a particular factor leads to zonation, eg the effect of the tide and coverage by water on a rocky seashore.

Method:

1. Choose the start and end positions of the transect.
2. Determine the direction and length of the transect.
3. Lay down a tape or string to mark out transect.
4. Sample the organisms along the line.
5. Perform further parallel transects to ensure results are reliable.
6. Take recording of the factors that could be influencing the distribution along the transect.

Various types of transect:

1. Record each organism, which is touching the line at suitable, regular intervals.
2. Place a quadrat at the start position and record its contents. Place the subsequent quadrats immediately touching the previous ones along the transect.
3. If the transect is very long, place the quadrats at suitable, regular intervals along the transect.

**Analysis of data**

**2, 4, 9, 3, 5, 2, 4, 2, 5**

**Mean:**

The average value; calculated by adding all the observations and dividing by the number of observations. Mean of above numbers is: 4

**Median:**

The middle value of a list when the numbers are arranged in numerical order. Median value of above numbers is 4

**Mode:**

The most common value in a list. Modal number of above numbers is 2

**Range:**

The difference between the largest and smallest number. Range of above is 2-9 (or 7)

**Biotic indicators**

Living organisms can be used as indicators of environmental change:

* **lichens** can be used as air pollution indicators, particularly of the concentration of sulphur dioxide in the atmosphere
  + symbiotic associations of algae and fungi which live on trees, walls, rock, etc
  + lichens absorb sulphur dioxide dissolved in water, which acts to kill the chlorophyll in the algae, preventing it from photosynthesising, and thus killing the lichen
* **freshwater invertebrates** can be used as water pollution indicators and are used to indicate the concentration of dissolved oxygen in water.
  + Oxygen concentrations decrease when pollutants are released into rivers and lakes
  + Some inverts survive in low oxygen concentrations (eg, bloodworms)
  + Some inverts survive only when oxygen levels are high (eg, mayfly larvae)

Biotic indicators are highly sensitive to changes to environmental conditions. They are easy to measure/count

**Non-living indicators**

Oxygen, temperature and pH are examples of non-living indicators that can be measured to give an idea of environmental change. All sorts of different instruments are available to take these measurements. As a rule:

* the fancier pieces of kit are more expensive, more likely to go wrong, and may depend on computers and electricity.
* the simpler equipment is cheap and easy to use but subject to human error