Biology Summer Independent Learning

Please complete **ALL** the following tasks ready for your first lesson in Year 13. You can print the booklet, write on the PDF file or answer the questions on paper. Your teacher will check that this has been completed in the first lesson back in September.

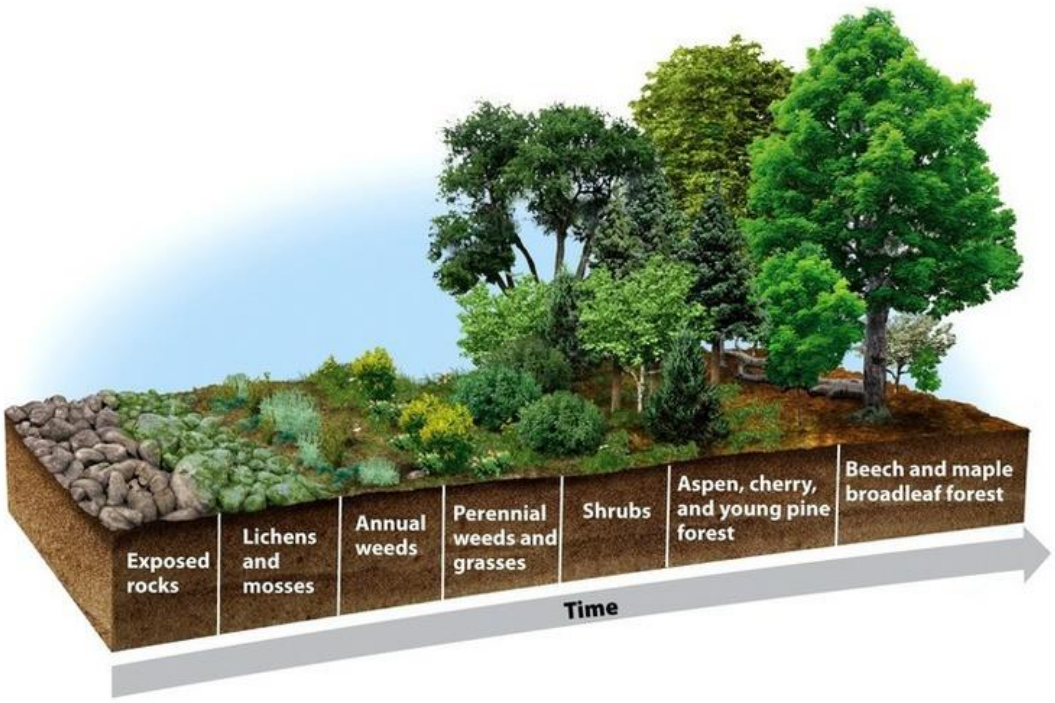
The SIL is split into 2 sections:

Core Content

1. Watch the suggested videos covering 3.7.4. Populations in ecosystems. Then complete the population booklet questions (paper copy handed out in lessons).
2. Test yourself on the definitions and content for 7.4 populations in ecosystems, in preparation for an assessment on your return to college.
3. Plan required practical 12

Highly recommended

This content will assist you in future topics covered in Y13



Core Content

Please watch the following videos covering 7.4 Populations in ecosystems. There will be additional material on your Year 13 Teams page.

https://www.youtube.com/watch?v=daH5_hwJY8o&list=PL0Mjub5NT756kVDMLLq1Pbh_vXg1rtGTl&index=5

https://www.youtube.com/watch?v=J35QIX7b9sc&list=PL0Mjub5NT756kVDMLLq1Pbh_vXg1rtGTl&index=2

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https://www.youtube.com/watch?v=_f6_f_7CJpA&list=PL0Mjub5NT756kVDMLLq1Pbh_vXg1rtGTl&index=4

Name:

Group:

Date:

A-level Biology

3.7.4 Populations in ecosystems

Biosphere	The part of Earth that contains all ecosystems	
Ecosystem	Community and its nonliving surroundings	
Community	Populations that live together in a defined area	
Population	Group of organisms of one type that live in the same area	 Bison herd
Organism	Individual living thing	 Bison

AQA A Level Biology

Learning Outcomes – 7.4 Populations in ecosystems (A-level only)

Learning Outcome	☺	😐	☹
Populations of different species form a community. A **community** and the non-living components of its environment together form an **ecosystem**. Ecosystems can range in size from the very small to the very large. Within a habitat, a species occupies a **niche** governed by adaptation to both **abiotic** and **biotic** conditions.			
An ecosystem supports a certain size of population of a species, called the **carrying capacity**. This population size can vary as a result of: • the effect of abiotic factors • interactions between organisms: **interspecific** and **intraspecific competition** and **predation**.			
The size of a population can be estimated using: • randomly placed quadrats, or quadrats along a belt transect, for slow-moving or non-motile organisms • the mark-release-recapture method for motile organisms. The assumptions made when using the mark-release-recapture method.			
Ecosystems are **dynamic** systems.			
Succession Primary succession, from colonisation by pioneer species to climax community. At each stage in succession, certain species may be recognised which change the environment so that it becomes more suitable for other species with different adaptations. The new species may change the environment in such a way that it becomes less suitable for the previous species. Changes that organisms produce in their abiotic environment can result in a less hostile environment and change biodiversity. Conservation of habitats frequently involves management of succession.			
Students should be able to: • *show understanding of the need to manage the conflict between human needs and conservation in order to maintain the sustainability of natural resources* • *evaluate evidence and data concerning issues relating to the conservation of species and habitats and consider conflicting evidence* • *use given data to calculate the size of a population* estimated using the mark-release-recapture method.			
Required practical 12: Investigation into the effect of a named environmental factor on the distribution of a given species.			

Introduction – Key terms

Ecology is "the scientific study of the factors which determine the **distribution** and **abundance** of organisms".

This involves finding out **what** lives **where**, in what **numbers**, and **why**?

An **ecosystem** is the term used to describe the environment and all the organisms that live in an area. This means it is made up of all the **abiotic** factors (*non-living* factors, i.e. physical and chemical) and **biotic** factors (*living*/biological factors, e.g. feeding relationships between organisms) in an area. Ecosystems can range in size from the very small to the very large. Therefore, studying ecosystems inevitably involves studying both their biotic and abiotic components.

List the main abiotic and biotic factors in an ecosystem

Abiotic	**Biotic**

A **community** is

A **population** is

An **ecosystem** consists of

Each organism occupies its own ecological niche within the community.

An ecological niche is

Investigating populations of organisms

In order to investigate ecosystems we may need to look at the **abundance** (numbers) of organisms in a particular area. At other times we may need to look at how a species is **distributed**.

To measure the number of all individuals and distribution of every species in an area is too time-consuming. So we have to **sample** an area to find out where plants and animals live, how many live there, and attempt to work out which factors (biotic and abiotic) appear to be the most important in determining their distribution. Fieldwork is often only able to **identify** patterns in the ecosystem and does not **prove why** the organisms are found there.

Ecosystems can be studied using:

A - randomly placed quadrats, or quadrats along a belt transect, for slow-moving or non-motile organisms

B - the mark-release-recapture method for motile organisms.

A. Plants or slow moving animals

Measuring abundance

Any samples we take must be big enough to be **representative** of the population as a whole and **avoid anomalies having too big an effect**.

Quadrats can be used to measure **density**, **frequency**, or **% cover** of plants or slow moving animals.

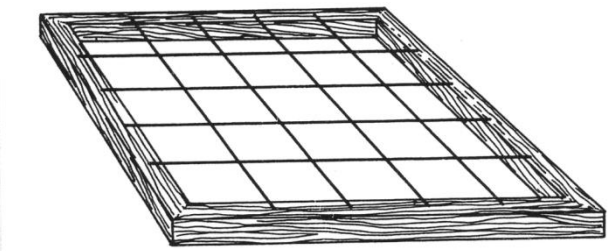


Fig 2.7 A frame quadrat: 0.5 m wooden frame with wires fixed at 10 cm intervals

When using quadrats there are three factors to consider

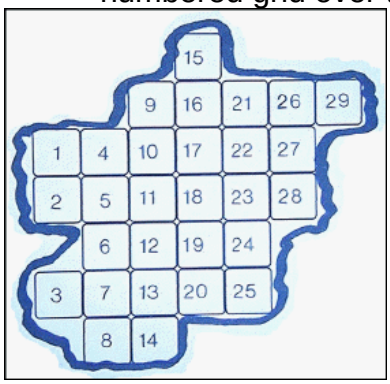
1. The positioning of the quadrat
2. The number of quadrats to use
3. The size of quadrat

1. The positioning of the quadrat

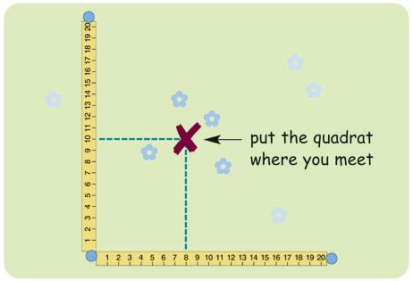
Random sampling is used to

- avoid bias
- be representative
- produce statistically significant results

a) You could map the area and then lay a numbered grid over the map.

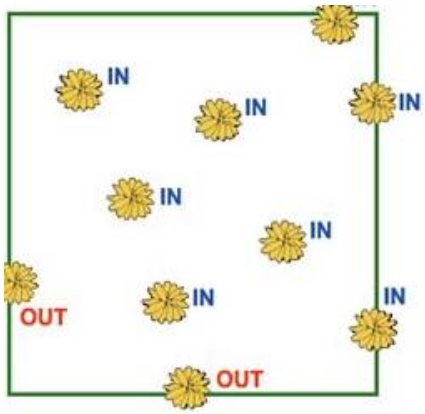


b) Or you could use 2 tape measures to mark out a grid.



Place the top left hand corner of the quadrat at the point where the coordinates lie and count all the plants of the species in the quadrat.

A random number generator is then used. This can be a random number table or generated using a calculator or computer. This allows you to select the areas to sample in. You can use a random number generator (e.g. calculator or a random number table) to generate pairs of numbers to act as coordinates.



Where a plant overlaps the edge of the quadrat, use the NE rule (where you only count those overlapping the top and right-hand side).

Record your results. Keep recording until your sample is large enough (see running mean below). Repeat the above for any additional areas you are sampling.

The number of organisms of a species is measured in a known fraction of the total area and then the estimate of the total numbers can be obtained by simple multiplication.

2. Deciding on the number of quadrats to collect - The Running mean

A sample needs to be big enough

- to be **representative** of the population
- to allow a **statistical test** to be carried out on the data.

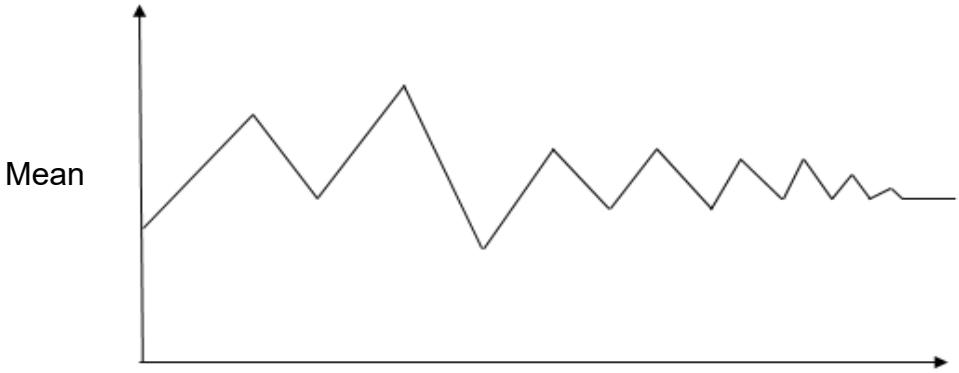
We often quote this figure as a rough guide as around 5-10% of an area. However, there are techniques to tell you when you have enough data.

If you are estimating population sizes with quadrats you can use a **running mean** as a method of estimating when you have taken a big enough sample. Data is collected in the usual way. As data

from each quadrat is taken a mean is calculated by adding the new data to the total collected from the previous quadrats. Complete the table below:

Quadrat	sample size		running total	running mean
1	4		4	4÷1 = 4
2	8		4+ 8 = 12	
3	9			

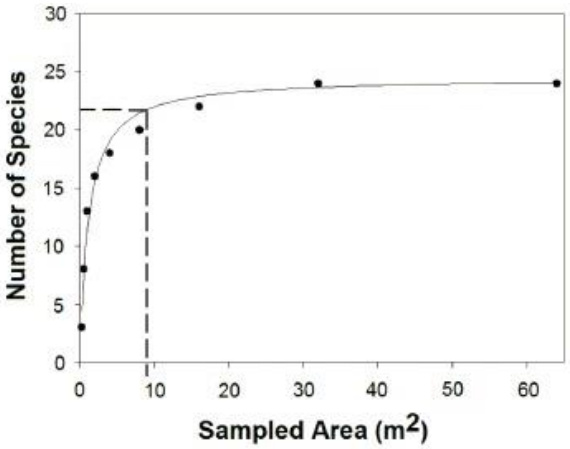
The mean initially **fluctuates** greatly. When it no longer changes much you will have collected a big enough sample. The data can be plotted on a graph to give a visual display of this.



3. The size of the quadrat.

This depends on the size of the organisms being sampled. Standard fieldwork quadrats measure 0.5m x 0.5m = 0.25m^2.

To work out the correct size of quadrat to use, plot the area of the quadrat in m^2 against the number of species found in the quadrat.



When the graph levels off, that is the size of quadrat to be used.

What to record:

a. **Measuring Frequency of a species**		b. **Measures of Percentage Cover**		**c. Measures of Species Density**	
This is when you just **record the presence or absence** of a species in each quadrat. i.e. is it there or not? For example if it occurs once in every ten quadrats, the frequency is 10%.		This is a measure of the **proportion of the ground occupied** by the species in the quadrat, and estimates the area covered by the species as a percentage of the total area. This method is useful if it is difficult to decide where one organism finishes and another one starts, eg. seaweeds. We will use this on the rocky shore in Scarborough.		This simply means **counting the number of individuals of a species** in a quadrat. This is fine if you can easily distinguish one organism from another.	
Advantage:	**Disadvantage**:	**Advantage:**	**Disadvantage:**	**Advantage:**	**Disadvantage:**

Investigating distribution

If you are trying to find out how species distribution **changes** across an area you need to sample **systematically**. e.g. a linear change in the area,

- from lake to shore,
- up a rocky shore from sea to land

You need to sample along a line; this is a **transect.** There are two types:

1. **Line transect.**

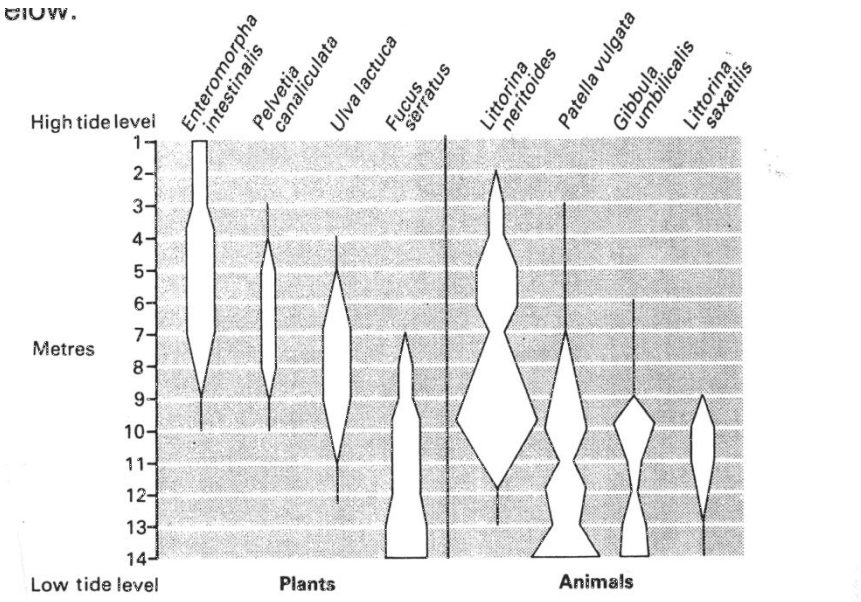
A measuring tape is stretched across the habitat and plants are sampled at regular intervals, for example every 10cm. **Each plant touching the line is identified** and recorded.
This is quick and provides a **non-quantitative** idea of some of the more typical species present. It is particularly useful in illustrating the main features of a **zonation** such as on a rocky shore (where the species vary with height above the tide, due to the varying degrees of submergence by the sea), or a succession from a water community to a land one.

2. **Belt transect/ Interrupted Belt transect**
This gives a more detailed record of the changes. Quadrats can be placed next to each other along a transect and estimates of the percentage cover or frequency of each species is recorded. This is more time consuming than a line transect and usually an **Interrupted Belt Transect** is

used, placing quadrats at regular intervals along the line and leaving unsampled “gaps” in between.
The diagram shows: a) a line transect, b) a belt transect, c) an interrupted belt transect

Records of the plants can be combined with topographical measurements (up and down measurements of the Earth’s surface) so that the results can be expressed in the form of a profile. Measures of relevant **abiotic** factors may also be taken along the transect to look for possible causes of the distribution observed.

Typically “kite” diagrams are drawn to show the distribution and abundance of the species.



Distribution of eight species (four plants and four animals) on a small shore

We will be completing an example of an **interrupted belt transect** across a rocky shore during our fieldwork.

Describe how you would collect data on the **population** of daisies in a field using random sampling	Describe how you would investigate how the distribution of plants changes from the middle to the edge of a woodland.

B. Measuring abundance in mobile animals- the mark-release-recapture method

Random sampling or systematic sampling can still be used but there needs to be a method to capture the organism first. Some examples are:

a pitfall trap – for crawling animals

a butterfly net- for flying insects

a kick sample net- for water or sediment living organisms

- **A large sample of the organisms needs to be collected. Random sampling methods can be used as before to identify where to place the nets or traps.**
- **They are then marked, counted and released back into the population and allowed time to remix with the rest of the population. The method of marking must not harm the animal in any way or affect their survival chances. e.g. Mice can be marked by clipping a small piece of fur from their back, snails can be marked with a tiny dot of waterproof paint.**
- **After release, give the animals time to move around and get thoroughly mixed in with the rest of the population.**
- **Then, once again, capture a large sample, using the same sampling technique as before. Count the total number which you catch, and the number of these which are marked.**

The population size can now be estimated using the following equation know as the **Lincoln Index:**

$$N = \frac{M \times C}{R}$$

N = population **N**umber estimate
M = the number captured, **M**arked and released on the first occasion
C = the total number **C**aptured on the second occasion
R = the number **R**ecaptured (i.e. the number of marked found during the second capture)

Calculate the population size of a moth population using the following information:

60 Individuals were caught in a light trap during the first sampling period. These were marked with a spot of cellulose paint, which was allowed to dry.

They were released and 48 hours later a further sample of 50 moths were caught. 15 of these were marked.

Your calculation:

What assumptions do we make about the organisms when we use this method?

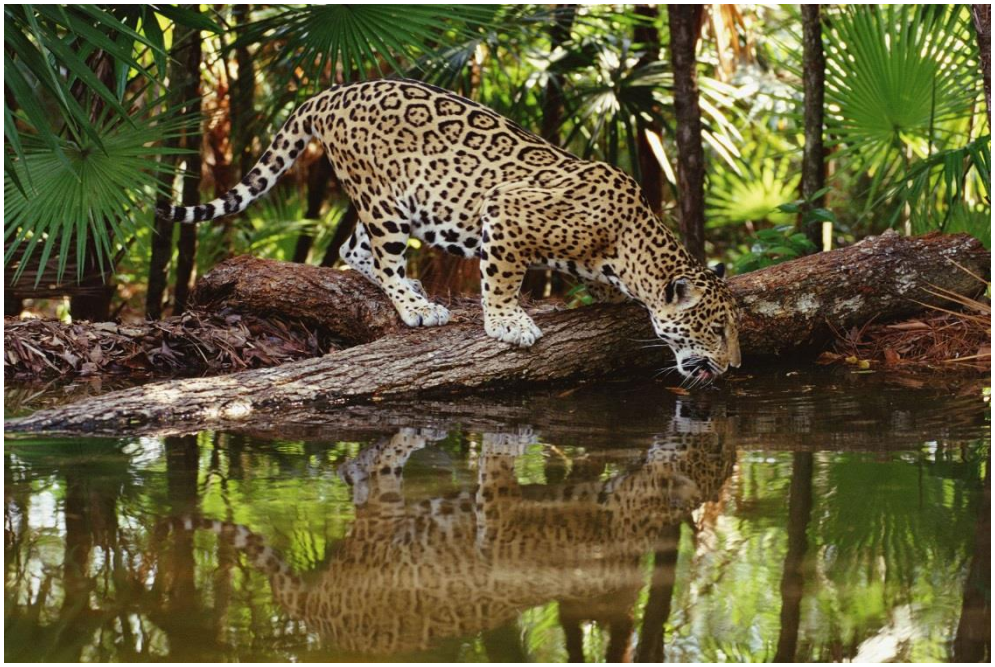
Which sampling technique would you use in each of these investigations?

1. Comparing the population of barnacles on a large rock in two areas
2. Estimating the population of *Gonatodes antillensis* (a species of dwarf gecko) lizards in Venezuela
3. Investigating how the variation of lichens changes with the height of a wall
4. Estimating the population of dandelions in a field
5. Estimating the population of sharks
6. Estimating the population of *Isolepis basilaris* (pygmy club brush) in a sand dune slack
7. The effect of distance from a rainforest on the population of weeds in a crop field
8. Estimating the population of field mice in an area
9. How the species of plants change across a sand dune
10. Investigating how using pesticides affects a population of weeds
11. Investigating how the population of *Mus musculus* (house mouse) are affected by logging on the south coast of New South Wales
12. Investigating how distance from the water affects barnacle populations

Line or belt transect	Random sample	Mark-release-recapture

Variation in population size and distribution

A vast range of ecological factors decide whether a species lives in a particular habitat, and how large the population is.



Abiotic factors are non-living factors. They vary a lot from place to place. **Biotic** factors are due to the **interactions** of organisms. Give examples of biotic and abiotic factors that play a role in determining which species are found in the rainforest shown above.

Abiotic	Biotic

Competition and predation are two important influences on population size.

Competition

More individuals of each species are born than the environment can support. Therefore there is competition for resources such as:

- Plants compete for
- Animals compete for

There are two types of competition:

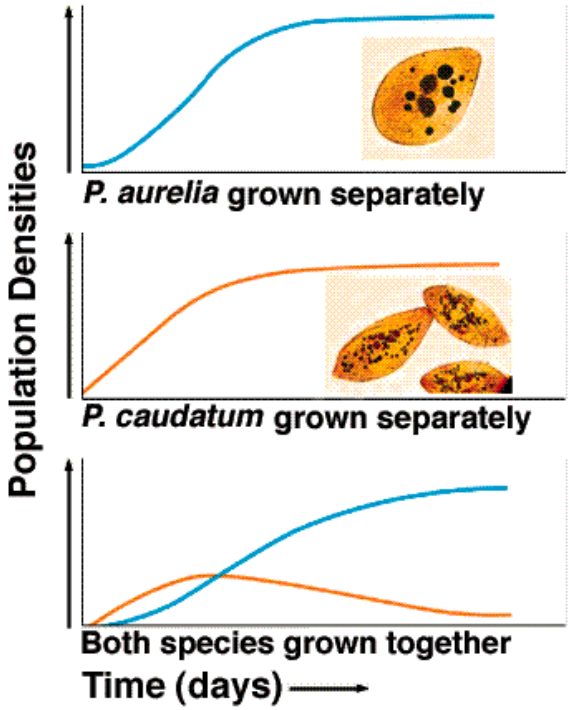
1. Interspecific competition.

Define this and give an example of this

An organism's role in its ecosystem is known as its **niche** e.g. its feeding role, the abiotic conditions it lives in, its physiology, behaviour and reproduction method. **No two species can occupy exactly the same niche** as there would be too much **interspecific competition** between them for the same resources.

The more similar the niches of two competitors, the greater the competition will be between them. The effect of this competition is likely to cause some species to disappear from the area as they are **competitively excluded** by stronger competitors.

Some experiments with populations of two similar species of Paramecium (a single celled protoctistan) illustrate this. *P. aurelia* is the stronger competitor under a particular set of conditions, even though both can survive well if alone.



P. aurelia

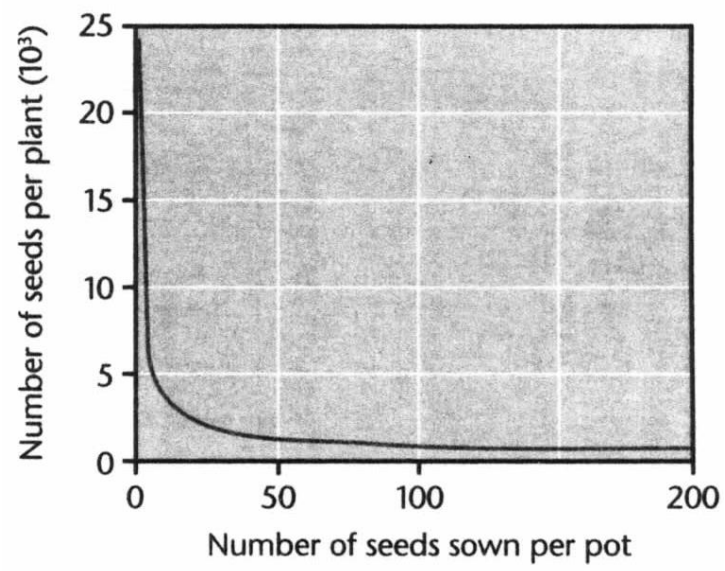
2. Intraspecific competition.

Define this.

A good illustration would be to sow seeds at increasing densities in otherwise identical pots.

List some of the factors which must be kept the same for each pot used in this nvestigation.

Assuming they all germinate, the growth of the plants can be monitored and compared. Typical results are shown in the graph below.



Here the plants were competing for light, water and minerals. The more intense the competition, (the greater the number of seeds per pot) the fewer seeds each plant produces. Some individuals may not even mature and produce any seeds.

When growing crops e.g. wheat plants in a field it is important to sow the seeds at the optimal density to gain maximum yield.

What other actions can the farmer take to reduce the effect of intraspecific competition?

Predation

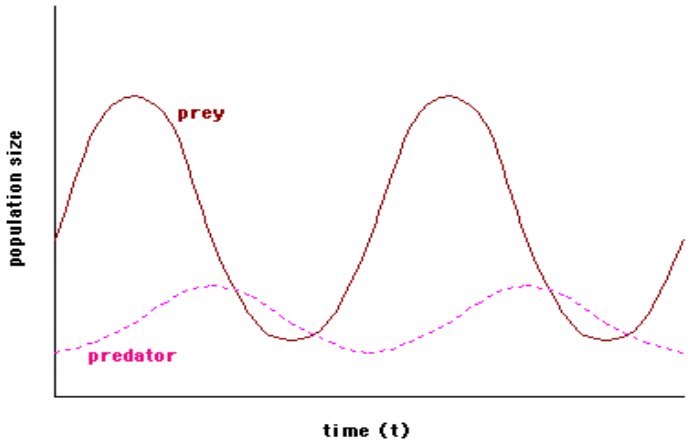
A predator is an organism that hunts, kills and eats another, the prey.

It seems obvious that the number of predators in an area will affect the size of the prey population – as the number of predators increases, the prey population will decline.

What effect will this decline in prey numbers have on the predators?

In response to this, what will then happen to the size of the prey population?

The overall effect is that both populations will fluctuate but only within narrow limits, each species preventing the other increasing beyond the size that the environment will support. The changes in the predator population "lags behind" the changes in the prey population – see graph below.



In each species the best adapted individuals have the best chance of survival, so both species benefit.

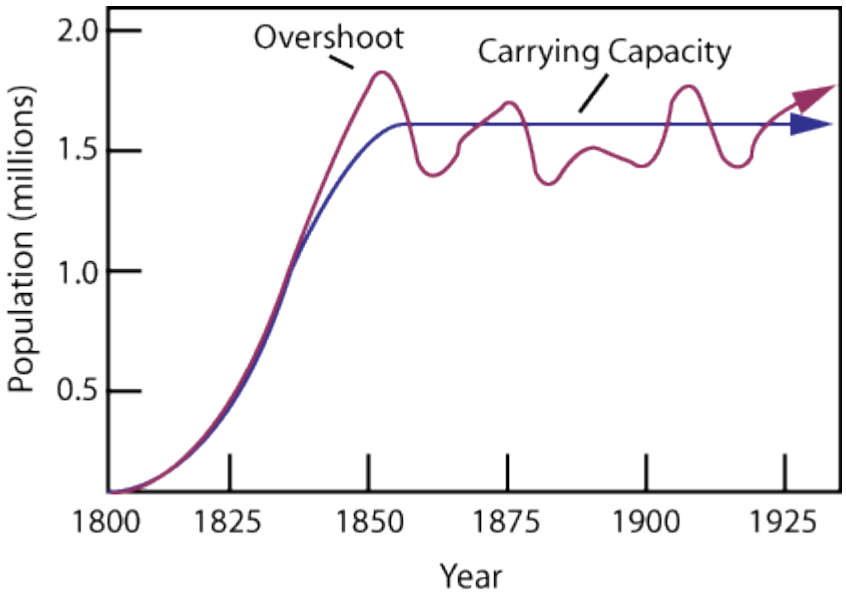
Carrying Capacity

Populations within an ecosystem can only reach a certain size. The maximum size that a population can remain sustainable in a particular habitat is called the **carrying capacity.**

The population size can vary as a result of:

- the effect of abiotic factors
- interactions between organisms e.g. competition and predation

For most non-human species, the concept is quite simple. Intraspecific competition for resources such as food and water increases as the size of the population increase and gets nearer to the maximum that can be supported sustainably in a particular habitat. If the carrying capacity is exceeded, the population declines because its environment can no longer support the excess numbers. In many situations this can happen very rapidly because excessive demand degrades or even devastates the environment and this may lead to a sudden fall in the size of the population.



Succession

In an area where a habitat is newly formed or has been subjected to a disturbance, **changes occur in the biotic community over time**. This process is called **succession**.

It can be defined as: **The way in which the different species of organisms which make up a community change over a period of time.**

Main events of succession

harsh environment – colonised by pioneer species

↓

habitat changed by **pioneer** species

↓

The **changed environment** becomes more suitable to support new species

↓

Establishment of new plant species increases the species diversity as various groups of animals enter the habitat; the early colonisers are replaced by new species

↓

Changes in the abiotic factors result in a **less hostile** environment and an increase in biodiversity

↓

A **climax community** develops which is in balance with the climate and geology

Primary Succession

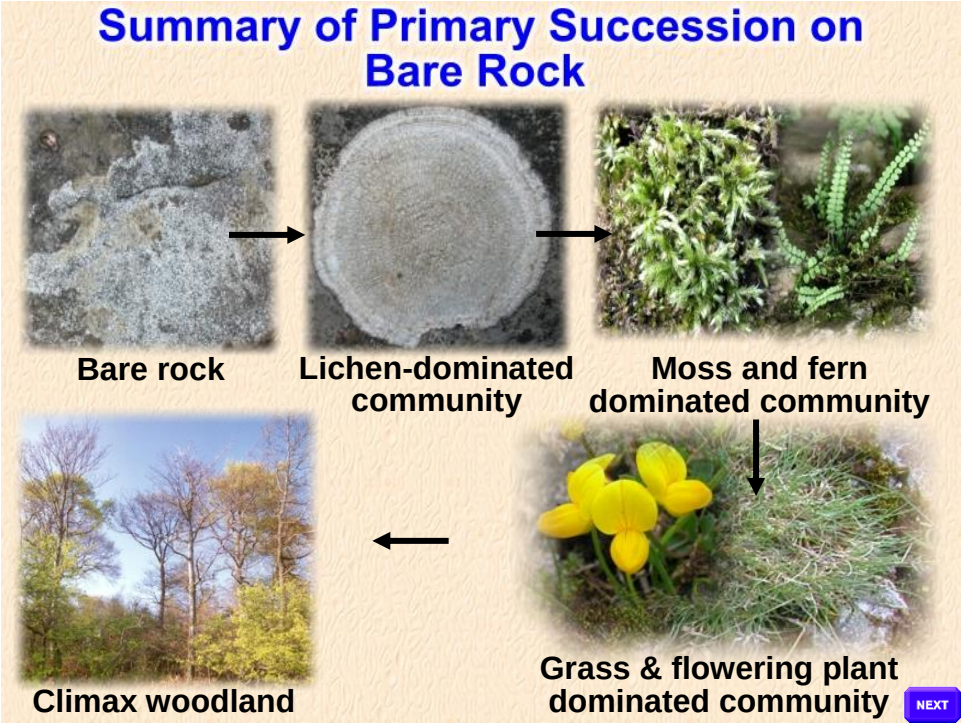
Succession takes place in a series of stages. The first stage is the colonisation of a harsh environment by organisms called **pioneer species**. These organisms have features that suit them to early colonisation.

Give some examples of such features:

At each stage, the following events occur:

- Certain species can be identified which **change the environment**, especially the soil, so that it becomes **more hospitable** for other species (**less hostile**).
- These changes include increase in the nutrient, e.g. nitrate content of the soil. Increase in the water carrying capacity of the soil.
- These other species then **out-compete** the species in the existing community and **become established** themselves, and so a new community is formed.

The final stage is very stable, with a high biodiversity and complex food webs. The community is stable, with no further changes to the species present, and the populations remain relatively stable (at around the carrying capacity). It is known as the **climax community.** The climax community is determined by the main abiotic factor. For example, trees may not develop on very high mountains because it is too windy or the soil is too thin.



Conservation and Succession

Conservation is concerned with managing biological diversity and ecosystems. An individual species can only survive if it has a suitable habitat in which to live, so many conservation projects involve management of succession.

In Britain much of the countryside such as grassland and moorland is being managed by grazing and controlled burning, so deflecting the natural succession process and **preventing a climax**

community from developing. The aim is to ensure there are a variety of different types of habitat in the UK.

How does grazing by e.g. sheep, prevent succession?

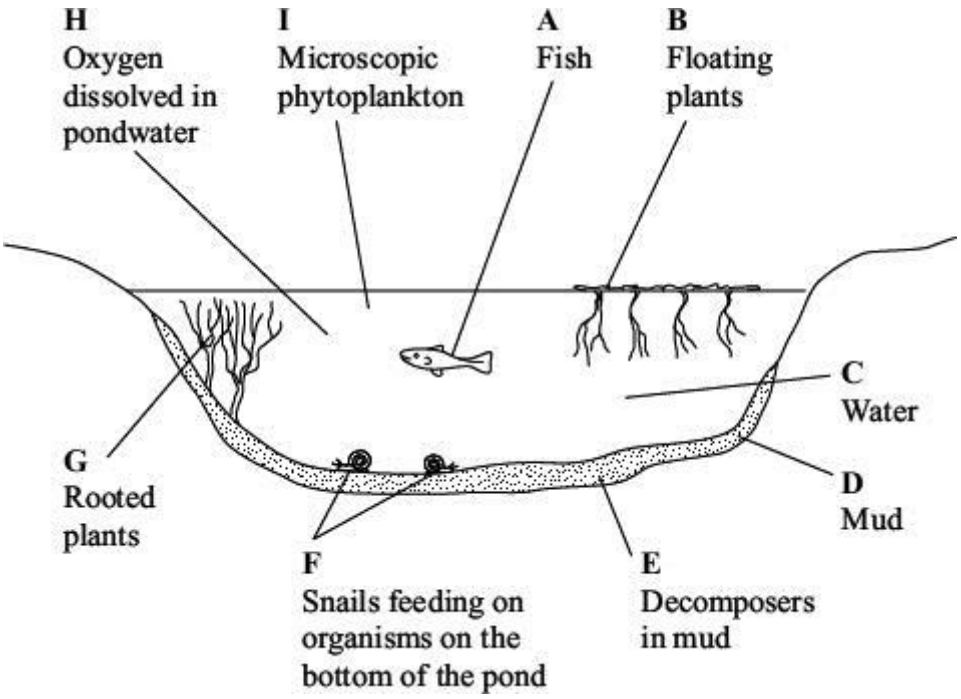
Summary Activity

Complete the table below:

Feature	Early stages of succession	Late stages of succession	Climax Community
Species diversity			
Variety of food types			
Number of niches			
Gross productivity			
Biomass			

Note: *Secondary* succession can also occur. This is where an area that has been previously colonised has been disturbed (e.g. by a forest fire) but some soil, and perhaps some species, remain. Species can then start to re-colonise the habitat.

Q1. The diagram shows some of the components of a pond ecosystem.



(a) (i) What is an ecosystem?

_____

_____ **(1)**

(ii) List the letters that represent those components that are part of the pond community.

_____ **(1)**

(b) New Zealand pygmy weed has been introduced into many garden ponds and has spread to some natural ponds. Here, it competes with naturally occurring plants. Suggest how the introduction of pygmy weed may lead to a reduction in the diversity of the community in a natural pond.

_____

_____

_____

_____

_____

_____

(3)

Q2. (a) What term is used to describe populations of different species living in the same habitat?

_____ **(1)**

(b) Different species occupy different ecological niches.

Explain the advantage of species occupying different niches.

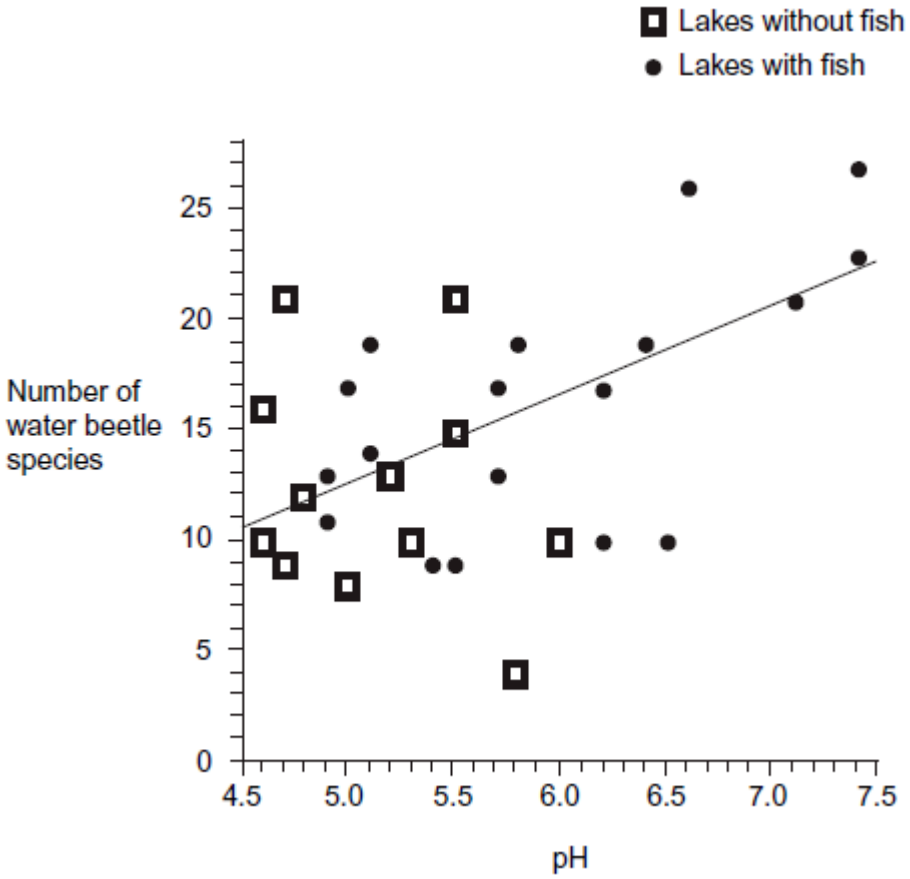
_____

_____

(1)

Scientists recorded the number of water beetle species in 30 lakes. In each lake, they measured the pH of the water and recorded whether there were any fish present.

The graph shows their results.



(c) A student concluded that a decrease in acidity caused an increase in the number of water beetle species. Evaluate this conclusion.

_____

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_____

(3)

(d) Explain how the presence of fish in a lake could cause an increase in the number of water beetle species.

_____

_____ **(1)**

Q3. Lettuce is classified in the same family as dandelions. Dandelions commonly grow on roadside verges and may accidentally be sprayed with salt when salt is added to the road in winter. Describe how you could use a transect to investigate whether the distribution of dandelions changed with increased distance from the road.

_____

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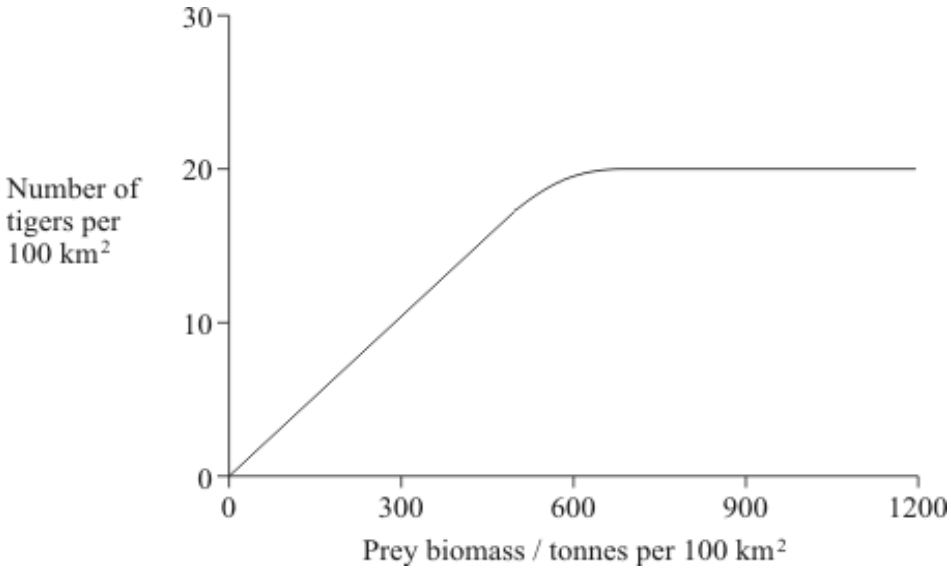
_____ **(4)**

Q4. Tigers inhabit forests where they feed mainly on large prey animals. Over the past fifty years, there has been extensive deforestation in many areas where tigers are found. The graph shows the relationship between the prey biomass of an area and the tiger population that the area can support.



(i) What is meant by the ecological term *population*?

_____

_____ **(1)**

(ii) Use the graph to explain how deforestation might cause a reduction in the number of tigers in an area.

_____

_____

_____

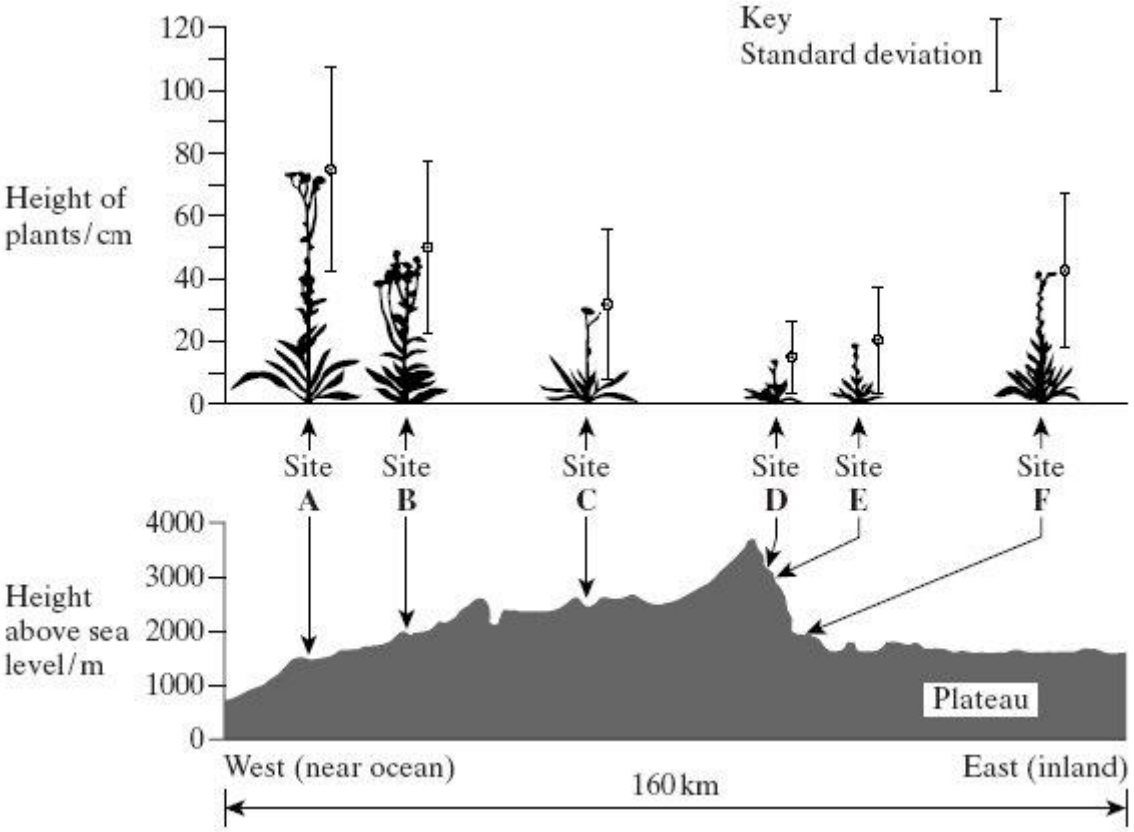
_____

_____ **(3)**

Q5. Climatic factors, such as temperature and rainfall, vary greatly over short distances across mountain ranges. In an investigation, populations of the plant, *Achillea lanulosa*, were sampled from several sites on a transect across a mountain range. At each sampling site, seeds were collected at random. Each batch of seeds was germinated and grown to maturity under the same experimental conditions.

The diagram shows

- a profile indicating the position and altitude of the sampling sites
- the mean height of mature plants grown from each sample of seeds
- the standard deviation of heights of the mature plants grown from each sample of seeds.



(a) (i) Give **one** limitation of using a line transect to collect these data.

_____

_____ **(1)**

(ii) Suggest how plants should be chosen at each sampling site to avoid bias and to be representative.

_____

_____

_____

_____ **(2)**

(b) (i) What information does the bar representing standard deviation give about the plants in a sample?

_____

_____ **(1)**

(ii) Describe what the results show about the variation of the height of the plants in relation to altitude.

_____

_____

_____

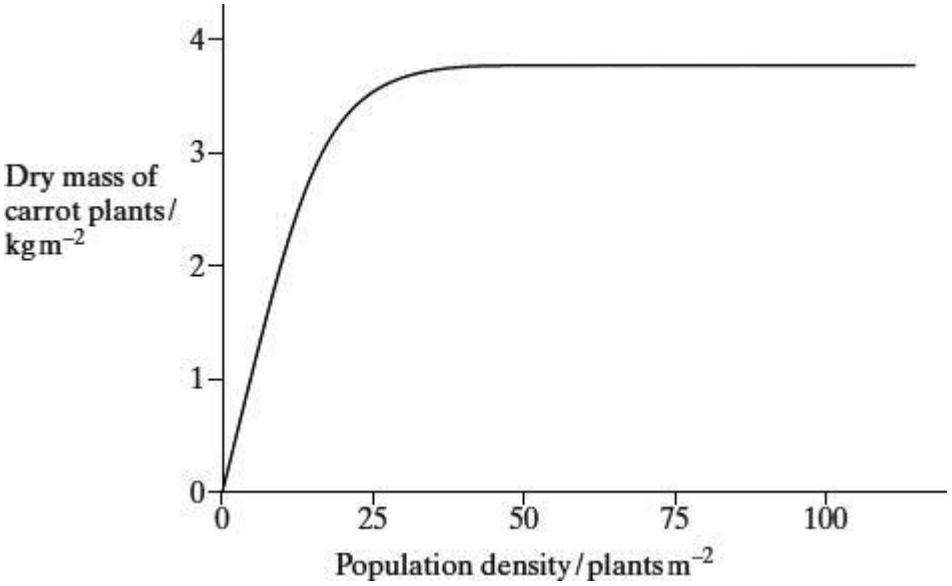
_____ **(2)**

(iii) There was a significant difference between the mean heights of the plants grown from seeds taken from sites **A** and **D**. Describe the evidence from the information given which shows that this is likely to be due to genetic differences between the two populations.

_____

_____ **(1)**

Q6. (a) In an investigation, carrot seeds were planted at different densities. After 120 days, the dry mass of the carrot plants was measured. The results are shown in the graph.



(i) What is the advantage of measuring the dry mass rather than the total mass of the carrot plants?

_____ **(1)**

(ii) What type of competition is shown in this investigation?

_____ **(1)**

(iii) Explain the shape of the curve.

_____

_____

_____

_____ **(2)**

(b) Commercial growers want all the carrots to be the same size when harvested. Suggest **two** ways in which they can try to ensure this.

1. _____

_____

2. _____

_____ **(2)**

Q7. Algae are photosynthesising organisms. Some grow on rocky shores. Scientists investigated the abundance of different species of algae at two sites, **A** and **B**, on a rocky shore. Site **A** was on the upper shore and site **B** was on the lower shore. The diagram shows the location of sites **A** and **B** on the rocky shore.

Table 1 shows some of the results the scientists obtained.

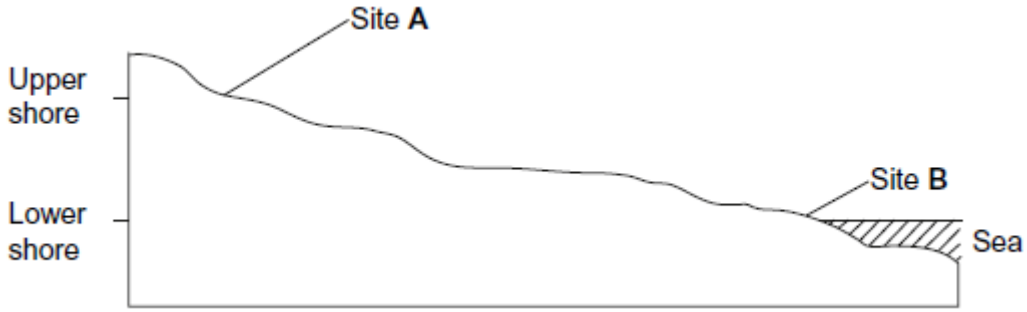


Table 1

	Site A **Upper shore**	**Site B** **Lower shore**
Species of algae with percentage cover more than 1%	*Gigartina leptorhynchos* *Gigartina canaliculata* *Gelidium coulteri* *Rhodoglossum affine*	*Gigartina spinosa* *Rhodoglossum affine* *Laurencia pacifica* *Gastroclonium coulteri* *Centroceros clavulatum* *Gigartina canaliculata* *Corallina vancouveriensis*

(a) The scientists recorded data from 40 large rocks at each site.

Describe **one** method that the scientists could have used to ensure that the large rocks were chosen without bias.

_____

_____

_____

_____ **(2)**

(b) The scientists used percentage cover rather than frequency to record the abundance of algae present

Suggest why.

_____

_____ **(1)**

(c) Apart from availability of water, describe and explain how **two** abiotic factors may have caused differences in the species of algae growing at sites **A** and **B**.

Factor 1 _____

Explanation _____

_____

Factor 2 _____

Explanation _____

_____ **(2)**

(d) Use the information provided in **Table 1** to explain why the diversity of consumers will be greater at site **B**.

_____

_____

_____

_____ **(2)**

(e) The scientists also investigated the algae eaten by two consumers found on the rocky shore, the sea slug and the shore crab. The scientists carried out their investigation in a laboratory.

- They put each consumer into a separate tank through which aerated seawater flowed slowly.
- Each tank contained 5 grams of one species of alga.
- After 50 hours, they measured the mass of the alga remaining in each tank.
- They repeated this procedure several times using a different sea slug and a different shore crab each time.

The scientists then calculated the mean mass of each species of alga eaten by the

consumers. They used a statistical test to determine the P value.

Table 2 shows some of the results they obtained.

Table 2

Species of alga	Mean mass eaten / g		P value
	Sea slug	Shore crab	
Laurencia pacifica	4.42	0.22	<0.01
Egregia leavigata	0.12	0.08	>0.05
Microcystis pyrifera	0.19	0.14	>0.05
Cystoseira osmondacea	0.17	0.04	<0.05

(i) The consumers were starved for 5 days before the investigation. Explain why.

_____

_____

_____

_____

(2)

(ii) The data in **Table 2** for the mean mass of alga eaten were adjusted for loss of mass by the alga due to respiration. Suggest how the scientists were able to determine the loss of mass due to respiration of a sample of alga.

_____

_____

_____

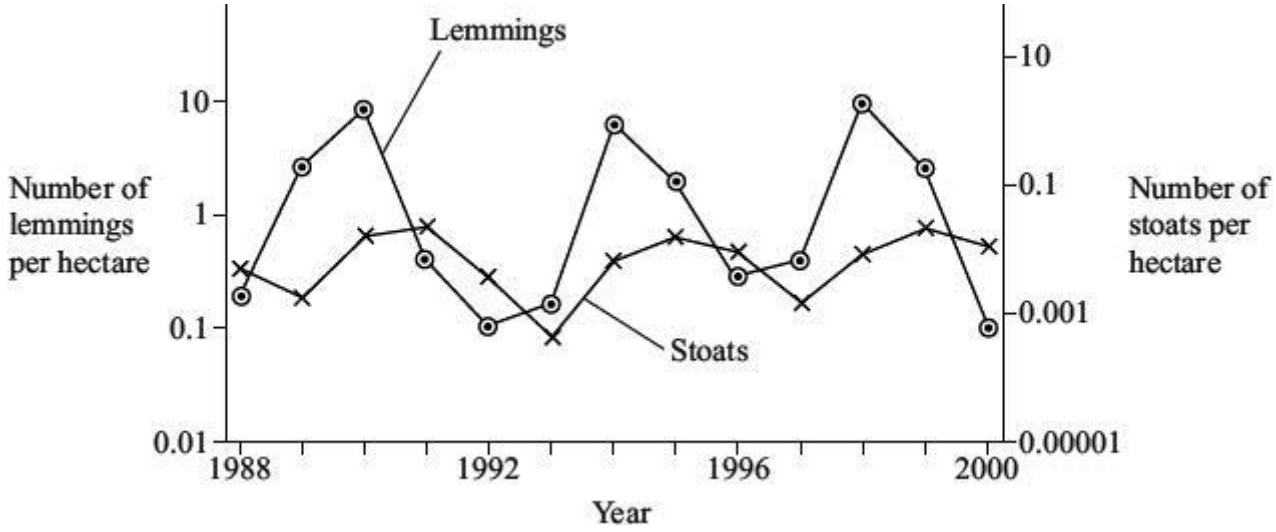
_____

_____

_____

(3)

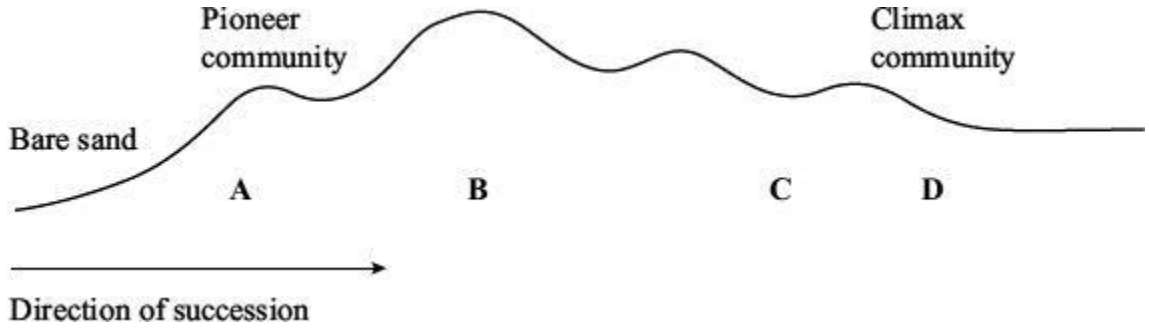
Q8. Lemmings are small mammals which live in the Arctic. Their main predator is the stoat, a small carnivorous mammal, which feeds almost entirely on lemmings. The graph shows the changes in the numbers of lemmings and stoats from 1988 to 2000.



(a) Describe and explain the changes which occur in the lemming and stoat populations.

(6)

Q9. In a sand dune succession the pioneer community (**A**) colonises bare sand. This community is replaced over time by other communities (**B** and **C**) until a climax community of woodland (**D**) is formed.



(a) The communities **A** to **D** are composed of different species. Explain how the change in species composition occurs in a succession.

_____

_____

_____

_____ **(3)**

(b) Which community, **A** to **D**, is the most stable? Explain what makes this the most stable community.

_____

_____

_____

_____ **(2)**

(c) Many species in the pioneer community are xerophytes. Suggest and explain how having sunken stomata is an advantage to these plants.

_____

_____

_____

_____

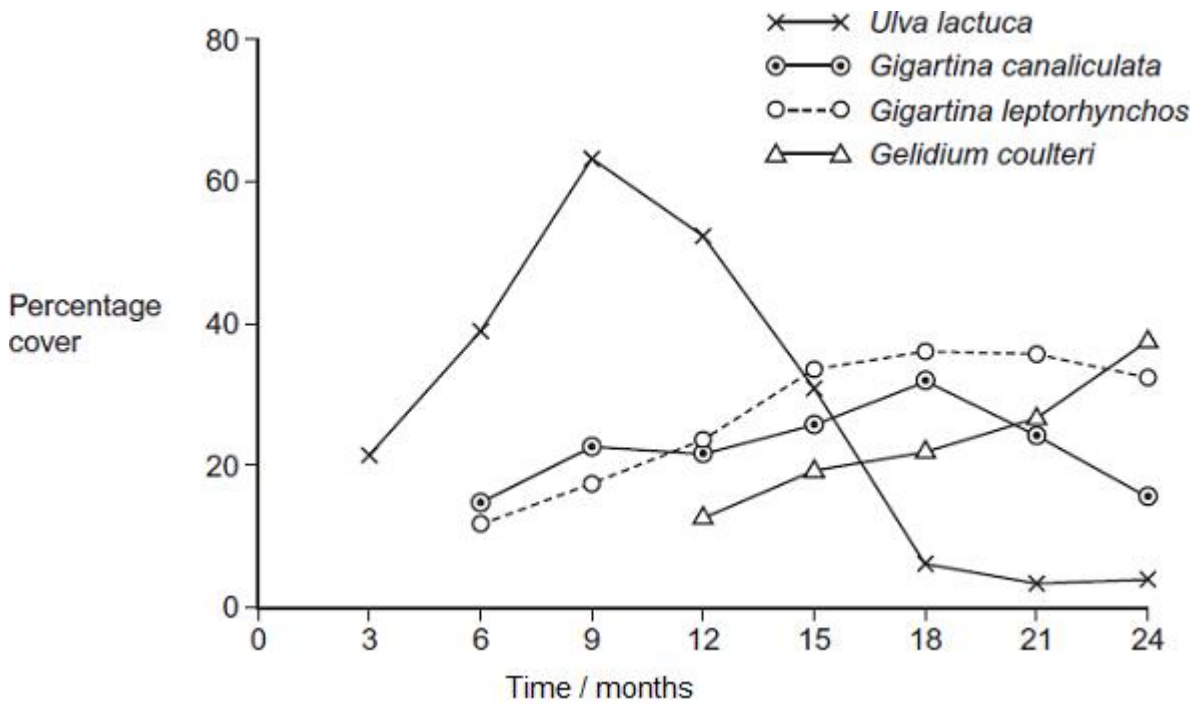
_____ (**3**)

(d) Explain why it would be more appropriate to use a transect rather than random quadrats when investigating this succession.

_____

_____ **(1)**

Q10. Algae are photosynthesising organisms. Some algae grow on rocky shores. A scientist investigated succession involving different species of algae. He placed concrete blocks on a rocky shore. At regular intervals over 2 years, he recorded the percentage cover of algal species on the blocks. His results are shown in the graph.



(a) Name the pioneer species.

_____

(1)

(b) (i) The scientist used percentage cover rather than frequency to record the abundance of algae present. Suggest why.

_____

_____

_____

(1)

(ii) Some scientists reviewing this investigation were concerned about the validity of the results because of the use of concrete blocks.
Suggest **one** reason why these scientists were concerned about using concrete blocks for the growth of algae.

_____

_____

_____

(1)

(c) Use the results of this investigation to describe and explain the process of succession.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

Q11. A student investigated an area of moorland where succession was occurring. She used quadrats to measure the percentage cover of plant species, bare ground and surface water every 10 metres along a transect. She also recorded the depth of soil at each quadrat. Her results are shown in the table.

	Percentage cover in each quadrat A to E				
	A	**B**	**C**	**D**	**E**
Bog moss	55	40	10	–	–
Bell heather	–	–	–	15	10
Sundew	10	5	–	–	–
Ling	–	–	–	15	20
Bilberry	–	–	–	15	25
Heath grass	–	–	30	10	5
Soft rush	–	30	20	5	5
Sheep's fescue	–	–	25	35	30
Bare ground	20	15	10	5	5
Surface water	15	10	5	–	–
Soil depth / cm	3.2	4.7	8.2	11.5	14.8

– Indicates zero percentage cover.

(a) Explain how these data suggest that succession has occurred from points **A** to **E** along the transect.

_____

_____

_____

_____

_____ **(3)**

(b) The diversity of animal species is higher at **E** than **A**. Explain why.

_____

_____

_____

_____

_____ **(2)**

(c) The student used the mark-release-recapture technique to estimate the size of the population of sand lizards on an area of moorland. She collected 17 lizards and marked them before releasing them back into the same area. Later, she collected 20 lizards, 10 of which were marked.

(i) Give **two** conditions for results from mark-release-recapture investigations to be valid.

1. _____

_____

2. _____

_____ (**2**)

(ii) Calculate the number of sand lizards on this area of moorland. Show your working.

Answer = _____ **(2)**

Learn the following definitions.

Key Word	Definition
Abiotic	*non-living* factors, i.e. physical and chemical e.g. CO_2, O_2, water, temperature, salinity, light and mineral ions
Abundance	the number of individuals of a species in a given area
Adaptation	the evolutionary process whereby an organism becomes better able to live in its habitat
Bias	this may happen when individuals of some species are sampled more frequently, or less frequently, than expected. This can cause the population size to be either overestimated or underestimated
Biotic	*living*/biological factors, e.g. feeding relationships between organisms such as predator- prey relationships, competition, parasites and symbiosis
Community	all the organisms / populations present in a habitat
Distribution	the geographical area within which that species can be found
Ecology	the scientific study of the factors which determine the distribution and abundance of organisms
Ecosystem	the environment and all the organisms that live in an area. This means it is made up of all the abiotic factors and biotic factors in an area
Habitat	the place where an animal (or community of organisms) lives which is characterised by physical conditions and the species of other organisms present
Interspecific competition	competition between individuals of different species
Intraspecific competition	competition between individuals of the same species
Mark–release–recapture	a method commonly used in ecology to estimate the population size of mobile animals such as fast-moving or flying terrestrial animals, such as insects
Niche	it describes how an organism fits into its environment – where it lives and what it does there
Population	all the individuals of one species in a habitat
Predation	a biological interaction where a predator (an organism that hunts and eats other animals) feeds on its prey
Quadrats	a square frame which can be used for ecological surveying to sample plants or slow moving animals.
Random sampling	taking samples in a way that avoids bias, usually carried out when the area under study is fairly uniform, very large, and or there is limited time available
Sample	a part of the ecosystem that is representative of the whole
Species	a group of organisms with similar characteristics that can breed to produce fertile offspring
Transects	a straight line or narrow section through an environment along which observations are made or measurements taken

Required practical 12 plan

Suggested Reading

https://www.physicsandmathstutor.com/biology-revision/a-level-aqa/practical-skills/effect-of-different-variables-on-species-distribution/

https://www.physicsandmathstutor.com/pdf-pages/?pdf=https%3A%2F%2Fpmt.physicsandmathstutor.com%2Fdownload%2FBiology%2FA-level%2FNotes%2FAQA%2FPractical-Skills%2FRP%252012%2520-%2520Effect%2520of%2520Different%2520Variables%2520on%2520Species%2520Distribution.pdf

https://filestore.aqa.org.uk/resources/biology/AQA-7401-7402-P12.PDF

https://qualifications.pearson.com/content/dam/pdf/A%20Level/biology-b/2015/teaching-and-learning-materials/AS-and-A-level-Biology-B-Core-Practical-16a-Distribution-of-Species-(Student,-Teacher,-Technician-Worksheets).pdf

https://practicalbiology.org/environment/fieldwork-techniques/biodiversity-in-your-backyard

https://filestore.aqa.org.uk/resources/biology/AQA-7401-7402-PHBK.PDF

https://www.saps.org.uk/index.php?option=com_customproperties&view=search&Itemid=157&bind_to_category=content%3A131%2Ccontent%3A107%2Ccontent%3A84%2Ccontent%3A85%2Ccontent%3A87%2Ccontent%3A90%2Ccontent%3A113&cp%5Bkey_stage%5D%5B%5D=post_16&cp%5Bkey_stage%5D%5B%5D=&cp%5Bsecondary_tags%5D%5B%5D=ecology&cp%5Bsecondary_tags%5D%5B%5D=&cp%5Bresource_type%5D%5B%5D=&submit_search=

https://www.saps.org.uk/secondary/teaching-resources/768-ecology-practical-abundance-diversity-and-random-sampling

Investigation into the effect of a named environmental factor on the distribution of a given species.

Your task is to plan an experiment to identify the effect of a named environmental factor on the distribution of a given species.

Competences assessed in this practical

Competencies	
2/(c) Identifies and controls significant quantitative variables where applicable, and plans approaches to take account of variables that cannot readily be controlled	
2/(d) Selects appropriate equipment and measurement strategies in order to ensure accurate results.	
3/(a) Identifies hazards and assesses risks associated with those hazards, making safety adjustments as necessary, when carrying out experimental techniques and procedures in the lab or field.	
5/(b) Cites sources of information demonstrating that research has taken place, supporting planning and conclusions.	

Before the practical

1. **Write an experimental plan**

You must carry out research to help you plan and carry out an investigation into the effect of a named environmental factor on the distribution of a given species.

Your plan should include:

- Title
- Hypothesis to be tested (include name of species and environmental factor being investigated)
- Null hypothesis
- List of apparatus (Justify your list of apparatus, see "**extra guidance**").
- Clear step-by-step instructions for the experimental work (this does not have to be extensive bullet points will do).
    - Make sure you state what you are using for each measurement. E.g. Measure 10cm^3 of salt solution **using a 10cm^3 graduated pipette.**
- Outline your variables. This should include the independent & dependant variables, as well as any variables to be controlled. For your control variables you must state how and why you are controlling them.

- The safety precautions that you will take to reduce the risks from any hazards in the form of a risk assessment (see example table below).

- Reference your sources of information. They should cover more than those provided and include research on the species being investigated.

Extra guidance

Apparatus: Explain the rationale for choosing relevant apparatus, especially the piece of equipment used to make the measurements e.g. quadrat with 50 small squares is more accurate / precise as it has a lower percentage error or uncertainty when calculating % cover.

Research: This needs to be from at least two different sources, it should be clear in your write up where you have used material from your research.

e.g

"The optimum temperature for an enzyme reaction is… [1]

At the end of the document you should have a section for references laid out like this:

[1] https://www.ncbi.nlm.nih.gov/pubmed/21319805 date accessed 23/4/18

IF YOU ARE UNSURE ASK.

2. Risk assessment.

Using your method complete the following risk assessment table. Some of the columns may not be relevant to each risk.

An **example** of the type of risk and level of detail required is shown below make sure that the risk assessment is form your perspective **e.g** tell the teacher I have broken a test tube as a precaution to minimise risk.

Use the student CLEAPPS guide (link below) and common sense to complete.
http://science.cleapss.org.uk/Resources/Student-Safety-Sheets/

Complete a table with the following headings.

Hazard	Risk and possible consequences	How to reduce the risk	What to do if risk occurs

Highly recommended content

Required practical 9 - Respiration

Watch the YouTube clip and answer the following questions:
https://www.youtube.com/watch?v=1YUONb7_CLs&list=PL0Mjub5NT75746Ok9jijVZoNXjrEzU53G&index=14&t=0s

1. **State the independent variable in the investigation.**
2. **State the dependent variable in the investigation.**
3. **State 2 control variables and explain how they are kept constant.**
4. **What is the purpose of the oil?**
5. **Why does the fluid move?**

Unit 5 – Nutrient Cycles

Watch the following video.

https://www.youtube.com/watch?v=_H5phG_Ae6M

Write an essay or create a concept map illustrating the importance of nitrogen in Biology.

Unit 5 – Productivity

Research and make a poster on how farmers can maximise productivity and the yield of crops.