Pearson Edexcel

Additional Assessment Materials
Summer 2021

Pearson Edexcel GCE in A Level Biology

Topic 10: Ecosystems

(Public release version)

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Additional Assessment Materials, Summer 2021

General guidance to Additional Assessment Materials for use in 2021

Context

- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

Purpose

- The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

1

The drawing shows a plant called white clover, *Trifolium repens*.

A student used a 50 cm × 50 cm quadrat to compare the abundance of white clover in a trampled area of grassland and an untrampled area of grassland.

Each area measured 90 m × 45 m.

The diagram shows the distribution of white clover plants in one quadrat from the area of trampled grassland. Each circle represents one clover plant.

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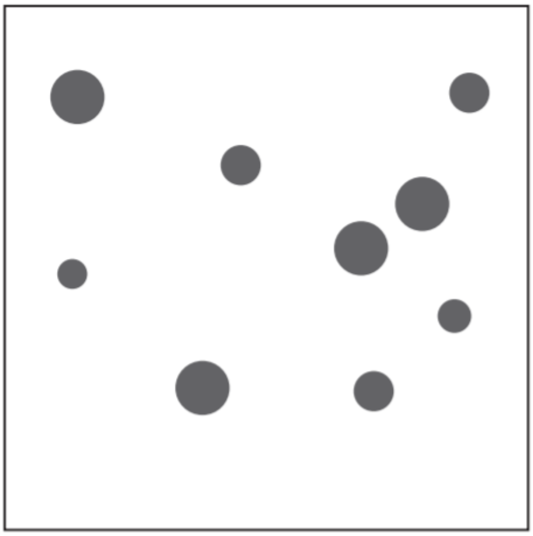


(a) (i) Use the results from this quadrat to calculate the total number of white clover plants present in the area of trampled grassland.

(2)

$50 \times 50 = 2500\,cm^2 = 0{\cdot}25\,m^2$

9 plants in $0{\cdot}25\,m^2$

$90 \times 45 = 4050\,m^2$

$\frac{9}{0{\cdot}25} \times 4050 = 145800$

Answer 145800

(ii) The student used the same method to calculate the total number of white clover plants in the area of untrampled grassland.

The student decided that the calculated values were not accurate.

Explain how you would modify the method to obtain more accurate results.

(3)

Use multiple quadrats (e.g. minimum of five) and random sampling. Use tape measures to make a grid so random coordinates can be generated and place the quadrats at these coordinates. The use of multiple quadrats ensures a large area is sampled and random sampling avoids bias.

(b) The student investigated the effect of one abiotic factor on the abundance of white clover plants.

(i) Name one abiotic factor, other than soil water content, that could affect the abundance of white clover plants in these areas.

(1)

Light intensity

(ii) Describe how you would measure the abiotic factor named in (b)(i).

(2)

Use a light meter to measure the intensity of light in each quadrat at a specific time of day.

(iii) The student obtained the following results for soil water content and the abundance of white clover plants in these two areas of grassland.

Area of grassland	Soil water content (%)	Abundance of white clover plants
Trampled	54.9	low
Untrampled	88.8	high

Explain the effect of trampling on the abundance of white clover plants.

(2)

The water content of trampled soil is lower than that of untrampled soil. In trampled soil, water may be a limiting factor and reduce the rate of photosynthesis, leading to a lower abundance of white clover plants.

2

The table shows information about one area of the North Atlantic Ocean.

Month	Mean hours of daylight / hr	Mean monthly temperature / °C	Net primary productivity (NPP) / g carbon m^{-2} day^{-1}
January	9.0	2.8	−1.0
February	10.0	3.1	−1.2
March	11.0	6.7	−0.5
April	13.0	9.4	+3.0
May	14.0	15.5	+4.0
June	15.0	20.6	+8.0
July	14.0	23.9	+7.0
August	13.5	23.3	+7.0
September	12.0	21.1	+5.0
October	11.0	16.1	+4.0
November	10.0	11.1	+3.0
December	9.0	4.0	−1.2

(a) (i) State what is meant by the term **net primary productivity** (NPP).

(1)

The energy in producers which is made available to primary consumers. Gross primary productivity minus respiration loss.

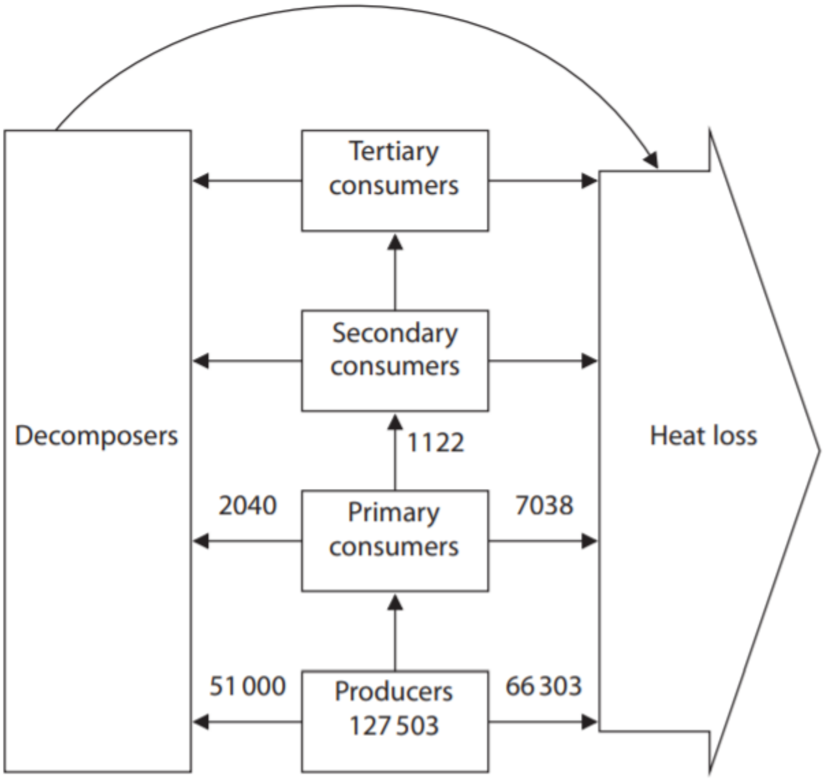
(ii) Analyse the data to explain the effect of daylight and temperature on NPP.

(3)

As daylight and temperature increases, NPP increases because the rate of photosynthesis exceeds the rate of respiration ∴ plants increase in biomass. As the mean hours of daylight decreases, light becomes a limiting factor and even if temperature rises, NPP decreases. This occurs in June and July. When the rate of respiration exceeds the rate of photosynthesis, NPP becomes negative. This occurs in January, February, March and December.

(b) The diagram shows some of the energy transfers through a food chain from this area.

The figures show the energy transfer in kJ m^{-2} yr^{-1}.



(i) Calculate the percentage efficiency of energy transfer from the producers to the primary consumers.

(2)

$$\frac{127503 - 51000 - 66303}{127503} \times 100 = 8.00\%$$

Answer 8%

(ii) Explain why the efficiency of energy transfer differs between different trophic levels.

(3)

At each trophic level, energy may be lost as heat energy from respiration, in indigestible parts, via excretion and via egestion. At each trophic level, different organisms are present which lose different amounts of energy in different ways. For example, more metabolically active animals lose more energy as heat during respiration, reducing the efficiency of energy transfer to higher trophic levels.

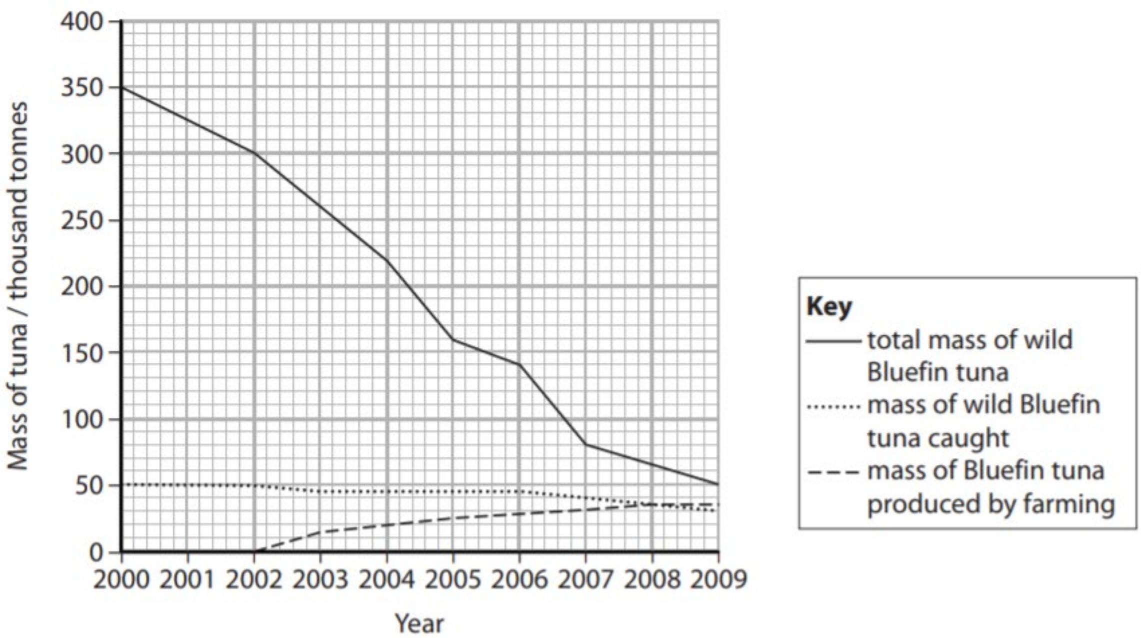
(c) Bluefin tuna are the top predators in this ocean.

Bluefin tuna are caught by the fishing industry for human consumption. The demand is very high.

One method to help meet the demand for Bluefin tuna is tuna farming.

This method traps young sexually immature fish from the wild. They are placed in submerged cages and fed on a diet of prey species captured from the ocean.

The graph shows the masses of wild Bluefin tuna caught and Bluefin tuna produced by farming. It also shows the total mass of wild Bluefin tuna in an area of the North Atlantic Ocean.



Comment on the impact of Bluefin tuna farming.

(4)

After tuna farming begins in 2002, the total mass of wild Bluefin tuna more rapidly decreases from 300 thousand tonnes in 2002 to 50 thousand tonnes in 2009. The mass of wild Bluefin tuna caught also begins to decrease from 2002, although less rapidly, from 50 thousand tonnes in 2002 to 30 thousand tonnes in 2009. These observations are likely due to the fact that tuna farming involves the removal of young sexually immature fish from wild populations. This reduces the breeding ability of future tuna fish generations, leading to a decline in population numbers. Moreover, farmed tuna are fed on a diet of prey captured from the ocean. This will reduce the amount of food available to wild populations, further reducing population numbers.

3

The island of Surtsey was formed by a volcanic eruption in the Atlantic Ocean in 1965.

The photographs show the formation of Surtsey in 1965 and part of the island in 2018.

volcanocafe.files.wordpress.com

vulkaner.no

Scientists have been studying the development of ecosystems on this island since its formation.

(a) (i) State what is meant by the term ecosystem.

(1)

Interactions between living organisms (biotic factors) and the physical environment (abiotic factors) in a given area.

(ii) Explain how ecosystems have developed on Surtsey since 1965.

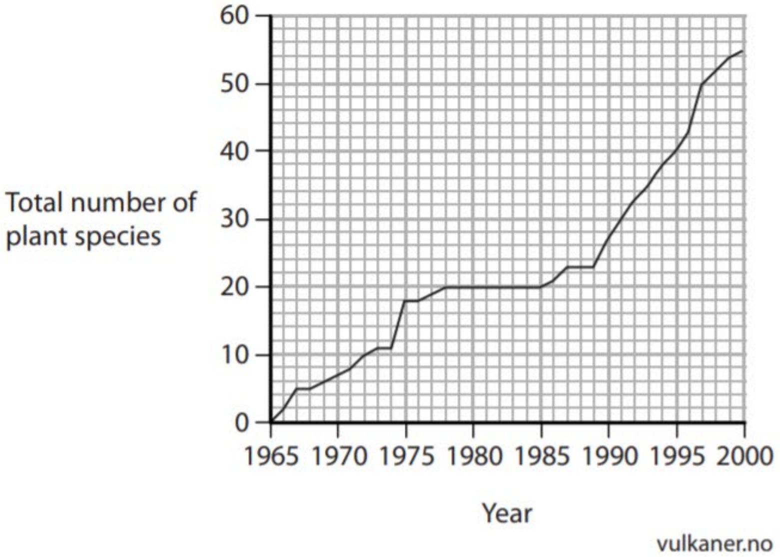
(5)

Pioneer species, which can survive in extreme conditions, colonise bare sand or rock left from the volcanic eruption. They break up and penetrate rock. As they die and decompose, they add nutrients to the ground. Humus builds and soil forms. The environment becomes gradually less hostile and can support other species (e.g. mosses, lichens). This is primary succession. Over time, soils deepen and can hold more nutrients and water. This enables more complex plants (e.g. shrubs, grasses) to grow. Plant diversity increases, providing new niches for animals and increasing animal diversity. This process continues until a stable ecosystem with high biodiversity is reached, climax community.

(b) The scientists recorded the number of different plant species on the island each year from 1965 to 2000.

The number of new plant species present at each survey was recorded.

The graph shows the total number of plant species that have been found on the island.



A few groups of one species of seagull arrived on the island in 1974.

In 1985 a large group of a different species of seagull, the black-backed gull, arrived on the island.

Comment on the effects of these two species of seagull on the number of plant species.

(4)

In both 1974 and 1985, as a new species of seagull arrived, the total number of plant species increased This increase was more rapid following the arrival of the seagull species in 1974. The increase in plant biodiversity could be for a variety of reasons. Firstly the seagulls may have brought seeds with them to the island in their beaks or claws. Following consumption and egestion, or simply dropping the seeds, germination and growth of new plant species would occur. The seagulls may have also consumed pests that were limiting or preventing the growth of some plant species. Egestion by the seagulls and their eventual decomposition following death would have also increased the nutrient composition of the soil.

A student measured the distribution of two plant species at the coast.

The distribution was measured from the high water line to 170 m inland.

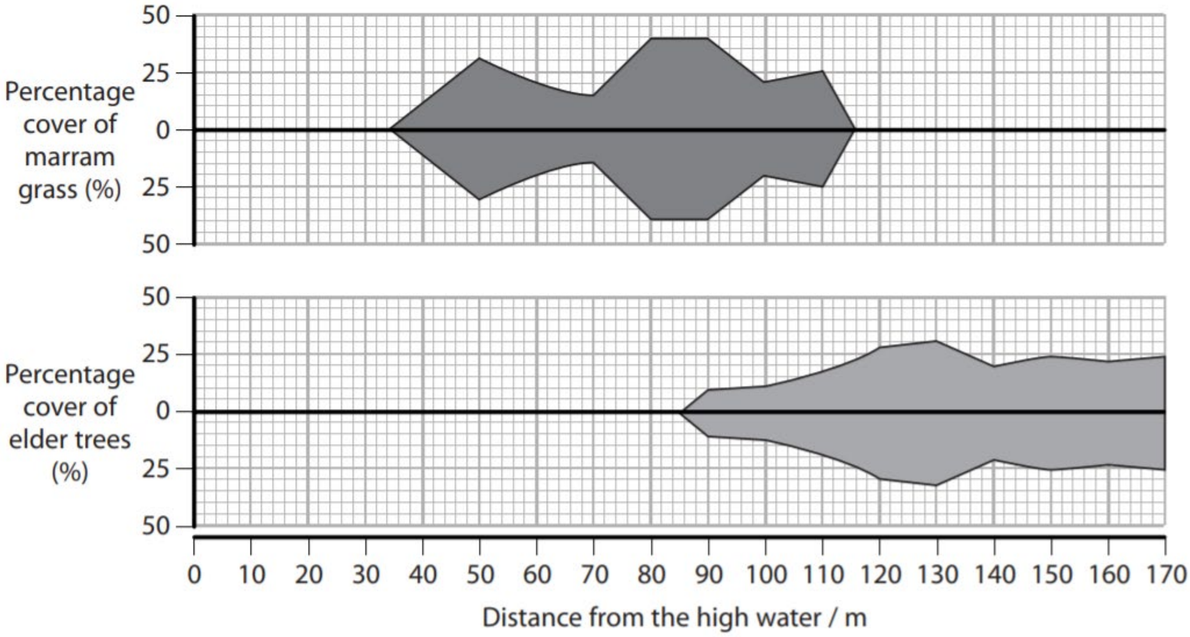
(a) State what is meant by the term species.

(1)

A group of species that share common characteristics and can successfully reproduce with one another (interbreed) to produce fertile offspring.

(b) The student represented the distribution of the two plant species in a kite diagram as shown.

The height of each kite diagram represents the percentage cover of plant species at different distances from the high water line.



(i) Compare and contrast the distribution of marram grass and elder trees.

(2)

The distribution of marram grass and elder trees overlap. Marram grass is found closer to the high water, between roughly 35 and 116m away. Elder trees are found further away, between 85 and 170m. Both species are found between 85 and 116m. The maximum % cover of marram grass is 80% which occurs between 80 and 90m whereas the maximum % cover of elder trees is around 66% at 130m. Neither species are found less than 35m from the high water line.

(ii) Explain how the student could have collected the data shown in the diagram.

(3)

Transect line placed perpendicular to the water, beginning at the high water line and moving inland. Every 10m, place the bottom left hand corner of a quadrat on the transect and estimate the % cover of each species. Record the data in a suitable table. Multiple transects can be used to increase the size of the sampling area.

(c) The student measured the water content of the soil from the high water line to 170 m inland.

Describe how the student could have carried out these measurements.

(3)

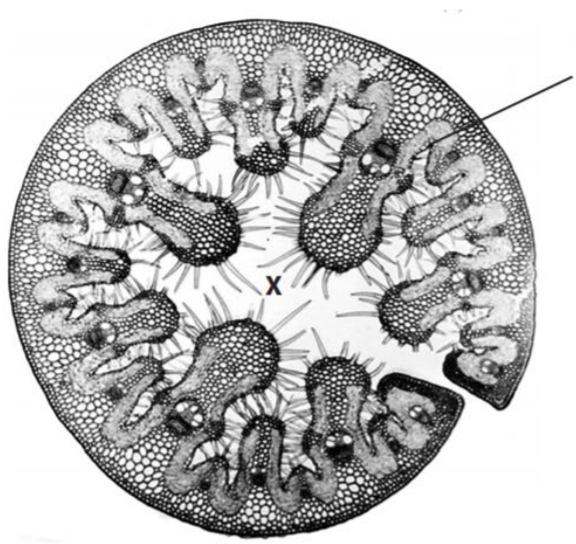
Transect line placed perpendicular to the water, beginning at the high water line and moving inland. Every 10m, take a sample of soil from the area touching the transect line. Measure the mass of the moist soil and record in a suitable table. Dry the soil using a drying oven, measure its mass and record. The % water content of the soil can be calculated using:

$$\% \text{ water content} = \frac{\text{mass of moist soil} - \text{mass of dry soil}}{\text{mass of dry soil}} \times 100$$

Carry out repeats so that the mean % soil water content can be calculated.

(d) Marram grass leaves are adapted to enable the plants to survive in dry soil.

The photograph shows a section of a marram grass leaf, as seen using a light microscope.



Explain how the structure of this leaf ensures that the water potential at X remains high.

(3)

The stomata are sunken in pores which trap moist air and provide shelter from the wind. This increases humidity, reducing the water potential gradient between X and the environment and thus decreasing the rate of transpiration. This maintains a high water potential at X. Leaf hairs in the epidermis also trap moist area around the stomata and slow down air movement, further reducing the water potential gradient and transpiration rate. The waxy leaf cuticle reduces evaporation and the leaf rolls in dry, hot conditions, trapping humid air and reducing water loss.

TOTAL FOR TEST = 45 Marks