

Q1.

Read the following passage.

5 Lake Malawi in East Africa has more species of fish than any other lake in the world. Many of these species have evolved from a common ancestor. Lake Malawi is one of the largest lakes in the world and was formed several million years ago. Since then, the water level has fluctuated greatly. As a result, what is now a large lake was at one time many smaller, separate lakes.

The country of Malawi has a total area of 118 000 km². The actual land area is only 94 080 km², because approximately one-fifth of the country is Lake Malawi.

10 In December 1990, forests covered 41.4% of the actual land area of Malawi. In December 2016, forests covered 26.4% of the actual land area of Malawi.

15 Deforestation and farming along the shores of Lake Malawi have caused increased soil erosion and loss of nutrients into the lake. This has resulted in a decrease in some fish populations. The mark-release-recapture method can be used to estimate the size of a fish population. However, this method can produce unreliable results in very large lakes.

Use the information in the passage and your own knowledge to answer the following questions.

- (a) Lake Malawi in East Africa has more species of fish than any other lake in the world (line 1).

Suggest and explain how this speciation may have occurred.

(4)

- (b) The percentage of forest cover in Malawi decreased between December 1990 and December 2016 (lines 9–10).

Calculate the mean loss of forest cover in km² per week during this time period.

Answer _____ km² per week

(2)

- (c) Loss of nutrients **into** Lake Malawi has resulted in a decrease in some fish populations (lines 12–13).

Explain why.

(4)

- (d) The mark-release-recapture method can be used to estimate the size of a fish population (lines 13–14).

Explain how.

(4)

- (e) Suggest why the mark-release-recapture method can produce unreliable results in very large lakes (lines 14–15).

(1)

(Total 15 marks)

(5)

(b) Suggest and explain how digesting insects helps the sundew to grow in soil with very low concentrations of some nutrients.

(2)

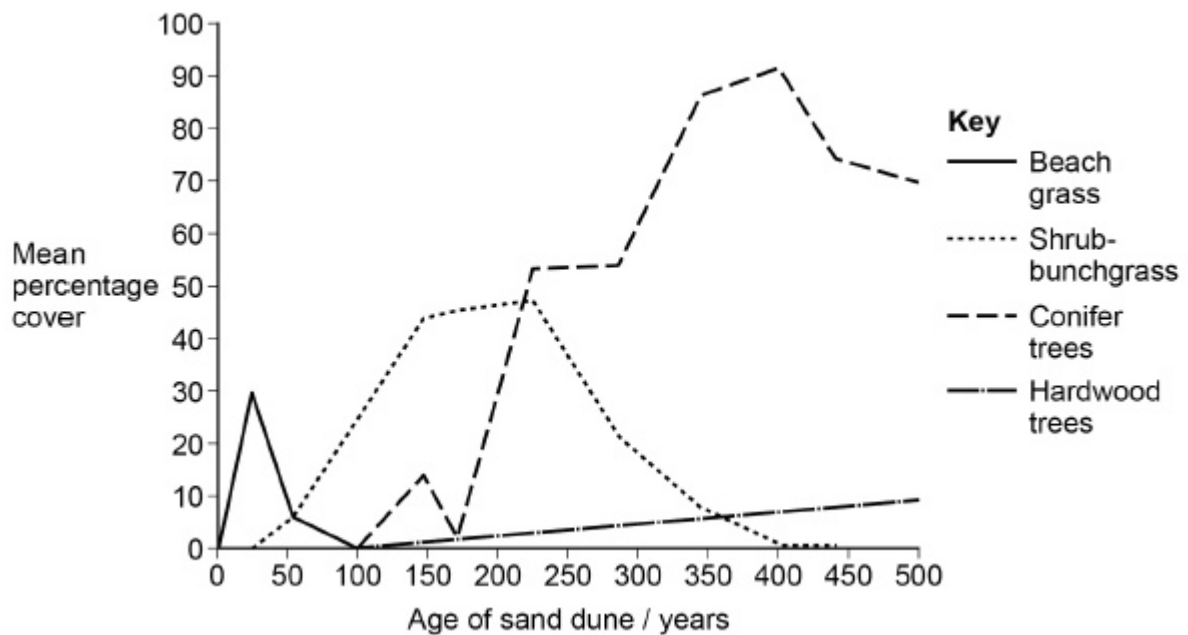
(Total 7 marks)

Q4.

Scientists investigated the process of succession on sand dunes. They measured the percentage cover of different species of plants on sand dunes of different ages.

Some of the results the scientists obtained are shown in **Figure 1**.

Figure 1



- (a) Describe how you would determine the mean percentage cover for beach grass on a sand dune.

(3)

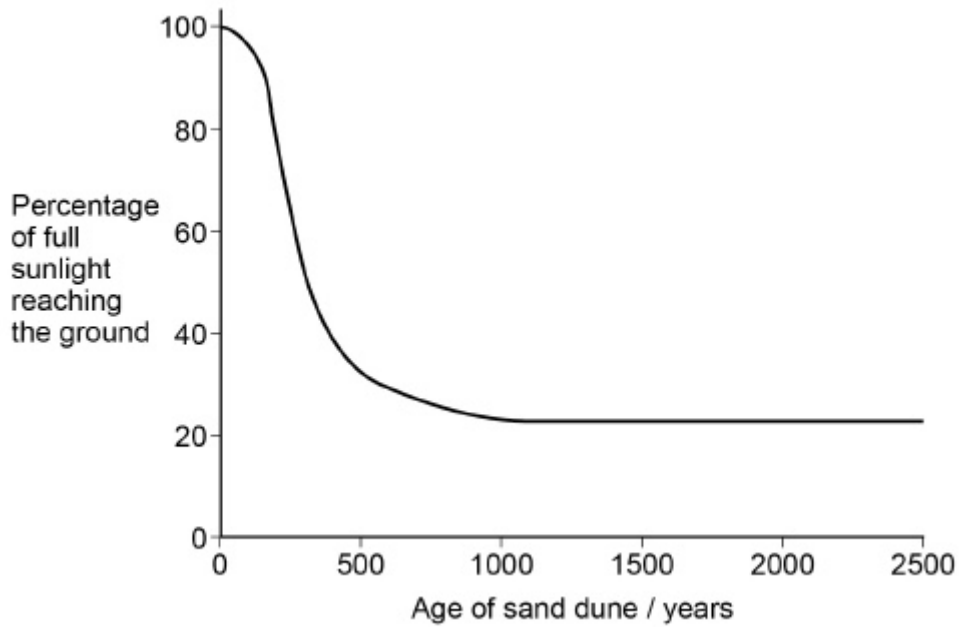
- (b) The scientists concluded that the results shown in **Figure 1** were due to succession taking place.

Use **Figure 1** to explain why the scientists reached this conclusion.

(4)

The scientists also investigated how the proportion of sunlight reaching the ground changed during succession. Some of the results the scientists obtained are shown in **Figure 2**.

Figure 2



(c) Use **Figure 1** to explain the results in **Figure 2**.

(1)

Q5.

Dengue is a serious disease that is caused by a virus. The virus is carried from one person to another by a mosquito, *Aedes aegypti*. One method used to try to reduce transmission of this disease is the Sterile Insect Technique (SIT). This involves releasing large numbers of sterile (infertile) male *A. aegypti* into the habitat. These males have been made infertile by using radiation.

- (a) Explain how using the SIT could reduce transmission of dengue.

(2)

- (b) Describe how the mark-release-recapture method could be used to determine the population of *A. aegypti* at the start of the investigation.

(3)

- (c) The release of radiation-sterilised *A. aegypti* has not been very successful in controlling the transmission of dengue.

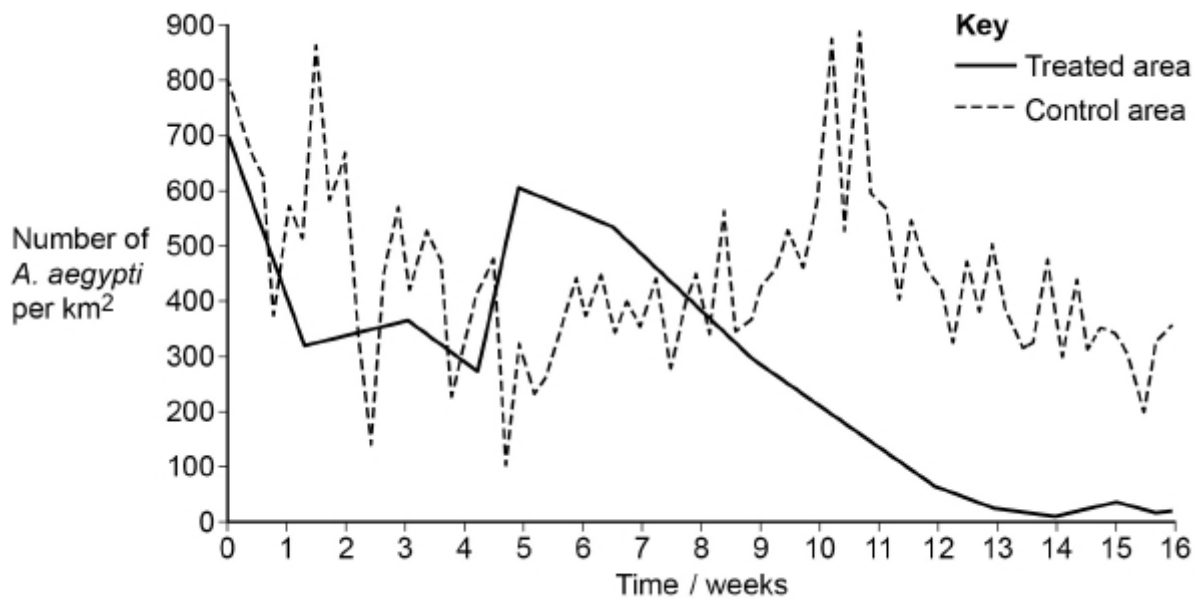
Suggest **one** reason why.

(1)

- (d) Recently a new method was developed to control *A. aegypti*. Scientists produced transgenic males carrying a 'lethal gene' which kills their offspring before they can reproduce.

The scientists released transgenic males every week in one area of a city in Brazil. At regular intervals they determined the number of *A. aegypti* per km² in the area where transgenic males were released and in a control area where no transgenic males were released.

The graph shows their results.



Suggest why the scientists released more transgenic males every week.

(1)

- (e) The release of transgenic males proved successful in reducing the number of *A. aegypti*.

Describe how the results in the diagram above support this conclusion.

(2)
(Total 9 marks)

Q6.

Ecologists studied a stream community before and after a flood. The flood reduced animal populations in the stream by 98%.

The table shows how the populations of six animal species found in the stream changed following the flooding.

Animal species	Number of days after flooding						
	1	5	13	22	35	49	63
	Mean number of organisms / thousands m ⁻³						
<i>Baetis quilleri</i>	0.03	0.85	2.6	9.3	6.4	0.9	0.3
<i>Leptohyphes packeri</i>	0.0	0.0	0.25	2.5	17.3	18.0	29.5
<i>Helicopsyche mexicana</i>	0.0	0.02	0.2	0.1	0.07	0.03	0.01
<i>Cryptolabis paradoxa</i>	0.0	13.3	21.3	55.8	62.9	168.7	182.6
<i>Pentaneurini guttipennis</i>	0.1	0.5	0.6	1.8	1.0	0.6	0.25
<i>Micropsectra klinki</i>	0.0	0.0	0.0	0.0	0.0	0.2	5.6

(a) Explain how the data in the table provides evidence of succession.

(5)

- (b) The populations of *Cryptolabis paradoxa* and *Leptohyphes packeri* both increased between days 13 and 63.

Calculate how many times the population growth per day of *Cryptolabis paradoxa* is greater than that of *Leptohyphes packeri* between these days.

Answer = _____

(2)

- (c) The stream eventually recovered to reach a climax community.

Give **two** features of a climax community.

1. _____

2. _____

(2)

(Total 9 marks)

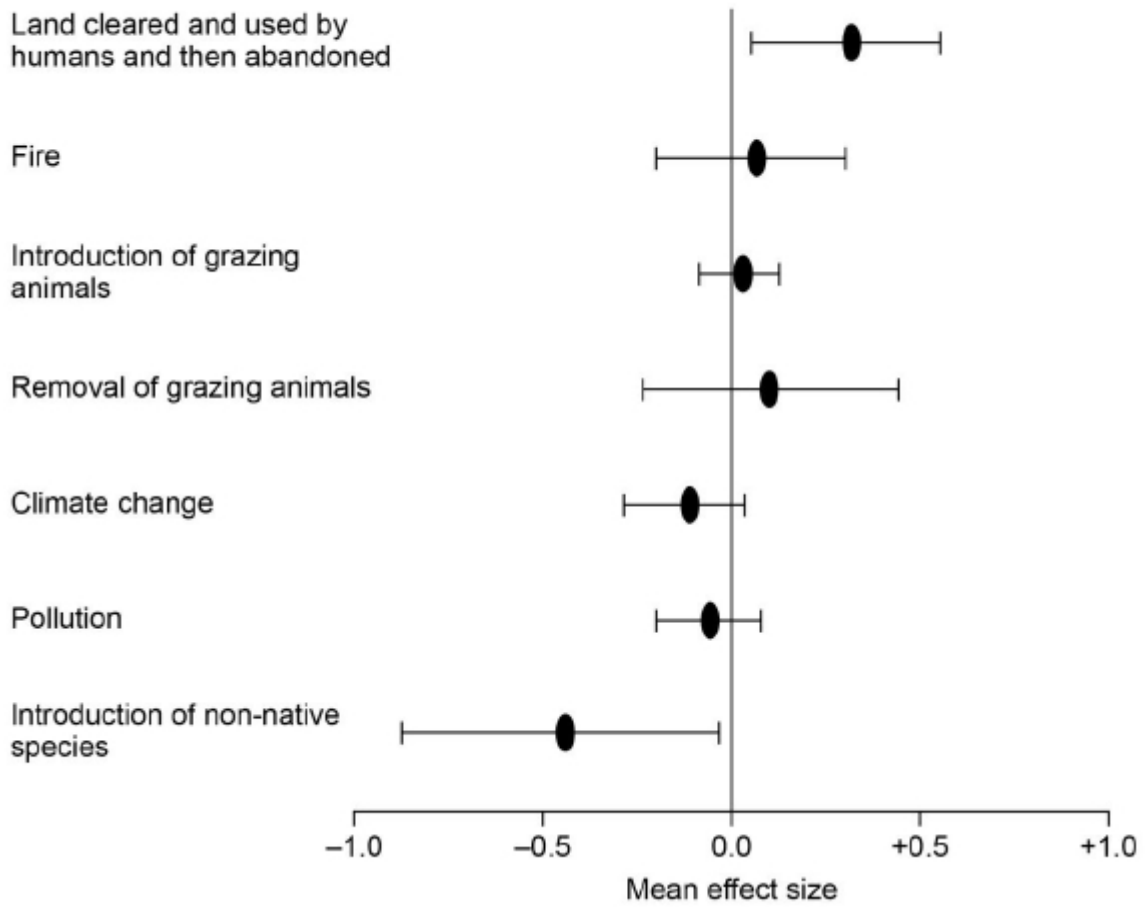
Q7.

Scientists investigated changes in plant biodiversity in different communities after changes caused by humans. They collected data from many published investigations that recorded changes in species richness of plants over a large number of years.

The scientists used data from each investigation to calculate the effect size. The effect size is a measure of change in species diversity with time. A positive value shows an increase in species richness with time.

The graph below shows the scientists results in the form in which they were published. The horizontal bars represent ± 2 standard deviations, which includes 95.4% of the data.

Human activity that changes community



(a) What can you conclude from these data about the effects of human activities on biodiversity?

(3)

- (b) Suggest an explanation for the effect size when non-native species were introduced to communities.

(2)

- (c) Describe how you would investigate the effect of an invasion by a non-native species of plant (a biotic environmental factor) over many years on the abundance of a native species of plant in a community.

(3)

- (d) Effect size is calculated in the following way.

1. Divide the species richness in the last year of an investigation (SR2) by species richness in the first year of the investigation (SR1).
2. Find the natural log (\log_e) of the result.
3. Divide this by the time (T) between the first and last year in decades (1 decade = 10 years).

In one community:

- species richness in year 2 (SR2) was 15.3
- species richness in year 1 (SR1) was 18.2
- and the investigation lasted for 29 years.

Use \log_e , SR2, SR1 and T to write an equation for 'effect size' and calculate its value for this investigation. On a calculator, the key for \log_e is shown as ln, or \log_e .

Effect size = _____

(2)

(Total 10 marks)

Q8.

In northern India, there is a conflict of interests between farmers of livestock (eg cows) and people trying to conserve ibex (a type of wild goat).

When livestock are given extra food, their populations can grow too large and compete with ibex.

(a) Name the type of competition between livestock and ibex.

(1)

Livestock will outcompete ibex if they:

- are in the same habitat
- eat a similar diet.

Scientists investigated this conflict of interests.

The table below summarises some of the scientists' findings.

Type of livestock	Difference between livestock food and ibex food*	Difference between livestock habitat and ibex habitat*
Cow	1.0	1.5
Horse	0.5	0.0
Yak	0.0	2.0

* A score of 0.0 indicates that the food or habitat is the same.

(b) There must be a balance between the need for conservation of the ibex and the need for farmers to keep livestock.

Using **all** the information, suggest and explain **three** actions that the farmers could take to achieve this balance.

1 _____

2 _____

3 _____

(3)

(Total 4 marks)