A-Level Biology

Populations in Ecosystems

Question Paper

Time available: 78 minutes
Marks available: 50 marks

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1. 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.

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2 _____

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(3)

(Total 4 marks)

2. The sundew is a small flowering plant, growing in wet habitats such as bogs and marshes. The soil in bogs and marshes is acidic and has very low concentrations of some nutrients. The sundew can trap and digest insects.

(a) Describe how you could estimate the size of a population of sundews in a small marsh.

(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)

3. 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.

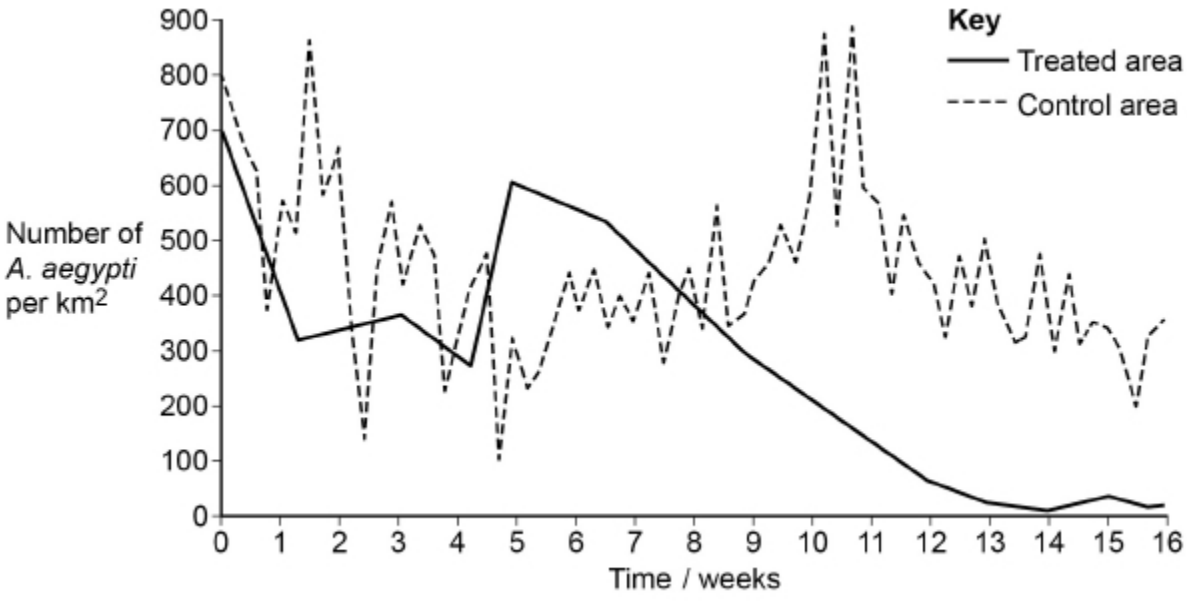
Suggest **one** reason why.

(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 km^2 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.

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(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.

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(2)

(Total 9 marks)

4. 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.

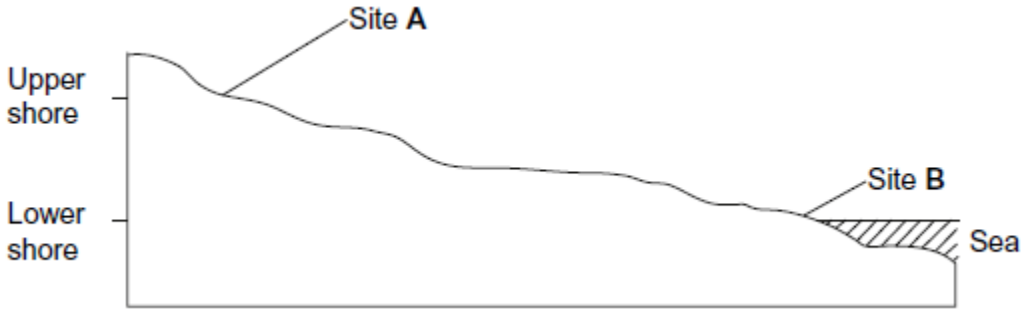

Table 1

	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.

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(2)

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

Suggest why.

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(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**.

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(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.

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(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.

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(3)

(iii) Suggest what conclusions the scientists could have made from this investigation when using the probability values in **Table 2**.

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(3)

(Total 15 marks)

5. Ecologists used a method called proportional sampling to estimate the population size of an animal species. This method is based on assumptions. Two of the assumptions are given below.

1. They know the size of the area, **A**, where the animal population lives.
2. The animals are uniformly distributed in this area.

To carry out the method, the ecologists:

- chose a region of known size, **R**, inside area **A**
- counted the number of animals in region **R**. They called this number **S**
- assumed that the number, **S**, would be in proportion to the size of the total population, **P**, in area **A**.

(a) Proportional sampling can be used to estimate the population size of a species that is uniformly distributed.

(i) What is a **species**?

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(1)

(ii) What is meant by **uniformly distributed**?

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(1)

(b) Use the letters **A**, **R** and **S** to write an equation showing how proportional sampling is used to estimate the total size of a population, **P**. Show your working.

P = _____

(2)

(c) Population size can be estimated using proportional sampling or mark-release-recapture.

(i) How do the assumptions made in proportional sampling differ from those made in mark-release-recapture?

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(2)

(ii) Give **one** assumption about the animals caught that is made in both methods.

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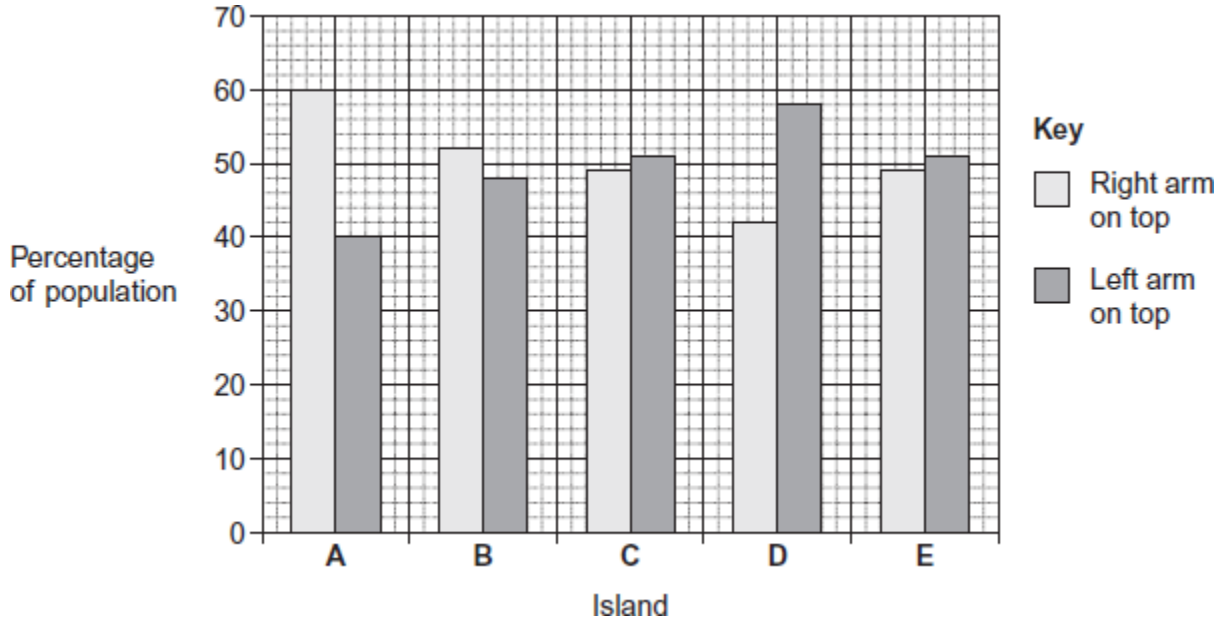
(1)

(Total 7 marks)

6. When most people fold their arms, they either always have their left arm on top, **L**, or always have their right arm on top, **R**. A geneticist investigated this characteristic on five small islands, **A, B, C, D** and **E**.

Her results are shown in **Figure 1**.

Figure 1



On one of the islands she recorded the arm-folding characteristics of parents and their children.

These results are shown in **Figure 2**.

Figure 2

Arm-folding of parents	Arm-folding of the children / %	
	Right arm on top, R	Left arm on top, L
R and **R**	41	59
R and **L**	45	55
L and **L**	44	56

The geneticist concluded that arm-folding is not determined by a single gene with a dominant allele and a recessive allele.

(a) The geneticist investigated arm-folding on five small islands.

(i) Use information from **Figure 1** to describe the results she obtained.

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(2)

(ii) Suggest advantages of using island populations in this investigation.

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(2)

(b) The geneticist concluded that arm-folding is **not** determined by a single gene with a dominant allele and a recessive allele.

Use information from **Figure 2** to explain why she reached this conclusion.

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(3)

(c) In another study, the geneticist investigated arm-folding in genetically identical twins. Data from this study supported her conclusion from the island study.

Suggest the evidence she found that supported her conclusion.

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(1)

(Total 8 marks)