

# Biodiversity

## Question Paper 2

<b>Level</b>	International A Level
<b>Subject</b>	Biology
<b>Exam Board</b>	Edexcel
<b>Topic</b>	Plant structure and function, Biodiversity and Conservation
<b>Sub-Topic</b>	Biodiversity
<b>Booklet</b>	Question paper 2

**Time Allowed:** 72 minutes

**Score:** /60

**Percentage:** /100

**Grade Boundaries:**

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

1 Read the following extract from a student's **unfinished** visit or issue report on the topic of using bees to deter elephants from damaging crops.

1. A major problem today is the rapid extinction of many species around the world. The Earth is going through mass extinction; with a loss of species at the rate of 0.01%–0.1% per year. As well as an 80% decline in biological diversity, which is caused by habitat destruction.
2. Human pressure on the environment is increasing, as is the demand for access to land for agriculture. Loss of habitats has led to conflicts between human needs and the needs of animals and plants.
3. Over the last 60 years, the number of Asian elephants in the wild has halved, partly due to human expansion into the elephants' habitats. The elephants leave their remaining natural habitat and enter agricultural land damaging crops. Furthermore, not only do elephants raid crops, they can often go on rampages. Angry farmers have begun to kill the elephants as a quick fix solution, however this has no effect on reducing the conflict between humans and elephants.
4. This report will explore this phenomenon and ways to reduce these conflicts.

Potential solutions are:

- Traditional methods – making noise, crop guarding, making fires, airborne missiles and decoy foods.
- Disturbance methods – intense bright flashes of light and flares, firing weapons and using tripwire alarms.
- Physical barriers – trenches, moats, stone walls, standard fences and electrified fences.

All these methods have limited success.

5. Scientists have found that the sound of buzzing bees causes elephants to move away. The elephants make low frequency cautionary rumbles to warn neighbouring elephants. Elephant skin can grow up to more than 3 cm thick, so it is impenetrable to bee stings. But skin behind the ears, eyes and the inner trunk is thinner and vulnerable to bee stings. So if elephants are stung here, this may make them fear bees in future.
6. In 2009, Lucy E. King and a team of researchers from Save The Elephants investigated the concept of deterring elephants with bees further and put it to the test. They used recordings of angry bees, from disguised loudspeakers in trees, on herds of elephants beneath the trees. The elephants soon became uneasy and vigilant. Within 10 seconds, almost half of the herd had fled with their tails in the air, occasionally throwing backwards glances at the loudspeakers. By 80 seconds, all but one was gone. The researchers played bee sounds to 17 families of elephants in this study and the control to 15. The control was the noise of a forest waterfall.

7. In another trial, one farm was protected with a bee fence (shown in the photograph below) and another was not. The number of incidents of crop damage by elephants, and the number of animals involved, were monitored over 6 weeks.



8. The results are shown in the table below:

Observation	Farm with bee fence	Farm without bee fence
Number of incidents of crop damage	7	13
Number of elephants involved in crop damage	38	95

The conclusion that can be drawn from this is that ....(note, I need to write a conclusion here).

9. The bee fence is robust enough to survive elephant raids and cheap enough for farmers to construct themselves.
10. Why not just use loudspeakers as King did? There is a chance that an elephant may encounter a fence but perceive that there are no bees. The elephant becomes aware that it is just speakers, so the chances of trespassing increase. Also, the loudspeaker system would be expensive and require electricity to run it.
11. There are some problems. The African honeybee is known to be very violent and to attack in large swarms. This could lead to an increase in the amount of deaths of young elephants, or at least cause them severe suffering. The introduction of beehives may also pose a threat to the residents around the local farm. African honeybees are well known for their defensive behaviour. Bee stings inject venom into the skin of the victim, and 3% of people that are stung have an allergic reaction, meanwhile 0.8% of bee sting victims may experience a life-threatening reaction called anaphylactic shock.

12. Offsetting this though, bee fences can provide extra income to the farmer from selling the honey. In addition, it could increase the amount of pollination in crops. This would be an ideal plan for poor farmers. You could call this a win-win circumstance. As there is no use of any guns, traps or poison; just a gentle nudge from nature.
13. There are some other innovative new methods. Farmers in Tanzania smear chilli mixed with engine oil on fences. When elephants approach the fence they 'snuffle and sneeze' and leave the scene. It is also an inexpensive and sustainable process adhering to the fence in all conditions. However, the advantages of the beehives overshadow this method.
- (a) A visit or issue report requires a problem to be identified. Suggest the problem that this extract identifies.

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- (b) Make a sketch to show how the data in the table in paragraph 8 could be compared.

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(c) Another feature of a visit or issue report is some discussion of the implications for humans and other organisms.

(i) Identify two economic implications discussed in this extract.

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(ii) Explain the benefits to other organisms of the use of bee fences.

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(iii) Explain the risks to humans of the use of bee fences.

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- (f) The report is required to use information or arguments obtained from three or more sources when researching the issue. The student decided to find some data to support various points made in the report to cover this requirement.

The student found the following:

Costs for the bee fence based on using traditional beehives were approximately US\$315 per 100 m. In Kenya, 1 kg of honey can sell for US\$2 and each traditional beehive has the potential to generate two to three annual harvests of 7-10 kg per harvest. Upgrading traditional beehives to the more productive Kenyan Top Bar (KTB) beehives would generate more income, particularly if a queen excluder were fitted to separate the valuable honey from the brood.

Suggest two paragraphs in the report where some of this information might be quoted. Give reasons for your answers.

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Paragraph number .....

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Paragraph number .....

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**(Total for Question 1 = 20 marks)**

2 The biodiversity of species in Costa Rica is one of the highest in the world.

Costa Rica represents 0.3% of the Earth’s total land area. It has 4% of all identified species of living organisms. Many of these species live in the rainforests of this country.

(a) (i) Explain what is meant by the term **biodiversity**.

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(ii) Describe how the species richness of the rainforests in Costa Rica could be measured.

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(b) A study was carried out to investigate the antimicrobial properties of plants found in Costa Rica. The species tested are all used in traditional medicine.

Nine of the species tested showed antimicrobial properties and six of these species are found only in the rainforest.

(i) Suggest why the results of this investigation support the need to maintain biodiversity.

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(iii) Some of the plants tested could be used to develop new drugs to treat diseases caused by bacteria.

Before these drugs could be approved for use, they would have to be tested on animals and healthy volunteers.

Suggest why these drugs would have to be tested on animals and healthy volunteers.

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**(Total for Question 2 = 12 marks)**

- 3 The finches of the Galapagos Islands have different shaped beaks to feed on different food sources.

The photograph below shows one of these finches, the medium ground finch, *Geospiza fortis*. The medium ground finch has a deep beak that enables it to crush seeds.

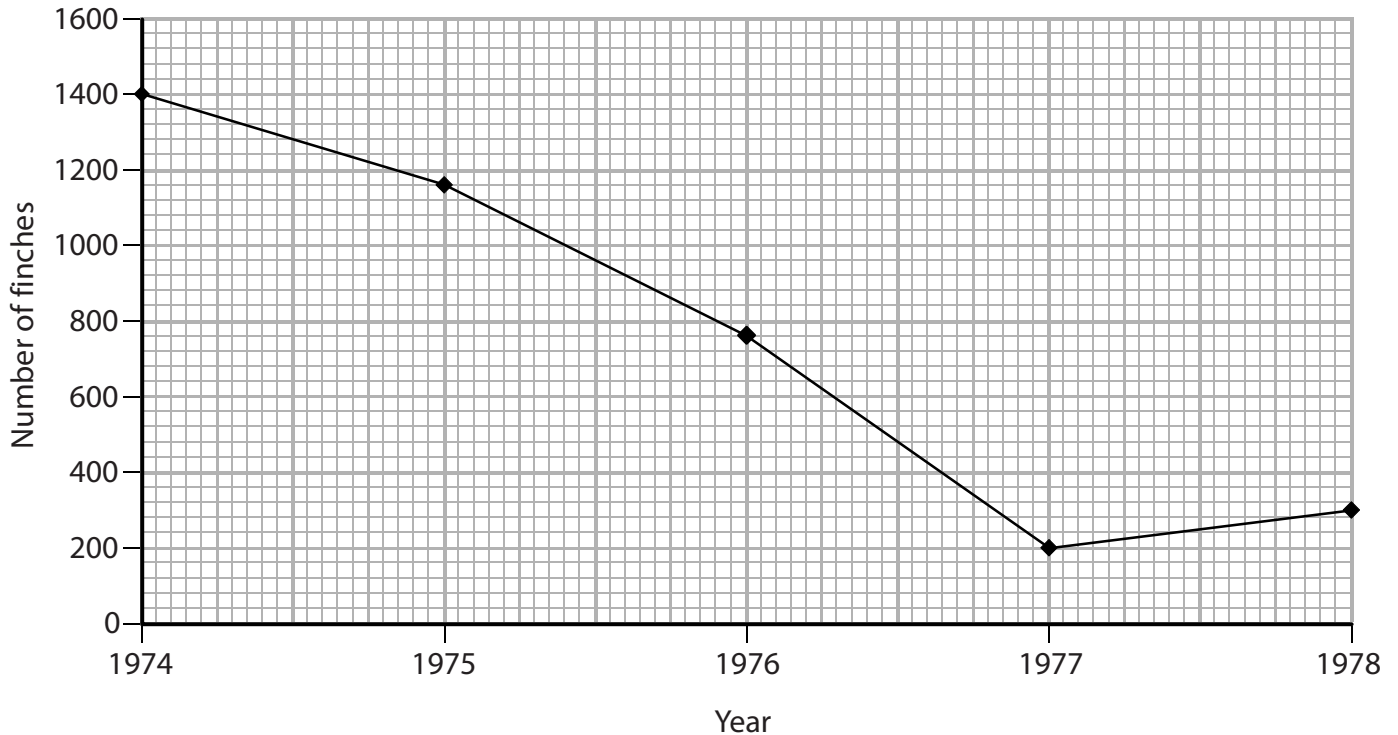


© Greg Lasley

Magnification  $\times 0.5$

In the 1970s, there was a severe drought on the Galapagos Islands. This caused a decrease in the production of the seeds eaten by this finch.

The graph below shows the number of medium ground finches, on one of the Galapagos islands, from 1974 to 1978.



(a) Place a cross ☒ in the box next to the correct word or words to complete each of the following statements.

(i) The deep beak of the medium ground finch is an example of

(1)

- A** anatomical adaptation
- B** behavioural adaptation
- C** physiological adaptation
- D** selective adaptation

(ii) The number of medium ground finches fell most rapidly from

(1)

- A** 1974 o 197
- B** 1975 o 197
- C** 1976 o 197
- D** 1977 o 1978

(b) Medium ground finches have a range of beak sizes.

Suggest an explanation for the variation in beak sizes in medium ground finches.

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- (c) One of the few plants that survived during the drought produces seeds in large, tough fruits. These are very difficult to eat for birds with small beaks.

Sampling the birds that survived and those that died provided the data shown in the table below.

Mean beak size / mm	Dead birds	Survivors
length	10.69	11.07
depth	9.42	9.96

As the population of the medium ground finches recovered, the mean beak size of the offspring increased.

Using the information in the table, suggest how this increase in mean beak size was brought about by natural selection.

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**(Total for Question 3 = 8 marks)**

**4 Read the following extract from a student's unfinished visit or issue report on the topic of the giant panda.**

1. The giant panda (*Ailuropoda melanoleucal*) is now in decline and there are only about 1 600 giant pandas alive in their natural habitat. However, there are 239 pandas that live in captivity, 27 of them outside China. Of these, 18 are on lease from China, the rest have been bred abroad. There are several reasons why pandas are now classed as endangered; humans have some part to play in this but most of it is to do with natural factors such as poor habitat size and low reproductive rates.
2. Giant pandas struggle to find mates in their natural habitat as they live in a fragmented environment where they are confined to a certain area, this results in limited movement leaving the pandas isolated. It is vital for them to find mates from a wide gene pool to maintain genetic variation throughout the wild population. Because they are often confined to a small area, pandas mate with others from their own family tree, which is very bad as they have a poor genetic make-up. If this were the case for all pandas, it would take only one disease to wipe out the entire wild population due to a poor genetic make-up.
3. Giant pandas have very low reproductive rates and a very short breeding season. Another problem the panda faces with breeding is that they take six years – longer than most other animals – to grow into mature adults that can reproduce. Pandas are also very fussy about choosing their mates.
4. Another obstacle for pandas to overcome is bamboo, their main source of food. Shortages across their habitat are common. Bamboo is the most important plant in a giant panda's life. In cold and rainy bamboo forests high in the mountains of western China, they spend at least 12 hours a day eating. Bamboo is low in nutrients and pandas eat as much as 84 pounds (38 kilograms) of it each day. However, shortages can occur which can have devastating effects on the panda population as they could potentially wipe out the whole of their main food source in that area; this would result in most pandas in that area dying from starvation/ malnutrition.
5. When bamboo plants reach maturity, they flower and produce seeds, and then the mature plant dies. The seeds grow slowly into plants large enough for pandas to eat. Giant pandas can eat 25 different types of bamboo, but they usually eat only the 4 or 5 kinds that grow in their home range. An unusual thing about bamboo is that all of the plants of one species growing in an area will bloom and die at the same time. If the bamboo plants die out, pandas move to another area full of bamboo. Unfortunately, pandas now struggle to do this as humans have taken up much of their habitat and divided it in to several small areas across China.
6. The giant panda is in decline due to the destruction and separation of its habitat. Destruction of the panda's natural habitat is now the major threat to its survival. In the 11 years from 1973 to 1984, suitable panda habitat shrunk by 50 per cent in the six areas where pandas live. Human activity – logging, animal grazing, and agriculture – is the major source of habitat destruction.
7. There are methods to help boost populations, the main one being artificial insemination. Male panda sperm is inserted into the female panda artificially.

8. Semen is collected from the male by the use of electro ejaculation. The probe is inserted via the rectum and placed over the glands of the male's reproductive tract. A brief electrical stimulus is applied several times to induce ejaculation. In the giant panda a rectal probe has been used in successful semen collections. The average collection time is around nine minutes. To reduce stress on the animal during the procedure, and also to increase the safety of the procedure, the male is always anaesthetised during the process. Next the panda's semen is inserted into the female panda so that her egg is fertilised.
9. The target number of pandas to be bred in captivity was 300 and, as of 2010, this has been achieved. The slow process of releasing pandas back in to the wild can begin. The release process has to be done slowly so as not to overpopulate the pandas' habitat.
10. There are some problems with this breeding solution. The semen used to fertilise female pandas may come from only a few males. This creates very low genetic variation, which can lead to the pandas inbreeding in their natural habitat. This puts future generations at risk from mass wipe out due to various diseases as they all carry some of the same genetic make-up, thus having the same susceptibility to disease/viruses.
11. Due to the use of artificial insemination, pandas may have never bred naturally with another panda. So, when released in to the wild they may have no real idea how to reproduce naturally. This would be a problem as pandas would be in the same situation as they are in at the moment; not able to breed and boost their own population to a sustainable level without human intervention.
12. The use of artificial insemination to breed more pandas can be seen as an advantage to China's economy. China leases each panda for 10 years at a price of \$1 million per year. The government will keep funding the programme as long as money is coming in. This is also good publicity for China and its tourism; if people can't see a giant panda in their home country then they may go to China to see one.
13. Although the main solution to saving the giant panda at the moment is artificial insemination there are alternatives. One alternative is the use of cloning, which is where an organism is produced without sexual reproduction occurring. Taking an animal cell and inserting its DNA into an egg cell from a female make a cloned animal. However, there is a problem with cloning mammals at the moment, they often die soon after birth or suffer from various diseases in later life and die young.

- (a) The report lacks data. The student found the following information in a published paper about the quality of habitats for pandas.

Between 1965 and 1997 the area of high quality habitat decreased from 14 250 hectares to around 11 500 hectares. The biggest decrease was between 1975 and 1997 when high quality habitat was reduced from 14 000 hectares to 11 500 hectares. Over the same dates the amount of unsuitable habitat rose from 116 000 hectares to 126 000 and then 134 000 hectares.

- (i) Make a sketch to show how the data for high quality habitat could be compared with the data for unsuitable habitat.

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- (ii) State the number of the paragraph in the report where this sketch would support the information given and explain why.

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Paragraph number.....

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(iii) Suggest the risks to giant panda populations of the use of these solutions.

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(c) This report has made reference to the economic benefits to China of leasing pandas to foreign countries.

Using the information in the report, calculate how much China will make from leasing pandas over a 10-year period. Assume the number of pandas in captivity remains the same.

Show your working.

(3)

- (d) When checking the student’s bibliography his teacher noticed a reference to a paper by Andreas Kontoleon and Timothy Swanson. This paper was published in a journal called *Land Economics*.

What further information would the student need to write a full and complete reference?

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**(Total for Question 4 = 20 marks)**