

Fig. 2.1

(ii) Explain why the introduction of wolves to Yellowstone Park in 1995 is an example of conservation.

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..... [2]

[Total: 14]

2 (a) *Bombus pratorum* and *Bombus terrestris* are two British species of bumble bee.

These bumble bees are social insects. They live in colonies founded by a female queen bee who lays eggs. The eggs develop into female worker bees, who collect food (nectar and pollen) and look after the young and the nest.

When the number of worker bees starts to decrease, young queens and males are produced. These mate and the mated queens survive winter underground and start a new colony the following spring.

Why do the two bee species share the first name *Bombus*?

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..... [1]

(b) Fig. 2.1 shows the number of worker bees of *B. pratorum* and *B. terrestris* observed at one location over a year.

Table 2.1 shows some differences in the food collecting behaviour of worker bees of these species.

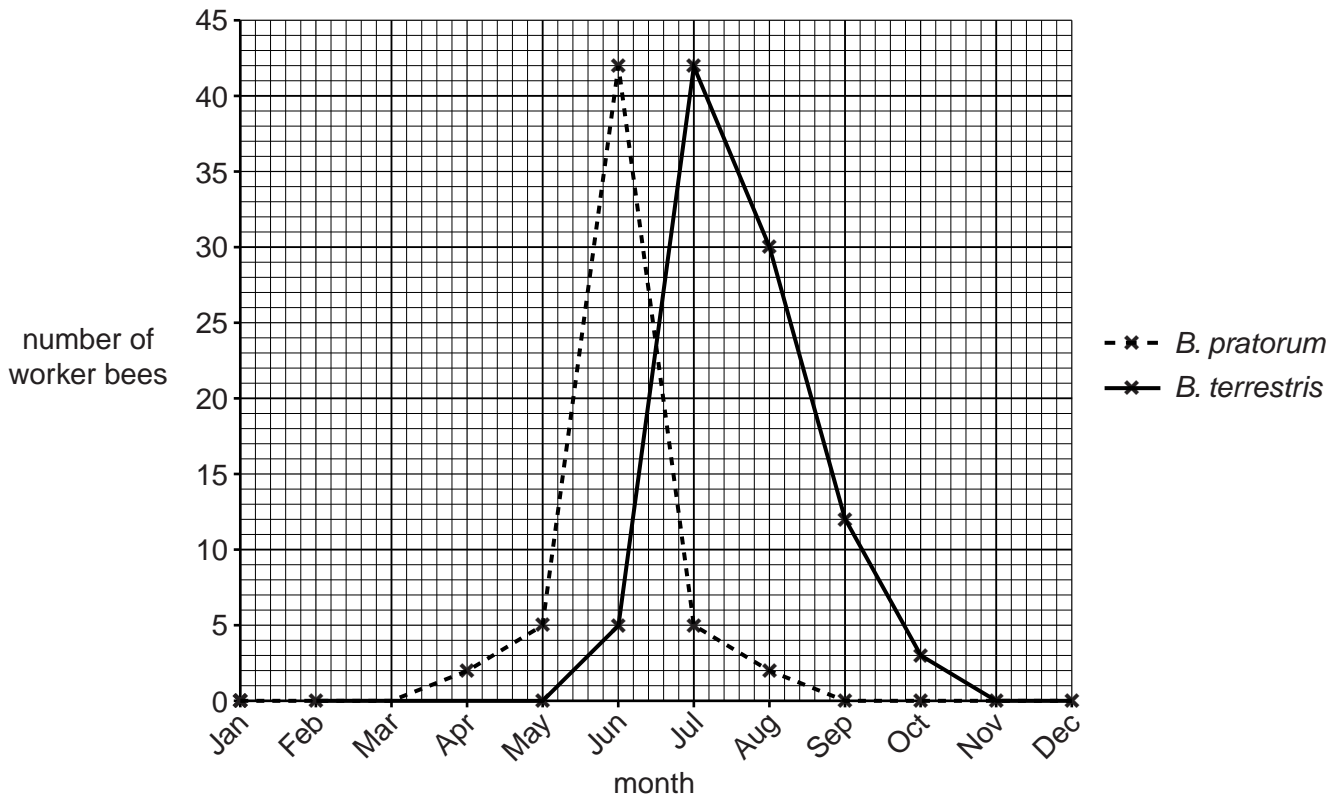


Fig. 2.1

Species of bumble bee	Mean depth of flower visited (mm)	Visits to flowers when nectar only collected (%)	Visits to flowers when pollen only collected (%)	Visits to flowers when both nectar and pollen collected (%)
<i>Bombus pratorum</i>	7.4	23	10	67
<i>Bombus terrestris</i>	6.3	80	11	9

Table 2.1

(c) Bees show a variety of interesting behaviour patterns.

(i) Consider the following observations about bee behaviour and suggest what type of behaviour is being shown in each observation.

Observation	Type of behaviour
The time taken for a worker bee to collect food from a flower decreases with practice.	
All bumble bees start at the bottom of a vertical spike of flowers and work upwards.	

[2]

(ii) On returning to the colony, worker bees perform 'dances' to tell other bees the direction and distance of a food source.

How might this social behaviour benefit the colony?

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..... [1]

(d) In a colony of bees, about 5% of the workers are more adventurous than other workers. These bees are known as scout bees. They actively seek out new food sources and, if necessary, new nest sites.

Researchers investigated how gene expression differed in the brains of the scout bees compared to the normal worker bees.

- The researchers extracted mRNA from the brain cells of **normal worker** bees.
- This mRNA was used to produce lengths of single-stranded DNA, which were then attached to a fluorescent dye.
- These lengths of single-stranded DNA were used as gene probes fixed onto a device known as a 'microarray DNA chip'.
- mRNA extracted from the brain cells of **scout** bees would only bind to the gene probes that matched it, causing these probes to fluoresce.
- The locations of the brightest fluorescent spots on the DNA chip revealed which genes were most active.

(i) Name the enzyme that can be used to convert mRNA to single-stranded DNA.

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(ii) Explain how the locations of the fluorescent spots on the DNA chip reveal which genes are most active.

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3 Describe the differences between the following biological

(a) a pioneer community and a climax community terms:

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(b) decomposition and denitrification

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..... [2]

(c) conservation and preservation

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..... [2]

(d) nitrogen fixation and nitrification.

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[Total: 8]

4 The Galapagos Islands are 600 miles away from the nearest land mass, South America. They consist of 15 main islands, 3 smaller islands, and 107 rocks and islets. This collection of islands is home to many endemic species of animals and plants. This means that these species are found nowhere else in the world.

(a) Explain, using scientific terms, why a collection of small islands remote from the mainland provides optimal conditions for speciation.

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(b) In 1978, the United Nations (UN) declared the Galapagos Islands a World Heritage Site. This led to a rise in the resident human population and the number of visitors to the Islands.

Table 2.1 shows how the number of people living on and visiting the Galapagos Islands changed between 1980 and 2005.

Year	Resident population	Number of visitors
1980	5500	16 000
1985	7000	19 000
1990	9500	42 000
1995	12 500	58 000
2000	17 500	68 000
2005	27 500	125 000

Table 2.1

(i) Calculate the percentage increase in the number of visitors to the Galapagos Islands between 1980 and 2005.

Show your working. **Give your answer to the nearest whole number.**

Answer = % [2]

- (c) In 2007, the United Nations (UN) put the Galapagos Islands on its Red List of endangered sites. The Galapagos government's response to this action included making new laws and placing restrictions on human activity, issuing eviction orders and culling introduced species of animals.

Suggest **one** economic and **one** ethical problem that might have arisen from this 2007 UN decision.

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[Total: 13]