5 The Galápagos is a group of islands with a high biodiversity.

(a) *Geospiza fortis* is one of the many species of finch that live on the Galápagos islands. On one of the Galápagos islands, Daphne Major, scientists measured the bill size (length, width and depth) of individuals in a population of *G. fortis* over several years.

Fig. 5.1 shows a *G. fortis* female.

Fig. 5.1

G. fortis feed on seeds. Seed size and bill size vary. It is easier for *G. fortis* with smaller bills to eat small seeds and for *G. fortis* with larger bills to eat large seeds.

In 1977, a drought occurred on Daphne Major, which resulted in a large decrease in the availability of seeds, particularly small seeds.

Scientists observed an increase in the mean bill size in the *G. fortis* population on Daphne Major after the drought.

(i) State the type of natural selection that occurred in the *G. fortis* population on Daphne Major as a result of the drought.

..... [1]

(ii) Fig. 5.2 shows the distribution of bill size in the *G. fortis* population before the drought in 1977.

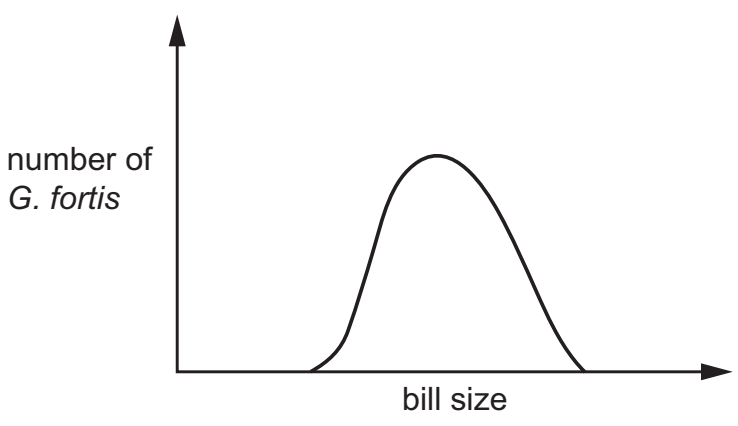

Fig. 5.2

Sketch a new curve on Fig. 5.2 to show the distribution of bill size in the *G. fortis* population after the drought.

[1]

(b) *G. fortis* also lives on Santa Cruz, another island in the Galápagos.

Most of the seeds available for *G. fortis* to eat on Santa Cruz are either small or large. There are few intermediate sizes of seed.

Fig. 5.3 shows the distribution of bill size in the *G. fortis* population on Santa Cruz.

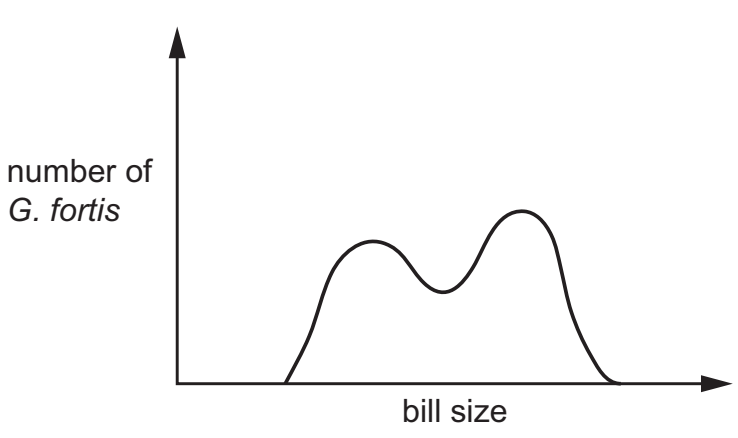

Fig. 5.3

Explain how natural selection in the *G. fortis* population on Santa Cruz has resulted in the distribution in bill size shown in Fig. 5.3.

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(c) Scientists studied the effect of an increase in the number of tourists each year on the number of invasive alien species present in the Galápagos islands.

The scientists recorded the number of invasive alien species present each year in the Galápagos islands over many years. The scientists also recorded the number of tourists visiting the islands each year.

Fig. 5.4 shows a graph of the data for five different years during the study.

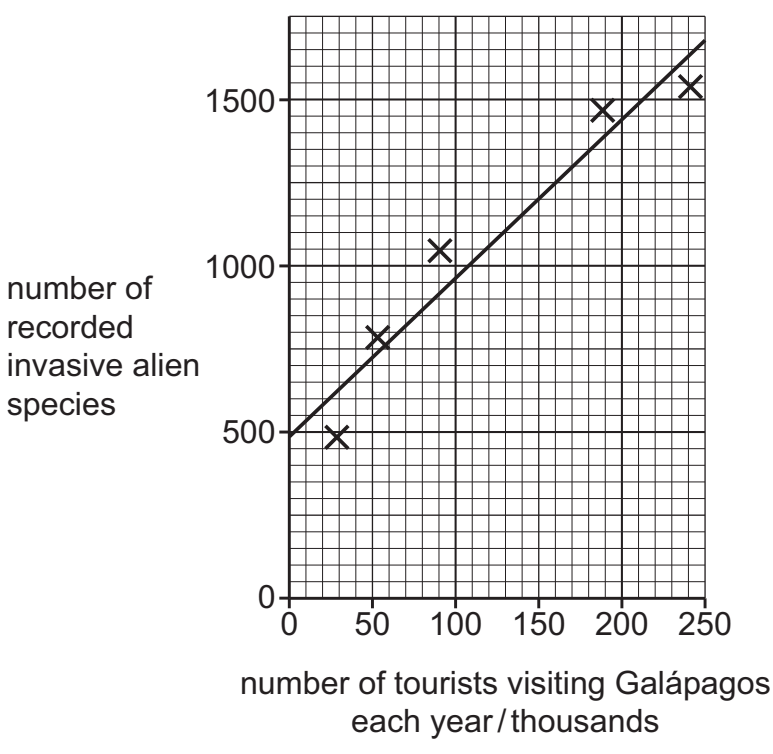

Fig. 5.4

(i) The scientists carried out a Pearson's linear correlation calculation for the data in Fig. 5.4.

The scientists calculated an ***r*** value of 0.930.

The scientists concluded that there is a significant correlation between the number of tourists visiting the Galápagos islands each year and the number of invasive alien species present.

Table 5.1 shows a probability table of critical values for Pearson's linear correlation.

Table 5.1

number of observations	probability level (*p*)	
	0.05	**0.01**
3	0.997	1.000
4	0.950	0.990
5	0.878	0.959
6	0.811	0.917
7	0.754	0.875

With reference to Table 5.1, explain why the ***r*** value of 0.930 indicates that there is a significant correlation between the number of tourists and the number of invasive alien species.

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(ii) Invasive alien species are thought to have contributed to extinctions recorded in the Galápagos islands.

Discuss the negative effects of introducing invasive alien species to an ecosystem.

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..... [4]

(iii) State **two** factors, other than competition and the introduction of invasive alien species, that can cause extinction.

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2 .....

[2]

[Total: 14]