Biodiversity Within a Community: AQA A Level Biology Exam Questions

18 questions · 38 marks · about 49 minutes. Answer in the spaces, then check the mark schemes at the end.

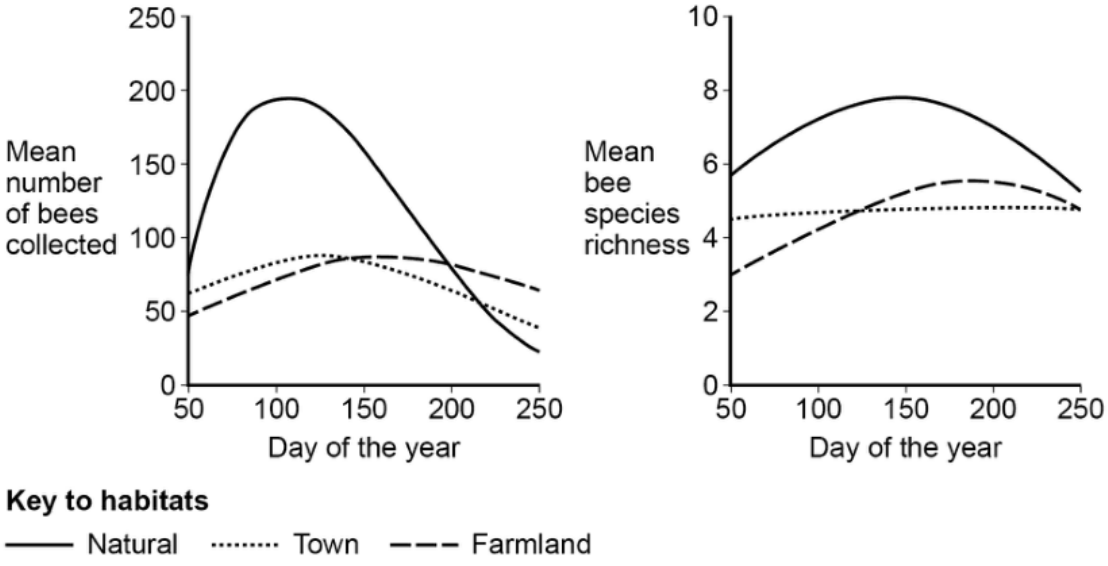
Question 1 · A level Paper 1 · June 2018 · Q03.1 · 1 mark

0 3 Bees are flying insects that feed on nectar made in flowers. There are many different species of bee.

Scientists investigated how biodiversity of bees varied in three different habitats during a year. They collected bees from eight sites of each habitat four times per year for three years.

The scientists' results are shown in **Figure 4** in the form they presented them.

Figure 4



0 3 . 1 What is meant by 'species richness'?

[1 mark]

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Question 2 · information from earlier in the question

0 4 Scientists investigated the effect of different types of animal farming on the diversity and number of dung beetles. They determined the number of dung beetle species and their total number on intensive (**I**), rough grazing (**R**) and organic (**O**) farms.

Figure 4 and **Figure 5** show some of their results.

Figure 4

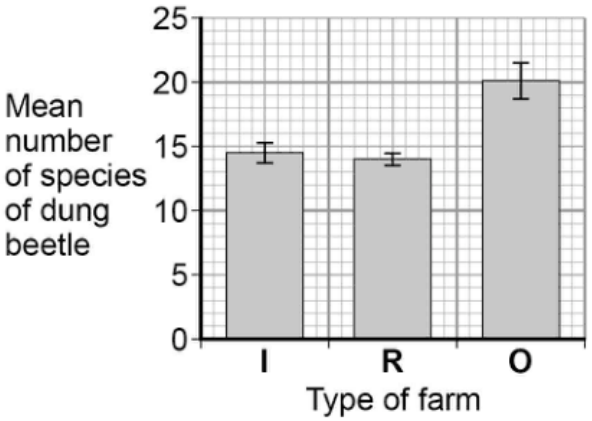
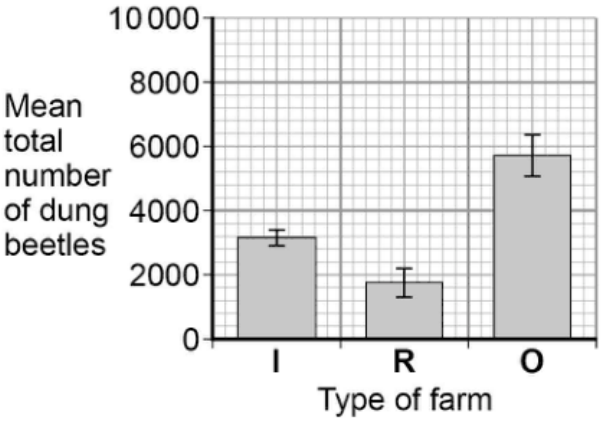


Figure 5



Key: I Standard deviation

Question 2 · AS Paper 2 · June 2016 · Q04.2 · 1 mark

0 4 . 2 In addition to the information provided in **Figures 4** and **5**, what other measurement is required to calculate an index of diversity for dung beetles?

[1 mark]

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Question 3 · information from earlier in the question

0 4 A scientist identified and counted the invertebrate species present in samples taken at two sites in a river. The scientist also measured the rate of water flow at each site.

His results are shown in **Table 2** and **Table 3**.

Table 2

Invertebrate species	Site 1	Site 2
Anglers' Curse mayfly	17	5
Flat-headed mayfly	6	8
Slate Drake mayfly	0	6
Water beetle	12	13
Midge fly	13	13
Total number caught	48	45

Table 3

	Site 1	Site 2
Index of diversity		4.7
Rate of water flow / cm s^{-1}	1–14	30–60

Question 3 · AS Paper 1 · June 2019 · Q04.2 · 2 marks

0 4 . 2 Explain why it is more useful to calculate an index of diversity than to record species richness.

[2 marks]

Question 4 · information from earlier in the question

0 4 Ecologists investigated changes in grassland communities on large islands off the coast of Scotland between 1975 and 2010. On each island, they used data from a number of sites to determine the change in mean species richness and the change in mean index of diversity.

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Question 4 · A level Paper 3 · June 2017 · Q04.2 · 3 marks

0 4 . 2 Outline a method the ecologists could have used to determine the plant species richness at one site.

[3 marks]

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0 7 Scientists investigated biodiversity in prokaryote communities found in soil.

The scientists:

- took soil samples from fields that had been managed for 20 years with two different farming methods
- sequenced all the DNA that coded for prokaryotic ribosomal RNA in the soil samples
- compared these base sequences to give a measure of species richness and an index of diversity for the prokaryote community
- recorded the total prokaryotic biomass and the mass of stored carbon for each soil sample
- obtained the mean wheat yield from the fields.

Table 4 shows the scientists' results.

Table 4

Data collected	**Farming method 1**	**Farming method 2**
Mean species richness (± 2 × standard deviation)	517 (± 17)	560 (± 24)
Mean index of diversity (± 2 × standard deviation)	0.251 (± 0.011)	0.230 (± 0.014)
Mean total prokaryotic biomass / kg m^{-3}	0.24	0.40
Mean carbon stored in soil organisms / μg g^{-1}	203	342
Mean wheat yield / g m^{-2}	451	377

The mean ± 2 × standard deviation includes 95% of the data.

0 7 . 1 Using the standard deviation data from **Table 4**, describe the differences in prokaryotic biodiversity found in the soil with these two farming methods.

In your answer, give the definitions of **species richness** and **index of diversity**.

[4 marks]

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Question 6 · AS Paper 1 · June 2023 · Q07.3 · 2 marks

0 7 . 3 Evaluate the balance between conservation and farming for these two farming methods.

Use the information provided in **Table 4** (on page 16).

[2 marks]

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1 0 Read the following passage.

Tropical rainforests are among the most biologically diverse ecosystems in the world. Their varied plant communities support a high biodiversity of animal species. Tropical rainforests form in parts of the world with high annual rainfall and high mean temperatures providing moist, warm conditions. Nutrient recycling occurs rapidly on the ground of these rainforests. The recycling of nitrogen-containing compounds from dead organic matter sustains the growth of plants.

Each year, large areas of rainforests are lost due to fires. Natural regeneration of rainforests occurs slowly by secondary succession. Secondary succession is similar to primary succession but occurs in areas previously inhabited. There is conflict between the needs of humans and conservation of rainforests. Deforestation by humans is removing large areas of rainforests. Farming practices have prevented the natural regeneration of rainforests by secondary succession.

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

1 0 . 1 In tropical rainforests, there is a high biodiversity of animal species (lines 1–3).

Explain why.

[3 marks]

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0 4 Scientists investigated the effect of different types of animal farming on the diversity and number of dung beetles. They determined the number of dung beetle species and their total number on intensive (**I**), rough grazing (**R**) and organic (**O**) farms.

Figure 4 and **Figure 5** show some of their results.

Figure 4

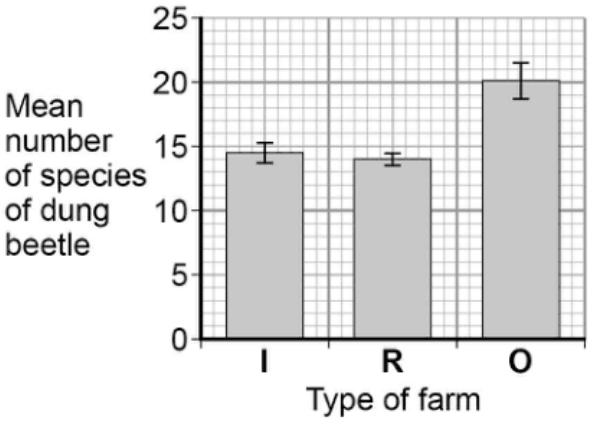
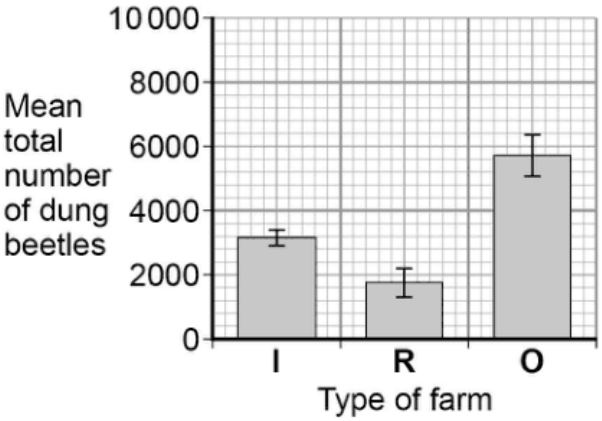


Figure 5



Key: I Standard deviation

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Question 8 · AS Paper 2 · June 2016 · Q04.5 · 3 marks

0 4 . 5 On the intensive farms, the farmers had removed hedges to increase land for grazing. This resulted in a decrease in the diversity of birds on these farms.

Explain why the removal of hedges caused a decrease in the diversity of birds.

[3 marks]

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Question 9 · AS Paper 1 · June 2024 · Q05.4 · 2 marks

0 5 . 4 In a different investigation, the student found that:

- the species richness of plants in a field of wild flowers is greater than the species richness of plants in a field of wheat
- the species richness of **bees** in a field of wild flowers is greater than the species richness of **bees** in a field of wheat.

Suggest **one** reason why the species richness of bees in a field of wild flowers is greater than the species richness of bees in a field of wheat.

Explain your answer.

[2 marks]

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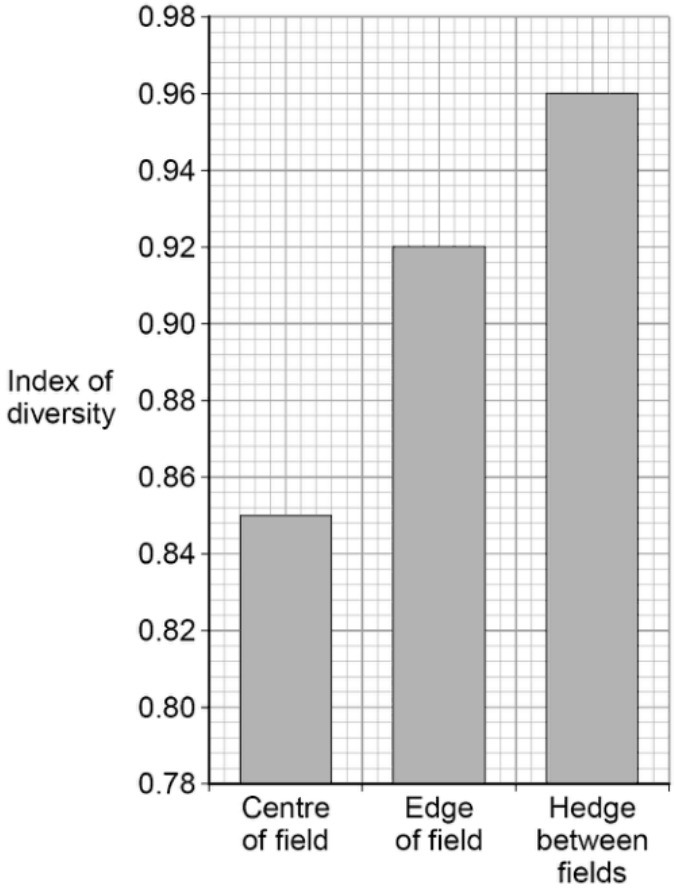
Question 10 · information from earlier in the question

0 3 A group of students investigated biodiversity of different areas of farmland. They collected data in each of these habitats:

- the centre of a field
- the edge of a field
- a hedge between fields.

Their results are shown in **Figure 4**.

Figure 4



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Question 10 · A level Paper 1 · June 2019 · Q03.4 · 2 marks

0 3 . 4 Farmers are now being encouraged to replant hedges on their land.

Suggest and explain **one** advantage and **one** disadvantage to a farmer of replanting hedges on her farmland.

[2 marks]

Advantage _____

_____

_____

_____

_____

Disadvantage _____

_____

_____

_____

_____

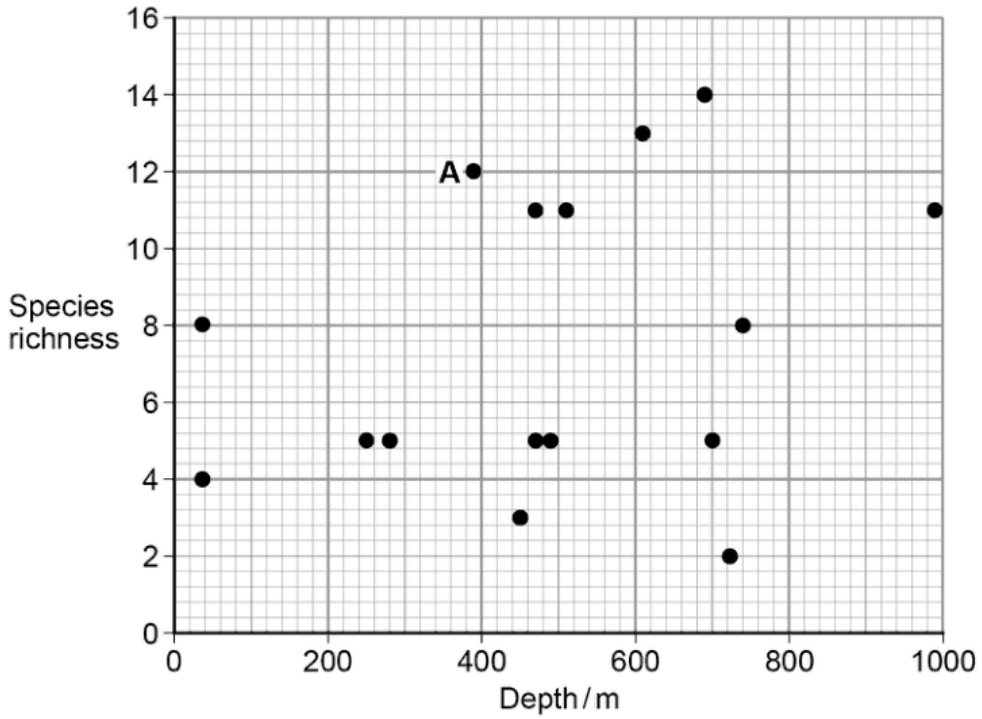
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Question 11 · information from earlier in the question

Scientists investigated the species richness of fish caught at various depths in the Pacific Ocean close to the western coast of Chile.

Figure 9 shows the scientists' results. 68% of all the fish caught in this investigation came from sample **A**.

Figure 9



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Question 11 · AS Paper 1 · June 2017 · Q09.3 · 3 marks

0 9 . 3 68% of all the fish caught in this investigation came from sample **A**.
A student thought this showed that sample **A** had a greater index of diversity than any of the other samples.

It is **not** possible to draw this conclusion from the given data. Give reasons why.
[3 marks]

Question 12 · information from earlier in the question

0 4 Ecologists investigated changes in grassland communities on large islands off the coast of Scotland between 1975 and 2010. On each island, they used data from a number of sites to determine the change in mean species richness and the change in mean index of diversity.

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0 4 . 3 Some of the ecologists' results are shown in **Table 2**. They carried out a statistical test to find out whether any differences between the 1975 and 2010 means were significant. The values for P that they obtained are also shown in **Table 2**.

Table 2

Island	Change in mean species richness between 1975 and 2010	Value of P	Change in mean index of diversity between 1975 and 2010	Value of P
Islay	+8.89	≤0.001	+0.22	>0.05
Colonsay	+14.70	≤0.001	+2.68	≤0.01
Harris	–5.13	≤0.001	–2.44	≤0.01

Do these data show that there were any significant changes in the grassland communities on these islands? Give reasons for your answer.

[3 marks]

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Scientists investigated the effect of the number of fungal species in soil on the diversity of plant species.

Table 1 shows their raw data for soil containing 14 fungal species.

Table 1

Plant species	Total shoot biomass / g m^{-2}
Poa compressa	2
Achillea millefolium	4
Aster cordifolius	5
Aster novae-angliae	7
Chrysanthemum leucanthemum	15
Daucus carota	36
Fragaria virginiana	51

0 1 . 3 Suggest **one** reason the scientists used biomass instead of the number of individuals of each plant species when collecting data to measure diversity.

[1 mark]

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0 5 . 3 A student investigated biodiversity in a community of bee species in a field of wild flowers.

The student trapped and identified the bee species in the field over 6 months.

Table 4 shows some of the student's results.

Table 4

Bee species	Total number of trapped bees after 6 months
Cuckoo bee	250
Domestic honeybee	800
Clover bee	200

The index of diversity in a community of organisms is determined using the formula

$$d = \frac{N(N-1)}{\sum n(n-1)}$$

where N = total number of organisms of all species
and n = total number of organisms of each species.

Use the formula and information in **Table 4** to calculate the index of diversity in this community of bee species.

[2 marks]

Answer _____

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0 7 A meadow is an area of grassland with a wide range of plant and animal species. A student investigated whether cutting some of the plants in a meadow had any effect on the biodiversity of insects in that meadow.

The student created two sample areas, called plots, in the meadow. Each plot measured 10 m × 5 m

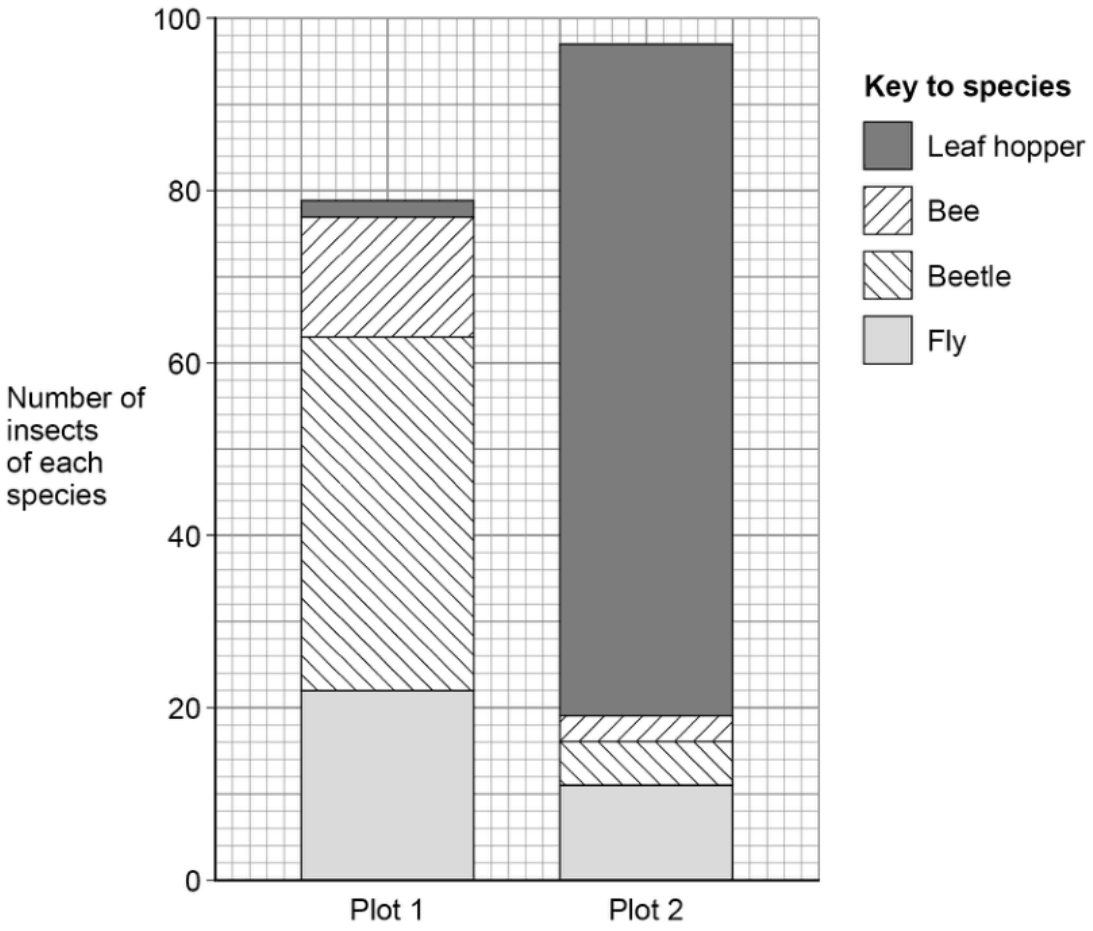
The student:

- did not cut plants in **plot 1**
- cut the plants in **plot 2** with a lawn mower once a week.

After 10 weeks, the student captured all of the organisms of four insect species found in each of these plots.

Figure 7 shows the student's results.

Figure 7



0 7 . 1 Use the information in **Figure 7** to calculate the index of diversity for the insects captured in **plot 1**.

The formula to calculate the index of diversity (d) is

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Question 16 · AS Paper 1 · November 2021 · Q07.2 · 1 mark

0 7 . 2 The student concluded that cutting plants with a lawn mower increased the species richness of insects in that meadow.

Use information in **Figure 7** to explain why the student's conclusion is incorrect.

[1 mark]

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0 5 Scientists investigated the effect that the release of heated water into a river from a power station had on the biodiversity of a local fish community over 29 years.

They measured the species richness and the number of fish of each species at the same site in October every year. The scientists used this information to calculate an index of diversity (d) of fish for each year.

Figure 7 and **Figure 8** show their results.

Figure 7

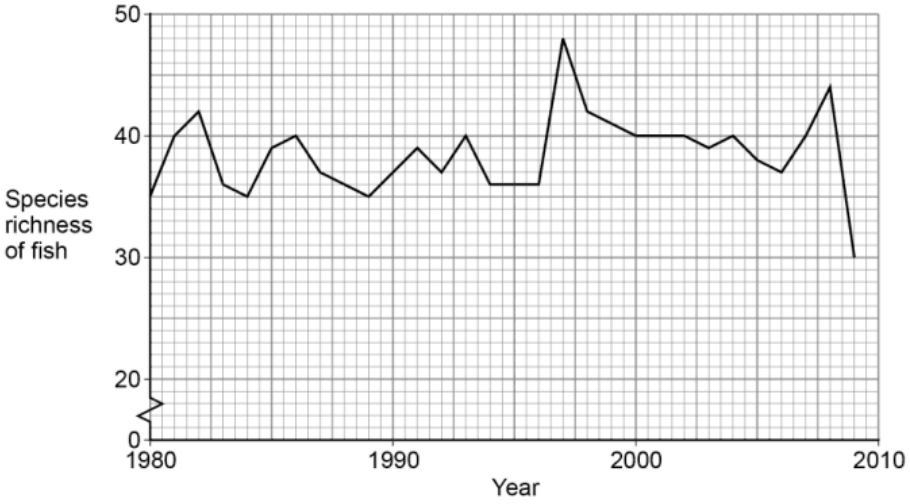
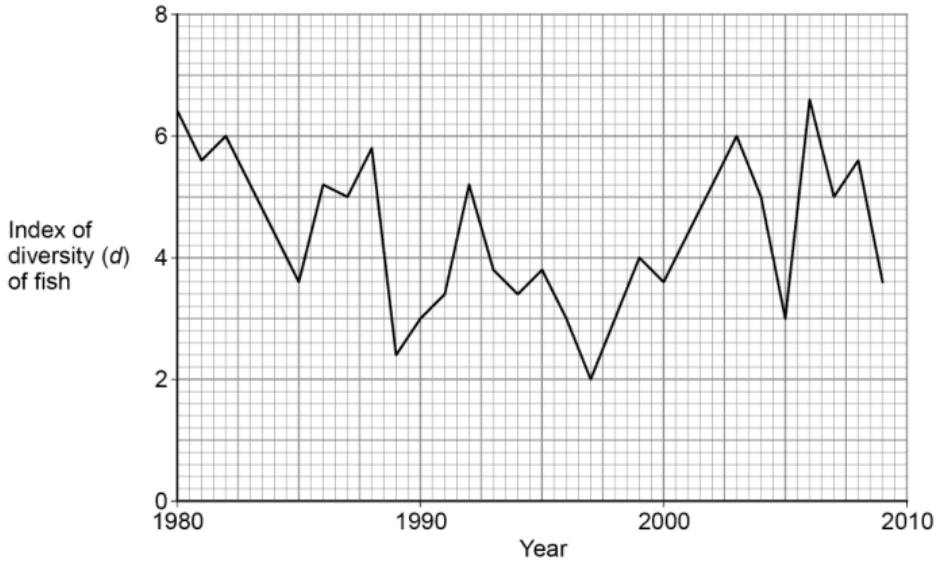


Figure 8



0 5 . 1 The scientists used the following formula to calculate the index of diversity (d) of fish.

$$d = \frac{N\,(N-1)}{\Sigma n\,(n-1)}$$

where N = total number of fish of all species
and n = total number of fish of each species

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Question 18 · A level Paper 3 · June 2023 · Q05.2 · 2 marks

0 5 . 2 In 1997, the scientists recorded the highest species richness, but the lowest value of *d* over the 29 years.

Describe **and** explain how these results for 1997 were possible.

[2 marks]

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Mark schemes

Question 1 · A level Paper 1 · June 2018 · Q03.1 · 1 mark

03.1	(A measure of) the number of (different) species in a community;	1	For 'community' accept 'habitat/ecosystem/one area/environment' Reject 'in a population'.

Question 2 · AS Paper 2 · June 2016 · Q04.2 · 1 mark

04.2	Number (of individuals) in each species (of dung beetle);	1	Accept: population of each species.

Question 3 · AS Paper 1 · June 2019 · Q04.2 · 2 marks

04.2	1. (Index of diversity also) measures abundance / number / population (size) of **each** species; 2. (So useful because) may be many of some species **OR** (So useful because) may be few of other species;	2	1. Ignore "total number of species" unqualified 1. Accept: every species for each species.

Question 4 · A level Paper 3 · June 2017 · Q04.2 · 3 marks

04.2	1. A method of selecting sampling sites at random; 2. Use of quadrat; 3. Identify (plant) species (at site/in each quadrat) OR Count number of (different plant) species (at site/in each quadrat);	3	1. Eg grid with coordinates selected using random number table 2. Frame or point 3. Reject refs to % cover, or counting individuals

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07.1	1. Species richness – number of species (in a community/habitat/ecosystem/area); 2. Index of diversity – the relationship between the number of species (in a community) and the number of individuals in each species; 3. No SD overlap for species richness **so** significant difference shown **OR** No SD overlap for species richness **so** difference not due to chance; 4. SD overlap **so** no significant difference in index of diversity **OR** SD overlap **so** any difference shown due to chance;

4 (2 x AO1, 2 x AO2)	1. Reject number of species in a population. 2. Accept equation with N and n correctly explained

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Question 6 · AS Paper 1 · June 2023 · Q07.3 · 2 marks

07.3	(For farming method 2 has) 1. Better conservation as higher species richness, higher (prokaryotic) biomass and more carbon stored (than farming method 1); 2. More microbial mass – more organisms for food web; 3. Higher species richness – more organisms for food web; 4. More stored carbon, less CO_2 in the atmosphere; 5. Lower yield so less food/less profit;	
2 max (2 x AO3)	Accept converse for farming method 1	

Question 7 · A level Paper 2 · June 2025 · Q10.1 · 3 marks

10.1	1. (Large) number/variety of plant species/populations; 2. (More/different) habitats/niches; 3. (Greater) variety/types/sources of food;	3 (3 x AO2)	1. Accept high plant species richness or high index of plant diversity 2. Ignore shelter/homes /environments 3. Ignore 'more food'

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Question 8 · AS Paper 2 · June 2016 · Q04.5 · 3 marks

04.5	1. Removes species/types of plant/insect; 2. Fewer food sources; 3. Fewer habitats/niches;	3	1. Accept: decrease in plant/insect diversity. 2. Ignore: less food. 2. Accept: less variety of food. 2. Accept: removes a food source. 3. Accept: loss/removal/destruction/ of a habitat. 3. Accept: no habitat. 3. Ignore: homes/shelters.

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05.4	(In relation to wild flower fields) 1. More **plant** species **OR** Larger **plant** (index of bio)diversity; 2. (So) more variety of food/nectar/pollen **OR** (So) more (types of) habitat/niche **OR** (So) more/better protection from predators;	2 (2 x AO2)

Accept the converse in the context of wheat fields

1. Accept more types/variety of plants

1. Accept greater species richness of plants

2. Ignore more/better food but accept more food sources

2. Ignore more shelter

2. Ignore more homes

2. Accept ‘types of’ for ‘variety of’

2. Accept ‘fewer predators’ for ‘more protection’

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Question 10 · A level Paper 1 · June 2019 · Q03.4 · 2 marks

3.4	Advantage - 1. Greater (bio)diversity **so** increase in predators of pests **OR** Increase in predators of pests **so** more yield/income/less pesticides/less damage to crops **OR** Increase in pollinators **so** more yield/income **OR** May attract more tourists/subsidies to their farm **so** more income (from diversification); Disadvantage - 2. Reduced land area **for** crop growth/income **OR** Greater (bio)diversity **so** increase pest population **OR** Increase pest population **so** less yield/less income/(more) need for pesticides/(more) damage to crops **OR** Increased (interspecific) competition **so** less yield/income **OR** More difficult to farm **so** less income;	2	Accept description of yield eg crop growth. For 'crop' accept 'plant'. Accept other valid suggestions **with** explanation that will affect the farm as a whole. Examples of 'more difficult to farm' – can't use large machinery, more difficult to plough/seed/harvest.

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09.3	1. Number of individuals of each species not known; 2. **Almost** all (of sample A / the 68%) could be of the same species; 3. Two / other samples have a higher number of species / higher species richness but a lower number of individuals / fish; 4. Other samples may have more individuals of each species;

3 max	2. If not stated otherwise, assume MP2 relates to sample A / 68%

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04.3	1. Significant increase in species richness on Islay and Colonsay **and** (significant) fall on Harris; 2. Change in diversity on Islay not significant; 3. Greater than 0.05/5% probability of getting this change/difference by chance (on Islay) OR (For other differences) less than 0.001/0.1% probability of getting this change/difference by chance (for species richness on Colonsay, Harris, Islay) OR Less than 0.01/1% probability of getting this change/difference by chance (for diversity index on Colonsay, Harris);	3

2. Accept converse about significance of differences in other cases

3. Reject **results** are due/not due to chance

3. Ignore refs to P unqualified

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Question 13 · A level Paper 1 · June 2022 · Q01.3 · 1 mark

01.3	Individual organisms could not be identified/separated **OR** Too small/numerous to count individuals **OR** Too time consuming;	1 (AO2)	Ignore too difficult to identify/distinguish different species Ignore too difficult to count unless qualified Accept reference to fungi for plants

Question 14 · AS Paper 1 · June 2024 · Q05.3 · 2 marks

05.3	Correct answer of 2.11 = **2 marks;;** Incorrect answer that shows correct total in numerator 1561250 = **1 mark** **OR** Correct total in denominator 741250 = **1 mark;**	2 (2 x AO1)	For 2 marks, accept 2.1(0623946) or any correct rounding eg 2.1 or 2.106 etc

Question 15 · AS Paper 1 · November 2021 · Q07.1 · 2 marks

07.1	Correct answer for 2 marks = 2.7;; Accept for 1 mark, 79 × 78/6162 in numerator (value of $N(N-1)$) **OR** 2286 in denominator (value of $\Sigma n(n-1)$) **OR** 22, 41, 14, 2 (correct readings of bar chart for all species) **OR** 0.37 – 0.38 (correct calculation using correct numerator and incorrect figures from bar chart: 22, 63, 77, 79)	2

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Question 16 · AS Paper 1 · November 2021 · Q07.2 · 1 mark

07.2	1. Same number of (different) species (in both plots) **OR** (Both plots) have 4 species;	1

Question 17 · A level Paper 3 · June 2023 · Q05.1 · 1 mark

05.1	1982 and 2003; 1 (AO3)	Reject if any other years are given

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05.2	1. There were many/48 (different) species **OR** (1997 had) the high**est** number of (different) species; 2. (However,) one/a few species were present in (very) large numbers **OR** **Most** species were present in (very) small numbers;	2 (2 x AO2)

1. Accept a lot/lots of (different) species for many
2. Accept dominated by one/a few species
2. Ignore each/all species were present in (very) small numbers

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