

Questions

Q1.

* The photograph shows a tawny owl. These owls live in areas close to the Arctic Circle.



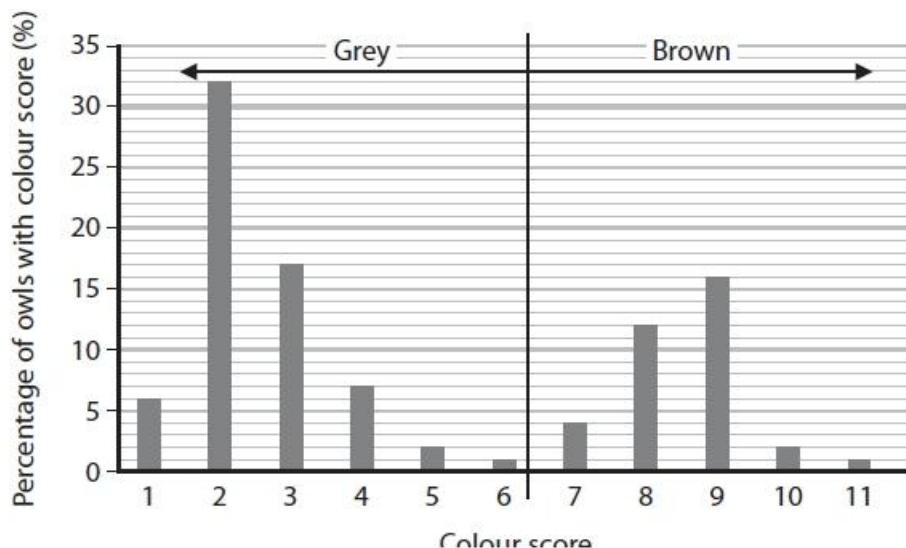
(Source: © LINDA WRIGHT/SCIENCE PHOTO LIBRARY)

Scientists investigated the feather colours of a population of tawny owls. Feather colours of the owls were scored on a scale of 1 to 11, according to how grey or brown they were.

Grey feathered owls were given a score between 6 and 1, with 1 being the most grey.

Brown feathered owls were given a score between 7 and 11, with 11 being the most brown.

The graph shows the percentages of owls in the population with each of the colour scores.



The scientists investigated the effect of climate change on the frequencies of these two alleles for feather colour in populations of tawny owls.

The percentage survival rates of both colours of owl were measured when there were different depths of snow.

The mean depth of snow was recorded each year between 1980 and 2007.

The percentage of owls that were coloured brown between 1960 and 2007 was also recorded.

Q2.

In Kenya, an in-situ conservation project has been set up to make paper from elephant dung.

This project aims to help conserve elephant populations, conserve biodiversity and help local communities.

Elephant conservation often involves the setting up of protected areas to stop poaching. Local people are banned from entering these areas.

This method of elephant conservation sometimes causes conflict with local people, as elephants can trample and eat crops in nearby farmland. Farmers sometimes burn areas of grassland and forest to stop elephants destroying their farmland.

The new paper conservation project encourages local people to make paper from elephant dung they collect from the conservation area. The paper they make is sold at a high price.

Conservationists measured the effect of the new paper project on the index of diversity of the area over two years. They also measured the effect of a protected conservation area where local people were banned from entering on the index of diversity. The results are shown in the table.

Area	Index of diversity	
	At start of project	After two years
Conservation area with paper project	2.8	3.6
Conservation area where local people are banned from entering	2.4	2.2

(i) State why calculating an index of diversity is a better measure of biodiversity than counting the number of different species.

(1)

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(ii) Give two advantages of in-situ conservation of elephants compared with ex-situ conservation of elephants.

(2)

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(iii) Explain the effect of the new paper project on biodiversity compared with the protected area where local people were banned.

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(Total for question = 7 marks)

Q3.

In Kenya, an in-situ conservation project has been set up to make paper from elephant dung.

This project aims to help conserve elephant populations, conserve biodiversity and help local communities.

Describe the limitations of CITES in the conservation of organisms such as elephants.

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(Total for question = 2 marks)

Q4.

Grassland is an important habitat for grazing animals such as cattle.

* When grazing animals such as cattle, sheep and horses are kept in fields, their faeces are left on the ground, and are known as dung.

The dung is eaten by dung beetles, which in turn are eaten by other animals.

Dung beetles bury dung up to one metre underground in tunnels they have made. This removes the dung from the surface of the field.

A cow can produce over eight tonnes of dung per year.

There are around 60 species of dung beetle in the UK. In 2016, 50% of these were identified as being scarce or threatened.

The photograph shows a dung beetle.



(Source: © Simon Webster/Alamy Stock Photo)

Scientists believe factors causing the decline of dung beetles include:

- farmers using more land to grow crops, and using more land for building and development
- keeping some grazing animals in sheds over the winter, rather than them spending the winter in fields
- fewer habitats for dung beetles, leading to populations of dung beetles becoming isolated and preventing outbreeding
- grazing animals routinely being treated with anti-parasitic drugs that can kill dung beetles.

Some scientists have stated that farming practices need to change to conserve the species of dung beetle, and to maintain biodiversity and the stability of ecosystems.

Discuss the validity of this statement.

(Total for question = 9 marks)

Q5.

Organic farming does not use artificial insecticides, herbicides or fertilisers, all of which are used in conventional farming.

Students investigated the effect of organic farming on the species diversity of butterflies.

They compared fields used for growing crops on an organic farm and on a conventional farm.

Some conventional farms have converted to organic farming.

A further experiment was carried out to investigate the effect on species diversity of how long the farms have used organic methods.

(i) Butterflies and plant species were sampled from a range of farms that had used organic farming methods for different lengths of time.

The number of plant species and the number of butterfly species were recorded.
The results are shown in the table.

Years of organic farming	Number of plant species	Number of butterfly species
0	17	4
1 to 5	38	12
6 to 15	42	14
16 to 25	39	12

Explain how the number of years of organic farming affects the biodiversity of butterfly species.

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(ii) Creeping thistle is considered to be a weed.

Creeping thistle has a deep root system and takes many years to be completely removed by organic farming methods.

The moth population and the number of creeping thistle plants were counted.

The results are shown in the table.

Years of organic farming	Number of moth species	Number of creeping thistle plants
0	15	10
1 to 5	27	235
6 to 15	20	74
16 to 25	10	14

Explain the changes in the number of moth species.

(2)

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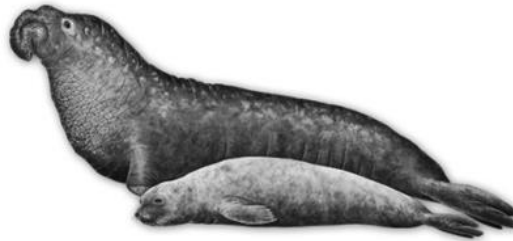
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(Total for question = 5 marks)

Q6.

The Northern elephant seal is a mammal found in the Eastern Pacific Ocean.



In the nineteenth century, Northern elephant seals were hunted and this reduced the population to about 20 seals.

The seals were listed as an Appendix II species when CITES was established in the 1970s.

The population has now recovered to over 100 000 individuals.

The seals in this population have developed health problems, including a high mortality rate for newborn pups, deformities and weak immune systems.

(i) Describe the role of treaties such as CITES in maintaining global biodiversity.

(2)

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(ii) Explain why, although the population of seals has recovered, many of the seals have health problems.

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(Total for question = 4 marks)

Q7.

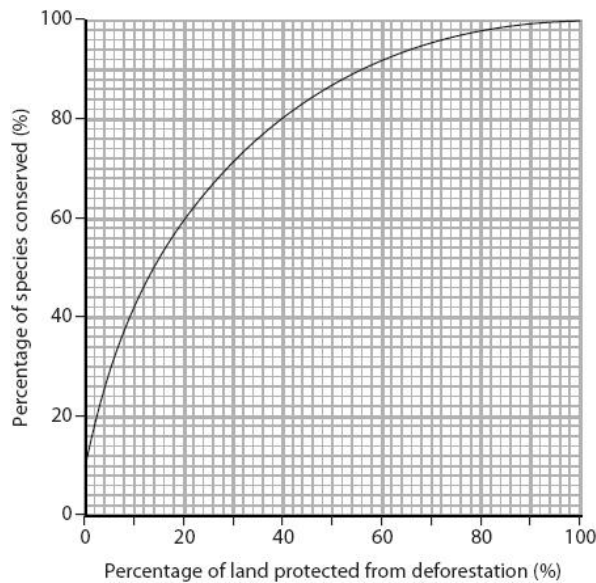
The World Wide Fund For Nature (WWF) is the largest conservation organisation in the world.

The WWF recently claimed that 'some 46 000 to 58 000 square miles of forest are lost each year. This is equivalent to 36 football fields every minute'.

This level of deforestation affects biodiversity.

Scientists studied the relationship between protecting land from deforestation and the percentage of species conserved.

The graph shows the results of the study.



Analyse the data in the graph to explain how protection of land affects the percentage of species conserved.

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(Total for question = 4 marks)

Mark Scheme

Q1.

Question Number	Indicative content
*	<p>Answers will be credited according to candidate's deployment of knowledge and understanding of material in relation to the qualities and skills outlined in the generic mark scheme.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant.</p> <ul style="list-style-type: none"> • with increasing snow depth, there is higher survival of grey owls / fewer brown owls survive / more grey owls D • snow depth has decreased over time D • the percentage of brown owls has increased over time / percentage of grey owls has decreased D <p>For</p> <ul style="list-style-type: none"> • with less snow, more ground is visible / uncovered / more twigs and trees visible E • with less snow, grey owls more obvious (to predators / prey) / less camouflaged E • with less snow, natural selection would favour brown owls / more brown (advantageous) alleles passed on / fewer grey alleles passed on / brown owls outcompete grey owls E • enhanced greenhouse effect due to carbon dioxide emissions reflecting radiation back / absorbing radiation (causing melting) E <p>Against</p> <ul style="list-style-type: none"> • no direct measure of greenhouse gas / temperature / fossil fuel emissions A • graphs show correlations not causal links A • data for owl survival with snow depth is scattered / gaps in data / weak correlation A • data for mean snow depth has many outliers / anomalies / not all points are around line / data is scattered A • other factors (named factors) could be affecting the owl population A • reduced snow may not be due to greenhouse gas release A
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Level 0	Marks	No awardable content
Level 1	1-2 (1-3)	Limited scientific judgement made with a focus on mainly just one method, with a few strengths/weaknesses identified. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made 1 mark : any 1 from D, E, A 2 marks : any 2 from D, E, A
Level 2	3-4 (4-6)	A scientific judgement is made through the application of relevant evidence, with strengths and weaknesses of each method identified. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made. D and, E OR A 3 marks : at least 3 points. Any combination of D, plus E, or A 4 marks : at least 4 points. Any combination of D, plus E, or A
Level 3	5-6 (7-9)	A scientific judgement is made which is supported throughout by sustained application of relevant evidence from the analysis and interpretation of the scientific information. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made. D, E, AND A 5 marks : at least 5 points. Must have combination of D, E, and A 6 marks : at least 6 points. Must have combination of D, E, and A

Q2.

Question Number	Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> (index of diversity) takes into account populations (of each species) (1) 	<p>Accept considers abundance / number of each species</p> <p>Accept because an area could have many different species but different populations</p>	1 exp

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An answer that makes reference to two from the following points:</p> <ul style="list-style-type: none"> other species are also conserved (in the ecosystem) (1) animals are not humanised / behaviours are natural / no change to behaviour (1) less inbreeding occurs (1) 	<p>Accept converse for <i>in situ</i></p> <p>Accept other species are protected / food webs are maintained / maintains biodiversity / maintains links in ecosystem</p> <p>Accept more space for animals Accept no need to transport animals</p> <p>Accept less inbreeding depression / maintain gene pool</p>	2 grad

Question Number	Answer	Additional Guidance	Mark
(iii)	<p>An explanation that makes reference the following points:</p> <ul style="list-style-type: none"> biodiversity has increased (in the paper project area) more (than the protected area) (1) as less / no grassland is burnt / less poaching (1) (more) niches are available / habitats are not destroyed / elephants transfer plant seeds (1) local people make money from the paper project / if the elephants are not present, local people lose a source of income (1) 	<p>Accept biodiversity has increased but {did not increase / went down} in area where people are banned</p> <p>Accept grassland burning / poaching still occurs in unprotected area Accept converse for protected area</p> <p>Accept converse for protected area</p> <p>Accept people have a vested interest in the elephants / make a profit</p>	4 exp

Q3.

Question Number	Answer	Additional Guidance	Mark
	<p>A description that makes reference to two of the following points:</p> <ul style="list-style-type: none"> not all countries sign the treaty / signing the treaty is voluntary (1) many species move across national boundaries (1) monitoring is expensive / some countries are too large to monitor / high financial rewards for {poaching / smuggling} / CITES (only) prevents trade (1) 	<p>Accept the treaty is not legally binding (within nations)</p> <p>Accept some species migrate / have very large ranges</p> <p>Accept not all species are classed as endangered Accept countries may not be able to monitor within their borders Accept some poaching will continue</p>	2 exp

Q4.

Question Number	Answer	Additional Guidance	Mark
	<p>Level 1: links information given to effect on dung beetles as below (up to 3 points from anywhere)</p> <p>Level 2: links information given to effect on dung beetles as below (up to 3 points from one category and up to 3 points from either one or two other categories)</p> <p>Level 3: links information given to effect on dung beetles as below (up to 3 points from one category and up to 3 points from each of the other 2 categories)</p> <p>No credit for points quoted from information given without qualification</p> <p>Indicative content</p> <p>Threats to dung beetles (T points)</p> <ul style="list-style-type: none"> • (less grazing animals on land) so less dung available ie reduced food source • (farmland used for building / development) so reduced habitat • (animals kept in sheds overwinter) so food source unreliable / not constant • (routine use of anti-parasitic drugs) so drugs in animal faeces which kill dung beetles • (isolated populations of dung beetles) so genetic diversity is reduced • (isolated populations of dung beetles) - small populations of dung beetle species have a small gene pool, so allele frequencies can change rapidly • (many) dung beetles feed specifically on the dung of particular species, so reduction in species of grazing animals decreases diversity 		
	<p>Benefits of dung beetles (B points)</p> <ul style="list-style-type: none"> • (remove dung from fields) so more access for grazing by animals • (remove dung from fields) so less chance of parasites living in dung and re-infecting cattle • (bury dung underground) so decomposers can break it down • decomposition of dung is faster if dung beetles are present • (decomposed dung) increases mineral content of soil • (eaten by birds etc) so provide food for other animals / loss of dung beetles could lead to collapse of food chains <p>Wider points and consequences to farming (W points)</p> <ul style="list-style-type: none"> • climate change may be having an effect on decline eg rise in temperatures, changed rainfall patterns • if farming practices change animals will suffer • if farming practices change, less economically viable to farm • if farming practices change, less food produced • adding fertilisers disrupts dung beetle life cycle • ploughing pasture disrupts dung beetle life cycle • small populations much more vulnerable to disease • pesticides may affect other animals in food chain: accumulation • (digging tunnels) improves soil structure by aeration • dung beetles may be involved in seed dispersal (seeds in faeces being moved around by beetles) • (routine use of anti-parasitic drugs) kill other beneficial invertebrates (as well as dung beetles) • No evidence or stats to prove or disprove • A new predator might be responsible for decline • Parasite numbers would increase if treatment stops • Cattle contribute to global warming, so better not to farm cattle • Urbanisation might be causing change, not farming practices 		

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Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> • number of butterfly {species / diversity} increases then {levels off / decreases} (1) • because there are more plant {species / diversity} / positive correlation between number of butterfly species and plant species (1) • providing more {niches / food sources / nesting sites} / decrease due to competition from other organisms (1) 		(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> number of moths is highest when creeping thistle is highest (1) because creeping thistle is a {food source / habitat / niche / used for reproduction} (1) 	ACCEPT converse statement	(2)

Q6.

Question Number	Answer	Additional Guidance	Mark
(i)	<p>A description that makes reference to two of the following:</p> <ul style="list-style-type: none"> CITES prevents {exploitation / hunting / sale / trade / poaching} (1) by countries that sign up to the treaty (1) by {protecting / conserving} endangered species (1) 		(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An explanation that makes reference to two of the following:</p> <ul style="list-style-type: none"> (genetic / population) bottleneck (1) causing reduced {genetic diversity / gene pool / number of different alleles} (in populations) (1) therefore the chance of inheriting two harmful recessive alleles increases (1) 	Accept small / restricted gene pool	(2)

Q7.

Question Number	Answer	Additional guidance	Mark
	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none">• increase in land protection increases species conserved (1)• because (trees) provide {niches / habitat / food / shelter} (1)• when no land protected (10 to 12%) species still exist (1)• because these species {live in soil / not in trees} (1)		(4)