Mark Scheme - Biodiversity

2 1		i	genetic (biodiversity) ✓	**1**	**Examiner's Comments** Many candidates correctly named this type of biodiversity as genetic. Incorrect answers included 'variation' or suggested 'environmental', 'habitat' or 'species'.
		i i	allows for adaptation to changing environment ✓ provides variation for natural selection ✓ can offer, camouflage / protection from predators ✓	**1 max**	**ACCEPT** in the context of an example e.g. species survival when, a / new, disease introduced **Examiner's Comments** Many suggested that the colour variation was an adaptation to the environment but did not indicate the crucial idea of a *changing* environment. Camouflage was a popular correct answer.
			Total	**2**	
2 2	a	i	have significant effect on ecosystem✓ many other species rely on activity of beavers✓	2	

		ii	*created dams* flooded areas upstream / reduced flow rate downstream creating still / slow moving water for aquatic species✓ *felled trees* opened up tree canopy allowing light to ground level✓ *built lodges* creates sheltered habitat for insect species / beaver parasites✓	Max 3	**ALLOW** any other valid point
		iii	ecotourism / education / scientific study✓ water quality improved as silt is held back by dams✓	Max 1	
	b		species diversity will rise as more species live in the new habitats✓ genetic diversity will increase as species have a wider range of conditions in which to live ✓	2	
	c		loss of farmland due to flooding ✓ strength of argument depends on area affected ✓ (probably) not a strong argument as relatively small areas affected✓ trees cut down✓ (of concern to foresters) likely to occur only in area near water – so not a strong argument ✓ damage to river bank needing costly repairs ✓ cost should be shared by all who benefit (including those downstream) so not a strong argument ✓	max 4	
			Total	**12**	
23		i	28 (%) ✓ ✓	**2**	**Correct answer = 2 marks** (indicated by 2 ticks) even if no working shown **IGNORE** minus sign **ALLOW 1 mark only** for correct but unrounded answer (e.g. 28.18) **or** for incorrect answer **either** (110 – 79) ÷ 110 **or** 31 ÷ 110 **or** 100 – 71.81 **or** for 27(%) (as 80 was used instead of

					79 but method correct) **or** for 29(%) (as 78 was used instead of 79 but method correct) **Examiner's Comments** Many candidates correctly calculated a percentage difference using the graph to obtain starting and end figures. Candidates are expected to read data from a graph correctly to the nearest half grid-square. They should *not* give approximate or rounded figures. Some candidates were not sure how to calculate a percentage change. The most common error was to divide the final figure by the starting figure and multiply by 100, instead of finding the *difference* between the starting and final figures and dividing that by the starting figure before multiplying by 100. A few candidates did not follow the rubric instructing them to give their final percentage difference figure to the nearest whole number.
		i i	1. number in farmland stays higher than in woodland ✓ 2. number of butterflies in woodland, has a greater decrease / drops faster / falls more steeply, (than those on farmland) **or** number of butterflies on farmland, has a smaller decrease / drops slower / falls less steeply, (than those in woodland) ✓ 3. from 2004 to 2012 they both fall by, similar / same, rate or by 6 (per km^2) ✓ 4. woodland population (decreases), from 98 to 48 (per km^2) / by 50 (per km^2) / by 51% farmland population, **and** from 110 to 79 (per km^2) / by 31 (per km^2) / by 28% (per km^2) in 1992 **or** **and** difference of 31 (per km^2) in 2012 difference of 12 **or** 23% more decrease in woodland /	**2 max**	Must be comparative statements 2 must be stated and not implied from figs 4 **ecf** for 27% / 29% (if that is candidate's answer to (a)(i)) **Examiner's Comments** This question required the skill of description in translating data from the graph into words, but also the

			woodland decreased by 19 (per km^2) more than farmland ✓		skill of drawing paired comparisons. Many candidates did not understand this principle and commented or quoted data about either farmland or woodland but not both. Few recognized that the farmland population is always higher than that in the woodland, even though this was very clearly seen on the graph. Stronger answers included comparative adjectives such as *higher* (number in farmland), *greater* (decrease in woodland) and *smaller* (decrease on farmland). Mistakes in quoting the data (i.e. reading figures from the graph or manipulating them to find a difference or the percentage decrease in woodland) were fairly frequent. As previously stated, candidates should *not* give approximate or rounded figures.
		iii	*woodland population dropped more because of* new / more, predator(s) / parasite(s) / disease(s) (of butterflies) **or** more interspecific competition / new species competing for food **or** (lack of management / woodland became over grown / reduction in open spaces, leading to) loss of, habitat / food supply / breeding sites ✓ *farmland decreased less because* leave, wildlife refuges / area to grow wild **or** conserve hedgerows **or** fewer, predators / parasite(s) / disease(s) (of butterflies) **or** (more open spaces) for breeding sites ✓	**1 max**	Must specify which population is being discussed. **DO NOT ACCEPT** in the context of deforestation **Examiner's Comments** Candidates find 'suggest' questions difficult, although in this case many linked new predators, loss of habitat or loss of food supply to the steeper decline in woodland. Fewer candidates gave answers concerning butterfly numbers on farmland. Some candidates stated that the woodland was overgrown or lacked management without explaining how this has an impact on butterfly numbers, or else providing a very simplistic idea such as 'butterflies have less space to fly'. In direct

					contradiction to the information supplied in the question that woodlands were becoming more overgrown, deforestation was occasionally mentioned as a cause of the butterfly decline in woodland.
		iv	*lacks validity because* 1. weather conditions only apply to 2012 ✓ 2. numbers were falling before 2012 ✓ 3. weather conditions and butterfly decline may not be linked / other factors may be responsible ✓ 4. not enough / no / need more, data / evidence (to know that it is the cause of decline) ✓ 5. weather conditions in North of England not representative of the whole country ✓	**2 max**	**IGNORE** statements relating to being valid **1 ACCEPT** we only know that it was cold and wet in 2012 **4 ACCEPT** we need more information about weather **5 ACCEPT** we only know about the weather in Northern England **Examiner's Comments** Most candidates made only one comment although there were two marks available. A large number of candidates were afraid to commit and maintained that the statement was partly valid. Acceptable reasons given for the statement not being valid were that there was insufficient data provided and that other factors may also have an effect on butterfly populations. Few candidates used the information that introduced the graph and referred to wet and cold weather conditions being limited to only part of the time period shown in the graph.
		v	(same) time of year / time of day / time between sampling **or** (same) size of sample area / length of transect / number of transects **or** (same) capture / counting / sampling, technique **or** (exactly the same) place in each habitat ✓	**1 max**	**Mark the first variable.** **IGNORE** 'time' unqualified **Examiner's Comments** Most candidates named a suitable variable that should have been controlled and showed an awareness of ecological sampling methods and constraints. A few candidates delivered a 'standard'

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td>answer that related more to laboratory-based experiments, such as pH or temperature, or misinterpreted the term ‘survey’ in this context and referred to asking questions of the same people in the survey.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>8</td><td></td></tr>
<tr><td>24</td><td>a</td><td>i</td><td>any three from:
dig hole and place container in soil ✓
make top of container level with soil level ✓
cover to protect from, rain / scavengers ✓
leave overnight ✓
identify / count, (named) invertebrates ✓
sample both areas, randomly / at 5(+) sites ✓</td><td>3 max
(AO1.1)</td><td></td></tr>
<tr><td></td><td></td><td>ii</td><td>columns two and three of table correctly filled ✓
column four correctly filled (first 4 figures) ✓

correct value of D to two significant figures = 0.69 ✓

<table>
<tr><th>Species</th><th>n = Number of organisms</th><th>n / N</th><th>$(n / N)^2$</th></tr>
<tr><td>Common Woodlouse</td><td>9</td><td>0.429</td><td>0.184</td></tr>
<tr><td>Black sexton beetle</td><td>6</td><td>0.286</td><td>0.082</td></tr>
<tr><td>Spotted wolf spider</td><td>2</td><td>0.095</td><td>0.009</td></tr>
<tr><td>The woodlouse spider</td><td>4</td><td>0.190</td><td>0.036</td></tr>
<tr><td></td><td>N = 21</td><td></td><td>$\Sigma(n / N)^2$ = 0.311</td></tr>
<tr><td></td><td></td><td></td><td>$1 - \Sigma(n / N)^2$ = 0.689</td></tr>
</table></td><td>3
(AO2.5)</td><td>IGNORE final answer 0.689 / 0.69 in column 4 for mp 2

ALLOW ECF at any stage of calculation.
If no answer on answer line, ALLOW MP3 for correct answer given in table (column 4)</td></tr>
<tr><td></td><td></td><td>iii</td><td>area B more stable as has a higher, diversity (value) / Simpson’s index ✓</td><td>1
(AO1.2)</td><td>ALLOW ECF from (ii)
e.g. if answer to (ii) is greater than 0.84, ALLOW ECF for saying Area A has more stable community than area B due to greater diversity value</td></tr>
<tr><td></td><td>b</td><td>i</td><td>any two from:

1 use a tape measure to mark the line ✓
2 at, fixed / 1m, intervals (along the tape) ✓
3 use quadrat to measure percentage cover ✓
4 identify with, key / field guide / app ✓
5 repeat / use group data (not just your own results) ✓</td><td>2 max
(AO3.3)</td><td></td></tr>
</table>

		ii	*any four from:* statement true as only heather is present at, 4-6m / 8m ✓ statement true as only bracken is present at 9m ✓ statement false as bracken and heather both present at 0-4m / 7m ✓ comparative % (cover) figures for heather and bracken at one point with units ✓ only one of the two species present at 5 out of 9 points ✓	4 max (AO3.3 AO3.4)	
			Total	**13**	
25		i	8 | 0.0964 | 0.0093 (1) (1) (1)	3	
		ii	A has greater richness (1) **ORA** B has greater evenness (1) **ORA**	2	
		iii	stratified **AND** random (within each area) (1) *idea that* the number of samples within each area should be proportional to their size (1) correct suggestion for the number of samples taken within each area (1)	3	**ALLOW** description of stratified e.g. 8 in conifer area, 24 in marshy area, 32 in grazed area
			Total	**8**	
26	a	i	t = 13.61 (1)(1)	2	**ALLOW** correct working for 1 mark. $\frac{[31.3 - 20.0]}{\sqrt{\frac{4.1^2}{50} + \frac{4.2^2}{50}}} = \frac{11.3}{\sqrt{\frac{16.81}{50} + \frac{17.64}{50}}} = 0.3362$ $= 11.3 / \sqrt{0.689}$ $= 11.3 / 0.830 \quad = 13.61$
		ii	probability is highly significant, calculated t value is greater than the critical value at 0.001 / there is a chance (probability) of below 0.001 that the differences in the shell height seen can be due to chance **and** the null hypothesis can be rejected (1)	1	
	b		histogram correctly plotted for the values (1) two sets of data distinguished by a key or other suitable method to identify them (1)	4	**DO NOT ALLOW** a bar chart or a line graph as neither would represent the data correctly. **ALLOW** a correlation scattergram.

			x axis labelled 'height (mm)' **and** *y* axis labelled 'number of dog whelks / *Nucella lapillus* / shells / class' (1) makes good use of the graph paper **and** both axes are correctly scaled with ascending equidistant intervals (1)		**ALLOW** '% of the sample' for the *y* axis if this has been calculated.
	c		three from positive correlation between the height of the whelk shell and the type of the shore (1) correct calculation of the correlation coefficient (1) (histogram / data, indicates that) shore exposure has an impact on height (1) Nucella show adaptation to harsher wave action (1) shells measured may not all be exposed to wave action (1)	3	**ALLOW** correlation is strong or a reference to relationship such as:- taller shell height and sheltered shore or shorter shell height and exposed shore. **ALLOW** little overlap on the histogram bars. **ALLOW** the idea that the differences may be due to direct wave action or adaptation.
	d		no detail for the random sampling technique was given / *Nucella* from the whole population may not have been sampled (1) **and** use (two) metre tapes to set out a grid and use randomly generated coordinates (1) no measuring instrument specified (1) **and** use vernier callipers with a precision of more than 0.5 mm (1) incorrect identification of *Nucella* / several types of shelled molluscs that are similar to *Nucella* (1) **and** use a sea shore key to correctly identify the whelk (1) classification of the shore as sheltered or exposed was subjective (1) **and** use an approved shore classification (such as Ballantine's) (1)	2	**Limitation and improvement must be linked for 2 marks.**
	e		*one from* increase the number of, *Nucella* used in the data collection / samples (1) replicate / repeat, the entire experiment again (1)	1	**ALLOW** a value given such as increasing number to 100 from each shore. **ALLOW** an understanding of the

					idea that the procedure has only been carried out once for each shore.
	f		*not valid* a small percentage of N*ucella* sampled and some areas not sampled at all which would lead to skewed data (1) human interpretation of the measurement causes accuracy of the data to be questioned (1) genetic variations or sub species not taken into account (1) *valid* random sampling techniques mean no bias in collection (1) 100 *Nucella* sampled in total (50 in each area) so large sample size (1) precise instructions for consistent measurement of shell height (1)	3	**ALLOW** reverse arguments made. *idea that* conclusion will be distorted
			Total	**16**	
27		i	estimate will be inaccurate (because of low numbers) ⟩ dangerous (for collector or jaguar) ⟩	**2**	**IGNORE** refs to conspicuousness of tags **ALLOW** catching one more jaguar will make a big difference to the calculated number **ALLOW** the technique only works well with large populations **IGNORE** difficult to catch **ALLOW** the jaguars might die **IGNORE** inhumane / cruel / stressful **Examiner's Comments** Just under half of candidates gained one mark for (a)(i) for alluding to the dangerous nature of capturing jaguars but very few gained a second mark. Many candidates did not notice the reference to the capture-recapture technique and answered in terms of the inappropriateness of camera traps, which did not gain credit.

		i i	**1** appropriate calculation of, observed / expected, population density ⟩ **2** lower than estimate ⟩ **3** so does not support ⟩ **4** low / unknown, repeatability / reproducibility (of results) ⟩ **5** (some) support because, figure / 3, is close (enough) to, estimate / 5 ⟩ **6** some individuals not photographed ⟩ **7** *idea that* if many individuals not trapped population could be higher than estimate ⟩	**4 max**	**1 CREDIT** e.g. • 3.3 / 3 (jaguars per 100 km^2) • 13.55 / 13 / 14 (est. pop. in 271 km^2) • 0.05 and 0.033 / 0.03 (jaguars per km^2) • 20 and 30.1 / 30 (mean area per jaguar) **1 IGNORE** significant figures **2 ALLOW** ecf from candidate's calculation **3** Must be in context of mp 1 or 2 **4 ALLOW** low reliability **4 ALLOW** ref. to one-off study / should be repeated **4 IGNORE** accurate / valid **6 ALLOW** some not caught by camera **Examiner's Comments** The strongest candidates coped with the evaluative nature of this question well and achieved full marks – usually for the first three points on the mark scheme plus marking point 4, 5 or 6. The majority of candidates focused only on the extent to which the data did not support the conclusion and often scored three marks. The fourth marking point was seen regularly but candidates often used the term 'reliability' which is not encouraged because of its ambiguous nature. Centres should refer to the OCR Practical Skills Handbook for a list of terms used to describe investigative results and their agreed definitions. Although the candidates were not explicitly directed to complete a calculation for

					this question, almost all did and the vast majority of these were correct.
		i i i	*human sightings* *idea of any one of the following* misidentification seeing the same individual twice exaggeration / lying poor recollection jaguars likely to be in, places / times, humans are not method unlikely to spot cubs (as still in den) ⟩ *footprints* *idea of any one of the following* misidentification might disappear (before recording) multiple prints in same spot makes counting difficult same print might be counted on different occasions many prints made by the same individual hard to distinguish individual jaguars footprints not always left ⟩	**2**	**IGNORE** hard to spot **IGNORE** misidentification if given in human sighting **Examiner's Comments** This was generally well answered. Candidates who thought that jaguars lived alongside tigers or cheetahs were not penalised for incorrect general knowledge.
			Total	**8**	
2 8		i	50 ✓✓✓	3(AO2. 8)	If the answer is incorrect, award one mark for (1,000,000 / 20 =) 50000 / 5 x 10^4 and one mark for (50,000 / 10 =) 5000 / 5 x 10^3 **Examiner's Comments** This was a difficult question for many candidates, involving a multi stepped calculation, where a few candidates did not attempt. Many candidates who miscalculated either the second or third division still scored one or 2 working marks (for 50000 or 5000), and many gained full marks. **OCR support** The mathematical skills handbook can be used to support candidates with serial dilutions:

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td>https:/www.ocr.org.uk/Images/294471-biology-mathematical-skills-handbook.pdf</td></tr>
<tr><td></td><td></td><td>ii</td><td>idea of (with low colony numbers) small (random) differences (in plating) produce large errors when estimating / scaling ✓</td><td>1
(AO3.3)</td><td>DO NOT ALLOW assumes bacteria are equally distributed when removing the sample

<u>Examiner’s Comments</u>

Very few candidates recognised the implications of the low colony count for generating error when scaling up. Several candidates knew that too many dilutions had occurred, but found it difficult to express the correct idea clearly.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>4</td><td></td></tr>
<tr><td>29</td><td></td><td></td><td>stratified (sampling) ✓

detail of stratified sampling ✓

correct calculation:
40% (in farmland), 20% (in grassland), 40% (in peat bog)
OR
proportional numbers ✓</td><td>3
(AO3.3)
(AO3.4)</td><td>e.g. number of samples in each sector is proportional to the area or implied by correct calculation / random sampling within each sector

e.g. 8, 4 and 8 samples</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>3</td><td></td></tr>
<tr><td>30</td><td></td><td>i</td><td><table>
<tr><td>Species</td><td>n</td><td>n/N</td><td>(n/N) ^{2}</td></tr>
<tr><td>Meadow buttercup</td><td>6</td><td>6/24 = 0.250</td><td>0.063</td></tr>
<tr><td>Common daisy</td><td>7</td><td>7/24 = 0.292</td><td>0.085</td></tr>
<tr><td>Red clover</td><td>3</td><td>3/24 = 0.125</td><td>0.016</td></tr>
<tr><td>Ribwort plantain</td><td>8</td><td></td><td>0.111</td></tr>
</table></td><td>3</td><td>Correct final answer of 0.73 = 3 marks, even if working (and intermediate figures 0.275 and 0.725) not shown

CALCULATIONS TO MORE OR FEWER D.P
ALLOW any figure within each range:

Σ = from 0.271 to 0.276 to more or less d.p.

1 - Σ = from 0.724 to 0.729 to more or less d.p

final answer = 0.72 OR 0.73

CALCULATIONS USING</td></tr>
</table>

				8/24 = 0.333		
				Σ =		**0.275** ✓

1 − 0.275 = **<u>0.725</u>** ✓

final answer to 2 s.f:
0.73 ✓

FRACTIONS
ALLOW these options for first 2 mps:

Σ = 158/576 **OR** 79/288

1 - Σ = 418/576 **OR** 209/288

WORKING ERRORS
ECF to **max 2 for a final answer to 2 s.f.** after one class of error in working somewhere, e.g.

in the n/N stage or the $(n/N)^2$ stage or in adding up the Σ sum or in subtracting the answer from 1.

If final answer is **not** given to 2 s.f. after one class of error in working, then **ECF** as above to **max 1**.

ALLOW a final answer slightly below or above correct answer (0.71 − 0.79) 2 marks ECF by assuming 1 error at one stage.

<u>Examiner's Comments</u>

Candidates seemed well-prepared for this task. Many sensibly added two extra columns to Table 6 to calculate n/N and then $(n/N)^2$. Where a slip was made in calculating the sum of these, error carried forward was applied, so that the subtraction of this figure from 1 was credited, as was giving the answer to two significant figures. This illustrates the general principle for maths questions on Biology papers; that it is the process in each step is important for credit to be given, and not the absolute value of the number obtained.

For further practice in calculating Simpson's Index of Diversity see the

					OCR support box. Intermediate working may be given as fractions or decimals. If using decimals candidates should be trained to present their working to show the steps in the process to the same number of decimal places throughout (2 or 3 would be suitable here) while conducting calculator working to the maximum number of decimal places shown on the display. http:/www.ocr.org.uk/qualifications/by-subject/biology-related/maths-for-biology/m1-handling-data/ (see learner activity)
		ii	(point / frame) quadrat(s) ✓	1	**Additional incorrect answer = 0 marks** **IGNORE** random number, generator / calculator **Examiner's Comments** This was an easy question with most candidates naming a 'quadrat'. A random number generator is not a single piece of equipment, though as a useful tool on a computer, this was ignored if given as an additional answer. The spelling 'quadrant' is not acceptable.
			Total	**4**	
31	a		*idea of* more transects in different parts of area 1 and 2 (1) (collect at) different, times of day / times of year / weather conditions (1) method of ensuring that individuals not counted again (1) (use a method to) capture individuals (1) (use a method to) correctly identify species (1)	3	**ALLOW** example of appropriate method, e.g. (butterfly) net **ALLOW** e.g. photograph / use of key

	b	i	(Area) **2** (because it) has, more / 6, species (1)	1	
		i i	(Area) **2** *idea that* the range of n is smaller (1)	1	**ALLOW** use of figures to exemplify
		i i i	<table><tr><th></th><th>Area 1</th><th>Ar</th></tr><tr><td>Species of butterfly</td><td>Number of individuals (n)</td><td>Number of individuals (n)</td></tr><tr><td>Grayling</td><td>2</td><td>5</td></tr><tr><td>Large heath</td><td>16</td><td>10</td></tr><tr><td>Gatekeeper</td><td>9</td><td>7</td></tr><tr><td>Green hairstreak</td><td>3</td><td>5</td></tr><tr><td>Silver-studded blue</td><td>0</td><td>2</td></tr><tr><td>Small heath</td><td>8</td><td>11</td></tr><tr><td></td><td></td><td>N = 40</td></tr><tr><td>Simpsons Index</td><td>0.7131</td><td></td></tr></table> any successful calculation of $(n/N)^2$ (1) ($\Sigma(n/N)^2$ =) 0.2024 (1) ($1-\Sigma(n/N)^2$ =) 0.7976 (1) answer given to 4 significant figures (1)	4	**Correct answer given to 4 sig. fig. with no working shown = 4 marks** **ALLOW** correct answer with different sig. figs **ALLOW** correct answer with different sig. figs
	c		For answers marked by levels of response: Read through the whole answer from start to finish, concentrating on features that make it a stronger or weaker answer using the indicative scientific content as guidance. The indicative scientific content indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the science content of the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, **best** describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme. Once the level is located, award the higher or lower mark.		

			The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met. **The lower mark** should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing. **In summary:** • **The science content determines the level.** • **The communication statement determines the mark within a level.**		
			Level 3 (5–6 marks) Full and detailed evaluation of the students' conclusion taking into account the validity of the method used **and** the implications of the data collected. Learner demonstrates a holistic judgement of the information including evidence for **and** against the claim. The candidate makes a judgement that there is not enough evidence to support the students' conclusion. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.*	6	**Indicative scientific points may include…** **Evidence to support the conclusion (that fencing increased biodiversity)** • calculated Simpson's Index of Diversity is higher in fenced area • high Simpson's Index means high biodiversity • greater number of species / higher species richness in fenced area • silver-studded blue only occurs in fenced area.
			Level 2 (3–4 marks) An evaluation of the students' conclusion taking into account the validity of the method used **and** / **or** the implications of the data collected. Learner demonstrates a holistic judgement of the information including evidence for **and** against the claim. The candidate makes a judgement in line with the argument they have presented. *There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.* **Level 1 (1–2 marks)** An evaluation of the claim is attempted including discussion of either the validity of the method **or** the		**Students' conclusion may be overdrawn because…** • difference in Simpson's Index of Diversity between two areas is small (12%) • range of number of individuals is greater in Area 1 (0–16) than Area 2 (2–11) • higher number of individuals of 'Large heath' and 'Gatekeeper' butterflies sighted in Area 1.

			implications of the data. The answer includes evidence for **or** against the claim. A definitive judgement may not be present. *A basic structure and some relevant information is provided, although a clear line of reasoning may not be present. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 marks** No response or no response worthy of credit.		• do not know length of time Area 2 has been fenced off. • *limitations of method* o samples taken on only two days o samples only taken in one season o no method to prevent recounting o observation at a distance might have led to mis-identification.
			Total	**15**	
3 2			(species evenness is) low / uneven / not even / poor / not high **AND** many / large, number OR abundance OR population of, leather jackets / meadow ants / two species / some species, but, not many / only a few / small number of / hardly any / small population of, click beetles / wireworms / two species / other species ✓	1	**ALLOW** comparatives e.g. a lot more ants than wireworms, ants much more common than click beetles **ALLOW** dominated by (mostly) leatherjackets and ants / 2 species **IGNORE** comparative pairs of figures that lack a qualification like 'only' to show which figure is small(er) **IGNORE** percentage figures unqualified by description **Examiner's Comments** Most candidates stated that the sample showed species unevenness and compared the figures to explain why. An answer that only restated figures from the question such as: 'There were 24 leatherjackets and 2

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td>click beetles' did not score. Some evidence of candidate evaluation was required, like: 'There were a large number of leatherjackets but only 2 click beetles'.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>3
3</td><td></td><td>i</td><td>FIRST CHECK ON ANSWER LINE
If answer = 0.648 or 0.649 award 3 marks ✓✓✓

If answer is incorrect ALLOW 2 marks max for…

(some) correct values for n/N and $(n/N)^2$ ✓

$\Sigma(n/N)^2 = 0.350$ or 0.351 ✓✓

1 - calculated $\Sigma(n/N)^2$ to 3 s.f. ✓

0.65 ✓✓</td><td>3 (AO 2.4)</td><td>IGNORE s.f. in working

ALLOW 3 correct in each column

<table><tr><th>n/N</th><th>$(n/N)^2$</th></tr><tr><td>0.500</td><td>0.250</td></tr><tr><td>0.029</td><td>0.001</td></tr><tr><td>0.071</td><td>0.005</td></tr><tr><td>0.286</td><td>0.082</td></tr><tr><td>0.114</td><td>0.013</td></tr></table>
<u>Examiner's Comments</u>

The majority of candidates achieved all three marks. Some marks were not awarded because of incorrect rounding or inappropriate use of significant figures. Some candidates missed out on working marks by not clearly showing their working in the space provided.</td></tr>
<tr><td></td><td></td><td>i
i</td><td>1a species (bio)diversity / variety of species / species evenness
2a shown by calculated Simpson's Index
or
1b species (bio)diversity / number of species / species richness ✓
2b shown by 5 (plant species) ✓
3 variety / diversity / range, of habitats ✓
4 shown by, coppiced and mature / reference to two woodland, habitats / AW ✓
5 idea that genetic diversity not measured by or evident from students' fieldwork ✓</td><td>3 max (AO 1.1) (AO 2.1)</td><td>1&2 AWARD the pair of marking points that gives the candidate more marks

1a ALLOW range of species

2a Must be linked to 1a

1a ALLOW range of species

2b Must be linked to 1b</td></tr>
</table>

					3 IGNORE ‘different habitats’ must be in the context of habitat diversity **4** Must be linked to 3 **Examiner’s Comments** Most candidates discussed species richness and species evenness and were able to access one mark. However, many candidates did not link these terms to the students’ fieldwork as the question instructed them to do and so they missed out on a second mark. Others attempted to link species richness and evenness to the fieldwork but an obvious misunderstanding about the meanings of these terms often made this impossible – it was clear from many candidates’ answers that they understood species richness to mean the number of individuals in a species. Only a few candidates referred to habitat diversity, although when they did they often gained two marks for referring to the example of coppiced and mature. Many candidates referred to genetic diversity but almost none of these pointed out that this was not addressed by the students. Some candidates discussed vertical levels within woodland. None of these approaches achieved any credit.  **Misconception** Despite the use of the word ‘levels’ in the specification many candidates had different interpretations of the word. Some thought that levels meant ‘areas’ e.g. coppiced and mature woodland; others, that it

					referred to classification, from kingdoms to species and individuals. **OCR support** OCR 'Delivery Guide' on Biodiversity: https:/www.ocr.org.uk/qualifications/as-a-level-gce-biology-a-h020-h420-from-2015/delivery-guide/module-ba04-module-4-biodiversity-evolution-and-disease/delivery-guide-badg011-biodiversity-421
			Total	**0**	
3 4	a		(Habitat B =) 0.61 ✓ Habitat with the greatest biodiversity = A ✓	**2**	**DO NOT ALLOW mp 2 if value of D not calculated** **ALLOW ECF** if B has been identified as the habitat with greatest biodiversity, (if value of D calculated for habitat B greater than 0.71) **Examiner's Comments** Most candidates gained both marks here. Candidates who showed clear working and an understanding of the method to calculate Simpson's index scored well, but without clear workings, answers were often wrong. Some candidates forgot to take their calculated number from 1. Most candidates who had correctly calculated the biodiversity for habitat B understood the significance of the result and stated that habitat A had a greater biodiversity.
	b	i	climax community ✓	**1**	**Examiner's Comments** Many candidates gained credit by making reference to the climax community. Unsuccessful responses often indicated that the candidate

					had not understood the question and their response related to the beginning of the process of primary succession. Common errors included pioneer species and climax population.
		ii	belt / line, transect / described **or** stratified sampling / described ✓ random selection of transect sites **or** systematic sampling / place quadrats at, set / pre-determined, intervals along the transect **or** random sampling using quadrats in, selected areas / strata ✓ pooter / sweep nets / pitfall traps / light traps / tree-beating ✓	3	e.g. ' lay tape from edge of lake and sample along it' (N.B. only allow random sampling in context of stratified sampling) **ALLOW** any suitable method of trapping insects **IGNORE** capture mark recapture **Examiner's Comments** Successful responses referred to the use of a belt or line transect to sample stages of succession and a few referred to the use of stratified sampling. Candidates were less successful in describing how to minimise sampling bias, the most common error was to refer to random sampling without stating in what context this would be used. Contradictory statements referring to the use of random sampling along a transect, lost many candidates marks. Candidates showed a good understanding of methods to sample insect biodiversity, the most frequent successful responses referred to the

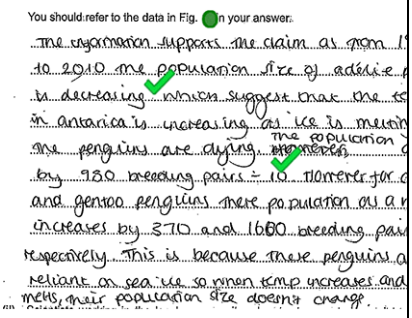
					use of pooters, sweep nets or pitfall traps.
		iii	Woodland = (k)g m^{-2} yr^{-1} / (k)J m^{-2} yr^{-1} **AND** Lake = (k)g m^{-3} yr^{-1} / (k)J m^{-3} yr^{-1} ✓	**1**	**ALLOW** (k)g h^{-1} yr^{-1} / (k)J h^{-1} yr -1 / tonnes h^{-1} yr^{-1} / (k)g (k)m^{-2} yr^{-1} / (k)J (k)m^{-2} yr^{-1} **ALLOW** (k)g (d)m^{-3} yr^{-1} / (k)J (d)m^{-3} yr^{-1} / (k)g (k)m^{-3} yr^{-1} / (k)J km^{-3} yr^{-1} **ALLOW** hectare $^{-1}$ for h^{-1} **ALLOW** y for yr **DO NOT ALLOW** 'per' **ALLOW** '/' instead of $^{-1}$ **Examiner's Comments** This was a high level question, and as expected, only the most able candidates answered this question correctly. Very few understood the idea of mass/energy +area/volume + time, make up the unit.
			Total	**7**	
35			A	1	**Examiner's Comments** Candidates needed to be clear about the definitions of species richness and species evenness in order to answer this question. Option D was a common incorrect suggestion. Some candidates suggested G or H, which were not valid options.
			Total	**1**	
36		i	loss of, (rainforest) habitat / food source **or** deforestation ✓ hunting / poaching (for horn) ✓	max 2	**IGNORE** disease **ACCEPT** loss of (rainforest) ecosystem **IGNORE** only lives in rainforest **Examiner's Comments** 'Poaching' or 'hunting' and

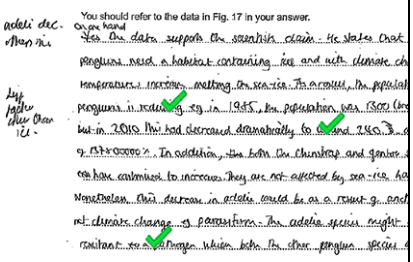
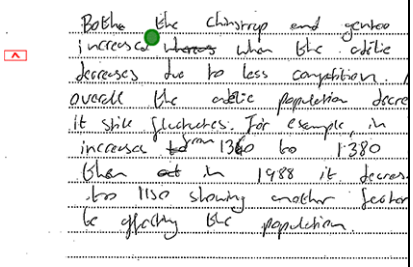
			climate change ✓		'deforestation' were the most common correct reasons given for why the species is critically endangered.
		ii	1 hard to find a mate / may be gender imbalance ✓ 2 (inbreeding leading to) low genetic diversity / small gene pool / genetic bottleneck ✓ 3 cannot / less likely to, cope with / adapt to, (named) environmental change ✓ 4 all wiped out by the same disease ✓ 5 more vulnerable to, predators / poachers ✓ 6 natural disaster could wipe out, one / some, of the small populations ✓	max 2	1 **ACCEPT** few individuals of reproductive maturity 2 **ACCEPT** description 3 **ACCEPT** (population) unable to cope with new selection pressures 4 **DO NOT CREDIT** that they are more susceptible to disease in general **Examiner's Comments** Many candidates stated that less reproduction would occur but did not further develop the idea. A smaller gene pool or less genetic variation was often correctly stated but fewer candidates went on to explain how this would speed up extinction in terms of a lack of ability to adapt to environmental change or all being vulnerable to a particular disease. There was a misconception for some candidates in this question, since they discussed problems for small animals as opposed to small populations.
		iii	education / awareness ✓ support for / promote, conservation projects / research ✓	max 1	**IGNORE** ref to cloning In the context of educating the general public e.g. information displayed in the zoo or on website / holding education days for schools 'support' could mean: raise money / provide funds / provide technical support / provide expertise / etc. **CREDIT** in the context of an example e.g. sending people to monitor

					populations in the wild e.g. supporting the setting up of nature reserve **IGNORE** zoo sets up nature reserves **Examiner's Comments** This question proved to be challenging for most candidates who often failed to note from the information in the question that captive breeding programmes with *D. sumatrensis* have been unsuccessful. It was very common to read in their responses that the zoos could re-introduce the rhinos into the wild, rather than correctly referring to zoos providing funding or support for conservation projects or raising public awareness.
			Total	**5**	
37		i	**FIRST CHECK ON ANSWER LINE** **If answer = 0.41 award 2 marks** 13/32 ✓ correct answer to 2 s.f. ✓	2 AO2.4	*Max 1 if answer given as %*
		ii	*supports because…* **1** species B has greater (calculated genetic) polymorphism (than species A) ✓ ora *might not support because…* **2** numbers / polymorphisms , are similar ✓ **3** no statistical test performed ✓ **4** might not have sampled <u>same loci</u> ✓ **5** no indication of (fruit flies) sample size ✓	3 max AO3.1 AO3.2	**1 ALLOW** ecf from calculated answer to part (i) **4 IGNORE** different numbers of gene loci studied **5 IGNORE** sample size is small
			Total	**5**	
38			A because mean proportion of heterozygotes is higher (1) A = 0.898 **AND** B = 0.854 (1)	2	**ALLOW** any correct number of significant figures and percentages

			Total	**2**	
3 9			***Please refer to the marking instructions on page 3 of this mark scheme for guidance on how to mark this question. In summary:*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors,* ***Level 1****,* ***Level 2*** *or* ***Level 3****, best describes the overall quality of the answer.* *Then award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* • o *award the higher mark where the Communication Statement has been met.* o *award the lower mark where aspects of the Communication Statement have been missed.* • ***The science content determines the level.*** • ***The Communication Statement determines the mark within a level.*** **Level 3 (5−6 marks)** A good range of explanations are provided. The explanations clearly indicate how the decrease in biodiversity is caused. *The explanations are clearly linked to the factor considered. There is a logical structure and use of scientific terminology is at an appropriate level. All the information presented is relevant and forms a continuous narrative.* **Level 2 (3−4 marks)** Some explanations are provided. The explanations do not always clearly show how the decrease in biodiversity is caused. *The explanations are not always clearly linked correctly to the applicable factor. There is some structure and use of appropriate scientific terminology. The information presented is mostly relevant.*	• Max 6	**Indicative scientific points may include:** Human population growth: • Need for more agricultural land / housing • Destroys habitats • More waste produced • More pollution produced • Damaging ecosystems • Specific example provided Agriculture: • Agricultural land has monoculture / lower biodiversity • Loss of older / wild type strains • Reduced genetic diversity

			Level 1 (1−2 marks) A limited number of explanations are provided. The explanations do not clearly show how the decrease in biodiversity is caused. *There is some structure to the answer. The explanations though basic are linked to the applicable factor.* **0 marks** No response or no response worthy of credit.		• Subject to disease • Inability to adapt to changing conditions • Altering habitats • Specific example provided such as draining of wetlands reduces habitat diversity • Pesticide use • Use of fertiliser • Nitrate pollution • Eutrophication Climate change: • Warmer / drier climate • Modern strains/species not adapted • Migration may not be possible • Rise in sea level reduces land area • More frequent flooding affects terrestrial ecosystems
			Total	**6**	
4 0		i	*supports because…* **1** Adélie / ice-reliant / AW , penguin (population) decreased **OR** gentoo / chinstrap / non-ice-reliant , penguin (population) increased ✓ **2** figs that support either point given above ✓ *does not support because…* **3** idea that changes could be explained by (chance) <u>arrival</u> of , gentoo / chinstrap (and subsequent competition) ✓ **4** change in another described factor could explain changes (in a single species) ✓ correlation does not mean causation ✓	3 max (AO3.1) (AO3.2)	*Marks must reference support / AW* **2** Must quote 2 numbers and 2 years or a calculated , increase / reduction **2 IGNORE** units **4 ALLOW** *only* disease present in Adélie only **or** change in food availability that favours , gentoo / chinstrap **or** new predator that preys more on

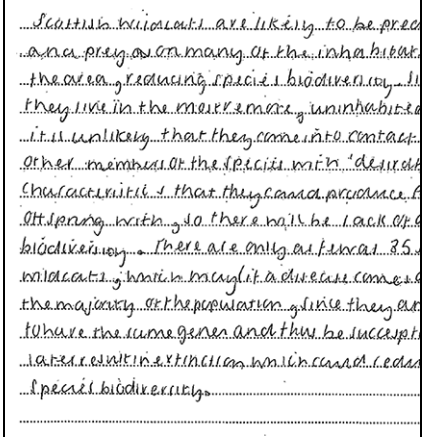
			5		Adélie **Examiner's Comments** This AO3 question tested the candidates' ability to assess whether a claim was supported by evidence presented and, as such, answers that did not mention whether or not the evidence supported the claim were unable to gain marks. However, 2 marks were commonly credited, usually for good descriptions of supporting evidence with figures. When discussing whether evidence supports a claim, candidates are expected to consider both sides of the argument, but most responses did not address reasons why the claim might not be supported. Those that did often did not suggest a plausible reason that would be consistent with the evidence presented – merely stating, 'there could be other factors'. A few were able to clearly express the idea that correlation does not imply causation. When asked to discuss whether evidence supports a claim, or to evaluate the support given by evidence to a claim, candidates are advised to consider reasons that support and reasons that do not support the given claim. Exemplar 4  You should refer to the data in Fig. 5 in your answer. The information supports the claim as from [illegible] to 2010 the population size of adélie penguins is decreasing which suggest that the [illegible] in Antarica is increasing as ice is melting the penguins are dying. The population decreased by 980 breeding pairs ÷ 10 numbers for adélie and gentoo penguins their population on a [illegible] increases by 370 and 1680 breeding pairs respectively. This is because these penguins [illegible] reliant on sea ice so when temp increases and melts, their population size doesn't change This typical response achieves two marks easily for explaining how the

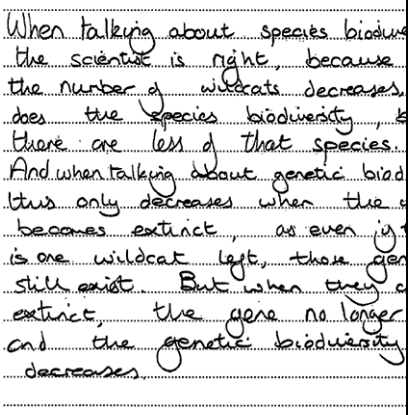
					evidence supports the claim but fails to address why the evidence might not support the claim. Exemplar 5  This response addresses both sides of the argument and achieves full marks. Exemplar 6  This response correctly mentions an increase in chinstrap and gentoo and a decrease in Adélie penguins but it does not link these statements to supporting the claim.
		i i	**1** reduction in extent of ice ✓ **2** change in ocean current ✓ **3** change in (penguin) food (species or population) ✓ **4** new , disease / parasite ✓ **5** change in predator (species or population) ✓ **6** new animal (species) present on land ✓ **7** change in population of (aquatic) plants ✓	2 max (AO3.2)	**1 ALLOW** increased rate of ice melt **1 IGNORE** sea level changes **3 IGNORE** fish or other named aquatic animal **5 ALLOW** plausible examples, e.g. seals, orcas, sharks. **Examiner's Comments**

					This AO3 question was generally low scoring. Most candidates stated the type of evidence that might be available but, as the question asked for evidence that would *support* such a claim, plausible answers had to be in the context of a *change* from previous levels. Hence, 'extent of sea ice' did not get a mark but 'reduced sea ice' did. Many candidates repeated information given in the stem about water temperature or water animals, not recognising the significance of 'further' in the question.
			Total	**5**	
4 1		i	for, fur / pelts / sport / trophies **or** to stop them, killing / eating, (named) birds / poultry / eggs / lambs / young goats ✓	1(AO2. 1)	**Mark the first answer.** If an additional incorrect answer is given then = 0 marks **IGNORE** for food / meat / commerce / commercial / cosmetic / aesthetic / dangerous **ALLOW** 'to protect' for 'stop them, killing / eating' named e.g: pheasant / grouse / partridge / chicken / duck **DO NOT ALLOW** large livestock e.g. cattle / horses / deer / pigs **Examiner's Comments** Candidates mostly suggested that wildcats were killed for their fur, which was given as it may have been the case in the distant past. The nineteenth century persecution was mainly due to gamekeepers protecting the eggs and chicks of ground-nesting birds.  **AfL** This question provides a useful springboard for a case study on evolution and conservation. Up to date information may be found at the

					website of Scottish Natural Heritage: https:/www.nature.scot/plants-animals-and-fungi/mammals/land-mammals/wildcats Further detailed information is available at: https:/www.nature.scot/snh-commissioned-report-360-scottish-wildcat-survey-2006-2008 which gives this information about historic wildcat decline: "By the end of the 19th century the wildcat was becoming scarce in Scotland (Langley & Yalden, 1977). Accounts by St John (1893) and Mackenzie (1921) highlighted the rise of game-keeping in Scotland and attitudes toward vermin indicated a wish to exterminate both wildcats and foxes. Nethersole-Thomson (1951) gives figures for the killing which took place in Glen Garry, where 198 wildcats were killed in three years, and in Glen Quoich where 207 wildcats were killed over 19 years. These may have been an exaggeration to impress estate owners but there was a substantial decline in numbers. Although general information prior to 1900 is sparse, Langley & Yalden (1977) inferred killing was the primary cause of their dramatic decline from 1800 onwards and the decline in carnivores during this period matches well with the increase in game-keeping."
		ii	***Please refer to the marking instructions on this mark scheme for guidance on how to mark this question.*** ***In summary:*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors,* ***Level 1, Level 2*** *or* ***Level 3****, best*	6	**Indicative scientific points may include** *genetic biodiversity:* • genetic, diversity / variation, low / will decrease • small gene pool / few alleles (at each locus)

			describes the overall quality of the answer. *Then, award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* ○ *award the higher mark where the Communication Statement has been met.* ○ *award the lower mark where aspects of the Communication Statement have been missed.* • ***The science content determines the level.*** • ***The Communication Statement determines the mark within a level.*** **Level 3 (5–6 marks)** A detailed description **and** explanation of the potential effects of small population size on genetic **and** species biodiversity. *There is a well-developed line of reasoning which is clear and logically structured. All the information presented is relevant and substantiated.* **Level 2 (3–4 marks)** A basic description **and** explanation of potential effects of small population size on genetic **and** species biodiversity. **OR** A detailed description **and** explanation of the potential effects of small population size on genetic **or** species biodiversity. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** A description of some potential effects for genetic **and** species biodiversity of small population size. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** No response or no response worthy of credit.		• proportion of polymorphic loci is small • homozygosity increases / heterozygosity decreases • inbreeding (depression will occur) • (as closely-) related cats, mate / breed • loss of alleles / genetic erosion • by chance / genetic drift • correct ref. to disease susceptibility • low potential for adaptation (to future change) • new alleles may arise (slowly) • by mutation • (slow as) one / few, generation(s) per year *species biodiversity* • wildcats may go extinct (in Scotland) • one less species • correct ref. to species richness • correct ref. to species evenness • former prey species may, return / increase / extend range (increasing biodiversity) • affect food chain / example of food chain effect • conservation, efforts / effects • only one cat species (in Scotland) **Examiner's Comments** Most answers explained that small population size would reduce genetic biodiversity and many stated that a small gene pool decreased the likelihood of successful adaptation to change in environment. Few

					answers showed an evaluative tendency by considering that new alleles might arise due to mutation. Candidates often referred to species biodiversity and also species richness and species evenness but not all could use these terms in a way that showed they understood their meaning. Higher ability candidates related the possible extinction of the wildcat species to a decrease in species richness or diversity, and considered the knock-on ecological effects of a decline in wildcats, suggesting an increase in prey population size or prey diversity and sometimes a corresponding decline in producer numbers or diversity. A key feature of a high-scoring answer was following the question instruction fully to make valid points about both genetic biodiversity and species biodiversity. **Exemplar 1**  Exemplar 1 uses subject-specific vocabulary correctly and shows an evaluative approach by considering the ecological role of the wildcat population within its community and habitat (L3 with communication statement met, 6/6).

					Exemplar 2  Exemplar 2 misuses the term species biodiversity apparently to mean population size, or possibly species evenness, and wrongly implies that the members of the wildcat population are all 100% homozygous. Their only correct point is raising the possibility that the wildcat may become extinct (L1 with communication statement not met, 1/6).
			Total	**7**	
4 2			**1** ecotourism ✓ **2** *idea that* money from tourists is used to support conservation ✓ **3** example of conservation project (facilitated by tourism revenue) ✓	2 max (AO 2.1)	**3 CREDIT** only if **2** has been awarded e.g. planting trees wildlife rangers maintain footpath rewilding removal of non-native species creating nature reserves reintroduction programmes **Examiner's Comments** Many candidates achieved at least 1 mark here. Many candidates

					seemed to have forgotten the term 'ecotourism', but some appreciated that the money spent by tourists could be used on conservation. Others then went on to give a specific example of a project that could increase biodiversity. A minority of candidates argued that the increased urban development associated with tourism would lead to an increase in biodiversity because urban areas are more diverse than monoculture. Such responses were not given any credit. **Misconception** The most common misconception here was that candidates thought that the seeds/spores/bacteria, and even pets, brought by tourists would boost the biodiversity, or that their behaviour (e.g. trampling or dropping food) would change the ecosystem to benefit more organisms.
			Total	**0**	
4 3		i	**FIRST CHECK ON ANSWER LINE** **If answer = 767 or 768 award 2 marks** 545 × 100/71 ✓	2 max(A O 2.2)	*If answer incorrect* **ALLOW** max 1 mark for 76.6 **ALLOW** max 1 mark for 1535 (quoting individuals rather than pairs) **Examiner's Comments** Most candidates did this calculation successfully. Others multiplied 545 by 0.71 and so gave an answer lower than 545, which does not make sense in the context of the question. ***Exam tip*** Estimate the size of an expected answer and then use this estimate to accept the calculated answer, or to reject it and try again.

		i i	deliberate killing to maintain grouse numbers / pollution / pesticides / disease / loss of another food source / competition from new predator ✓	1 (AO2.5)	*Mark as prose* **IGNORE** habitat loss **ALLOW** hunting
			Total	**3**	
44		i	seed dispersal	1	
		i i	(named) economic reason (named) aesthetic reason	2	
			Total	**3**	
45			*argument for* important, (N or C) recyclers / saprotrophs (1) *argument against* not a predator (1) large in abundance / biomass (so effect on environment not disproportionate) (1)	2	
			Total	**2**	
46		i	cell wall ✓ (named) metabolic reaction ✓ reproduction of bacterium ✓	1 max	e.g. protein synthesis
		i i	many drugs, found in / originated from, plants / microbes ✓ (so, maintaining biodiversity) increase the chance of, finding / developing, new drugs ✓ maintains a genetic resource (for future) ✓ *idea that:* once a species is extinct it's gone forever ✓	2 max	**ALLOW** forest
			Total	**3**	
47		i	**D** ✓	1(AO2.1)	**Mark the first answer.** If any additional answer is given then = 0 marks **Examiner's Comments** Candidates who understood ex-situ scored with D. Confusion with in-situ led to the wrong answer A.

		i i	**A** ✓	1(AO2. 1)	**Mark the first answer.** If any additional **incorrect** answer is given then = 0 marks **IGNORE B** **Examiner's Comments** Statement 'A' scored one mark. An additional answer of B was ignored since neutered cats have smaller territory sizes and so are less likely to encounter one another.
		i i i	**C** ✓	1(AO2. 1)	**Mark the first answer.** If any additional answer is given then = 0 marks **Examiner's Comments** Most candidates scored this mark with answer C.
		i v	**B / D** ✓	1(AO2. 1)	**Mark the first answer.** If any additional **incorrect** answer is given then = 0 marks **Examiner's Comments** Either B or D scored a mark, with most candidates opting for D due to the reference to pure-bred cats in Table 3.
			Total	**4**	
4 8			<table><tr><th></th><th>Is consistent with…</th><th></th></tr><tr><td>organisms are **not** removed from their natural habitat</td><td>B **and** C</td><td>✓</td></tr><tr><td>human intervention is happening</td><td>A **and** B</td><td>✓</td></tr></table>	2 (AO2.5)	**ALLOW** *in situ* and preservation **ALLOW** ex situ and in situ **Examiner's Comments** Most candidates achieved 1 mark and almost half got both. A number only put 1 letter in each box, despite the emboldened instruction. All three letters appeared often in the lower box, suggesting a misunderstanding

					about preservation on the part of some candidates.
			Total	**2**	
49		i	*Measures* fishing quotas (1) mesh size (1) species restriction (1) trawler size / days at sea (1) penalties / sanctions (1) monitoring / surveillance (1) publicity / public education (1) *Difficulties* area too large (1) expense of monitoring (1) monitoring hampered by, weather / seasons (1) false reporting of, catches / trawler size / mesh size / days (1) death of fish caught but not kept (because of restrictions) (1)	4	**The difficulties should relate to the measures proposed.**
		ii	*argument for* comparison of the energy in large fish and krill shows humans would get 100x more kJ / energy from krill than large fish (1) *argument against* would require large change to fishing industry / consumer habits **or** could impact ecosystem at first trophic level (1)	2	**ALLOW** the use of figures to illustrate the data comparison.
			Total	**6**	
50		i	(species are conserved) in their (natural) habitat ✓	1(AO2.1)	
		ii	controlled grazing ✓ monitoring of population(s) ✓ restricting human access ✓ remove / AW , invasive species ✓	1 max(AO2.1)	**ALLOW** cutting heather **ALLOW** prevention of grazing **IGNORE** fence off the area **ALLOW** maintaining footpaths **IGNORE** ‘don’t allow building’ **ALLOW** remove weeds
			Total	**2**	
51		i	*advantage:* exhibit natural behaviour / less likely to catch	2	Must give one advantage and one disadvantage.

			disease from humans (1) *disadvantage:* poaching more likely / could be wiped out by disease / more difficult to count (1)		
		i i	3.1 (%) (1)(1)	2	**ALLOW** one mark if calculation correct but final figure incorrect e.g. (480 − 254) / 254 × 100 / 29 = **ALLOW** 3% or 3.07%
		i i i	*three from* no evidence of causal effect (1) the data may be inaccurate as a result of, indirect methods used / unhabituated animals hard to find (1) annual growth rate higher after 1993 (1) 3.2% (per year) before 1993 against 3.8% after 1993 (1) figures may not be accurate due to collection technique (1)	3	
			Total	**7**	
5 2	a		*General statement identifying place and y axis variable **plus** two of options below:* in Eastern Africa, poaching / number of illegally killed elephants / percentage of elephants killed illegally, is *comment or comparison about absolute number* **1** (kept) below 60 / low**est** / low**er** (than C/W. Africa) ✓ *identify most recent sustained trend as far as 2015* **2** decreasing / less, since 2011 / from 60 to 40 ✓ *figures quote to show trend* **3** quote any two figures **and** years **and** ref. decrease ✓	2 max	**Mark evidence 1 and 2 together as prose** **ALLOW** AW for 'decrease' e.g.reduce / decline / drop / fall **ALLOW** AW for 'increase' e.g. goes up / rise / climb **ALLOW** ORA, e.g: in, Central / Western, Africa, poaching / number of illegally killed elephants / percentage of elephants killed illegally, is **1** (mostly) over 60 (or quote of figure over 60) / higher (than E. Africa) **2** increasing / more, since 2013 / from, 60 to 82 (W) / 70 to 75 (C) **3** quote any two figures **and** years **and** ref. increase

					IGNORE calculated 'by x %' figures **Examiner's Comments** Candidates generally picked out at least one piece of evidence but needed to include detailed description, i.e. the number of illegally killed elephants in a named place. Single figure comparisons were acceptable, as were descriptions of increase or decreasing trends and figures quotes to support these.
	b	i	to, protect / conserve, species endangered by trading activities **OR** to, prevent / restrict, trade in endangered species ✓ to, regulate / restrict / reduce , international / cross-border, wildlife trade ✓	1 max	**ALLOW** for 'trading activities' and 'trade' the **buying** or **selling** of, live animals / body parts such as tusks or ivory / plant bulbs / etc. **ALLOW** for 'endangered' - threatened / rare / vulnerable **ALLOW** an example of an endangered species, e.g. *'stop people from selling elephant tusks'* gets mp 1 **ALLOW** for 'wildlife trade' the buying or selling of, live animals / body parts such as tusks or ivory / plant bulbs. **ALLOW** for 'international' and 'cross-border' a description such as import from Africa to Europe, etc. **Examiner's Comments** Many candidates recognised that CITES is linked to protecting endangered species but wrote vaguely about conservation without specifying the restriction on trade.
		i i	**1** ref. 95% (decrease) **OR** 5% (remain) **OR** 25 000 (in 2113) ✓ **2** 1250 (in 2213) **OR** 4 (orders of magnitude) ✓	2	**Look for two correct stages of working corresponding to mps 1 and 2, irrespective of final answer.** *Exemplar working:* There is a 95% decrease in 100 years from 1913 to 2013, so:

					2113: 500 000 × 0.05 = 25 000 left 2213: 25 000 × 0.05 = 1250 left 1.25×10^3 compared to 1×10^7 is 4 orders of magnitude smaller. **Examiner's Comments** Candidates found this question very challenging and only very high ability candidates achieved a final answer of 4 orders of magnitude. See the AfL box for a step-by-step approach to solving this problem, and the OCR support box for links to useful resources.  **AfL** Since the initial number of elephants was very large and the challenge was to find the difference in order of magnitude between a starting and final figure, it may be helpful to re-state the figures in standard form as follows: 1. In 1913 there were 1 ' 10^7 elephants. 2. In 2013 there were 5 ' 10^5 elephants. 3. The percentage remaining after 100 years is calculated as the final number divided by the starting number multiplied by 100 (= 5%) OR The percentage decrease after 100 years is calculated as the difference divided by the starting number multiplied by 100 (= 95%). 4. Assuming the same rate of decline every 100 years, in 2113

					there will be 5% left of 5 ' 10^5 so 5/100 ' 500 000 = 25 000 (2.5 ' 10^4) 5. Again assuming the same rate of decline, in 2213 there will be 5% left of 2.5 ' 10^4 so 5/100 ' 25 000 = 1250 (1.25 ' 10^3). 6. To find the difference in order of magnitude between the elephant population in 1913 and 2213, compare 1 ' 10^7 with 1.25 ' 10^3. The difference in the exponential is 7 − 3 = 4 orders of magnitude. **OCR support** http:/www.ocr.org.uk/qualifications/by-subject/biology-related/maths-for-biology/m0-arithmetic-and-numerical-computation/ (using standard form) http:/www.ocr.org.uk/qualifications/by-subject/biology-related/maths-for-biology/m1-handling-data/ (orders of magnitude)
			Total	**5**	
5 3			<table><tr><th>Name of agreement</th><th>International agreement</th><th>Farmers are offered payments for conservation</th></tr><tr><td>Environmental (Countryside) Stewardship Scheme</td><td></td><td>✓</td></tr><tr><td>Convention on International Trade in Endangered Species</td><td>✓</td><td></td></tr></table>	2 (AO1.1)	**Examiner's Comments** Most candidates recognised the need to use stratified sampling in **(a)** and correctly described how the number of samples in each sector needed to be proportional to the area being measured. Some candidates omitted to include a calculation as was required by the question, or to name the sampling technique and so did not gain full marks. The calculations for **(b)(i)** were generally well understood, the most

			<table><tr><td>Rio Convention on Biological Diversity</td><td>✓</td><td></td></tr></table> All correct = ✓✓ 1 or 2 rows correct = ✓		common errors being failing to give the population sizes to the nearest whole number. Many candidates correctly concluded that the Chapman estimate was lower than the Lincoln estimate for one mark for **(b)(ii)**. However, few gained the second mark which required candidates to think in terms of the proportional difference between the estimates, rather than in absolute numerical terms. An impressive number of candidates understood the difference between preservation and conservation for **(c)**, and most scored one mark, but some struggled to word their answers clearly and relate them to the information provided. **OCR support** Support with Module 1.1 Practical skills can be found in the Practical activities support guide: https:/www.ocr.org.uk/Images/597719-practical-activities-support-guide.pdf
			Total	**2**	