



ANSWER BOOK

# Measuring biodiversity: richness, evenness and the index that catches both

Classification, biodiversity and conservation · Unit B18

AQA 3.4.6, 3.4.7 · OCR A 4.2.1 · Edexcel A Topic 4 (biodiversity and natural resources)  
CAIE 18.2

6 questions · 23 marks

NAVY EDITION

**SECTION B** · Standard, 3 to 5 marks

- B1** **B1** for: hedgerows restore habitat diversity, supplying nesting sites, shelter and food plants that a bare field boundary does not, and they link fragments of habitat so that species can move between them. **B1** for: an uncropped margin is neither sprayed nor harvested, so arable weeds survive and the insects feeding on them return, and with them the birds and predators above, so species diversity rises at more than one level in the food web. **B1** against: the strips and hedges take land out of production, so the yield of the farm falls and the same food has to be grown somewhere else, possibly by farming another area more intensively. **B1** against: the scheme does nothing about the genetic diversity of the crop itself, which is bred from a narrow set of parents and planted over enormous areas, and margins cannot recreate habitats such as unimproved grassland that took centuries to develop. **B1** judgement: the scheme is worth doing where hedgerow removal is what reduced diversity, because it addresses that mechanism directly, but it should be judged by measuring richness and evenness on the farm rather than assumed to work, and the payment is needed precisely because the farmer bears the cost in yield and land. [5]
- B2** **M1**  $N = 40 + 25 + 20 + 15 = 100$ , and each  $n \div N$  is that species' proportion of the total: 0.40, 0.25, 0.20 and 0.15. **M1** the squared proportions are 0.1600, 0.0625, 0.0400 and 0.0225, which sum to 0.285. **A1**  $D = 1 - 0.285 = 0.715$ , or 0.72 to two decimal places. **B1** a higher value of this form means a more diverse community, because the sum that is subtracted is the probability that two individuals taken at random are the same species and so falls as diversity rises. [4]
- B3** **M1**  $N = 60 + 20 + 10 + 6 + 4 = 100$ , so  $N(N - 1) = 100 \times 99 = 9900$ . **M1** the terms  $n(n - 1)$  are  $60 \times 59 = 3540$ ,  $20 \times 19 = 380$ ,  $10 \times 9 = 90$ ,  $6 \times 5 = 30$  and  $4 \times 3 = 12$ . **A1**  $\sum n(n - 1) = 4052$ . **A1**  $d = 9900 \div 4052 = 2.44$ . [4]
- B4** **B1** species richness is only a count, and it treats a species represented by one individual exactly like a species represented by a thousand. **B1** an index also depends on evenness, which is how equally the individuals are shared out between the species present. **B1** where one species holds most of the individuals, two organisms taken at random are very likely to belong to the same species, so the dominance term is large and the index of diversity is low. **B1** where the individuals are spread evenly that probability is much lower and the index is high, so two communities of equal richness are separated by evenness alone. [4]

- B5** **B1** measure the proportion of gene loci that are polymorphic: the number of loci at which more than one allele is present, divided by the total number of loci examined. **B1** compare the base sequence of DNA between individuals, which is the most complete method, or the base sequence of mRNA, which shows only the genes a tissue is actually transcribing. **B1** compare the amino acid sequence of a protein between individuals, which detects differences that changed the product but misses those the degenerate code absorbed. [3]
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- B6** **B1** if she chose where to put the quadrats, the sample is biased towards whatever caught her eye, so she should number a grid and place the quadrats at coordinates produced by a random number generator. **B1** six quadrats may not be enough: plotting the running total of species against the number of quadrats placed shows whether the curve has flattened, and she should carry on sampling until it has. **B1** if she recorded percentage cover rather than counts of individuals, those figures cannot be put into Simpson's index at all, because the index requires numbers of individuals. [3]
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