AQA

ASSESSMENT and
QUALIFICATIONS
ALLIANCE

General Certificate of Education

Environmental Science 6441

ESC7 Alternative to Practical Investigation

Mark Scheme

2007 examination – June series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Environmental Science

June 2007   **ESC7**

Instructions: ; = 1 mark / = alternative response A = accept R = reject

Question 1

(a)   (i)   Method for selection of sites for measurements to be taken eg
                   random/systematic/
                   stratified/grid and co-ordinates/sites in variety of woodlands/various tree heights;
                   [**A** transect]
                   choice of appropriate method(light meter/datalogger/electronic probe/quadrat and
                   percentage of visible sky/camera);
                   details of use: **2 of:**
                       calibration of light meter;
                       reset each time used;
                       record light reflected off white sheet of paper;
                       same height above ground for readings;
                       same time of day/time of year for readings;
                       ref' to adjusting sensitivity of light meter;
                       constant aperture setting for camera ;
                       (appropriate number of) repeats; [**A** several]
                   [**R** measuring ground flora]
                   [**R** measuring different tree heights]
                   (MAX 4 marks for method)

                   justification
                   qualified comments relating to accuracy/precision of measurement/lack of
                   subjectivity;
                   availability/simplicity of apparatus;
                   justification of sampling method eg lack of bias;
                   consideration of alternative methods;   MAX 5
                   [**R** reference to fair testing/health and safety issues]
                   (MAX 2 marks for justification)

         (ii)   Variability (of light levels) with reason (cloud cover/time of day/time of year);
                   qualified comment relating to accuracy of measurement/calibration/subjective
                   judgement of percentage visible sky method;
                   ref to differences in tree density/age/species affecting light levels;   MAX 2
                   [**R** ref to sample area not being representative]
                   [**R** references to shortcomings]

(b)   (i)   Suitable representative area eg 10 m × 10 m;
grid with co-ordinates;

random number table or equivalent; [**A** systematic sampling]
indication of size/volume of sample needed/constant volume;
indication of depth sample taken/constant depth;
method sample extracted eg auger/trowel/corer/spade etc;
samples sealed;   MAX 5
[**R** repeats]

(ii)   Soil sample weighed before and after drying;
dry in oven at temp approx 80–130 °C (for 24 hours);
repeat to constant mass/cool in dessicator;
$\frac{\text{original mass-final mass}}{\text{original mass}} \times 100$;
[**A** difference in mass divided by original mass × 100]   MAX 3
[**R** changed mass]

(c)   (i)   Mean is average value and median is middle value; (**both** needed)
median value useful if data distorted by extreme values/mean affected by
anomalous results;
if mean and median similar – indicates normal distribution;   MAX 2

(ii)   Spread of measurements around the mean/measurement of central tendency;   1

(d)   (i)   **3 of**
pH/organic matter (or humus)/nutrient content [**A** named nutrient]/soil depth/litter
depth/soil temperature/profile/mineral content/texture/structure/biota/
air content [**A** named gas]/infiltration rate;;;   MAX 3

(ii)   Appropriate method;
details;;

eg organic matter:
<u>dry</u> soil sample weighed before and after burning;
burn <u>strongly</u> (in crucible);
repeat to constant mass/cool in dessicator;
$\frac{\text{original mass – final mass}}{\text{original mass}} \times 100$;

pH
add distilled water to soil sample (5 – 10g);
add barium sulphate;
add universal indicator (in equal quantity);
compare with colour standard; (MAX 3)
OR
pH probe;
constant depth;
constant time interval;
OR

pH meter;
constant time/depth;
calibrate with buffer of known pH;   MAX 3

Total marks = 24

Question 2

(a)   Representative sample(s) of each tree species used;
constant time for collecting;
variety of sampling methods needed/analysis of all parts of the tree (leaves/buds/
stems/bark);
beating tray/sweep net;
sticky trap/interception trap;
direct observation/presence of galls/holes in bark;
fumigation;
count/identify different species;
credit extra relevant detail on any of the above methods –1 mark per method
[**R** estimates of population size/Lincoln Index]
[**R** pitfall trap/light trap/Tüllgren funnel]   MAX 5

(b)   (i)   The earlier the arrival date, the larger the number of species/null hypothesis
<u>related to correlation</u> [*Must be implied or stated in candidate's own words*];   1
[**R** 'link'/re-statement of the question stem]
[**R** hypotheses based solely on number of species related to native/non-native
trees with no reference to time of colonisation]

       (ii)   Spearman rank;   (1)

              relationship between 2 variables (from flow chart);
              investigating correlation;
              paired data;
              appropriate sample size;   (MAX 2)   MAX 3

       (iii) Attempt to rank data;
              correct ranking of data;
              correct values for d;
              correct value for Σd^2;
              correct application of formula;
              correct value for r_s;   6

       (iv)   Correct critical value from table;
              correct conclusion;   2

(c)   Longer established trees have more insect species;
more insect species on native trees than non-native trees;
more time for insects to adapt to native plants/exploit niches;
insects support other animal species eg birds;

Anomalies:
anomaly on native tree identified with reason (eg large number on oak/few on holly);
anomaly on non-native tree identified with reason (relatively large number on rhododendron/few on walnut/horse chestnut);
holly has tough/unpalatable leaves (so fewer insects);
suitable suggestion for large number of insects on oak (large tree size/tender shoots);
suitable suggestion for large numbers on rhododendron/few on walnut/horse chestnut;
                                                                                         MAX 4

(d)   Bird surveys;
method of measuring bird populations eg ringing/direct observation/counting nests;
mammal surveys/named mammal;
method of measuring mammal populations eg traps/tracks/burrows/sightings/droppings/ remote cameras;
survey of invertebrates at ground level;
pitfall traps;
soil and litter organism surveys;
Tüllgren funnel/Baerman funnel;
Lincoln Index/mark-release-recapture;
sweep nets/butterfly nets/butterfly walks;   MAX 6
credit extra detail on any of the above methods – 1 mark per method
[**R** diversity index/Simpson's Index/biotic index]
[**A** reference to palatability/pollinators]

                                                                        Total marks = 27

Question 3

(a)   Different number of recording days per month;
        birds may have been counted more than once/not at all;
        indication of relative abundance rather than absolute abundance;
        problems of accurate identification/birds may be heard not seen;
        large number of different recorders;
        migrants may not all have arrived/seasonal differences/no winter surveys;
        daytime recording would not sample nocturnal species;
        observation causes changed behaviour/disturbance;
        MAX 4
        [**R** ref to other areas of the UK/different sites]
        [**R** ref to weather/climate]
        [**R** ref to small sample size/limited days per month]

(b)   (i)   Line graph – must be straight line or bar;
                [**A** points joined, curve or trend line if points plotted correctly]
                axes labelled correctly and key given/lines labelled;
                appropriate scale used;
                points plotted accurately;   4
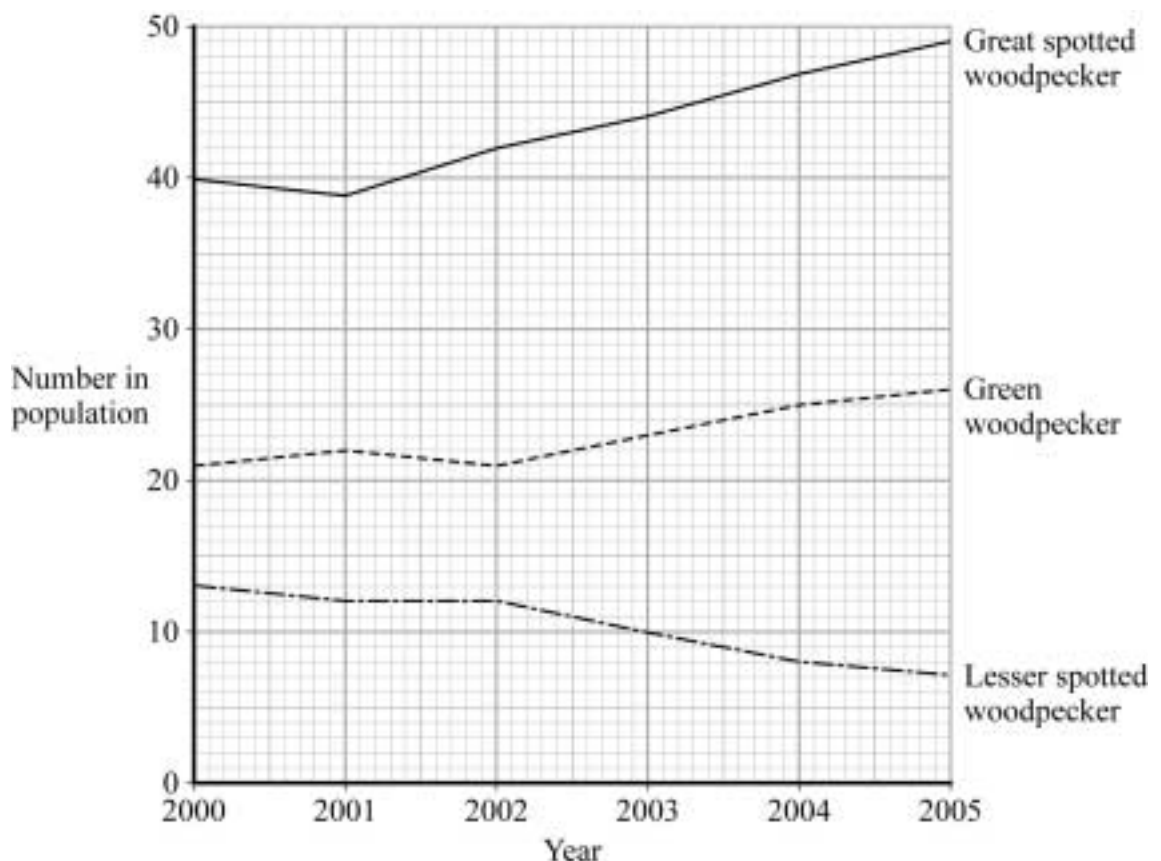
(ii)   Most species show increase in population;
       increase in blackcap/great spotted woodpecker/green woodpecker/nuthatch;
       decrease in lesser spotted/song thrush;
       stable population in mistle thrush/nightingale;
       fluctuation in nightingale/willow warbler/dunnock;
       comparative comments eg differences in starting population sizes/relative trends;
                                                                                    MAX 4

       (If trends for only woodpeckers given – MAX 2 marks)

(c)   Loss of food source;
       presence of disease/predators;
       presence of competitors (at same trophic level);
       habitat destruction/fragmentation/loss of trees for nesting;
       climate change/weather conditions (affecting reproduction or food source);
       disturbance by visitors;   MAX 2

                                                               Total marks = 14

Question 4

Priority to native trees in preference to non-native trees/plant native trees alongside conifers;
native trees support more insect species (or converse);
insects support bird/animal populations;
soils from oak/broadleaved woodlands hold more moisture for plant growth/more soil biota/
more fertile;
conifer soils acidic/ litter rots slowly;
conifer soils have low nutrient levels for plant growth;
conifers reduce light to forest floor so reduces ground flora;
plants support animal populations/food chains;
manage habitat for different layers/niches/habitats/increased biodiversity;
manage habitat for (declining) woodland bird populations;
examples of habitat management (nest boxes/supplementary feeding/control of predators/leave
dead trees for woodpeckers);
remove/control invasive species eg rhododendron;
in order to reduce competition for native species;
leave dead wood/debris on woodland floor (as habitat for
detritivores/fungi)/coppicing/pollarding;
controlled access/minimise trampling pressure/visitor disturbance;
type of tree planted depends on soil/climate/altitude;   MAX 8

Quality of Written Communication

Mark	Descriptor
2	All material is logically presented in clear, scientific English and continuous prose. Technical terminology has been used effectively and accurately throughout. At least half a page of material is presented.
1	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate. Some minor errors. At least half a page of material is presented.
0	The account is generally poorly constructed and often fails to use an appropriate scientific style to express ideas.

MAX 2

Total marks = 10

Working for Question (b)(iii) and (b)(iv)

Tree species		R_1	Number of Insect Species	R_2	d	d_2
Native species (in estimated order of arrival)						
Silver birch		**1**	229	**2**	1	**1**
Hazel		**2**	102	**3**	1	**1**
Alder		**3**	90	**4**	1	**1**
Oak		**4**	284	**1**	3	**9**
Elm		**5**	82	**5**	0	**0**
Holly		**6**	10	**9.5**	3.5	**12.25**
Beech		**7**	64	**6**	1	**1**
Introduced species	**Approximate date of introduction / AD**					
Sweet chestnut	150	**8.5**	10	**9.5**	1	**1**
Walnut	150	**8.5**	5	**12**	3.5	**12.25**
Sycamore	1300	**10**	15	**8**	2	**4**
Horse chestnut	1650	**11**	7	**11**	0	**0**
Rhododendron	1765	**12**	31	**7**	5	**25**

$$\sum d^2 = 67.5$$

$$r_s = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$$

$$= 1 - \frac{6(67.5)}{12(12^2 - 1)}$$

$$= 1 - \frac{405}{1716}$$

$$= 1 - 0.236 \,/\, 0.24$$

$$r_s = 0.764 \,/\, 0.76$$

Critical value for r_s for 12 pairs of measurements is **0.59**. Therefore the calculated value > critical value therefore null hypothesis rejected / positive hypothesis accepted.