Ecosystems

Q1. Hydrilla (*Hydrilla verticillata*) is an aquatic plant which has become a major pest of waterways in parts of the USA. Hydrilla is not a native species of the USA. It was introduced into natural habitats from aquariums. In many freshwater habitats it has rapidly become the dominant plant species.

(a) In many freshwater habitats Hydrilla has rapidly become the dominant plant species. Suggest two reasons why.

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(b) The spread of Hydrilla has had economic consequences for commercial activities and for the government’s environmental agency. Suggest two economic consequences of the spread of Hydrilla.

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(c) Scientists investigated the effect of the chemical fluridone as a method of controlling Hydrilla. The study was carried out using samples of Hydrilla grown under controlled laboratory conditions. Several samples of the plant were grown at different concentrations of fluridone. The results are shown in the following table.

<table>
<thead>
<tr>
<th>Days of treatment</th>
<th>0</th>
<th>20</th>
<th>40</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration of fluridone / μg dm⁻³</td>
<td>Mean biomass of Hydrilla / g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.0</td>
<td>5.0</td>
<td>16.4</td>
<td>20.4</td>
<td>33.4</td>
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<tr>
<td>0.5</td>
<td>5.0</td>
<td>14.1</td>
<td>18.2</td>
<td>31.3</td>
</tr>
<tr>
<td>1.0</td>
<td>5.0</td>
<td>9.7</td>
<td>8.9</td>
<td>7.4</td>
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<td>5.0</td>
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<td>4.6</td>
<td>2.8</td>
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<td>25.0</td>
<td>5.0</td>
<td>3.2</td>
<td>1.6</td>
<td>0.4</td>
</tr>
</tbody>
</table>
(i) The scientists obtained the biomass of each sample by heating it at 75 °C for 2 hours. They then weighed the sample, reheated it for 15 minutes and weighed it again. They continued this cycle of reheating and weighing until they found the sample had a constant mass. Explain how this method helped to provide a reliable measurement of the biomass.

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(ii) A scientist reviewed the results of this investigation. He suggested that fluridone should be used in the habitat at a concentration of 5.0 μg dm⁻³ rather than at the other concentrations tested. Use the information provided and your knowledge of chemical control to explain why he made this suggestion.

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(d) Scientists have also investigated the use of an integrated system to control Hydrilla. This involved using fluridone and a fungus as a biological control agent. They set up four different experiments.

  • Experiment 1 – Hydrilla left untreated
  • Experiment 2 – Hydrilla treated with the fungus
  • Experiment 3 – Hydrilla treated with fluridone
  • Experiment 4 – Hydrilla treated with both fluridone and the fungus.

The scientists determined the biomass of Hydrilla at the end of each experiment.

(i) Experiment 1 acted as a control. Explain why the scientists carried out experiment 1.

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(ii) The scientists isolated the fungus from the tissue of Hydrilla growing in its country of origin. Suggest two possible advantages of using this fungus as the biological control agent.

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(iii) The treatment in experiment 4 was the most effective. Use your knowledge of integrated pest control systems to suggest why the treatment in experiment 4 was the most effective.

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(c) Population size can be estimated using proportional sampling or mark-release-recapture.

(i) How do the assumptions made in proportional sampling differ from those made in mark-release-recapture?

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(ii) Give one assumption about the animals caught that is made in both methods.

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(Total 7 marks)

Q3. Algae are photosynthesising organisms. Some algae grow on rocky shores. A scientist investigated succession involving different species of algae. He placed concrete blocks on a rocky shore. At regular intervals over 2 years, he recorded the percentage cover of algal species on the blocks. His results are shown in the graph.

(a) Name the pioneer species.

.................................................................................................................................................. (1)

(b) (i) The scientist used percentage cover rather than frequency to record the abundance of algae present. Suggest why.

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(ii) Some scientists reviewing this investigation were concerned about the validity of the results because of the use of concrete blocks. Suggest one reason why these scientists were concerned about using concrete blocks for the growth of algae.

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(c) Use the results of this investigation to describe and explain the process of succession.

Q4. (a) What is meant by a community?

(b) A farmer stopped using a field for growing crops. Scientists studied succession in the field over the next 30 years. The graph shows the number of species of Hemiptera (an order of insects) present during that period.

Explain the increase in the number of species of Hemiptera.
(c) To calculate a diversity index at a given time, it is necessary to know the number of insects in each population. Name one method that could be used to estimate the total number of insects in a population.

................................................................................................................................................. (1)

(Total 6 marks)

Q5. The diagram shows the dominant plants in communities formed during a succession from bare soil to pine forest.

![Diagram showing plant succession]

(a) Name the pioneer species shown in the diagram.

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(b) The species that are present change during succession. Explain why.

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(iii) There was a significant difference between the mean heights of the plants grown from seeds taken from sites A and D. Describe the evidence from the information given which shows that this is likely to be due to genetic differences between the two populations.

........................................................................................................................................ (1)
(Total 7 marks)

Q7. (a) Individuals in a population show phenotypic variation.

Give the two types of factor that cause this variation.

........................................................................................................................................ (2)

(b) What is allopatric speciation?

........................................................................................................................................ (2)
(Total 4 marks)

M1. (a) 1. No / few consumers / pests / pathogens;
   
   Accept: No / few predators.
   Accept: description of competition for a named resource with reference to ‘other species’.
   Accept: More resistance to disease.

2. Outcompetes / better competitor for resources / light / CO₂ / abiotic factor / ideal niche;
   
   Neutral: competition for food.
(b) 1. (Cost of) control / removal;
2. (Cost of) restoring habitat / conservation;
3. (Loss of income) from fishing;
4. (Loss of income) from boating / tourism / recreation;
   Accept: any valid recreational activity e.g. canoeing.
   2 max

(c) (i) 1. Removes water;
2. Water content can vary in sample / plant;
   Note: Reweighing / constant mass indicates all water removed = 2 marks.
   2

(ii) 1. 0.5 is not effective / has little effect / 1.0 is less effective (than 5.0) / concentrations below 5.0 less effective;
   Accept: for first 3 mark points effect on growth / biomass as a measure of effectiveness.
   Accept: references to ‘this concentration’ = 5.0.
   Accept: 5.0 is the minimum effective concentration. 1. and 2. 5.0 is the minimum effective concentration that reduces growth = 2 marks.
2. At 5.0 biomass / growth is reduced;
3. Small difference between using 5.0 and 25.0;
4. Using 5.0 is cost effective / using 25.0 is expensive / high concentrations may affect the environment / other organisms / chemical may remain in habitat / bioaccumulation;
   Accept: any impact on the habitat e.g. contaminate water supply.
   4

(d) (i) To compare / see effect with / without fungus / fluridone / control agent / s;
   Neutral: for comparison on its own.
   Neutral: to see effect of variables / results / treatments / factors without further qualification.
   1

(ii) 1. Is specific / grows / survives in Hydrilla / habitat;
   Accept: ‘known to work’
2. Can reproduce / only one application required;
3. Does not become a pest;
   2

(iii) 1. Fluridone / chemical acts quickly / quickly reduces Hydrilla;
2. Fungus / biological control keeps Hydrilla in low numbers / fungus / biological control works over a long time / can reproduce / resistance does not develop against fungus / biological control;
   2

M2. (a) (i) (Organisms that) can breed together / interbreed and produce fertile offspring.
Need both aspects. Reject ‘inbreed’
Reject viable offspring

(ii) Same number (of organisms) in each region / (organisms) equally spread;
Allow other ways of expressing ‘region’ or ‘equally spread’, eg not clumped together, same number per unit area

(b) \[ P = \frac{AS}{R} \]

2 marks for correct answer
1 mark for having A on top of equation (recognises that total population related to total area)

Note:

[Note: P = A × S / R or P = A / R × S are also correct.]

Allow 1 mark for

\[ \frac{S}{P} = \frac{R}{A} \]

2

(c) (i) In mark–release-recapture (technique)
Accept converse by considering assumptions of proportional sampling
1. No assumption that organisms are uniformly distributed;
2. Size of total area / size of sampled region not required;
Marking point 1 or marking point 2 do not have to start with the same technique
In this case, allow difference by implication i.e. do not penalise if the two techniques are not compared
2

(ii) Animals are from / all part of the same population;

M3. (a) Ulva lactuca;
Reject: Ulva on its own
Accept: lactuca on its own
Accept: Incorrect spelling

(b) (i) Difficult / too many / too many to count / individual organisms not identifiable / too small to identify / grows in clumps;
Neutral: easier / quicker / representative / more accurate, unless qualified
1

(ii) Any described feature of concrete eg texture / flat / composition chemicals
null
M6. (a) (i) transect line may not go through representative areas / may avoid certain areas;  
   (ii) large sample; how random coordinates are generated / how random places chosen;  

(b) (i) spread of values around the mean height of the plant;  
   (ii) smaller plants at higher altitude; greater the altitude the lower the standard deviation; reference to figures to make a comparison;  
   (iii) the plants measured were grown under uniform conditions;  

M7. (a) Genetic (factors)/genes/alleles/mutations/meiosis;  
   Environmental (factors)/environment;  

(b) New species form from different populations/groups/gene pools;  
   In different areas/from isolated populations;  
   Accept alternatives/descriptions for ‘populations’