

B4.2 Ecological niches (SL)

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Answers

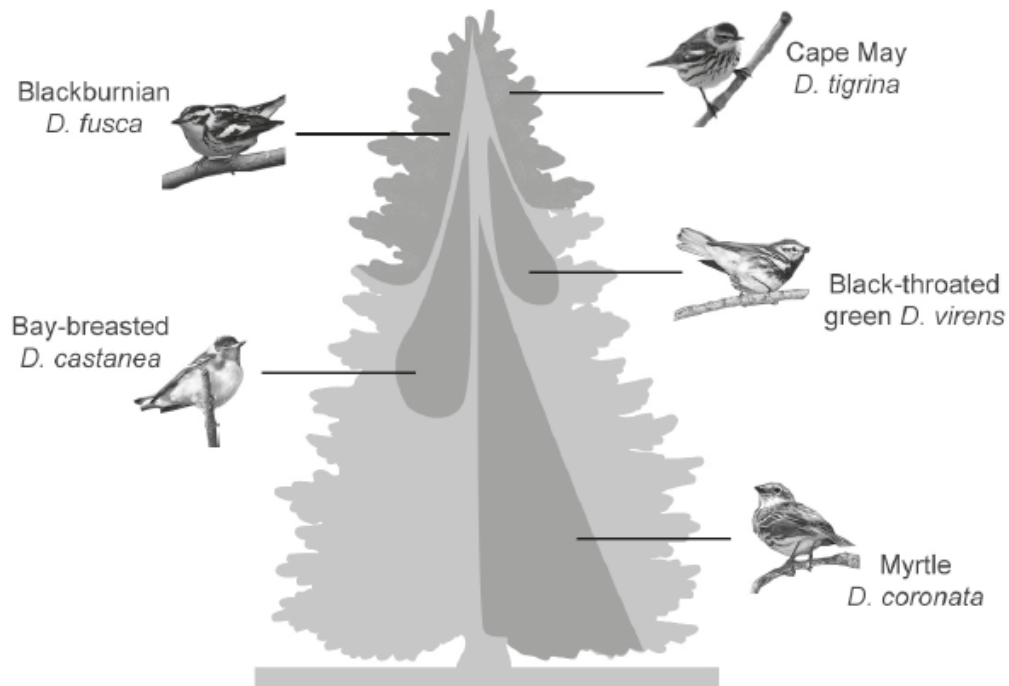
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Questions

B4.2.1—Ecological niche as the role of a species in an ecosystem

1a. [1 mark]

Ecologists studied the distribution of five species of insectivorous wood warblers of the genus *Dendorica* living on different parts of coniferous trees in mature forests.



Distinguish between the distribution of *D. tigrina* and that of *D. coronata*.

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1c. [2 marks]

Other than position in the tree, suggest **two** ways in which the niches of the warblers in the ecosystem may differ.

- 1.
- 2.

12. [4 marks]

B4.2.2—Differences between organisms that are obligate anaerobes, facultative anaerobes and obligate aerobes

B4.2.3—Photosynthesis as the mode of nutrition in plants, algae and several groups of photosynthetic prokaryotes

B4.2.4—Holozoic nutrition in animals

B4.2.5—Mixotrophic nutrition in some protists

B4.2.6—Saprotrophic nutrition in some fungi and bacteria

5. [1 mark]

Which organism can best be described as a saprotroph?

- A. A fungus that digests its food externally and absorbs the products of digestion
- B. A beetle that feeds by ingesting the dung of other animal species and digesting its food internally
- C. A single-celled eukaryote that is able to photosynthesize and consumes smaller organisms by endocytosis
- D. A giraffe that feeds by ingesting leaves from an acacia tree

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B4.2.7—Diversity of nutrition in archaea

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B4.2.9—Adaptations of herbivores for feeding on plants and of plants for resisting herbivory

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B4.2.11—Adaptations of plant form for harvesting light

B4.2.12—Fundamental and realized niches

18a. [1 mark]

Define fundamental niche.

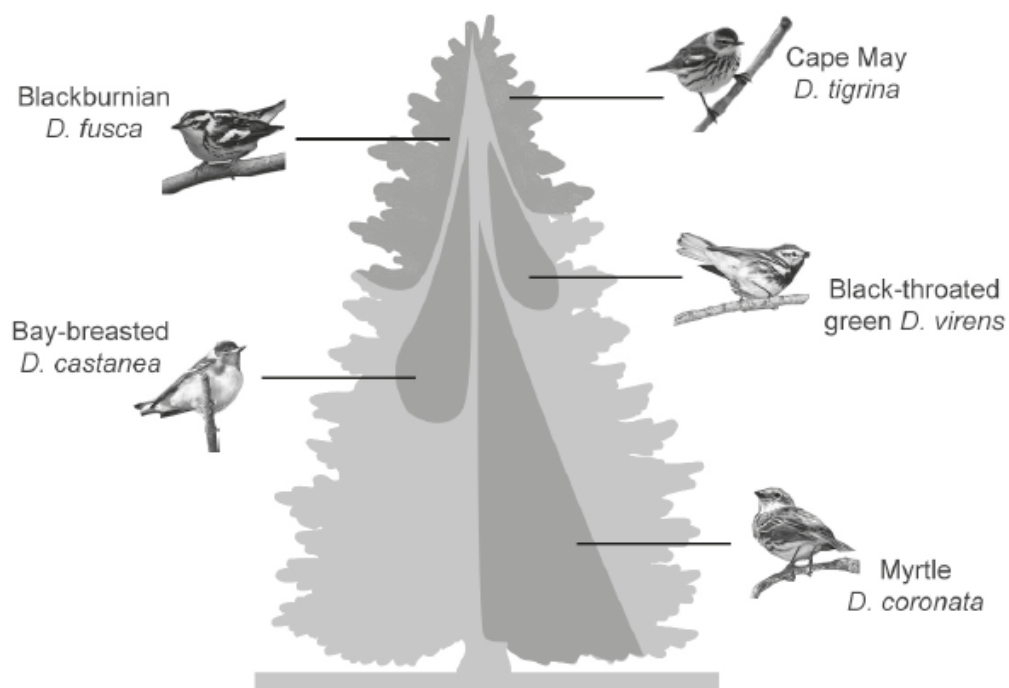
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1d. [2 marks]

Ecologists studied the distribution of five species of insectivorous wood warblers of the genus *Dendorica* living on different parts of coniferous trees in mature forests.



The diagram shows the realized niches of the five species of warbler. Suggest how the fundamental niche of *D. castanea* might differ from its realized niche.

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17. [4 marks]

Explain reasons for differences in the realized niche and fundamental niche of an organism.

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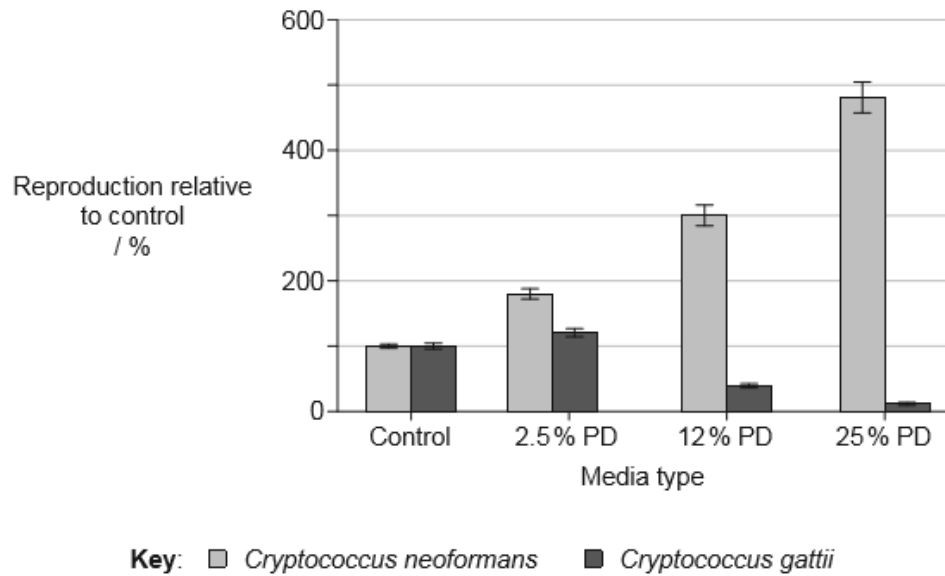
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25. [3 marks]

Cryptococcus neoformans and the closely related species *Cryptococcus gattii* are human fungal pathogens. The reproduction of these yeast species on increasing concentrations of pigeon droppings (PD) was examined to determine whether they occupy the same or different ecological niches. The results for reproduction are expressed as a percentage relative to the control.



[Source: adapted from K. Nielsen et al. (2007), "*Cryptococcus neoformans* Mates on Pigeon Guano: Implications for the Realized Ecological Niche and Globalization". *Eukaryotic Cell*, vol. 6, pp. 949–959, DOI: 10.1128/EC.00097-07. Amended with permission from American Society for Microbiology]

Suggest how this experiment shows that pigeon droppings represent a realized ecological niche for *C. neoformans* and a fundamental (but not a realized) niche for *C. gattii*.

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B4.2.13—Competitive exclusion and the uniqueness of ecological niches

18b. [1 mark]

Outline a reason for organisms seldom occupying their entire fundamental niche.

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1b. [2 marks]

Outline the principle of competitive exclusion.

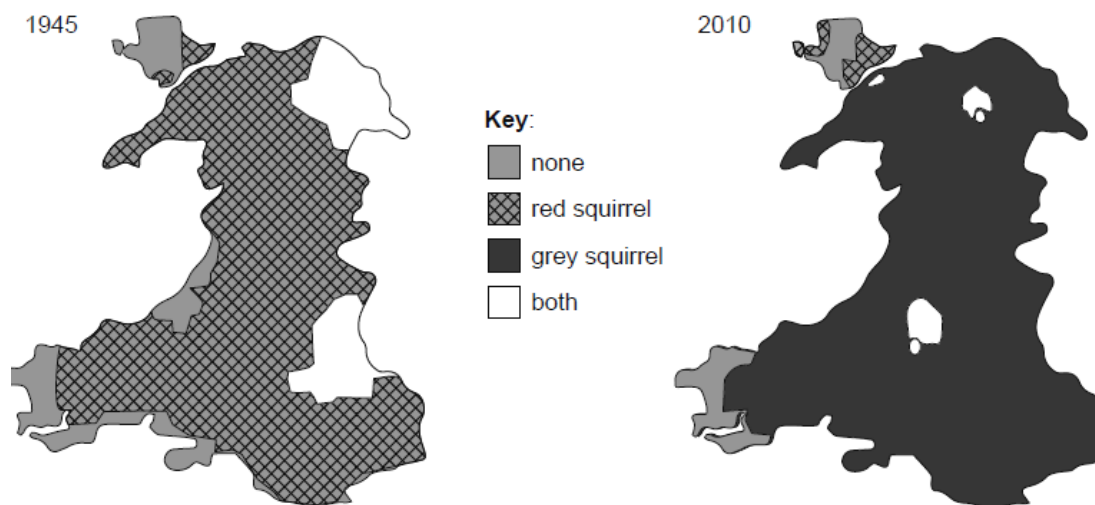
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9a. [2 marks]

In Wales, UK, the grey squirrel (*Sciurus carolinensis*) is an alien species and the red squirrel (*Sciurus vulgaris*) is endemic. The maps show the distribution of red and grey squirrels in 1945 and 2010.



[Source: © The Red Squirrel Survival Trust]

Outline the changes of distribution of the grey squirrel from 1945 to 2010.

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9b. [2 marks]

Suggest **two** possible reasons for the change in distribution.

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- 2.

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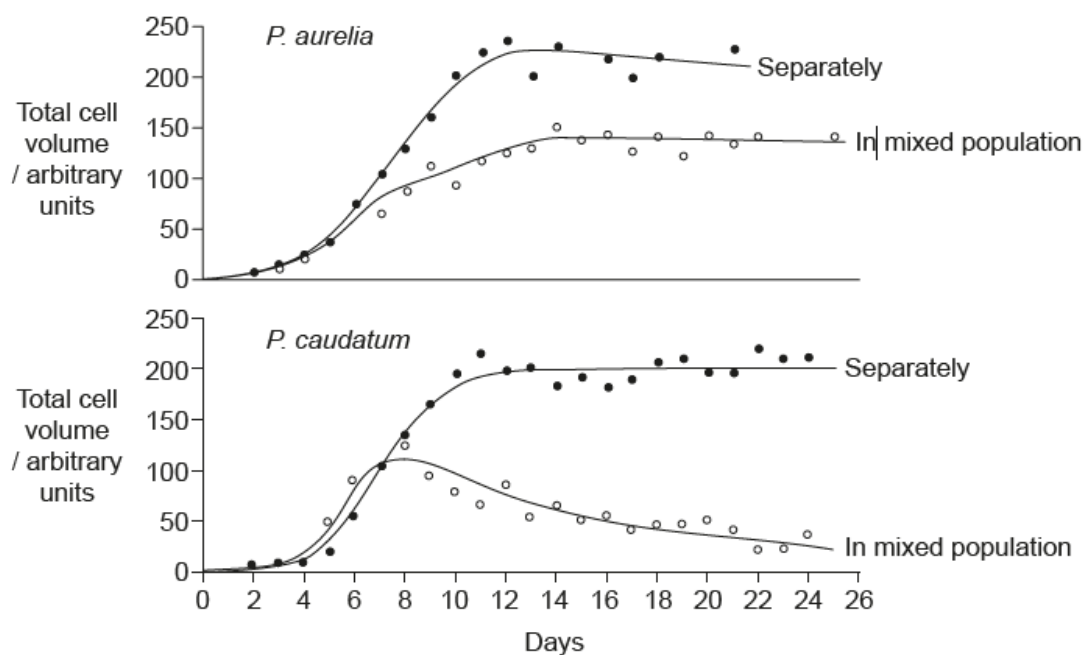
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9c. [3 marks]

The niches of the red and grey squirrels overlap. Explain the concept of competitive exclusion with respect to the changes in squirrel distribution shown in the maps.

20. [3 marks]

Paramecium aurelia and *Paramecium caudatum* are single cell organisms. They were grown separately and together. The population growth curves are shown.



[Source: G. F. Gause (1934) *The Struggle for Existence*, published by The Williams & Wilkins Company]

Explain the results shown in this experiment.

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8. [4 marks]

Explain what is meant by competitive exclusion, with respect to a **named** example of an invasive species.

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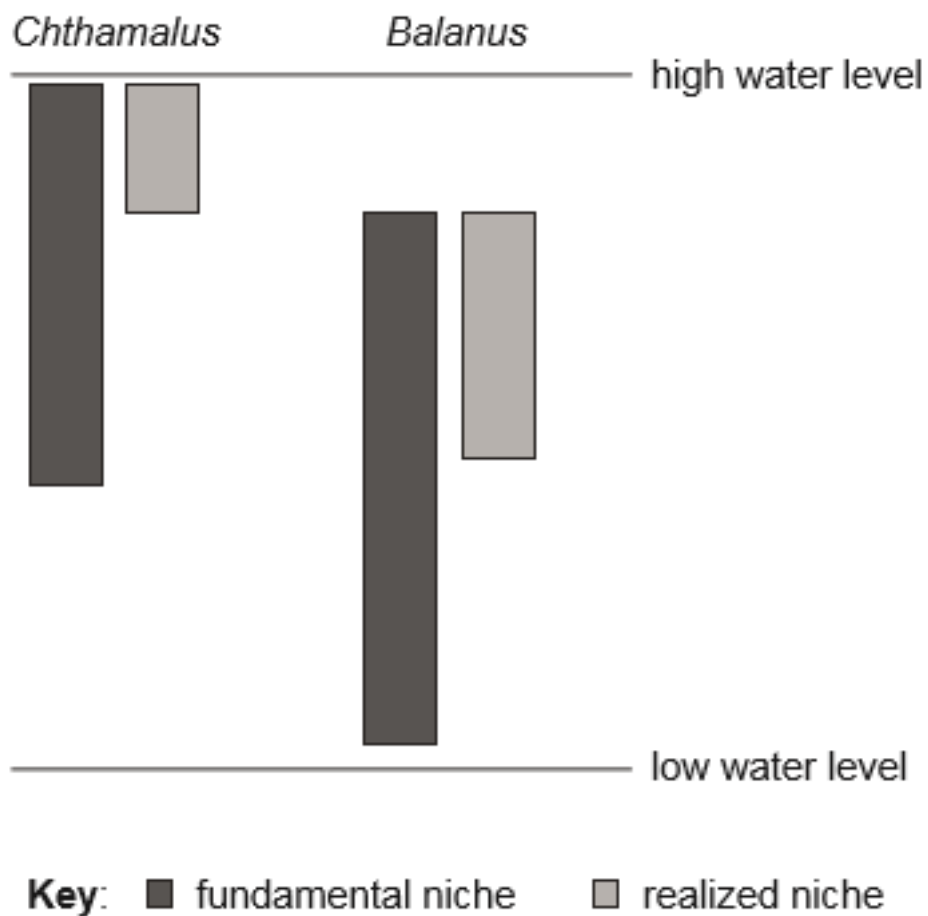
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23a. [1 mark]

Chthamalus and *Balanus* are two species of barnacles that live attached to rocks between the low and high tide level of the sea.
The distribution of each species is influenced by the presence of their own species and different species.



[Source: adapted from <http://bio.classes.ucsc.edu>]

Distinguish between a fundamental niche and realized niche.

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23b. [2 marks]

Suggest reasons that *Chthamalus* cannot live higher up the shore.

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23c. [3 marks]

Describe how the distribution of *Chthamalus* and *Balanus* is affected when both are present.

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Answers

B4.2.1—Ecological niche as the role of a species in an ecosystem

1a. [1 mark]

- a. *D. tigrina* lives higher in the tree than *D. coronata*;
- b. *D. coronata* occupies a greater area/height range than *D. tigrina*;
- c. *D. tigrina* found in the outer regions and *D. coronata* found on the inside;

Accept vice-versa.

Examiners report

Overall, well answered.

1c. [2 marks]

- a. different food/prey;
- b. different predators;
- c. active at different times of the day;
- d. present at different times of the year;
- e. different nest sites;
- f. different temperatures;

Do not accept "different habitats".

12. [4 marks]

- a. organisms have limits of tolerance and zones of stress
- b. listing any **two or more** abiotic factors
- c. example of named abiotic factor and how it affects distribution of plant/animal species
- d. example of another named abiotic factor and how it affects distribution of plant/animal species
- e. example of a third named abiotic factor and how it affects distribution of plant/animal species

Award up to 3 marks for valid examples:

light limiting photosynthesis (in a forest) dissolved oxygen affecting respiration in an aquatic animal salinity affecting osmosis in an estuarine species most organisms require a suitable temperature range for their metabolism.

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5. *[1 mark]*

A

B4.2.7—Diversity of nutrition in archaea

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B4.2.11—Adaptations of plant form for harvesting light

B4.2.12—Fundamental and realized niches

18a. [1 mark]

the potential/full range of conditions under which an organism can live

1d. [2 marks]

- a. the realized is the actual niche and the fundamental is in the absence of competition;
- b. with no competition the *D. castanea* would have a larger habitat/more food

OR

D. castanea could occupy the niches currently occupied by the other warbler species;

Accept named species.

Examiners report

Weaker candidates gave incomplete or confused suggestions in differentiating between the realised and fundamental niche.

17. [4 marks]

- a. an ecological niche is an organism's role/functional place in the environment
- b. the fundamental niche is the potential niche and the realized niche is the actual niche
- c. includes habitat/feeding/how it survives
- d. limiting factors play a part on the actual distribution of species
- e. competition prevents species occupying their fundamental niche
- f. species show competitive exclusion

OR

two species cannot occupy the same niche in an ecosystem

- g. «in competitive exclusion» one species will replace the other species

The answers given in the markscheme may be awarded if the candidate explains a suitable example

For marking point g, do not accept "one species becomes extinct" as a standalone answer unless it is clear they are referring only to the ecosystem under discussion

[Max 4 Marks]

25. [3 marks]

- a. the realized niche is the actual while the fundamental niche is «all of» the potential
 - b. «shared» fundamental niche shown by equal reproduction on control
 - c. *C. neoformans* reproduces on PD indicating a realized ecological niche
 - d. competitive exclusion decreases realized niche of *C. gattii*
 - e. *C. gattii* reproduces poorly on PD representing a fundamental niche
- OR**
- C. gattii* reproduces poorly on PD so not a realized niche

B4.2.13—Competitive exclusion and the uniqueness of ecological niches

18b. [1 mark]

competition for resources/named resource

OR

competitive exclusion «limits the niche»

1b. [2 marks]

- a. no two species can occupy the same niche;
 - b. competition between them would cause one species to drive the other out
- OR**
- one of the two species would need to adapt and evolve accordingly;

Examiners report

When describing competitive exclusion many candidates simply described competition. Some mentioned habitat rather than niche.

9a. [2 marks]

- a. overall the grey squirrel distribution has increased «and the red squirrel decreased»
✓
- b. in 2010 the grey squirrel was found in areas where it was previously not found ✓
- c. grey squirrel has dominated/red squirrel virtually eliminated ✓

OWTTE

Examiners report

While most candidates were able to achieve a mark by noting that the grey squirrel “dominated” in the second map, students again lost marks due to an inability to

communicate concepts clearly. A large number of students confused distribution with population size, an idea not addressed in the maps.

9b. [2 marks]

- a. no predators ✓
- b. ample food supply/habitats ✓
- c. few competitors ✓
- d. resistant to disease ✓
- e. high reproductive rate ✓
- f. no physical barrier to prevent spread of grey squirrels on mainland ✓

Examiners report

This was answered well by only a few students even though the mark scheme allowed for a wide range of answers.

9c. [3 marks]

- a. competitive exclusion states two species that occupy a similar niche in the same location cannot coexist ✓
- b. one of the two competitors will always have an advantage over the other ✓
- c. leads to extinction/displacement/evolution of the second competitor ✓
- d. grey squirrels have replaced/occupied niches formerly occupied by red squirrels
OR
habitats favour the grey squirrel in competition for the niche ✓
- e. the niche of one competitor/both competitors becomes narrower ✓

Examiners report

This question was yet another instance where weaker students were disadvantaged by their inability to access the appropriate subject-specific vocabulary. They tended not to use the term “niche” with this question, and too frequently “niche” and “habitat” were confused.

20. [3 marks]

- a. when they are alone they both show a greater population than when together
- b. two species cannot survive indefinitely in the same habitat if their niches are identical
OR
competitive exclusion

c. *Paramecia* compete for food/space

d. *P. caudatum* starts to disappear/decrease after day 6–8 days «whereas *P. aurelia* reaches a plateau» *Vice versa*

OR

the population of *P. caudatum* decreases much more than the population of *P. aurelia*

e. *P. aurelia* is better suited/fitted than *P. caudatum*

8. [4 marks]

a. when two species with similar niches occupy the same habitat ✓

b. the competition increases

OR

reduction in resources ✓

c. the population of one species will die/be excluded ✓

d. an invasive species «often» lacks predators ✓

e. the endemic species is usually the one that cannot compete ✓

f. eg: grey squirrel/Japanese knot weed/cane toad ✓

[3 max] if the invasive species is not named.

Do not allow humans.

Examiners report

This was generally well answered. There were a wide variety of verifiable invasive species and only a few confused examples. The most common example was the cane toad introduced into Australia. Candidates understood increased competition and lack of predation.

23a. [1 mark]

realized is actual niche, fundamental is potential niche

23b. [2 marks]

a. must spend some of their time under water / prevent dehydration

b. need water for food/nutrients

c. need water for reproduction

d. more accessible to their predators

e. there are no rocks for them to live on

OR

there is no suitable habitat for them

23c. [3 marks]

a. *Chthamalus* and *Balanus* / both have a reduced distribution

b. they are in competition for part of the habitat on the rock

c. *Balanus* occupies some of the habitat of the fundamental niche of *Chthamalus*

OR

where the fundamental niche overlaps *Balanus* prevails/survives

d. the distribution of *Balanus* is unchanged in areas colonized by *Chthamalus*

e. *Balanus* is in competition with other species closer to low water