Task 9 – Unit 4 Biology 12 Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Assessment type:** Extended response

**Conditions**

Period allowed for completion of the task:

* one week to research the task
* one hour in-class validation, consisting of questions based on this research

**Task weighting**

5% of the school mark for this pair of units

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**Amphibian Chytrid Fungus Disease (30 marks)**

Amphibian chytrid fungus disease, also known as chytridiomycosis, is an infectious disease that affects amphibians worldwide. The fungus, *Batrachochytrium dendrobatidis*, is widespread across Australia, including the south-west of Western Australia.

You are to research amphibian chytrid fungus disease, including:

* + geographical and temporal distribution
  + ecology (e.g. habitat, life cycle)
  + pathology (e.g. clinical signs and diagnostic tests)
  + impact on amphibians
  + management strategies.

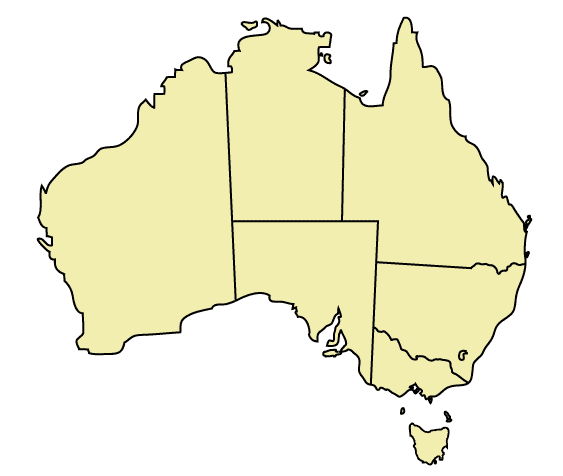
**You may bring your research notes to the test next week**

**Date of Validation Test \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Amphibian chytrid fungus disease Extended Response (30 marks)**

A decline in amphibian populations and the extinction of a number of species in Australia since the 1970s can be attributed to a number of causes, including an infectious disease caused by the amphibian chytrid fungus, *Batrachochytrium dendrobatidis.*

1. On the map below, shade the major regions in Australia infected by the amphibian chytrid fungus. (2 marks)



2. Many species of amphibians are threatened by the amphibian chytrid fungus, and the common factors appear to be related to their habitat and behaviour. Describe **three** reasons a species may become threatened due to this disease. (3 marks)

3. The life cycle of *Batrachochytrium dendrobatidis* has two distinct stages; a motile zoospore and a sessile sporangium that grows on the skin of amphibians. Resistant resting spores have not been found in this species.

Explain an advantage and a disadvantage of not having a resting stage in the life cycle for this fungus. (2 marks)

The following information refers to Question 4.

Scientists,K. M. Kriger & J.M. Hero, conducted a study into the seasonality of chytridiomycosis. They sampled a species of frogs, *Litoria wilcoxii,* along a 1 km stretch of the Nerang River in Numinbah Valley, south-east Queensland, Australia. Sampling took place at six-week intervals between April and January.

Disease prevalence was calculated by dividing the number of frogs testing positive for the disease by the total number of frogs sampled.

Air temperature at the site was recorded every 90 minutes and the mean of these recordings in the 30 days prior to sampling was used to represent the temperature for that sample.

Prevalence of chytridiomycosis on adult *Litoria wilcoxii* in Numinbah Valley, and mean 30-day air temperature

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Season** | **Sampling date** | **Sample size (n)** | **Mean 30-day air temperature (°C)** | **Prevalence (%)** |
| Winter | 4 Aug | 2 | 12.3 | 50 |
| Spring | 8 Sep | 26 | 12.6 | 38.5 |
| Spring | 24 Sept | 30 | 14.7 | 46.7 |
| Spring | 11 Oct | 36 | 15.9 | 58.3 |
| Spring | 3 Nov | 30 | 19.2 | 46.7 |
| Summer | 4 Dec | 38 | 19.5 | 7.9 |
| Summer | 22 Dec | 30 | 20.1 | 13.3 |
| Summer | 14 Jan | 32 | 22.4 | 12.5 |
| Summer | 10 Feb | 27 | 22.2 | 3.7 |
| Autumn | 12 Mar | 21 | 21.0 | 0 |
| Autumn | 13 Apr | 11 | 19.5 | 0 |
| Autumn | 29 Apr | 21 | 18.0 | 9.5 |
| Autumn | 20 May | 1 | 15.8 | 100 |

4.(a) Graph the prevalence of chytridiomycosis and mean 30-day air temperature for each of the sampling dates. Use separate scales on the y (vertical) axes for prevalence of chytridiomycosis and 30-day air temperature. (5 marks)

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|  | Aug | | | | Sep | | | | Oct | | | | Nov | | | | Dec | | | | Jan | | | | Feb | | | | Mar | | | | Apr | | | | May | | | |  |

Month

(b) (i) Name the independent variable. (1 mark)

\_\_\_\_\_\_

(ii) Name the dependent variable. (1 mark)

(c) (i) State the relationship between prevalence of chytridiomycosis and 30-day air temperature. Use data from the study to support your response. (3 marks)

(ii) In which season/s is the incidence of chytridiomycosis low or almost non-existent?

(2 marks)

1. Prior to this study, many chytridiomycosis field studies relied on opportunistic sampling, involving many variables. The scientists in this study attempted to catch 30 frogs at each sampling session, but winter sample sizes were small due to the difficulty in finding frogs.

Compare the reliability of the results for 4 August with the results for 8 September. Use data to support your answer. (3 marks)

(e) Explain how this information can be used in the scientific research of chytridiomycosis in frog populations. (2 marks)

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5. Explain how the skin of frogs makes them vulnerable to the fungal infection causing death

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(2 marks)

6. Explain **two** strategies that would help to manage chytridiomycosis in frog populations. (4 marks)

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**ACKNOWLEDGEMENTS**

**Question 1** Map from: Martyman. (2007). *File:Australia locator-MJC.png*. Retrieved April, 2015, from <http://commons.wikimedia.org/wiki/File:Australia_locator-MJC.png>

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**Question 4** Text information from, and table adapted from: Kriger, K.M., & Hero, J.-M. (2007). Large-scale seasonal variation in the prevalence and severity of chytridiomycosis. *Journal of Zoology*, pp. 353–355. [Published by Wiley; © 2006 The Authors]. Retrieved April, 2015, from [www.bio.davidson.edu/people/kabernd/berndcv/lab/website%20(summer%202009)/chytridreswp/Webpage1/Kiger%20and%20Hero-Large-scale%20seasonal%20variation%20in%20the%20prevelance%20and%20severity%20of%20chytridiomycosis%20copy.pdf](http://www.bio.davidson.edu/people/kabernd/berndcv/lab/website%20(summer%202009)/chytridreswp/Webpage1/Kiger%20and%20Hero-Large-scale%20seasonal%20variation%20in%20the%20prevelance%20and%20severity%20of%20chytridiomycosis%20copy.pdf)

Marking key for sample assessment task 9 – Unit 4

A decline in amphibian populations and the extinction of a number of species in Australia since the 1970s can be attributed to a number of causes, including an infectious disease caused by the amphibian chytrid fungus, *Batrachochytrium dendrobatidis.*

1. On the map below, shade the major regions in Australia infected by the amphibian chytrid fungus.

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Shades the following areas:   * Eastern Australia (from north Queensland to Melbourne, Victoria) * South West of Western Australia * Adelaide * Tasmania | 1–2 |
| **Total** | **2** |
| **Answer could include, but is not limited to:**  **(allow some flexibility in areas shaded, provided the area shaded roughly matches the map below)** | |
|  | |

2. Many species of amphibians are threatened by the amphibian chytrid fungus, and the common factors appear to be related to their habitat and behaviour. Describe three reasons a species may become threatened due to this disease.

|  |  |
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| **Description** | **Marks** |
| Any three of the following:   * occupy restricted geographic range/isolated * small population size * habitat suited to growth of the fungus, e.g. low temperature, high rainfall * habitat suited to spread of zoospores, e.g. streams/flowing water * low clutch size * environmental stress such as possibly high UV | 1–3 |
| **Total** | **3** |

3. The life cycle of *Batrachochytrium dendrobatidis* has two distinct stages, a motile zoospore and a sessile sporangium that grows on the skin of amphibians. Resistant resting spores have not been found in this species.

Explain an advantage and a disadvantage of not having a resting stage in the life cycle for this fungus.

|  |  |  |
| --- | --- | --- |
| **Description** | | **Marks** |
| **Advantage** | * Rapid growth/short life cycle * Allows the pathogen to establish quickly in a new area | 1 |
| **Disadvantage** | * Adverse conditions such as drought * Pathogen may not survive without host | 1 |
| **Total** | | **2** |

4.(a) Graph the prevalence of chytridiomycosis and 30-day air temperature for each of the sampling dates. Use separate scales on the y (vertical) axes for prevalence of chytridiomycosis and 30-day air temperature.

|  |  |
| --- | --- |
| **Description** | **Marks** |
|  |  |
| Uses appropriate scales / Selects correct axes with one on each side | 1 |
| Labels axes, including units | 1 |
| Uses line graphs/identifies each line using a key or legend | 1 |
| Accurately plots points and joins appropriately | 1 |
| Uses an appropriate title, showing the relationships between all the variables | 1 |
| **Total** | **5** |
| **Answer could include, but is not limited to:** | |
|  | |

(b) (i) Name the independent variable.

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Air temperature for the 30 days prior to sampling/ time of year | 1 |
| **Total** | **1** |

(ii) Name the dependent variable.

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Prevalence (%) of chytriomycosis | 1 |
| **Total** | **1** |

(c) (i) State the relationship between prevalence of chytridiomycosis and 30-day air temperature. Use data from the study to support your response.

|  |  |
| --- | --- |
| **Description** | **Marks** |
| States the relationship between prevalence of chytridiomycosis and 30-day air temperature | 1 |
| Quotes relevant data to support description of the relationship between prevalence of chytridiomycosis and 30-day air temperature | 1–2 |
| **Total** | **3** |
| **Answer could include, but is not limited to:** | |
| * As air temperature rises, the prevalence of chytridiomycosis decreases * Prevalence of disease was higher at temperatures between 12.3 °C and 15.8 °C * Above 19.4 °C, the prevalence of disease decreased significantly | |

(ii) In which **season/s** is the incidence of chytridiomycosis low or almost non-existent?

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Summer | 1 |
| Early autumn/autumn | 1 |
| **Total** | **2** |

(d) Prior to this study, many chytridiomycosis field studies relied on opportunistic sampling, involving many variables. The scientists in this study attempted to catch 30 frogs at each sampling session, but winter sample sizes were small due to the difficulty in finding frogs.

Compare the reliability of the results for 4 August with the results for 8 September. Use data to support your answer.

|  |  |
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| **Description** | **Marks** |
| * More frogs were sampled in September than August * September result is more reliable due to larger sample size | 1–2 |
| * In August, only two frogs were sampled, of which one was infected/50% * This may not represent the prevalence of infection in the population * In September, 26 frogs were sampled of which 10 were infected/38.5% * More likely to represent the prevalence of infection in the population | 1 |
| **Total** | **3** |

(e) Explain how this information can be used in the scientific research of chytridiomycosis in frog populations.

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Clearly explains how this information can be used in the scientific research of chytridiomycosis in frog populations. | 1–2 |
| **Total** | **2** |
| **Answer could include, but is not limited to:** | |
| Prevalence of disease is low in summer and would not be indicative of whether disease is present  The study shows the optimum conditions for the prevalence of the disease  Could lead to methods to control the disease/further research on heat vunerability | |

5. Explain how the skin of frogs makes them vulnerable to the fungal infection causing death

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Frog skin always wet making it suitable for fungal infection  Fungus invades the outer layer of the skin/ keratin material  It disrupts the normal functions resulting in electrolyte depletion, osmotic imbalance and reduced respiration | 1–2 |
| **Total** | **2** |

6. Explain **two** strategies that would help to manage chytridiomycosis in frog populations.

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| --- | --- |
| **Description** | **Marks** |
| Any two of the following, strategy (1 mark), explanation (1 marks):   * national survey * captive breeding and restocking programs * research and monitoring * quarantine * disease control standards * community education | 1-2  1-2 |
| **Total** | **4** |
| **Answer could include, but is not limited to:** | |
| **National survey**   * Determine the distribution of the chytrid fungus and fungus-free areas/identify affected amphibian species * Allow management strategies to be implemented to prevent the spread of the disease/provide a coordinated response to outbreaks/develop an action plan   **Captive breeding and restocking programs**   * Restock species that are under severe threat from infection * Use captive-bred stock free of disease / Standardised techniques and regulations   **Research and monitoring**   * Monitor threatened species of amphibians to determine changes in distribution and abundance * Develop diagnostic tools, e.g. trial PCR in the field, determine whether to test tadpoles or adult frogs, research biology of the chytrid fungus, develop survey protocols * Research into the biology of *B. dendrobatidis,* e.g. limiting factors in the environment, relationship between zoospores and prevalence of disease, spread of disease, vectors, eradication * Research pathogenesis of chytridiomycosis, including host and environmental factors/investigate surviving populations for evidence of resistance, * Assess effectiveness of management strategies, e.g. hygiene, whether populations can be reinfected, restocking programs   **Quarantine**   * Restrict movement into disease-free areas * Management to prevent accidental introduction of the amphibian chytrid (research, zoos, agricultural produce, pet stores, plants, water) | |
| **Answer could include, but is not limited to:** | |
| **Disease control standards**   * Movement of amphibians for any reason * Release of amphibians into the wild * Hygiene within facilities dealing with amphibians * Field hygiene * Accreditation   **Communication**   * Share information between agencies * Educate community targeting particular groups (pet trade, researchers, schools, wildlife carers, recreational water users, tourists) * Signage in parks, reserves and other areas that are infected | |

**ACKNOWLEDGEMENTS**

**Question 5(a)** Graph data from: Kriger, K.M., & Hero, J.-M. (2007). Large-scale seasonal variation in the prevalence and severity of chytridiomycosis. *Journal of Zoology*, pp. 353–355. Retrieved April, 2015, from [www.bio.davidson.edu/people/kabernd/berndcv/lab/website%20(summer%202009)/chytridreswp/Webpage1/Kiger%20and%20Hero-Large-scale%20seasonal%20variation%20in%20the%20prevelance%20and%20severity%20of%20chytridiomycosis%20copy.pdf](http://www.bio.davidson.edu/people/kabernd/berndcv/lab/website%20(summer%202009)/chytridreswp/Webpage1/Kiger%20and%20Hero-Large-scale%20seasonal%20variation%20in%20the%20prevelance%20and%20severity%20of%20chytridiomycosis%20copy.pdf)