MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD
UNIVERSITY OF MALTA, MSIDA

MATRICULATION CERTIFICATE EXAMINATION
ADVANCED LEVEL
SEPTEMBER 2005

SUBJECT:	BIOLOGY
PAPER NUMBER:	II
DATE:	5th SEPTEMBER 2005
TIME:	9.00 a.m. to 12.00 noon

Directions to Candidates

- *Answer ALL questions in Section A, any TWO questions from Section B and ONE question from Section C. Write all your answers in the separate booklet provided.*
- ***If more than two questions from Section B are attempted, only the best two answers shall be taken into consideration.***
- ***If more than one question from Section C is attempted, only the better answer shall be taken into consideration.***
- *The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated.*
- *You are reminded of the necessity for good English and orderly presentation in your answers.*
- *In calculations you are advised to show all the steps in your working, giving your answer at each stage.*
- *The use of electronic calculators is permitted.*

SECTION A (Answer **all** questions in this section):

1. Read the extract below carefully and afterward, from the information given and from your knowledge of biology, answer the questions that follow. The numerals in the left-hand margin are line numbers.

ALBATROSS CHICKS ATTACKED BY MICE

"Supersize" mice are eating seabird chicks alive on Gough Island, one of the most important seabird colonies in the world, UK conservationists report. The rodents are taking out one million petrels, shearwaters and albatrosses each year on the UK Overseas Territory in the South Atlantic. The Royal Society for the Protection of Birds (RSPB) says the mice infestation puts some species in danger of extinction. It hopes to find ways to control or even eradicate the rodents. "Successful eradications in the past have used poisons, particularly in New Zealand; that is one option," said Dr Richard Cuthbert, a biologist with the RSPB. "There are also potential diseases for mice we could introduce - the equivalent of myxomatosis for rabbits," he told the BBC News website.

Gough Island is some 8km long and 6km wide and is the most southerly of the Tristan da Cunha group. It is used as a nesting ground by 22 bird species, of which 20 are seabirds; 10 million individuals can be found there at any one time. Until passing sealing ships moored up in the 19th Century, the birds were largely safe from predators. But mice aboard the ships have infested Gough, and grown large, partly because of the abundant new food source on which they have recently started to indulge. This is a common phenomenon on island habitats -- for reasons much debated among scientists -- where small animal species often display “gigantism” and grow larger while big species such as elephants display "dwarfism" and become smaller.

"Mice and other small animals often do get bigger when they are put on islands, particularly islands at higher latitudes," Dr Cuthbert explained. "It's an ecological rule: if it's a cold environment, you are better off being a larger animal."

The albatross chicks spend eight months sitting waiting for food from their parents. They are nearly a metre tall and 250 times the weight of the mice but are largely immobile and cannot defend themselves. The mice gnaw into the birds' flesh as they sit on the ground. Researchers have seen as many as eight or 10 rodents feasting on a single ailing chick. It will turn around when under attack but cannot withstand such an assault.

The Gough mouse is one of 2,900 non-native species damaging native wildlife on the 17 UK Overseas Territories and Crown Dependencies, a review by the Joint Nature Conservation Committee (JNCC) has found. Dr Vin Fleming, who heads up the International Unit at the JNCC, told the BBC News website: "The British Overseas Territories stretch from the British Antarctic to Pitcairn, to the Caribbean territories and to all these South Atlantic ones.” The numbers of non-native species range from up to almost 1,200 on Bermuda to zero on the South Sandwich Islands. As we saw from the recent Millennium Ecosystem Assessment, invasive species are responsible for the greatest loss of biodiversity on islands; and are second only to habitat loss globally as a major cause of extinctions." The RSPB has been awarded £62,000 by the UK government's Overseas Territories Environment Programme to fund additional

research on the Gough Island mice and a feasibility study of how best to deal with them. Some of the rodents will be tracked to learn more about their behaviour, before a control programme is introduced.

Adapted from: BBC News Service, 19th July 2005

1.1 Why were these remote islands generally safe from predators? (lines 15-16)

[one mark]

1.2 The phenomena of gigantism and dwarfism in animals on islands have often been linked to the relative lack of predators on remote islands. Why should the absence of predators promote these processes? (lines 15-16 and 18-21).

[three marks]

1.3 How, in evolutionary terms, do the mice "get bigger"? (line 23).

[three marks]

1.4 The deliberate introduction of diseases, as suggested in lines 8-9, is frequently considered a dangerous step. Why should it be considered so?

[two marks]

1.5 Suggest an alternative (and practical) method of biological control of Gough Mice that does not involve the introduction of disease organisms.

[two marks]

1.6 "It's an ecological rule: if it's a cold environment, you are better off being a larger animal." (lines 24-25). Why should larger size be considered an advantage in a cold climate?

[two marks]

1.7 "….invasive species are responsible for the greatest loss of biodiversity on islands; and are second only to habitat loss globally as a major cause of extinctions." (lines 41-43). What life-cycle characteristics would contribute towards making an organism invasive?

[three marks]

1.8 How can so many different species of sea-birds, many of which would have broadly similar requirements, coexist on a single island? (lines 13-14).

[two marks]

1.9 Why are species on islands more vulnerable to extinction than mainland species?

[two marks]

[Total: twenty marks]

2. Changes in the patterns of behaviour of small invertebrates are usually the earliest biological indicators of environmental change. Populations that inhabit stable, unchanging environments would be expected to exhibit far less variety in their behaviour than populations living in unstable, changeable environments. The rationale for such an assumption is that adaptation to particular environmental features requires time (lifetime for individual adaptation, several generations for genetic adaptation). The stability of a number of beaches in North Africa was investigated by assessing the behavioural responses of sandhoppers (*Talitrus saltator*). These crustaceans are expected to show a tendency to

orient towards the shoreline where they would find moist sand in which to burrow at the water's edge. The behavioural responses of sandhoppers in beaches at Ratiba, Zouara, Tabarka, Korba and Kabila were investigated and the results obtained are summarised in the table below:

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	Ratiba	**Zouara**	**Tabarka**	**Korba**	**Kabila**
M	330˚	345˚	324˚	121˚	138˚
S	335˚	324˚	346˚	112˚	60˚
N	222	341	291	204	111

Where: M is the mean compass direction travelled by the sandhoppers
S is the compass direction towards which the seashore is oriented
N is the number of sandhoppers in each run of the experiment

The results were also presented graphically (Figure 1).

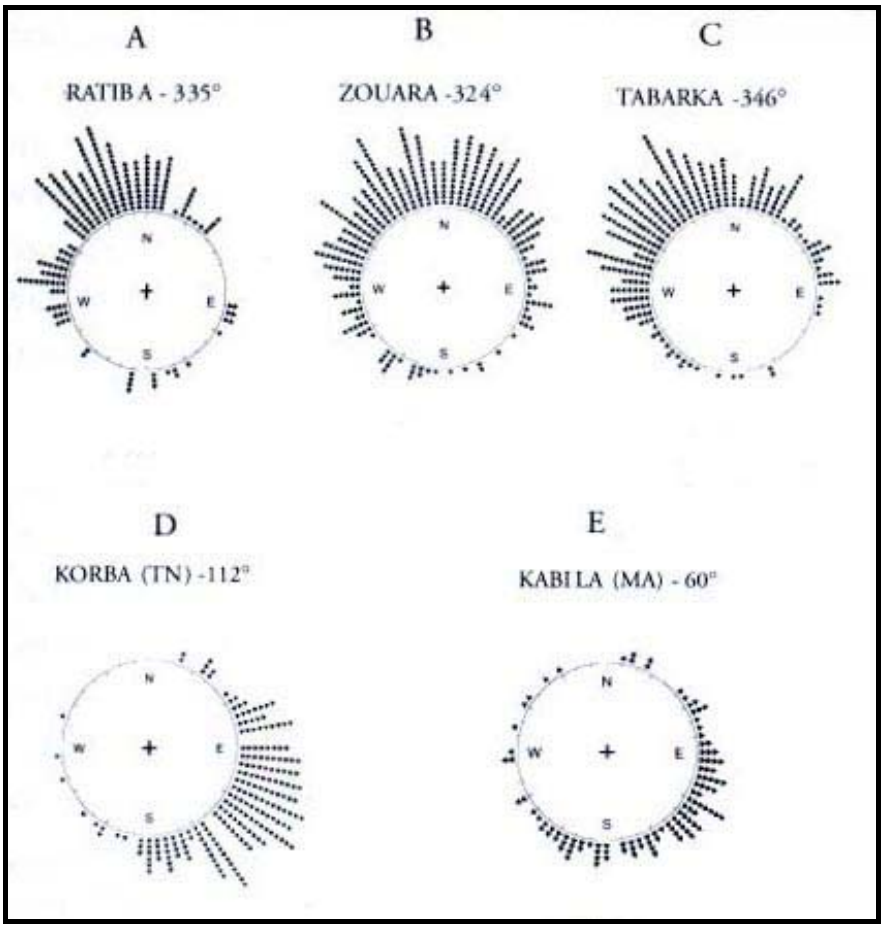

Figure 1: Orientation responses of sandhoppers on five sandy beaches in North Africa

All data and figures adapted from: Morgan, E. & Scapini, F. (2002). *Behavioural changes as indicators of beach stability*. Baseline research for the integrated sustainable management of Mediterranean sensitive ecosystems. Istituto Agronomico per l'Oltremare, Florence, Italy.

2.1 Comment on the pattern of results obtained by the researchers.

[five marks]

2.2 How are the diagrams in Figure 1 expressing the data? (Note that you should not comment on the patterns suggested by the data but on how the researchers have chosen to represent the data).

[four marks]

2.3 Why do the sandhoppers actively seek out moist sand?

[two marks]

2.4 Which of the beaches seems to be the most stable? Give reasons for your answer.

[three marks]

2.5 Which of the beaches is the least stable? Give reasons for your answer.

[three marks]

2.6 Suggest, with reasons, ONE environmental factor that may be confounding the results obtained.

[two marks]

2.7 Why are small organisms, such as sandhoppers, more suitable for experiments of this form than larger organisms?

[one mark]

[Total: twenty marks]

SECTION B

(Answer any **TWO** questions from this section; your answers should take the form of essays. Each question carries twenty marks).

3. Describe the role of the liver in the metabolism of proteins, carbohydrates and fats.

4. Give an outline of diversity within the plant kingdom.

5. Describe the general features of the immune system of the human body.

6. Compare and contrast the mode of nutrition of humans with that of ruminant mammals.

SECTION C
(Answer **ONE** question from this section).

7. Use your knowledge of biology to explain the following statements.

    7.1 Starfish and sea-urchins have very different appearances, yet are classified in the same phylum.
    7.2 Green algae, such as *Euglena* and protozoans, such as *Amoeba* have very different appearances, yet are classified in the same phylum.
    7.3 Snails and mussels have very different appearances, yet are classified in the same phylum.
    7.4 Scorpions and woodlice have very different appearances, yet are classified in the same phylum.

[five marks each]

[Total: twenty marks]

8. Use your knowledge of biology to explain the following statements.

    8.1 The search for life on other planets and moons often focuses on the presence or absence of liquid water.
    8.2 Most of Earth's carbon is in sedimentary rocks rather than in the atmosphere.
    8.3 All known living organisms are carbon-based.
    8.4 The surface of the planet Venus, at a temperature of 490°C, is considered too hot for life.

[five marks each]

[Total: twenty marks]