

國立臺灣師範大學 100 學年度碩士班招生考試試題

科目：生態學

適用系所：生命科學系

注意：1.本試題共 3 頁，請依序在答案卷上作答，並標明題號，不必抄題。2.答案必須寫在指定作答區內，否則不予計分。

1. Population biology (15 points)

a. Define “population growth rate” (3 points)

Now imagine that you are studying population biology of species “A” at a 10-km² study site. This species is a forest specialist that is vulnerable to habitat fragmentation. The study site is composed of one 5 km² forest patch, two 1 km² forest patches, and 3 km² of developed area with no forests. You collected the following data for the three forest patches:

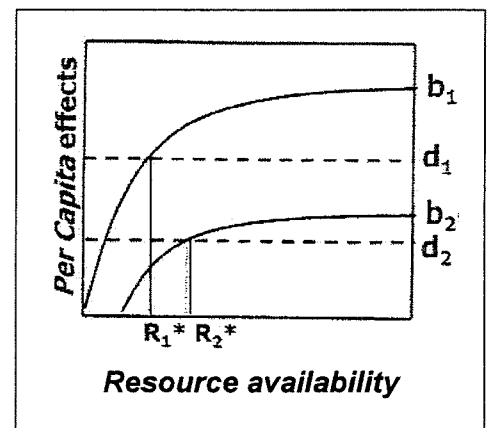
Patch size	Birth rate of “A”	Death rate of “A”	Population density of “A”
5 km ²	10	10	No data
1 km ²	0.5	0.5	10 individuals/ km ²
1 km ²	1	2	No data

- b. Which of these three populations are more likely to be source populations? Which are more likely to be sink populations? Why? (4 points)
- c. If you must provide an estimate on the number of individuals of species “A” at the study site based on this data, what is your estimate? Explain how you reach this estimate and list at least one assumption (e.g. population growth form, immigration/emigration) that you make in order to justify your estimate. (8 points)

2. Species interactions (20 points)

a. Define “ecological niche” (4 points)

In the figure on the right, the x-axis is the resource availability and the y-axis is the per capita effect of the resource on two consumer species, species 1 and 2. The solid lines are birth rates (b_1 : the birth rate of species 1; b_2 : the birth rate of species 2), and the dashed lines are death rates (d_1 : the death rate of species 1; d_2 : the death rate of species 2):



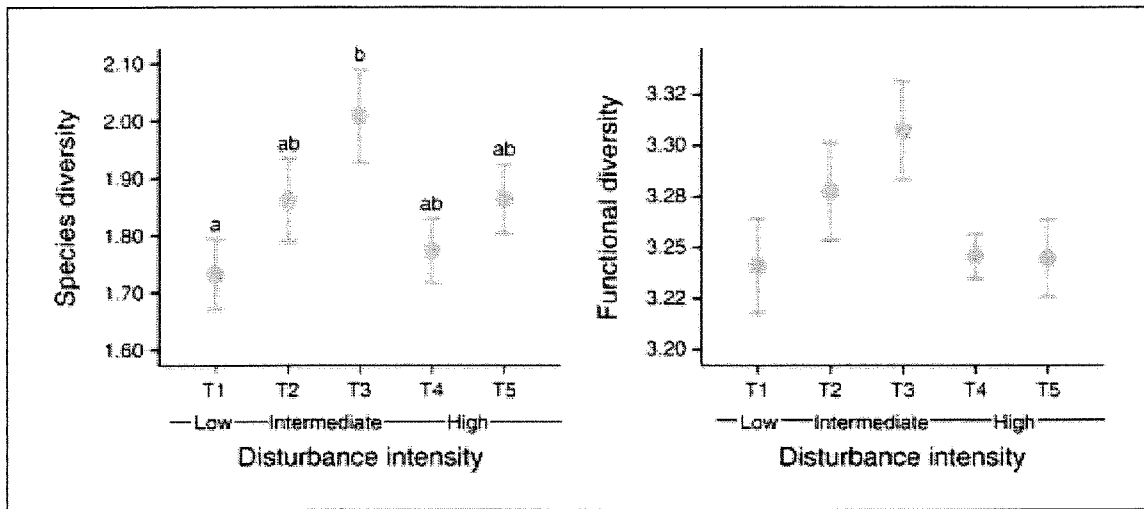
- b. How does the resource affect the birth and death rates of these two species? (2 points)
- c. Specify the niches of these two species in relation to R_1^* and R_2^* ? Do their niches overlap? (4 points)
- d. Is this an example of “exploitative competition” or “apparent competition”? (4 points)
- e. Do you expect these two species to coexist, and under what conditions? Or do you expect one of them to exclude the other, and if so, which species should win and why? (6 points)

3. Community and ecosystem ecology (15 points)

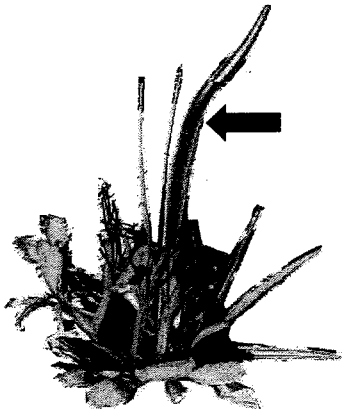
a. Define “intermediate disturbance hypothesis” (4 points)

國立臺灣師範大學 100 學年度碩士班招生考試試題

Biswas and Mallik (2010) conducted a research testing if plant diversity differs along a gradient of disturbance intensity. Below are their findings (error bars represent standard errors; different letters denote significant differences in species or functional diversity):



- b. How did species diversity respond to disturbance intensity? Is species diversity a linear function of disturbance intensity (4 points)?
 - c. How did functional diversity respond to disturbance intensity? (2 points)
 - d. Do species and functional diversity respond to disturbance intensity the same way? Discuss what ecological characteristics of these communities could have caused them to respond the same or differently. (5 points)
4. Adaptation (20 points)
- a. Please define what adaptation is. (4 points)
 - b. Adaptation had been used to explain evolution of all biological traits (e.g. morphology, physiology, behavior,...). A South African plant *Babiana ringens* has a long sterile inflorescence axis (indicated by the arrow in figure, Anderson et al. 2005). Do you think that this structure (a inflorescence without flower) is the product of adaptation? Why or why not? (8 points)
 - c. Please design an experiment to test your hypothesis. (8 points)



國立臺灣師範大學 100 學年度碩士班招生考試試題

5. Phylogenetics (14 points)
 - a. Please define phylogeny. (4 points)
 - b. A lot of people around the world believe that unlike other organisms, we, the human being, are the descent of aliens from outer space. Please use the phylogenetic concept to design a study to validate the alien hypothesis. (10 points)

6. Sexual selection (16 points)
 - a. Please define sexual selection (4 points)
 - b. If the sexual selection is correct, what kind of animal mating system(s) (monogamy, polyandry, polygyny, polygyny, or promiscuity) could be under strong sexual selection for males? (4 points)
 - c. The testis size of male primates varies greatly among species. For example, body weight of a male gorilla might be up to 200 kg and weight of its testis is around 30 g. In contrast, weight of a male chimpanzee is only around 45 kg, but its testis is almost four times heavier than that of a male gorilla (119 g). (For your curiosity, the average body weight for a man is about 64 kg, and his testis is about 40 g). Please propose a hypothesis to explain the testis size variation among primates according to the sexual selection theory (4 points).
 - d. How could you test your hypothesis? (4 points)