國立成功大學

113學年度碩士班招生考試試題

編　號：59

系　所：生命科學系

科　目：生態學

日　期：0202

節　次：第 3 節

備　註：不可使用計算機

※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1-1. (填空) Select appropriate words from the following options to fill in the blanks (A)-(H). You may use the same word many times.　[16%, 2% each]

birth rate, death rate, extinction rate, metabolic rate, intrinsic population growth rate, carrying capacity, competition, parasitism, predation, dispersal, positive, negative, zero, species 1, species 2, both species, neither species, left, right

Consider the Lotka-Volterra competition model:

$$\frac{dN_1}{dt} = r_1(1 - a_{11}N_1 - a_{21}N_2)N_1 \qquad (1a)$$

$$\frac{dN_2}{dt} = r_2(1 - a_{12}N_1 - a_{22}N_2)N_2 \qquad (1b)$$

where N_i (i = 1 or 2) is the population size of each species. r_i is defined as **(A)** and a_{ij} (i, j = 1 or 2) determines the strength of **(B)**. Solving the equation 1a (or 1b) at the equilibrium (i.e., $dN_i/dt = 0$) leads the following relationship 2a (or 2b).

$$N_1 = 0 \text{ or } a_{11}N_1 + a_{21}N_2 = 1 \qquad (2a)$$
$$N_2 = 0 \text{ or } a_{12}N_1 + a_{22}N_2 = 1 \qquad (2a)$$

These are called zero-net-growth isoclines (ZNGIs), which can tell you when the species can exclude or coexist with the other species. ZNGIs 2a and 2b are plotted as follows:
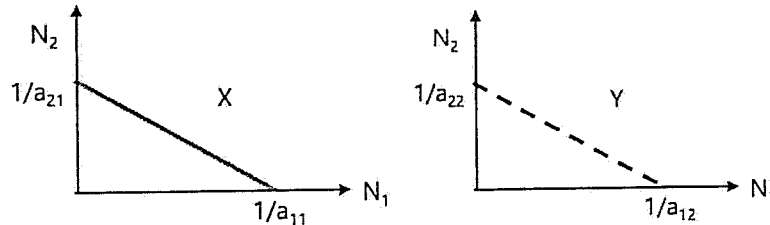
In the space above blue line (region X), the population growth rate of **(C)** is **(D)**, and the population growth rate of **(E)** is **(F)** in the space above red line (region Y). Two ZNGIs have four possible relationships, resulting in different competition outcomes. In the first two cases, one ZNGI is located over the other as follows.
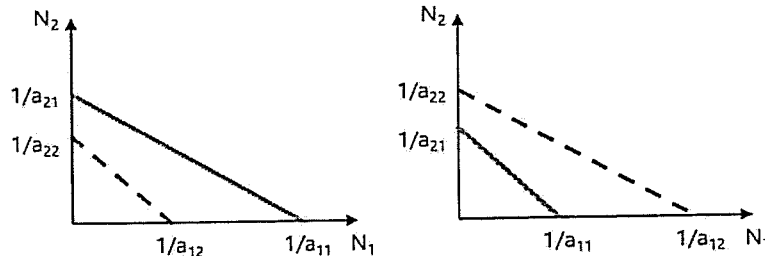
The left case occurs when $a_{22} > a_{21}$ and $a_{12} > a_{11}$, which biologically means that **(G)** is more competitive, and thus it excludes the other species.　The opposite is true in the right case.　In the other two cases, two ZNGIs intersect as follows:
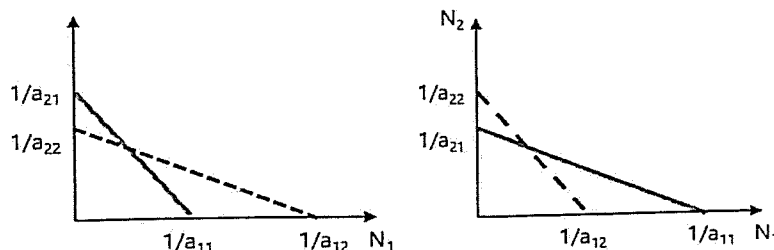
The two species can coexist in the **(H)** case, and in the other case, **(I)**.

1-2. (選擇) Choose either correct one from A to D to fill in the blank (I).　[3%]

A.　species 1 excludes species 2
B.　species 2 exclude species 1
C.　species 1 and 2 coexist
D.　which species wins is uncertain

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2. (選擇) Choose either correct one from A to D in each question.   [6%, 1% each]

2-1. In predator-prey population cycles, you can see that _____ after a decrease in prey abundance decreased predator abundance
(A) both predator and prey start to increase; (B) decreased predator allows prey to recover; (C) predator abundance turns to increase because of reduced competition; (D) both predator and prey go extinct

2-2. Plant species diversity is likely to increase when
(A) herbivores are absent; (B) climate conditions are stable; (C) environments are spatially heterogeneous; (D) soils are rich in nutrient

2-3. What is an inappropriate situation for large carnivorous species to survive?
(A) Primary productivity is high. (B) Disturbance frequency is high. (C) Habitat area is large. (D) Herbivores have low death rates.

2-4. A set of local communities that are linked by the dispersal of multiple, potentially interacting species is referred to as a(n)
(A)　ecotone; (B) protected area; (C) metapopulation; (D) metacommunity

2-5. What process is likely to be driving changes in landscape over time?
(A)　natural disturbance; (B) human activity; (C) community succession; (D) all of the above

2-6. The equilibrium model of island biogeography assumes that colonization rate and extinction rate decreases and increases, respectively, with the number of species existing on the island.　The species number increases when _____
(A) the island is closer to species pool; (B) the island has a wider area; (C) the speciation rate is higher; (D) all of the above

3. (解釋名詞) Define the following terms (15%, 3% each)
   3-1. Minimum viable population
   3-2. Intrinsic population growth rate
   3-3. Photoinhibition of photosynthesis
   3-4. Carrying capacity
   3-5. Water eutrophication

4. Short answer question (10%, 5% each):
   4-1. How are the increased number of extreme events, such as wildfires and floods, we've seen over the last couple of years directly related to climate change?
   4-2. If a new ecosystem called garbage patch was created due to the human disposal of trashes and within which a rare/new species were found, should we remove the garbage patch? Why or why not?

5. Short answer/essay question: Tilman D et al. (2014) reviewed studies from the last two decades and found that the effects of biodiversity on ecosystems are real and widely observed in different ecosystems.

Here are some of the key experimental results showing the relationships among species richness, functional composition, and ecosystem function.

　　A. According to this information, what are the possible functions of increased biodiversity? **(15%)**

　　B. What are 'transgressive overyielding' **(5%)** and 'niche complementarity' **(5%)** in the context of biodiversity and ecosystem functioning, and why are they important in ecological research?
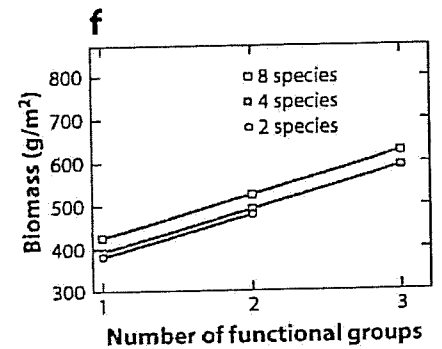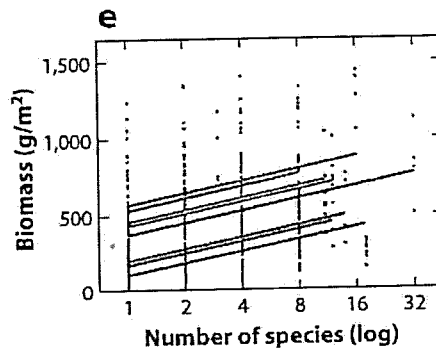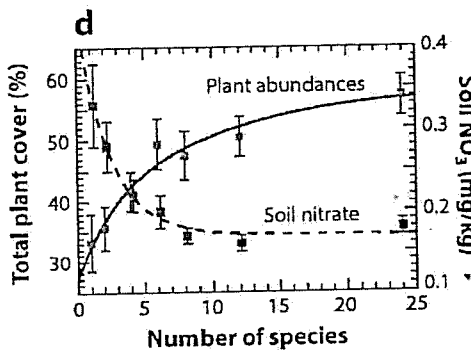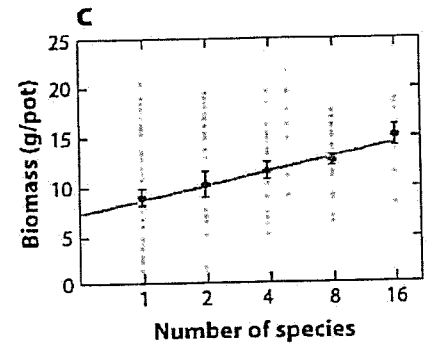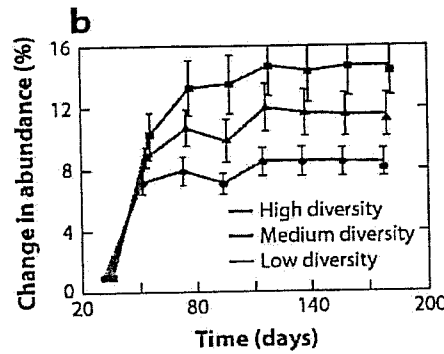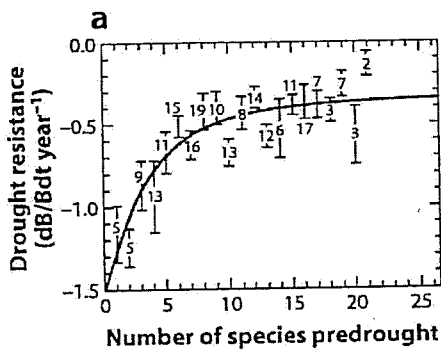
6. Describe **(a)** what **life history strategy** of a species is, along with any four notable traits or characteristics? **(6%)**; and then discuss why **(b)** understanding life history strategy is important for the conservation of any targeted species? **(2%; total 8%)**

7. **Animal personality** is emerging rapidly over the past three decades as a study subject in behavioral ecology. Discuss with an example why understanding animal personality is crucial for many current conservation issues such as climate change, habitat destruction, urbanization, and invasive species. **(8%)**

8. **(a)** What is an **umbrella species (2%)**, and what is a **keystone species (2%)**; **(b)** in your opinions what species in Taiwan may be designated as an umbrella species **(1.5%)** and a keystone species **(1.5%)**, and why? **(2%) (total 9%)**