

答案請填寫於試卷內，附上題號，並依序作答。可用中文或英文作答。

一、選擇題(1-9 每題 3 分，第 10 題 5 分，共 32 分)

1. Definition of ecosystem is
 - a) The community of organisms together with the environment in which they live
 - b) The abiotic component of a habitat
 - c) The part of the earth and its atmosphere which inhibits living organisms
 - d) A community of organisms interacting with one other
2. Species that occur in different geographical regions separated by spatial barrier are:
 - a) Allopatric
 - b) Sympatric
 - c) Sibling
 - d) None of the above
3. The final stable community in an ecological succession is called the
 - a) Final community
 - b) Ultimate community
 - c) Climax community
 - d) Serial community
4. An association between two individuals where both are benefitted and neither can survive without the other is:
 - a) Competition
 - b) Commensalism
 - c) Mutualism
 - d) Protocooperation
5. The gradual physiological adjustment to slowly changing new environmental conditions is known as:
 - a) Selection
 - b) Adaptation
 - c) Acclimatization
 - d) Quarantine
6. What variable is found in the logistic growth equation that is absent from the exponential growth equation:
 - a) The competition
 - b) The intrinsic population growth rate
 - c) The carrying capacity
 - d) The population size

見背面

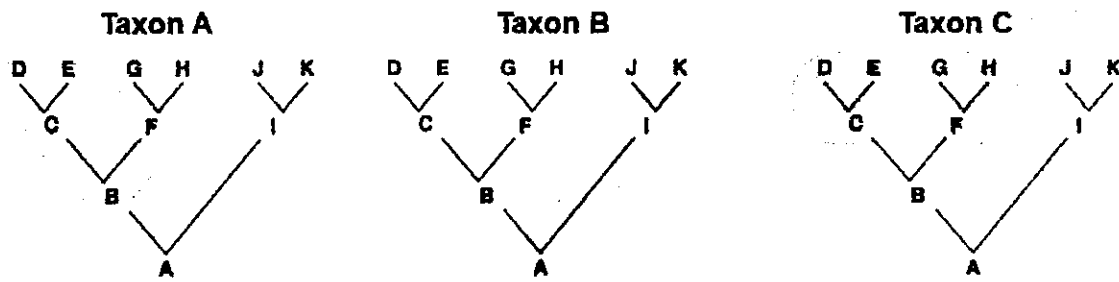
7. According to the theory of island biogeography, which type of island would you expect to hold the most species upon reaching the equilibrium:

- a) Small islands far from the mainland
- b) Small islands close to the mainland
- c) Large islands far from the mainland
- d) Large islands close to the mainland

8. The coral bleaching refers to:

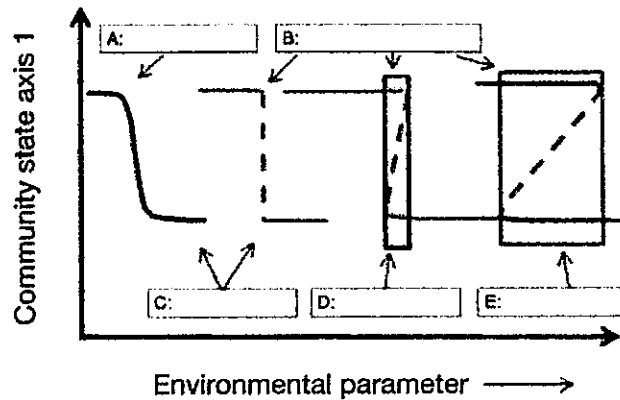
- a) The breakdown of the symbiosis between the coral and the zooxanthellae
- b) The mortality of the coral, exhibiting its skeleton made of calcium carbonate
- c) The Carbon Dioxide dissolving the coral skeleton and producing a white powder
- d) The use of a sodium hypochlorite solution to remove animal tissue form the coral skeleton

9. Among the following diagrams, which taxon represented by the shaded region correspond to a monophyletic group:



- a) Taxon A and B
- b) Taxon B and C
- c) Taxon C only
- d) Taxon A only
- e) Taxon B only

10. Annotate the following figure with: No Hysteresis, Low Hysteresis, High Hysteresis, Alternative stable states, Phase shift (Adapted from Dudgeon et al. 2010, Mar Ecol Prog Ser)



二、解釋名詞

1. (5分) Life table
2. (5分) Liebig's law of the minimum
3. (5分) r-k selection
4. (5分) match/mismatch hypothesis

三、簡答題

1a. (5分) Warder Clyde Allee (1885–1955), a University of Chicago zoologist, noticed that in many species it was undercrowding, not competition, that limited population growth. The phenomenon is then named after Allee. Please explain one of many possible mechanisms that cause Allee Effects.

1b. (9分) Describe how Allee effects are distinguished from other forms of density dependence (i.e., logistic growth) based on the three figures below (Fig. 1, adapted from Drake & Kramer, 2011). For Fig. 1 (c), use the solid lines only for your interpretation.

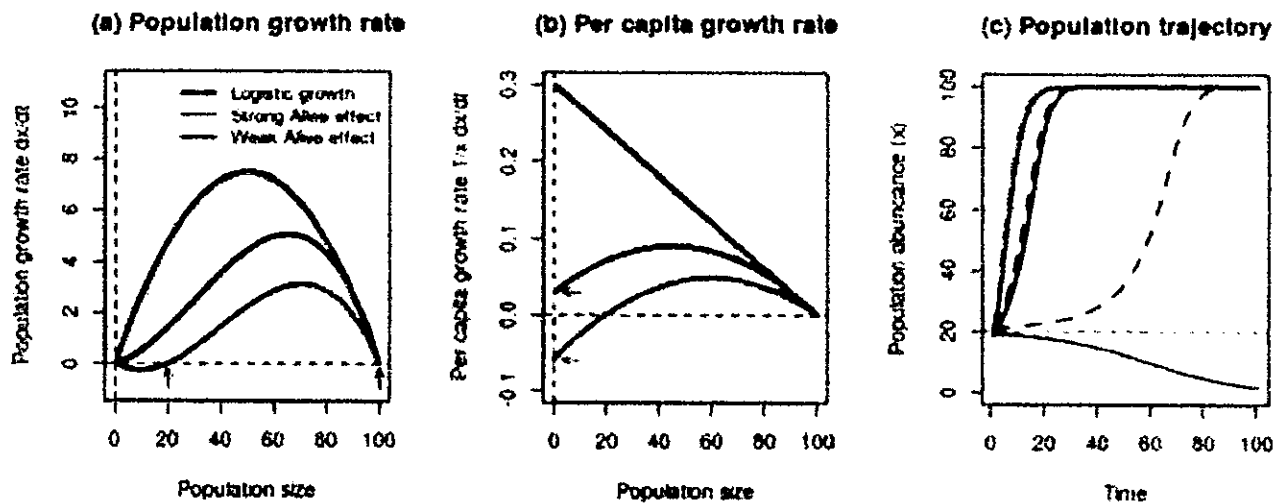


Fig. 1. Different density-dependent patterns among the logistic growth, weak Allee effect, and strong Allee effect.

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2a. (6分) The logistic growth model is a basic population growth model that incorporates density-dependent regulation on population growth rate. The basic model form (continuous time, in differential equation) is: $\frac{dN}{dt} = rN(K - N)/K$, where N is population size, r is the intrinsic population growth rate, and K is carrying capacity. Fig. 2 shows the trajectory of a population that follows the logistic population growth, with $r = 1.0$ and $K = 1000$ fish. Draw the relative changes of population trajectories for this population at 1) $r = 1.5$ and $K = 1000$ fish, and 2) $r = 0.7$ and $K = 600$ fish. In your answer sheet, please hand draw Fig. 2 and insert the trajectories of the two conditions in the same graph. Label each line and both axes.

2b. (9分) The logistic growth model also exists a discrete time form: $N_{t+1} = N_t + r_d * N_t(K - N_t)/K$, where N_t is population size at time t , N_{t+1} is population size at time $t+1$, r_d is discrete growth factor, K is carrying capacity. Depending on the value of r_d , the discrete time logistic population growth model can display different behaviors. Describe the three phases or hand draw three graphs to show population trajectories at $r_d = 0.8$, $r_d = 2.2$, and $r_d > 2.57$, respectively (assuming a constant $K = 1000$ fish). Label both axes for all graphs.

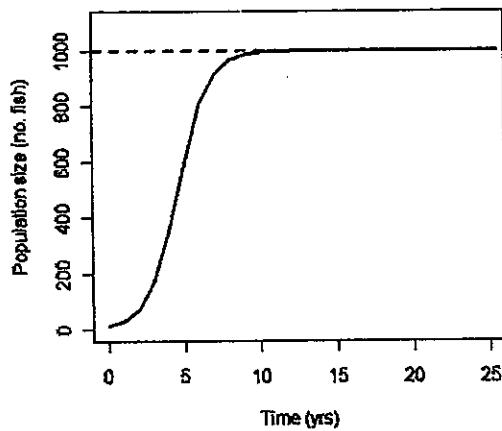


Fig. 2. Basic logistic growth model (with $r = 1.0$, $K = 1000$ fish)

3. (10分) Speciation is responsible for generation of species diversity over geologic time, but how diversity is maintained is a long-standing and not fully resolved question in ecology. Please consider the Fig. 3 to explain (1) what is **niche differentiation**; (2) what is **competitive exclusion**; and (3) How competition exclusion or coexistence may maintain the biodiversity?

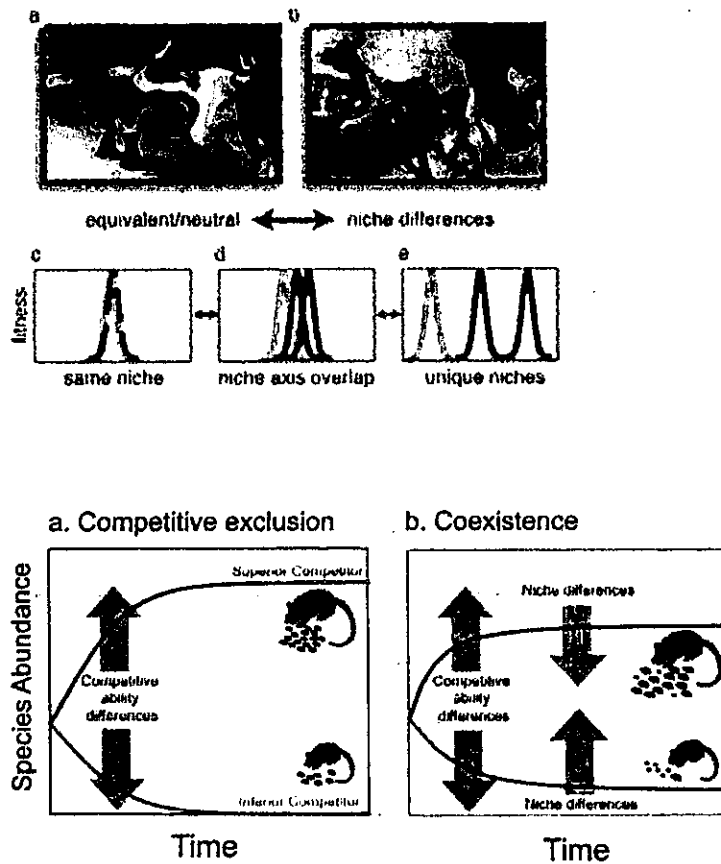


Fig. 3. Neutral vs. niche species and competitive exclusion vs. coexistence (adapted from Levine & HilleRisLambers, 2010)

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4. (9分) Crustose coralline algae (CCA) are important primary producer in the coral reef ecosystem. They create reef material through calcification. They stabilize reefs by binding coral rubble. They help prevent the biological destruction (bioerosion) of coral substratum. Some species chemically induce recruitment of corals and octocorals. In the tropical coral reefs, the fleshy algae, however, are competitively dominant over CCA and thus the grazing of herbivores keep fleshy algae from overgrown. Please use trophic cascade theory and consider Fig. 4 to explain (1) the effects of fishing large predatory fishes, (2) the effects of fishing herbivorous fishes, and (3) the effects of fishing sea urchins in the coral reef ecosystem.

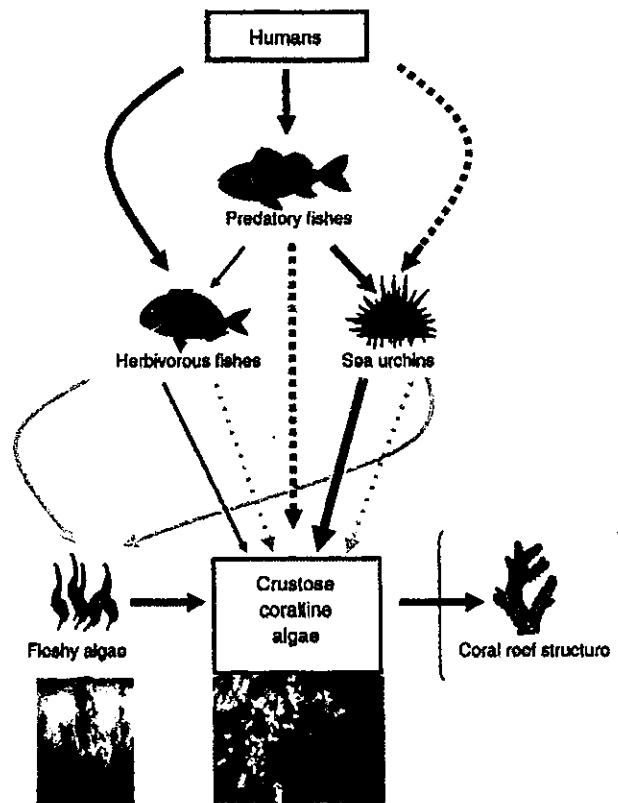


Fig. 4. Trophic cascade in the coral reef ecosystem. Solid lines indicate direct effects, and dotted lines indicate indirect effects. Gray lines (from herbivorous fishes and sea urchins to CCA) show the effects of algal removal (adapted from O'Leary & McClanahan, 2010).

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