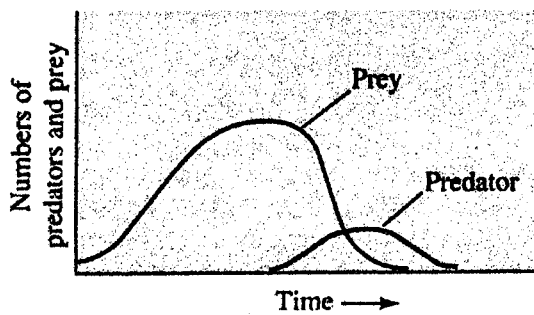


I. Define and compare the following pairs of terms

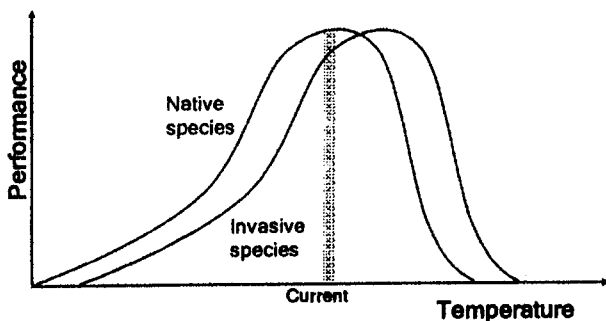
1. Decomposer and detritivore (8 points)
2. Mutualism and symbiosis (8 points)
3. Static life table and dynamic life table (8 points)
4. Stability and resilience (8 points)

II. Short answer questions

5. Please write the equation(s) of (A) exponential population growth, (B) logistic population growth, (C) geometric population growth; and (D) interspecific competition. (12 points)
6. The figure below showed the result when Gause (1935) grew *Paramecium aurelia* (prey) with *Didinium nasutum* (predator) in a simple laboratory microcosm in the absence of a refuge for the prey. Please draw the following two figures using the same axes in the figure below: (A) results of prey and predator interaction when a refuge is provided for the prey, and (B) when there is a refuge for and periodical restocking of prey. (6 points)



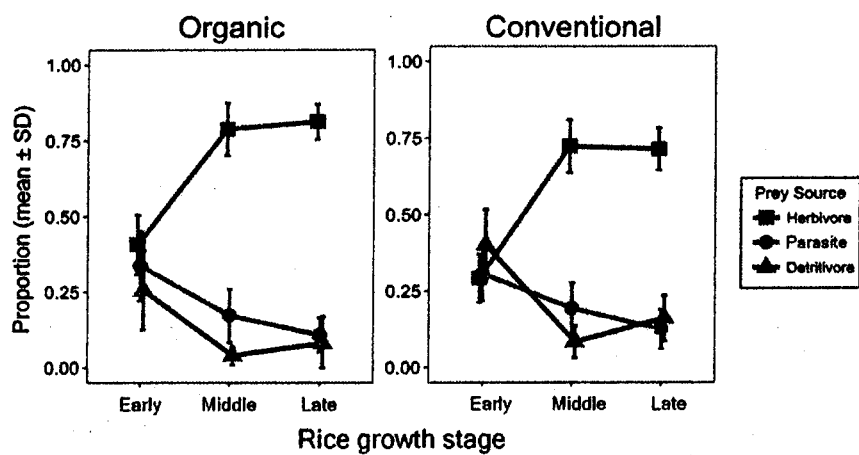
7. Lynx spiders often stays on pitcher plants. You suspect that a mutualistic relationship exists between them. (A) Please list a related hypothesis you can test. (B) Please briefly describe the methods to examine your hypothesis. (10 points)
8. Here are the thermal performance curves for a native and an invasive species in site Wonderland. (A) Please define thermal performance curve. Based on these curves, please predict (B) how climate warming may affect the competition between these two species in this site, and (C) how climate warming may affect the latitudinal distribution, altitudinal distribution, and phenology of these two species. (10 points)



9. (A) Please explain top-down control, bottom-up control, and trophic cascade. (B) If a community consists of an omnivorous predator species (consuming both herbivores and plants), a herbivore species, and a plant species, please predict how the predator species might affect the plant species. (10 points)
10. (A) Define niche, fundamental niche, and realized niche. (B) An invasive plant species is commonly found in Taiwan below 1000 m in elevation. Please list two mechanisms underlying this distribution pattern. (10 points)

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11. (A) Please define ecosystem service. (B) The diet (prey) composition of ladybugs in organic and conventional rice farms in Taiwan includes herbivores, parasites, and detritivores over rice growth stages (figure below). Please explain what ecosystem service the ladybugs provide and what findings this figure reveals. (10 points)



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