

There should be 8 pages to this exam - take a moment and count them now. Put your name on the first page of the exam, and on each of the last 3 pages (those with short answer questions). Please fill in your name on the front page of the bubble sheet  
 The following equations and constants may be helpful:

$$N_t = N_0 e^{rt}$$

$$dN/dt = rN(1-N/K)$$

$$dN_1/dt = r_1N_1(1-N_1/K_1 - a_{12}N_2/K_1)$$

$$dN_2/dt = r_2N_2(1-N_2/K_2 - a_{21}N_1/K_2)$$

$$dN_h/dt = r_hN_h - pN_hN_p$$

$$dN_p/dt = cpN_hN_p - d_pN_p$$

$$PV = nRT$$

$$N_t = \lambda^t N_0$$

$$N = nM/x$$

$$e = 2.72$$

$$\pi = 3.14$$

$$\ln(2) = 0.69$$

$$\ln(1) = 0$$

$$D = 1/\sum p_i^2$$

$$H = -\sum p_i \ln(p_i)$$

$$\log S = \log c + z \log A$$

Multiple Choice: \_\_\_\_/19 = \_\_\_\_\_/38

Question 20 \_\_\_\_\_/ 3

Question 21 \_\_\_\_\_/ 6

Quest. 22, Prepared essay: \_\_\_\_\_/ 16

\_\_\_\_\_

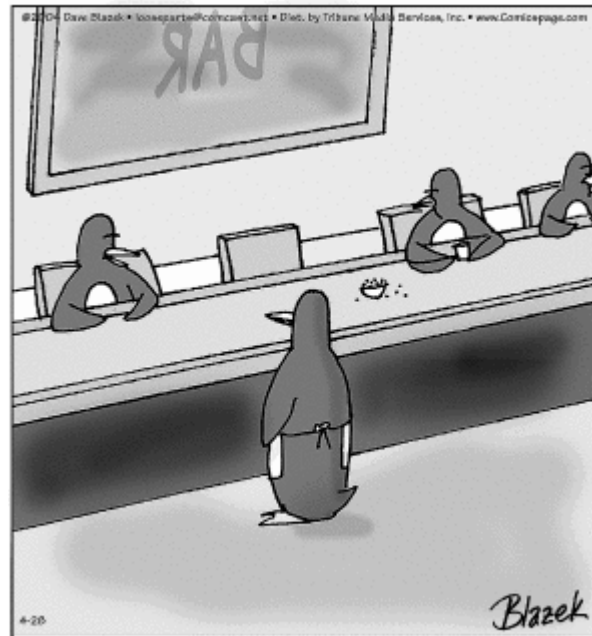
Total \_\_\_\_\_/63

**Loose Parts** by Dave Blazek



"Criminy! We can never have nice furniture around here."

**Loose Parts** by Dave Blazek

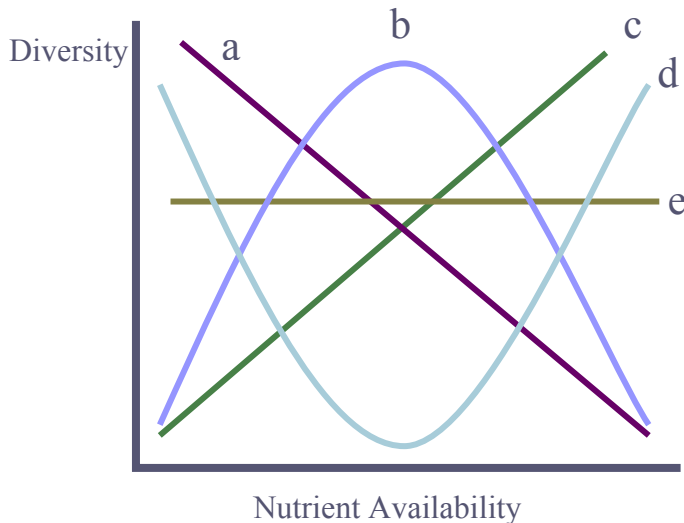


"Liquified regurgitated fish, please. And leave the bottle."

**Multiple Choice questions: 2 points each.** Please put your answers for this section on the bubble sheet. Feel free to use the question sheet for scratch work. Each question has only one correct answer. You will not be penalized for guessing on this section. Fill in your bubble sheet carefully. Make sure that the number of the question matches the number whose bubble you're filling in!

- 1) What kind of interaction exists between mycorrhizal fungi and plants?
  - a) Trophic mutualism
  - b) Competition
  - c) There is no interaction between these species
  - d) Predation
  - e) Parasitism

- 2) Which of the traces on the following graph best represent the way that community diversity is related to nutrient availability?

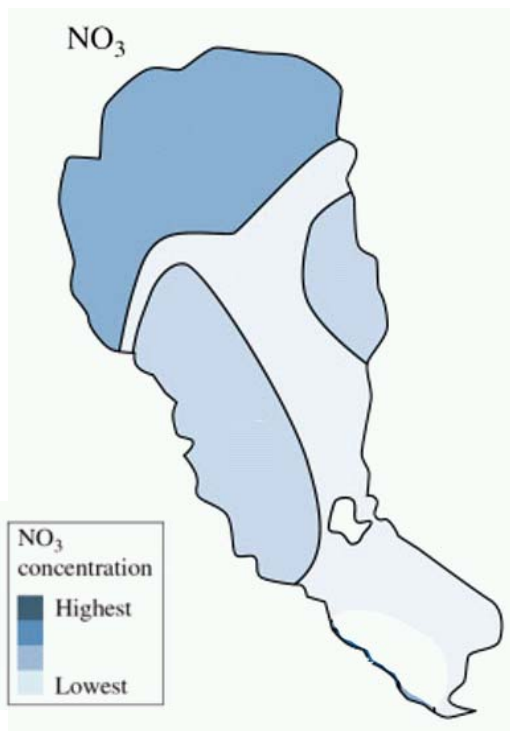
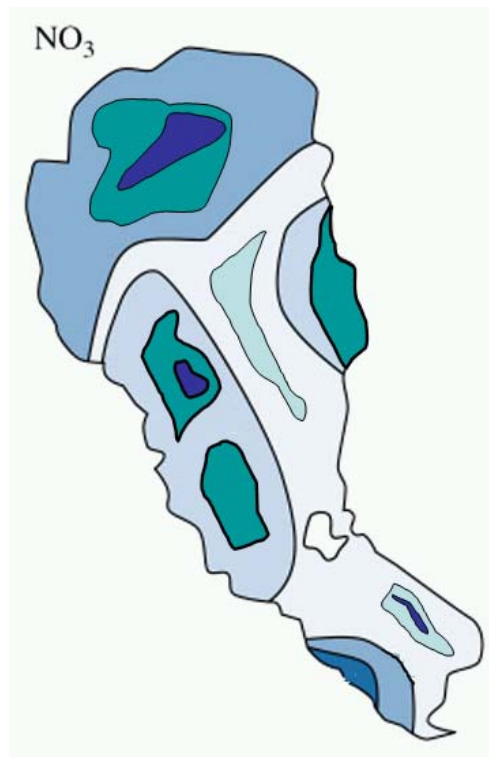


- 3) You have been employed to help assess the species diversity of the Insect Communities of the Bath Nature Preserve. Among the data you are to interpret are the following results from equal sized samples of several communities. Based on the best estimator of overall diversity, which of these communities is most diverse?

|                        | Number of Species | Shannon-Weaver Index (H') |
|------------------------|-------------------|---------------------------|
| A. Wetland Scrub-Shrub | 43                | 3.4                       |
| B. Disturbed Grassland | 10                | 1.2                       |
| C. Mature Woods        | 85                | 4.2                       |
| D. Disturbed Woods     | 13                | 2.2                       |
| E. Mature Grassland    | 98                | 3.9                       |

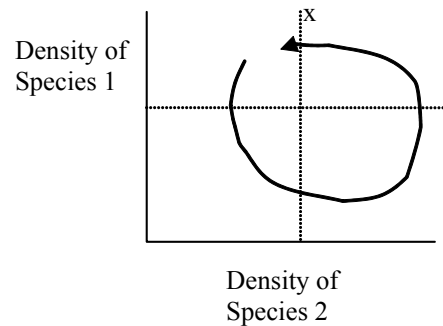
- 4) According to the intermediate disturbance hypothesis:
  - a) Species diversity is highest in the absence of disturbance
  - b) Species diversity is lowest at intermediate intensities or frequencies of disturbance
  - c) Species diversity is highest at intermediate intensities or frequencies of disturbance
  - d) Species diversity is highest when disturbance is both frequent and intense

- 5) These two diagrams show variation in abundance of dissolved Nitrate in two lakes that are near to each other. Based on what you've learned in this class, which lake is most likely to have more species of plankton and bacteria, and why?
- Lake 1, because it has a steady supply of nitrate
  - Lake 1, because it has a variable supply of nitrate
  - Lake 2, because it has a more complicated environment
  - Lake 2, because it has more nitrate
  - Neither, because they are the same size

**Lake 1****Lake 2**

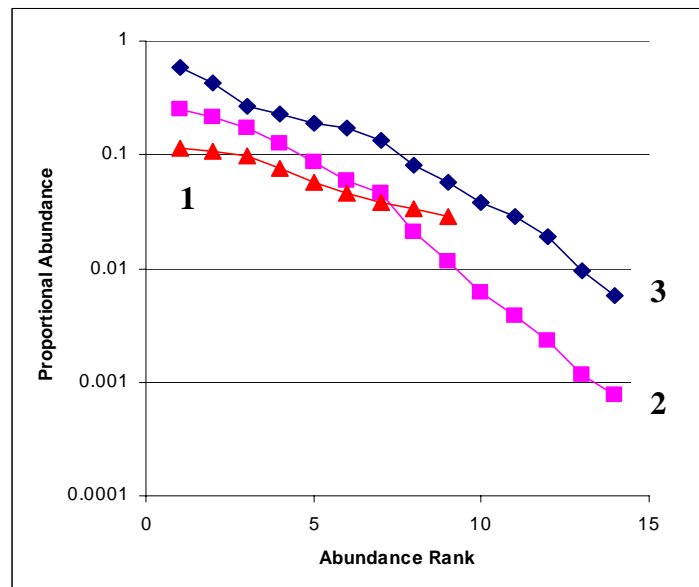
- 6) The main source of carbon dioxide in the atmosphere is:
- Burning of fossil fuels
  - Photosynthesis
  - Respiration
  - Dissolution of carbonate
  - Decay and decomposition
- 7) Food webs represent
- the sum total of food types consumed by an individual.
  - conceptual maps that link individuals together within a species.
  - conceptual maps that link species together within communities.
  - networks that capture resources
  - none of the above.

- 8) In class we used this type of graph when discussing:
- Amensalists
  - Competitors
  - Predator and Prey
  - Commensalists
  - Mutualists



- 9) Some Cabbage White butterflies emerge in the spring, and live for many weeks. As spring becomes summer, the environmental temperature gradually increases. During this time, a physiological shift in the optimum temperature for butterfly flight activity occurs. This is best considered to be an example of:
- Optimal foraging
  - Liebig's Law of the Minimum
  - Acclimation
  - Adaptation
  - C3

- 10) According to the rank-abundance curves displayed in the graph, which community is the most EVEN?
- community 1
  - community 2
  - community 3
  - communities 2 and 3 have equal species evenness
  - There is not enough information to tell

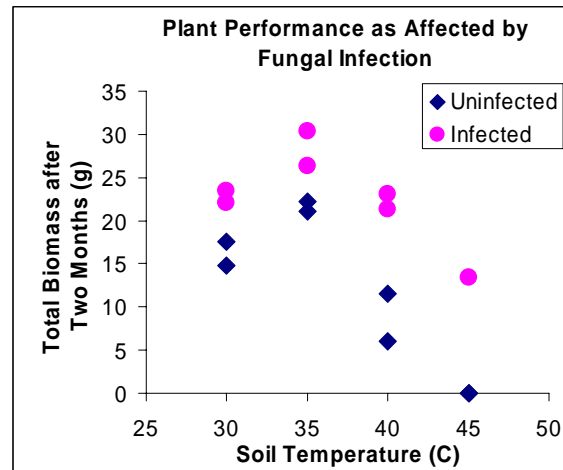


- 11) The Lotka-Volterra competition equations predict that two competing species can coexist if:
- both species inhibit each other equally
  - each species inhibits itself more than it inhibits the other species
  - each species inhibits itself less than it inhibits the other species
  - each species inhibits itself more than it is inhibited by the other species
  - each species is not inhibited by the other

- 12) Fill in the blanks of this sentence from the options below:  
Most species are \_\_\_\_\_; few are \_\_\_\_\_ or \_\_\_\_\_.
- a) carnivores; detritivores; producers
  - b) mutualists; predators; competitors
  - c) diverse; even; species rich
  - d) moderately abundant; very abundant; extremely rare
  - e) keystone species; unimportant; invasive
- 13) Which of the following equations would be most useful in modeling the relationships between predator and prey?
- a)  $N_t = N_0 e^{rt}$
  - b)  $dN/dt = rN(1-N/K)$
  - c)  $dN_1/dt = r_1N_1(1-N_1/K_1 - a_{12}N_2/K_1)$ ;  $dN_2/dt = r_2N_2(1-N_2/K_2 - a_{21}N_1/K_2)$
  - d)  $dN_h/dt = r_hN_h - pN_hN_p$  ;  $dN_p/dt = c_pN_hN_p - d_pN_p$
  - e)  $H = -\sum p_i \ln(p_i)$
- 14) Which of the following situations was mentioned in lecture as a possible example of predator satiation?
- a) Cicadas that emerge every 13 or 17 years
  - b) Plankton blooms in ponds during the spring
  - c) Bacterial populations in Lake Michigan
  - d) Yuccas and yucca moths
  - e) Parasitoids that attack caterpillars
- 15) Which of the following DOES NOT promote coexistence of predator and prey in the Lotka-Volterra Predator-Prey mode?
- a) Predators are efficient at capturing prey
  - b) Predators switch to other prey
  - c) Prey have refuges
  - d) Density dependence in either species
  - e) Predator population growth responds quickly to changes in prey density
- 16) The interaction between sunflowers and bees is typical of most mutualisms in that it is:
- a) Diffuse
  - b) Tight
  - c) Obligate
  - d) Rare
  - e) Unstable
- 17) The main source of carbon dioxide in the Earth's atmosphere is:
- a) Photosynthesis
  - b) Dissolution of carbonate
  - c) Burning of fossil fuels
  - d) Respiration
  - e) None of the above

- 18) Diseases often exhibit cyclic outbreaks. In class we considered the possibility that this is because:
- a) diseases have mutualistic interactions with disease vectors like mosquitoes
  - b) diseases have a circadian rhythm
  - c) host immunity varies systematically over time
  - d) disease-host interactions are a form of predator-prey interaction
  - e) a and b
- 19) Your text presents an example of mutualism involving the ant *Pseudomyrmex ferruginea* and bullhorn acacia (*Acacia cornigera*). Which of the following statements about that particular relationship is FALSE?
- a) The tree provides food for the ants in the form of extrafloral nectaries at the bases of leaves and Beltian bodies on the tips of some leaves.
  - b) This ant species is the sole pollinator for this tree species.
  - c) Although other acacias lose their leaves during the dry season, this tree species retains its leaves year round, and thereby provides a year-round food source for the ants.
  - d) The ants defend the plants against not only herbivores, but also other plants which come into contact with their home tree.
- 20) There is strong evidence that the global concentration of carbon dioxide in the atmosphere is now higher than at any time in the last half million years. Which of the following is the reason for this increase cited in your book and in lecture?
- a) Increased volcanic activity
  - b) Increased photosynthesis
  - c) Increased combustion of fossil fuels
  - d) Increased respiration and metabolism by the growing human population
  - e) Gradual oxidation of elements in the earth's crust has slowly increased

Read the following to answer the next question: Yellowstone National Park is well known for being geologically active, with many hot springs and geysers. Few plants can grow in these thermally stressful environments, where the soil temperature often exceeds 40C, and goes well over 50C in the summer. Scientists were interested in the hypothesis that mutualistic fungi help plants to survive these conditions. In the November 22 2002 issue of the Journal "Science" (volume 298, page 1581) Regina Redman and her colleagues present a test of this hypothesis. They studied the effects of fungal infection on performance of "Hot Springs panicgrass" (*Dicanthelium lanuginosum*). To do this they isolated a fungus from the roots of Hot Springs Panic Grass plants. They grew this fungus in the lab. When kept at 20-35C, the fungus grew fine, but none survived when the temperature was above 40C. To assess the effect of the fungus on the plant, they grew the plants in the greenhouse at a range of temperatures from 30-45C. They infected half of the pots at each temperature with the fungus, and measured plant growth after two months. Microscopic examination of roots confirmed that plants in the uninfected treatment had no fungus on or in them, and those in the infected treatment did. Plant growth responses to fungal infection are in the figure above.



- 21) Are the results described above consistent with the idea that there is a mutualistic relationship between this plant and this fungus?
- No, because this is a parasitic relationship
  - No, because both groups of plants did worse at high temperatures than at low temperatures
  - Yes, because the infected plants grew better at high temperatures
  - Yes, because the fungus could not grow at high temperatures without the plant
  - More than one of the above

**16 points.** YOUR REVIEW SHEET HAD 3 QUESTIONS YOU WERE TO PREPARE FOR. OF THOSE, THIS IS THE ONE YOU MUST ANSWER. REMEMBER: your answer should be well reasoned and well written -- outline format is not acceptable (though you may outline the answer for your own benefit on the back of another page)

In your job at the Science Museum, you have been asked to set up an aquarium for tropical fish. However, your boss wants the aquarium to be sealed (nothing can go in or out of it), so that it will not require any maintenance or feeding. The only input to this system will be sunlight. Using the principles we have learned in this class, discuss some of the important issues that you would have to address when setting up a self-sustaining system of this type. Base your answer primarily on what you have learned about ecosystem and community ecology in this class.

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22) Draw a properly labeled graph showing how species richness typically changes during succession.

23) Answer ONE of the following questions

a) Dr. Peter Lavrentyev gave a guest lecture on Aquatic Ecology. Please identify and explain one area of his talk that especially interested you, or that fit particularly well with other information we've learned in this course. Briefly explain the topic, then carefully explain how that topic is related to other topics we've covered in this course

b) The course TA, Brian Cusack, gave a guest lecture about his research on Lizards. Please identify and explain one area of his talk that especially interested you, or that fit particularly well with other information we've learned in this course. Briefly explain the topic, then carefully explain how that topic is related to other topics we've covered in this course.