

There should be 10 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 few pages with short answer questions. Please fill in your name on the front page of the bubble sheet. FILL IN THE "TEST FORM" bubble in the lower right of the bubble sheet. You have **Test Form A**

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: ____/29 = _____/58

Question 27 _____/ 6

Question 28 _____/ 8

Question 29, Prep'd essay: _____/ 15

Total _____/87

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Armchair Naturalist

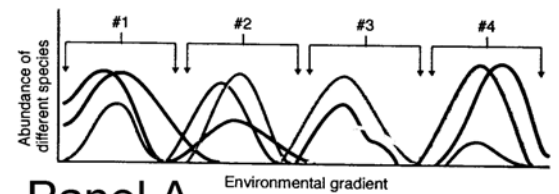


The main symptoms of this horrifying disease are the inability to see objects on a screen, underlaid with a growing feeling of perplexity."

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. Make sure that the number of the question matches the number whose bubble you're filling in!

- 1) Elephants are not the most common species in African grasslands. The grasslands contain scattered woody plants, but they are kept in check by the uprooting activities of the elephants. Take away the elephants, and the grasslands convert to forests or to shrublands. The newly growing forests support fewer species than the previous grasslands. Elephants can be defined as what type of species in this community?

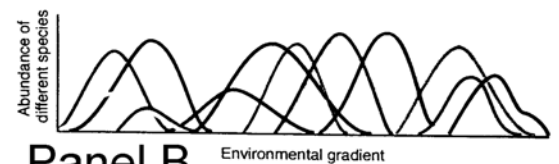
- Bottom-up
- Dominant
- Keystone
- Functional group
- None of the above



Panel A

- 2) Which of the panels in this figure best supports the idea that communities are like 'superorganisms'?

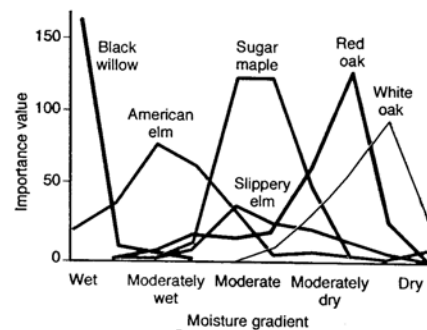
- Panel A
- Panel B
- Panel C
- All of them
- None of them



Panel B

- 3) The Park Grass Experiment in Rothamsted, UK is the longest running ecological experiment in the world. At that site, investigators have been fertilizing plants since 1856. Results from that study show:

- fertilization reduced productivity
- fertilization increased soil fertility and increased niche diversity
- fertilization increased heterogeneity in the soil and increased plant diversity
- fertilization decreased community diversity and homogenized soil conditions
- fertilization encourages symbiotic relationships with nitrogen fixers

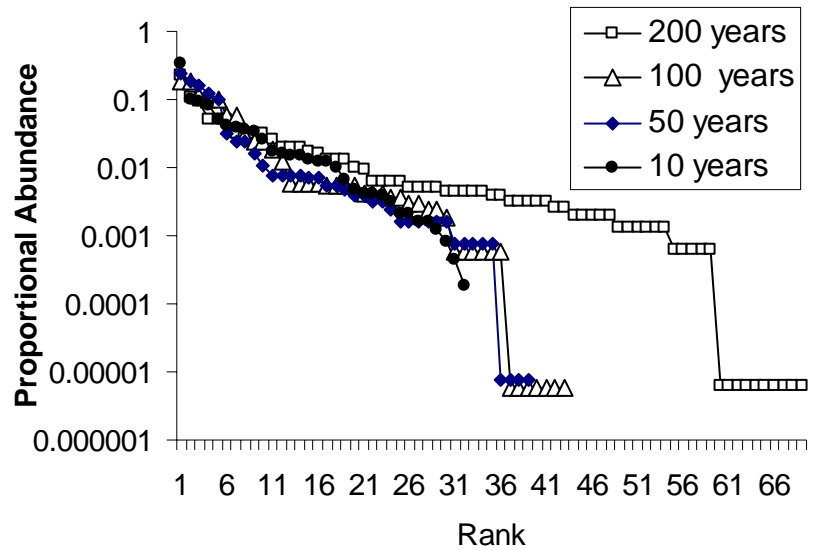


Panel C

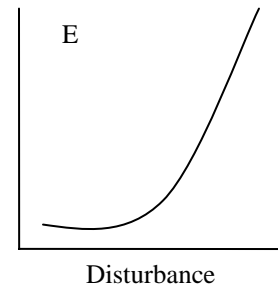
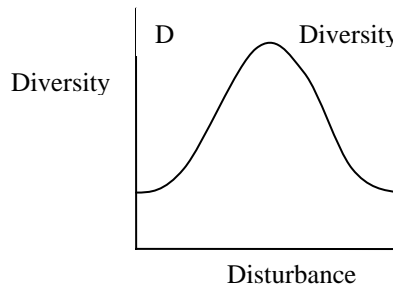
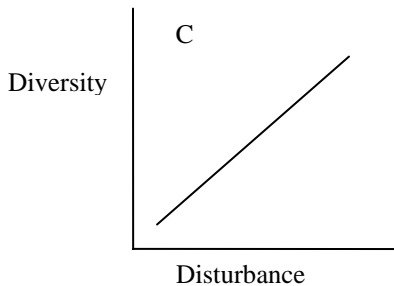
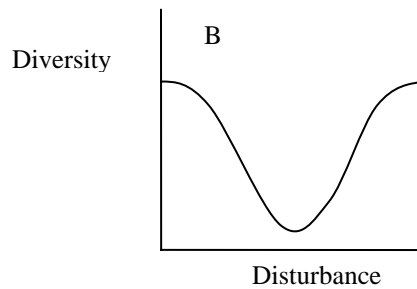
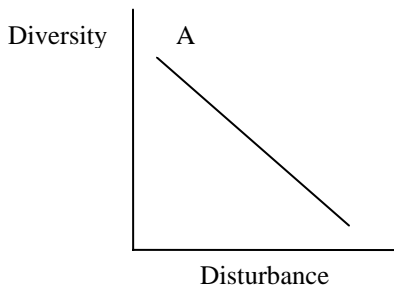
- 4) Which of the following often leads to "algal blooms" in freshwater lakes, which, in turn, result in the death of fish due to low oxygen concentrations in the water.

- Acid rain
- Global warming
- Top down control
- Succession
- Eutrophication

- 5) Here are some results from plant surveys of abandoned farms. Each farm has been abandoned for a different amount of time. Which conclusion does these data support?
- a) Species composition increases during succession
 - b) Dominant species increase during succession
 - c) Nitrogen cycling increases during succession
 - d) Thermal tolerance increases during succession
 - e) Diversity increases during succession



- 6) Which of the following demonstrated that starfish act as keystone predators?
- a) Robert MacArthur
 - b) Joseph Connell
 - c) Henry Gleason
 - d) Robert Paine
 - e) Frederic Clements
- 7) We have discussed the intermediate disturbance hypothesis in class. Which of the following graphs is the best representation of that hypothesis?

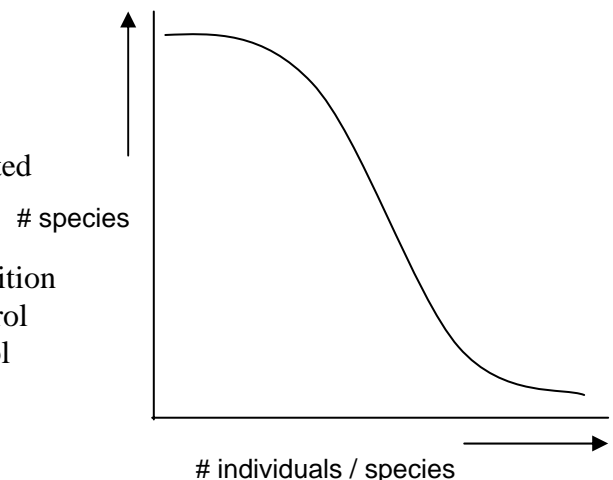


- 8) Succession in northeastern Ohio usually results in which of the following 'climax' communities?
- Herbaceous Perennials
 - Shrubs
 - Spruce-Fir Forest
 - Beech-Maple Forest
 - Oak-Hickory Forest
- 9) For mutualism to occur, which must be true:
- Neither species needs to benefit so long as they are not hurt
 - One species needs to benefit slightly so long as the other is not hurt
 - One species needs to benefit greatly
 - Both species need to gain a net benefit
 - Both species need to gain enough benefits to offset the costs

The following three questions involve the same situation:

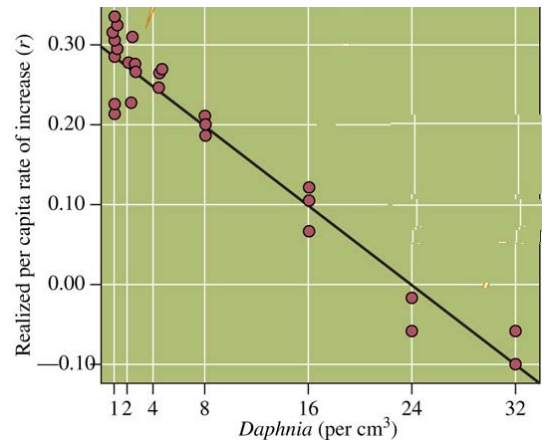
- 10) Each morning at breakfast you have been recording the bird species you see in your large backyard. At the end of a month you have tallied eight seed eaters, one nectar sipper, three woodpeckers, six insectivores, four predators, and one carrion feeder. What is the bird species richness of your backyard?
- 0.24
 - 6
 - 23
 - 17
 - Not enough information is given
- 11) What term best describes each of the categories you have used tallying the birds seen in your backyard (in the question above)?
- Community
 - Guild
 - Population
 - Habitat
 - Metapopulation

- 12) This graph shows a rank-abundance plot of the birds you saw at your feeder. Based on what we've learned in class, which of the following conclusions is supported by these data?
- Most species are very common
 - These bird species are experiencing heavy competition
 - This community is experiencing 'bottom-up' control
 - The community is experiencing 'top-down' control
 - You need to gather more data



- 13) Which of the following statements is false?
- Plants benefit from mutualistic partnerships with a wide variety of bacteria, animals, and fungi
 - Reef-building corals depend upon mutualistic relationships with algae and animals
 - Mutualism occurs when there is any benefit to either species in an interaction
 - Most species are moderately abundant; few are very abundant or extremely rare.
 - Mycorrhizal fungi aid plants by providing them with better access to mineral nutrients and water, while the plant provides carbohydrates to the fungi.
- 14) Akron and many cities across the country have ‘combined sewer’ systems to deal with liquid waste. Intense rainstorms in such areas can cause a ‘combined sewer overflow’. Which of the following is the best description of the outcome of a combined sewer overflow?
- The sewage overflows into the streets.
 - Raw sewage becomes mixed with rainwater, and bypasses the sewage treatment plant
 - Rain water from the roads is diverted around the sewage treatment plant, while only sewage is treated
 - The sewage treatment plant increases processing speed and keeps up with the extra demand
 - The combined sewers overflow into the separate sewers, which hold the extra water until it can be processed

- 15) Here are some data from your book concerning the response of water fleas (*Daphnia pulex*) to the density of conspecifics. Which of the following conclusions is supported by these data?
- r_{\max} is achieved at a density of 32 *Daphnia*/cm³
 - The carrying capacity is 24 *Daphnia*/cm³
 - This population does not show density dependence
 - This is a ‘K’ selected species
 - This population would best be described by an exponential growth model



- 16) In a deep-sea hydrothermal vent near the Galapagos Islands, bacteria obtain energy by oxidizing hydrogen sulfide released from the vents. Giant tube worms, which lack mouths and digestive systems, harbor the bacteria in their tissues and use them as a source of organic molecules. Clams obtain energy by filtering bacteria directly from the water, and numerous crabs and octopi feed on the clams. In this unique ecosystem, the bacteria are playing the role of
- Herbivore
 - Primary consumer
 - Parasite
 - Top Carnivore
 - Primary producer

- 17) The body temperature of most insects and reptiles is primarily determined by heat from their environment. Which of the following terms is the best scientific description of this situation?
- Cold-Blooded
 - Homeothermic
 - Ectothermic
 - Hot-blooded
 - Endothermic
- 18) Which of the following conceptual levels of ecological organization incorporates abiotic factors?
- Ecosystem
 - Community
 - Population
 - Species
- 19) What causes the seasons on Earth?
- rotation of the Earth on its axis
 - varying distance of the Earth from the sun
 - tilt of the Earth in relation to the sun
 - natural variation in the sun's output of heat
- 20) A biologist was observing the tiny floating plant "duck-weed" (*Lemna minor*) growing in a pond near Akron. She reports that the population started with a single plant. The number of plants doubled every week for 20 weeks, at which point the pond became completely covered with duck-weed. Assuming no limits on exponential growth, when was the pond half covered with duck-weed?
- after 19 weeks
 - after 15 weeks
 - after 14 weeks
 - after 5 weeks
 - after 1 week
- 21) While fishing in ponds and lakes, you catch mostly green sunfish when you set your line near shore, but even with the same bait, you catch mostly bluegill (a different species of fish that is very similar to green sunfish) out in the open water. Is this zonation likely to be the result of competition?
- yes; this is an example of resource partitioning
 - yes; competition theory predicts that complete competitors cannot coexist
 - no; these two species rely on different resources
 - no; these two species have different physiological tolerances
 - it is impossible to tell given this information
- 22) Carbon dioxide in the atmosphere has a residence time of about:
- 3 days

- b) 3 weeks
- c) 3 years
- d) 30 years
- e) 300 years

23) The ultimate source of energy for living things on the earth's surface is:

- a) Sugar
- b) Amino Acids
- c) Photons of sunlight
- d) Decomposition

24) What happens to energy as it moves up to successive trophic levels in the food chain?

- a) Energy is passed on to higher trophic levels with equal efficiency in all organisms because it is governed by simple physical principles.
- b) Most energy is lost because of maintenance metabolism and the cost of processing food
- c) Much energy is lost, but it is replaced at higher trophic levels by the process of photosynthesis
- d) Energy is passed with high efficiency to each succeeding trophic level.
- e) No energy is lost from the food chain as it is passed on to higher trophic levels, because energy is always conserved

25) What is the reason that climate models currently predict that the global temperature will increase 2-6 °C in the next 50 years?

- a) Human activities have liberated excess sulfur into the atmosphere, and the resulting acid rain is altering the climate
- b) Space aliens have been aiming heat beams at our planet to make the Earth conform more to their own niche requirements.
- c) Increased volcanic activity is not only adding sulfur and carbon dioxide into the atmosphere, but is also liberating the earth's internal heat at an accelerated rate.
- d) The climate goes through natural cycles, sometimes warmer, sometimes colder. We happen to be in a warming swing now, but this has nothing to do with human activities.
- e) Human activities have liberated excess carbon dioxide, and this increases the atmosphere's ability to retain heat

26) A chemical that is susceptible to Biomagnification would have which of the following attributes?

- a) soluble in fat
- b) short-lived
- c) necessary in nutrition
- d) long carbon chains
- e) vital in vitamin metabolism

27) Which of the following nutrient cycles is most directly involved with acid rain?

- a) Water

- b) Carbon
- c) Nitrogen
- d) Sulfur
- e) Phosphorus

- 28) During a walk in your neighborhood, you notice some dog poop in an inaccessible corner of the sidewalk. Being a scientist (and unsqueamish at that), you decide to study succession on this turd. Over the next 3 weeks you observe that bacteria are the first colonizers, followed by bluebottle fly larvae (maggots) within a few days, dung fly larvae within a week, then by several different species of beetle larvae after 2 weeks. Based on your observations, you hypothesize that this system follows the "facilitation" model of succession. Which of the following best supports this hypothesis?
- a) In later walks you discover fresh turds inhabited only by beetle larvae.
 - b) An experiment reveals that bluebottle fly maggots produce toxins that inhibit later arriving colonists
 - c) You prevent bacterial colonization of some turds and find that bluebottle fly larvae are unable to survive, although they survive fine on those turds colonized by bacteria.
 - d) In later walks you discover fresh turds that have bacteria, beetle larvae, bluebottle fly larvae, and dung fly larvae all at once.
 - e) Your neighbor scoops up the poop.
- 29) Which of these factors helps to stabilize mathematical models of mutualism?
- a) Obligatory relationships
 - b) Changing the a_{ij}
 - c) Fixed carrying capacity
 - d) Growth of both species
 - e) Unlimited resources

- 30) (6 points) Choose one concept you learned in this course that might be applicable to someone pursuing a career in medicine or human health. Briefly explain that concept AND how it is applicable to medicine or human health. Please use this as an opportunity to BRIEFLY demonstrate your mastery of the material.
- 31) 8 points. During a tropical snorkeling trip you observe that nearly all the sea anemones have small clown-fish associated with them. You hypothesize that these two species form a mutualism whereby the clown-fish obtains food and protection from the anemone and in turn removes parasites from the anemone. Describe the basic outline of some simple experiments to determine whether or not this is a mutualism (+/+). Indicate the results you expect if it is indeed a mutualism.

32) **15 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 unacceptable (though you may outline the answer for your own benefit on the back of another page)
In the chapter on global ecology we learned that humans have more than doubled the quantity of fixed nitrogen cycling through the biosphere. Discuss some of the consequences of this for the nitrogen cycle, and how such changes might affect natural communities and ecosystems.