There should be 10 pages to this exam. Put your name on the first page of the exam, and on each of the last few pages (those with short answer or essay questions). On the answer (bubble) sheet, please fill in name and course info (3100-217-001)

READ THE ESSAY AND SHORT ANSWER QUESTIONS CAREFULLY!

$$\frac{E}{T} = \frac{N_{e1}E_1 - C_s}{1 + N_{e1}H_1} \qquad \frac{E}{T} = \frac{\sum N_{ei}E_i - C_s}{1 + \sum N_{ei}H_i}$$

Exam begins in two pages

SCORE (to be filled in by grader)

Multiple choice:
20 questions (40 points total); 2 points each x ____ ==> _____

Short answers: 21) 2 points _____

22) 6 points _____

23) 6 points _____

24) 5 points _____

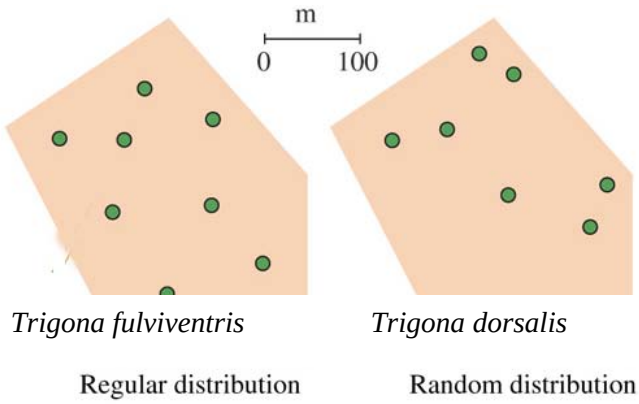
25) 6 points _____

26) 15 points _____

Total (80 points) _____ = _____%

Multiple Choice questions: 2 points each. Please put your answers to this section on the Standardized 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 Answer Sheet carefully. Make sure that the number of the question matches the number whose bubble you're filling in!

1) Detailed studies of stingless bees in tropical dry forest indicate that nests of some species (such as *Trigona dorsalis*) are distributed randomly within the habitat, while other species (such as *Trigona fulviventris*) are distributed regularly (See figure). Which of the following conclusions is most compatible with this finding?
   a) *T. fulviventris* nests are attractive to nests of the same species, while *T. dorsalis* is not.
   b) *T. fulviventris* nests are antagonistic to other nests of the same species, while *T. dorsalis* is not.
   c) *T. fulviventris* nests have a neutral effect on nests of the same species, while *T. dorsalis* does not.
   d) Distributions do not provide any insight on the interactions between nests
   e) These distributions are caused by competition and aggression between these two species.



2) Which of the following statements about small populations is most correct?
   a) They are much less common than are large populations for most species
   b) They have smaller niches than do large populations
   c) They are more likely to acclimate to new conditions than are large populations
   d) They are more likely to go extinct than are large populations
   e) They are more likely to be ectothermic

3) Mathematical models of optimal foraging involve which of the following?
   a) prey growth rates, predator population increases, and predator learning curves
   b) encounter rate, searching benefit, handling cost, and energy gain
   c) toxins, conditions, and the niche
   d) encounter rate, search cost, handling time, and energy yield per prey item
   e) temperature, salinity, and pH

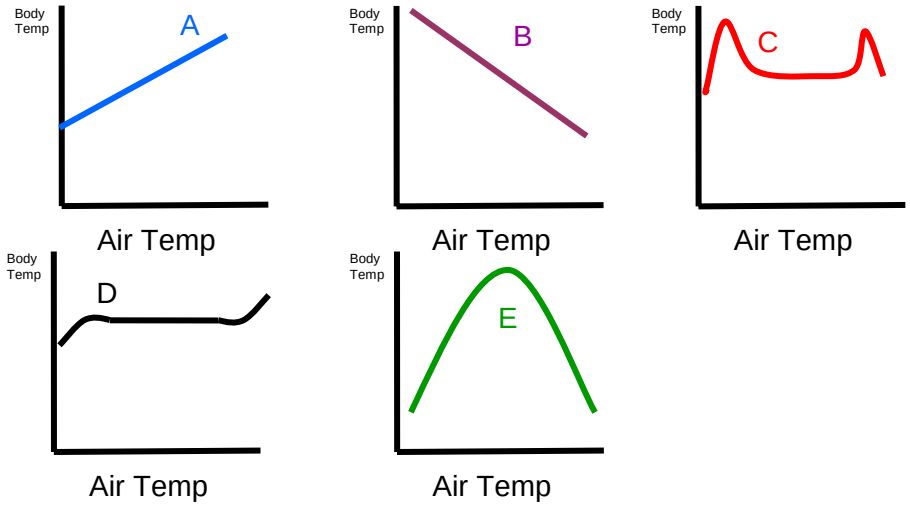
4) Which of the following hierarchies is correctly ordered by level of biological organization?
   a) population, ecosystem, landscape, individual,
   b) individuals, population, community, ecosystem
   c) biosphere, landscape, individuals, community
   d) ecosystem, landscape, populations, region
   e) None of the choices are correct.

5) Photosynthetic organisms derive their <u>energy</u> from

a) Sulfur-dioxide
b) Carbon dioxide
c) Hydrocarbons
d) Light
e) More than one of these, depending on environmental conditions

6) Based on your textbook, which animal is most likely to have the highest population density?
a) Blue Jays– because they are bigger
b) Juncos – because they are smaller
c) Neither – large and small animals have similar population densities
d) Neither –there is no predictable relationship between population density and organism size
e) It depends - there is so much variation in the real world that more information about their habitat is needed to allow even a rough prediction

7) In class we discussed toad in the Rocky Mountains and encountered an unexpected snowstorm and had no access to shelter. Which of these graphs should best describe how the toad's body temperature changed with the air temperature?

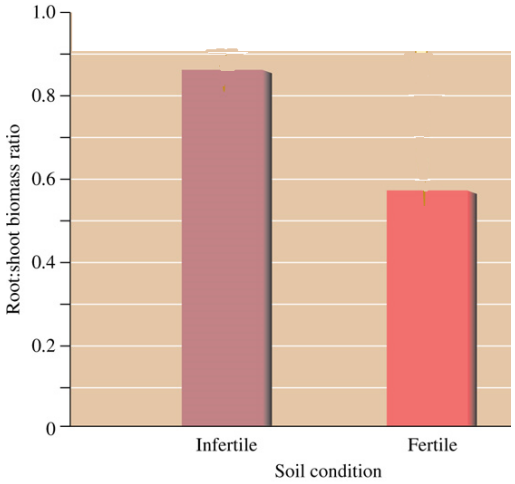


8) Which of the following is an advantage that plants with C4 photosynthesis have over plants that rely only on C3 photosynthesis?
a) C4 plants show a saturating response to light abundance
b) C4 plants can close their stomata more often, which reduces water loss
c) C4 plants can open their stomata more often, which allows them to increase the amount of sunlight they receive
d) C4 plants can reduce leaf temperature better than can C3 plants
e) C4 plants have higher transpiration rates than do C3 plants

9) While on a walk you notice that some dark leaves have fallen on the light dusting of snow. A bit later you notice that the snow has melted away near the leaves. This is most likely because of

a) Metabolic heat gain by the leaf.
b) Evaporative heat loss by the snow
c) Conductive heat loss by the snow
d) Radiative heat gain by the leaf
e) Convective heat gain from the air

10) To determine the effects of soil nutrients on plant growth, two scientists grew Birch tree seedlings in pots of boreal forest soils that were either infertile (low nitrogen content), or fertile (high nitrogen content). Their results are shown in this graph, which provides an example of:
a) The principle of Resource Allocation
b) The advantages of C3 photosynthesis
c) Müllerian mimicry
d) Experimental realism
e) Saturating resource availability



11) It's a hot summer day and even though you're in the shade, you begin to sweat. Which method of heat exchange is most affected by your sweating?
a) Conduction
b) Evaporation
c) Radiation
d) Metabolism
e) Endothermic

12) The idea of a metapopulation is of most value in understanding which of the following?
a) populations that periodically have surges in population size
b) populations occurring in fragmented habitats
c) populations with narrow niche requirements
d) populations that are at the edge of their geographic range
e) populations with broad niche requirements

13) Which of the following statements is **false**?
a) Variation in the aspect of a landscape can create microclimatic variation in temperature
b) Aquatic environments show less temperature variation compared to terrestrial environments
c) Microclimatic variation in temperature is usually small and unimportant
d) Most species perform best in a fairly narrow range of temperatures

14) Why does the air temperature in Akron get warmer in the summer?
a) The earth is closer to the sun.
b) The air becomes thicker and denser.
c) The sun's rays are more direct and days are longer.

d) The heat produced by cars and businesses increases
e) The sun puts our more heat energy

15) Your book defines 'ecology' as:
a) the study of the impact of human activity on the environment.
b) the study of the biosphere
c) the study of relationships between organisms and the environment
d) the study of the abiotic portion of the environment
e) the study of environmental change

16) In your study of the ecology of the Eastern Gray Kangaroo you decide to manipulate both the availability of food, and the availability of water in a large number of replicated plots in Southeastern Australia, each 1kmx1km in size. After 10 years you census the kangaroo population, and find the following results (average number of Kangaroos per plot):

Plots with food added:	11 kangaroos
Plots with water added:	20 kangaroos
Plots with neither added:	10 kangaroos
Plots with both added:	40 kangaroos

Which of the following statements best describes the results of this experiment?
a) Kangaroo niche requirements are met throughout Australia
b) Kangaroo habitats are not well supplied with food
c) The niche of Kangaroos does not involve food or water
d) Kangaroos show a synergism between their requirements for food and water
e) Kangaroo populations are not limited by food or water

17) Which scale of ecological investigation explicitly incorporates abiotic factors?
a) community
b) ecosystem
c) population
d) species
e) individual

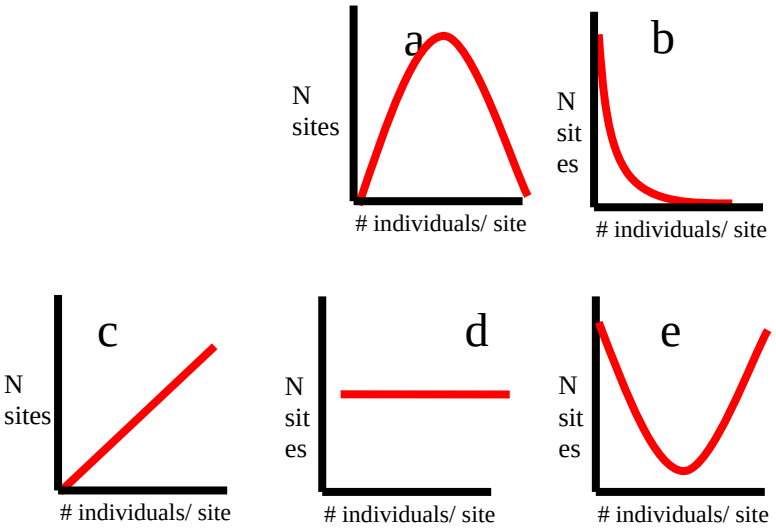
18) In general, a plant located in an arid climate will possess all of the following in order to prevent water loss **except**:
a) waxy coating.
b) decreased root biomass.
c) decreased shoot biomass.
d) reduced leaf size.

19) While traveling in the western United States, you visit some hot springs in Death Valley National Park. Where the hot spring waters mix and join with waters from a cold mountain stream, you see lots of small fish. With your thermometer you determine that the water from the hot spring is 110F, while the water from the mountain stream is 45F. Where the two waters come together and mix, the temperature is intermediate – warmest near the hot spring, coolest near the mountain

stream. Fish are found in all three areas – hot, cold, and inbetween, and seem to be healthy and happy. Which of the following terms would be the best for describing those fish?

a) Warm-blooded
b) Torpid
c) Poikilothermic
d) Endothermic
e) Hypoosmotic

20) Which of these graphs best describes how local abundance varies among sites for Red Eyed Vireos?



21) 2 points. What biome do we live in here in Akron?

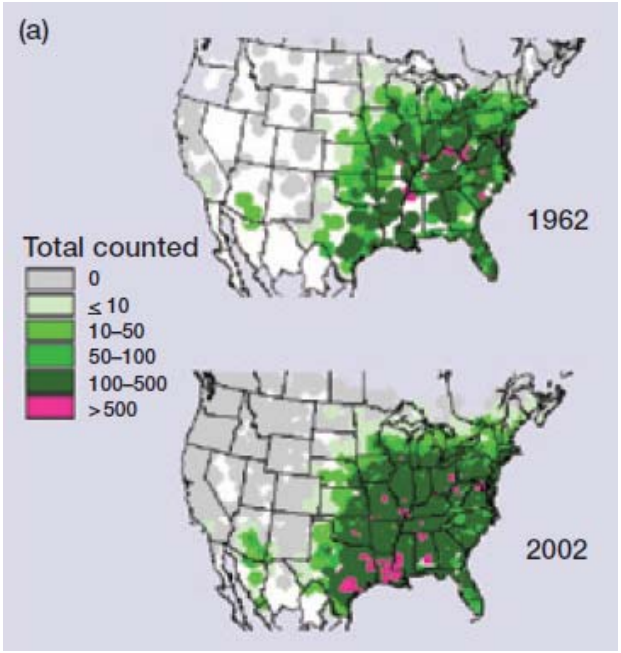
22) 6 points. Draw a fully labeled graph representing how an organism's performance typically varies with abundance of an important resource. Explain in words how and why this would differ from the response to a 'condition' of the environment?

23) 6 points. During a vacation on a tropical island, you spend a lot of time in your hammock, sipping an iced drink and watching the chameleons in the underbrush. After a while, you notice that these color-changing animals are mostly dark green in the morning, paler shades in the middle of the day, and dark again in the late afternoon. Give one reasonable hypothesis to explain this pattern.

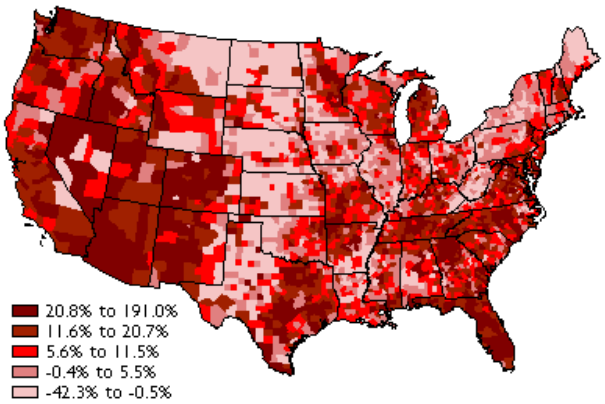
Now propose an observation or experiment that would test that hypothesis. What are some of the strengths and limitations of your plan?

24) **5 points.** In class we discussed both the Eltonian Niche, and the Hutchinsonian Niche. Please compare and contrast these two concepts

25) **6 points.** In your reading for the birdfeeder assignment the authors argued that the recent range expansion for Northern Cardinals (see figure to right) is in part a result of an increase in the abundance of bird feeders.



a) Below are some data on human population changes over approximately the same period). Does this additional information strengthen or weaken the author's interpretation of Northern Cardinal distributions? Why or why not?



b) Describe one piece of additional information that would help to support or refute the hypothesis that feeders are responsible for the observed changes in cardinal distribution. Be sure to explain how this information would help your evaluation.

26) **15 points**. Pre-prepared review sheet question: 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). Your answer should fit on this page.

At this time of year in Akron, animals and plants must deal with very low temperatures, and they exhibit a variety of responses to this thermal challenge. For an organism of your choice (provide both common and scientific name), list two adaptations that allow it to deal with the cold temperatures of an Akron winter. Explain how these meet the definition of an adaptation, and how each of these adaptations works – how they affect the organism's heat balance and avenues of heat exchange.

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