There should be 9 pages in this exam - take a moment and count them now. Put your name on the first page of the exam, and on each of the pages with written questions. Please fill in the first character or two of the sections on the front of the Bubble sheet, including SS #, name, and course information (3100-217-001).
     The following equations and constants may be helpful:

$\lambda = N_{t+1} / N_t$

$R_o = \Sigma \, l_x \, m_x$

$N_t = N_o \, \lambda^t$

$N_t = N_o \, e^{rt}$

$T = \Sigma x \, l_x \, m_x / R_o$

$dN/dt = rN$

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

$dN_1/dt = r_1 N_1 (1-N_1/K_1 - a_{12}N_2/K_1)$

$dN_2/dt = r_2 N_2 (1-N_2/K_2 - a_{21}N_1/K_2)$

$dH/dt = rh-pHP$

$dP/dt = apHP-mP$

$R_0 = S\text{ß}L$

$S_t = 1/\text{ß}L$

$PV = nRT$

$e = 2.72, \; \pi = 3.14159$

$\ln(2) = 0.69, \; \ln(1) = 0$

$E = mc^2$

Multiple choice (17, @ 2 pts each): _____ x 2 =   _____/ 34 points

19) Short Answer: _____/ 10 points

20) Short Answer   _____/ 4 points

21) Short Answer   _____/ 6 points

22) Essay (Pre-prepared)   _____/ 15 points

                                             _____

Essay (pre-prepared)
**TOTAL:**   _____/ **72 points**

Animal game shows

Multiple Choice questions: 2 points each. Please put your answers to 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) Predator and prey populations often exhibit linked cycles in the field, but this has been difficult to replicate in laboratory studies. This difference is mostly because:
   a) The laboratory environment is very simple
   b) Population cycles in the field are not caused by predation
   c) Small organisms that can be studied in the lab do not show population cycles, even in the field.
   d) Diseases become common in small populations
   e) Predators set a carrying capacity for laboratory populations

2) Shown in this figure are some of the results from Joe Connell's experiments in the middle intertidal zone, the zone where *Balanus* is normally the only abundant barnacle. These data are for survival of *Chthamalus* barnacles in areas where *Balanus* were experimentally removed. Which of the following conclusions do these data support?
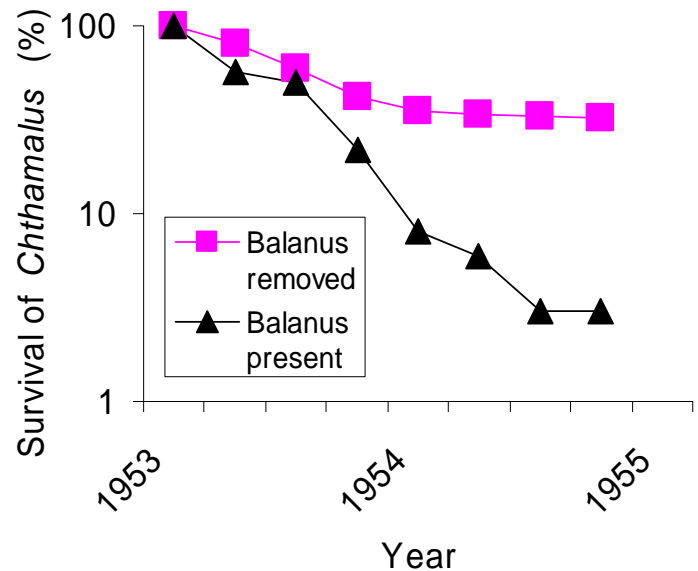

   a) Abiotic factors reduce survival of *Chthamalus*.
   b) Dispersal reduces survival of *Chthamalus*.
   c) Desiccation reduces survival of *Chthamalus*.
   d) Competition reduces survival of *Chthamalus*.
   e) Competition does not influence the survival of *Chthamalus*.

3) African killifish live in temporary pools, where their populations survive the dry season as eggs that lie dormant in the mud, developing and hatching only when the pools fill each year during the wet season. Which model of population growth would be most appropriate for this fish species?
   a) $N_t = N_o \lambda^t$
   b) $N_t = N_o\, e^{rt}$
   c) $dN/dt = rN$
   d) $R_0 = S\beta L$
   e) $dN_1/dt = r_1 N_1 (1 - N_1/K_1 - a_{12} N_2/K_1)$

4) A population experiencing logistic growth:
    a) Increases by a constant percentage per unit time
    b) Tends to show population cycles
    c) Grows steadily until it reaches the carrying capacity, and then stops
    d) Increases by a constant number of individuals per unit time
    e) Is more susceptible to disease

5) Lady Slipper Orchids (*Cypripedium acaule*) growing in Ohio begin flowering after they reach 10 years of age, and then produce flowers about once a year for the next 20 years. The technical term to describe this aspect of their life history is:
    a) Ruderal
    b) Semelparous
    c) Age Distribution
    d) Iteroparous
    e) Survivorship

6) Here are some data on Rio Grande cottonwoods (*Populus deltoides*). Which of the following statements is supported by these data?
    a) Older trees in this population are being replaced by young trees
    b) This population is dominated by young individuals
    c) Reproduction is sufficient to maintain the population
    d) This population is growing
    e) The absence of young trees suggests that this population will not persist
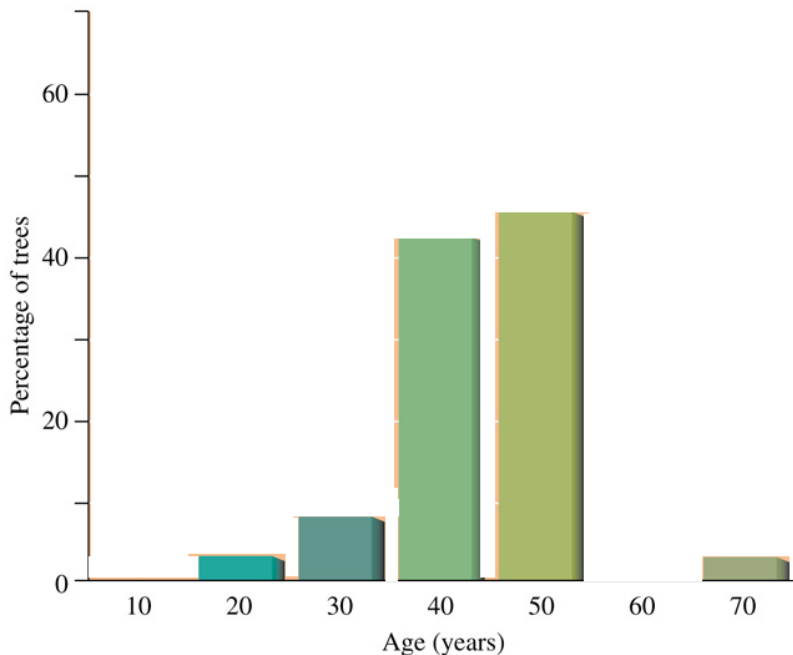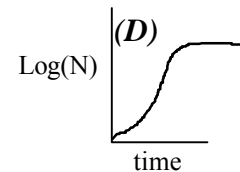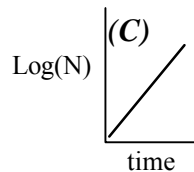
7) Which of the following pieces of information would you need if you wanted to calculate the net reproductive rate (R_0)?
   a) Population size in the previous generation
   b) The carrying capacity
   c) The age structure
   d) The survivorship schedule
   e) The competition coefficient

8) Which of these graphs best demonstrates purely exponential growth?
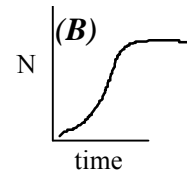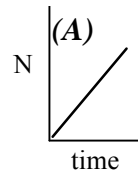
   (E) None of the above

9) In class we discussed how hummingbirds defend territories of food plants against other hummingbirds. This is an example of:
   a) Predation
   b) Commensalism
   c) Mutualism
   d) Exploitation competition
   e) Interference competition

10) These are real demographic statistics from human populations in 2005. Assuming these values stayed constant, which one of the following countries would grow fastest?

	Births/1000 population	Deaths / 1000 Population
a) Afghanistan	48	22
b) Iran	18	6
c) Kuwait	19	2
d) Israel	21	6
e) Iraq	37	10

11) Compared to K-selected plants, r-selected plants should have:
   a) Better competitive ability
   b) Faster reproduction
   c) Higher survivorship
   d) More variable competition coefficients
   e) Greater predator satiation

12) This graph from Populus was used in modeling which of the following interactions?
   a) Competition
   b) Predation
   c) Exponential growth
   d) Amensalism
   e) Logistic Growth
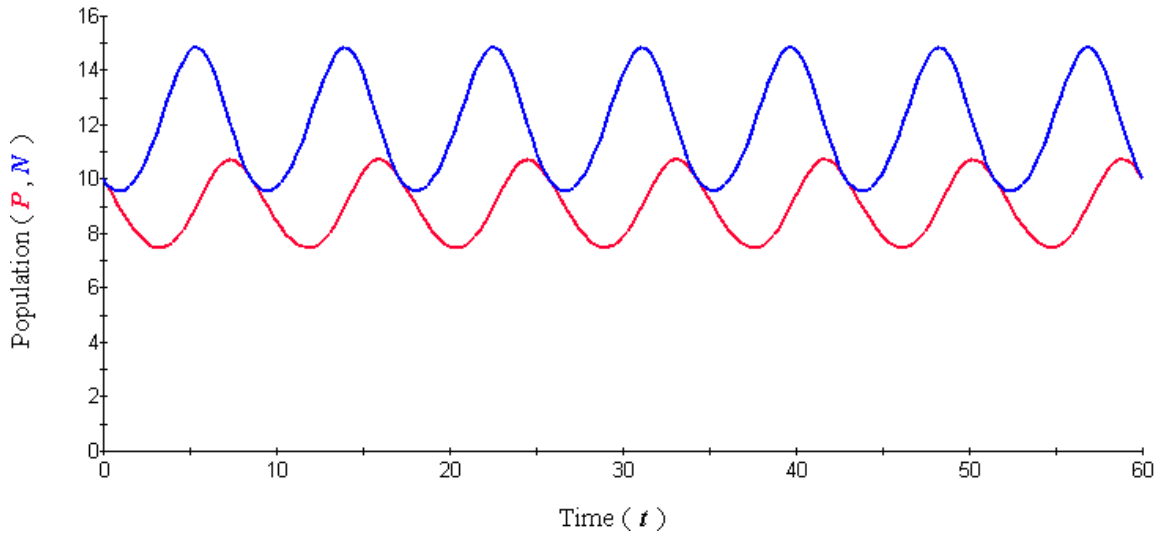
13) Here is an age distribution for the human population of the Marshall Islands (in the Pacific Ocean) for the year 2000. Based on these data, how would you characterize this population?
   a) rapidly growing
   b) predatory
   c) stable
   d) at the carrying capacity
   e) declining
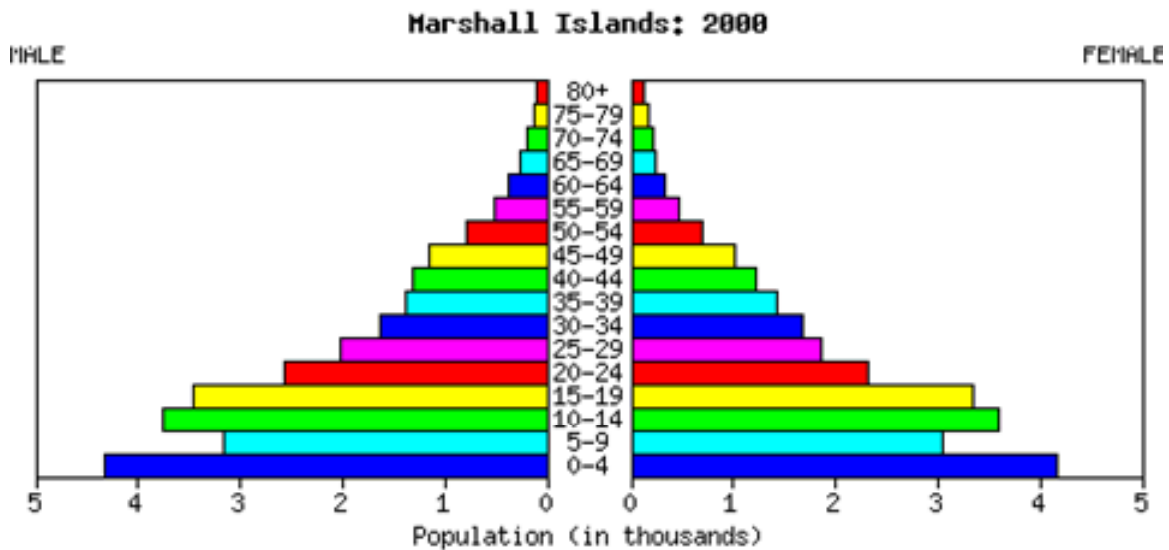
14) Your book uses the emergence patterns of the 17-year cicada as an example of:
   a) Predator satiation
   b) Competitive exclusion
   c) Character displacement
   d) Mutualistic release
   e) Resource limitation

15) Which of these values is closest to the current size of the human population on Earth?
   a) 0.650 billion
   b) 6.5 billion
   c) 65 billion
   d) 650 billion
   e) 6500 billion

16) Your book presents the following data on the number and size of eggs produced by darters (a type of fish). These data support which of the following conclusions?
   a) Darter reproductive effort increases with egg size
   b) Larger darters produced smaller eggs
   c) Egg size and number are important life history traits
   d) The relationship is consistent with the principle of allocation
   e) Gene flow between populations is greater when egg number is larger.
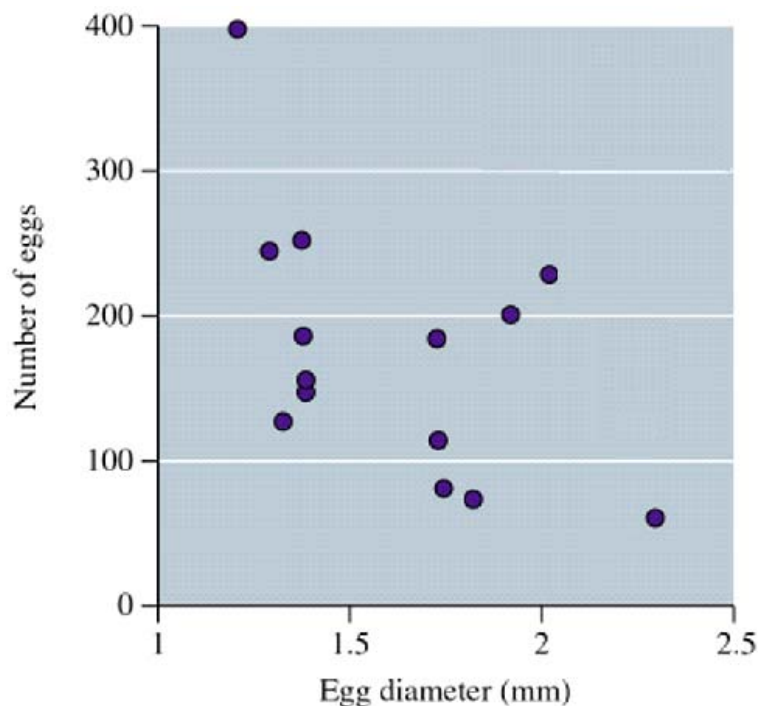
17) A population with discrete generations is growing with $\lambda = 1$. If the population size now is 3 individuals, what will the population size be in 3 generations?
   a) 81
   b) 27
   c) 9
   d) 6
   e) 3

SHORT ANSWER:

18) In the savanna of Africa you find several large herbivores (Zebra, Giraffe, Wildebeast, Antelope) coexisting.
   a) **4 points**. Briefly explain TWO hypotheses for why these potential competitors can coexist.

   b) **6 points**. Describe a method to test one of your hypotheses, and explain what sorts of outcomes of your test would support your hypothesis.

19) 4 points. Suppose you are the only population ecologist in a small country that has limited space and limited natural and financial resources. The president of the country comes to you seeking advice about how to slow the growth of his nation's human population. Based on what we've learned in class, please list **two** measures you would advise, and explain how and why they would be likely to help.

20) **6 points**. What is the carrying capacity for this population? Does this population display density dependence? Explain why you came to this conclusion.
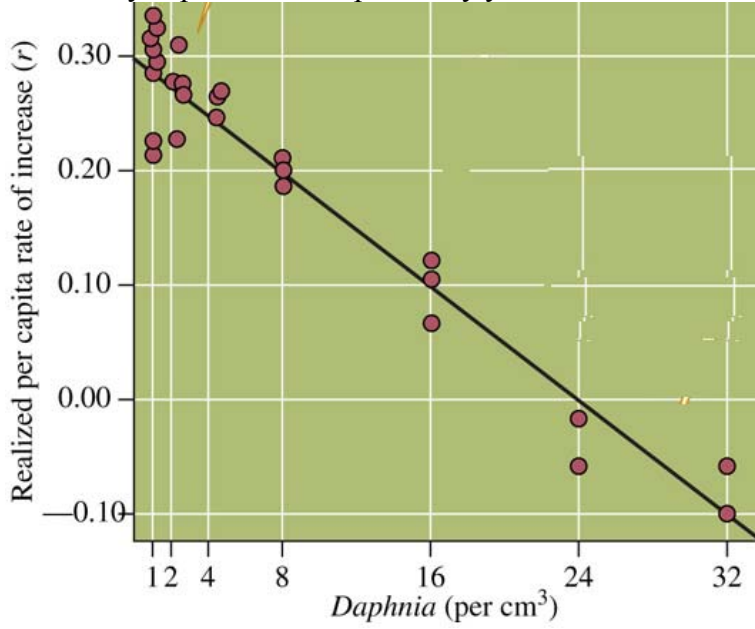
15 **points.** *YOUR REVIEW SHEET HAD 3 QUESTIONS YOU WERE TO PREPARE FOR. OF THOSE, THIS IS THE ONE YOU MUST ANSWER. REMEMBER: your answer should be well reasoned and well written -- outline format is not acceptable (though you may outline the answer for your own benefit on the back of another page).*
What is the role of food and predators in producing cycles of abundance in populations of snowshoe hares? After this brief explanation, identify and explain an important question about hare population cycles, and briefly describe a new experiment or observation that would help answer that question. Be sure to explain how this information would relate to the question.