Exam 2. Principles of Ecology. Oct. 15, 2008. Name Key

Some potentially useful relationships:

$N_t = N_o\lambda^t$ | $dN/dt = rN - aNP$ | $dN_1/dt = r_1N_1(K_1 - N_1 - \alpha_{12}N_2)/K_1$

$N_t = N_oe^{rt}$ | $dP/dt = acNP - dP$ | $dN_2/dt = r_2N_2(K_2 - N_2 - \alpha_{21}N_1)/K_2$

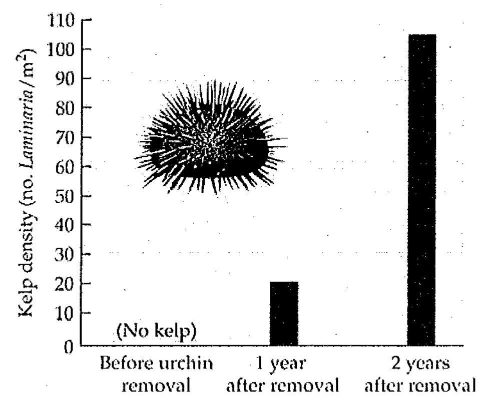
$N_{t+1} = \lambda N_t$ | $N_{t+1} = N_t + r_oN_t(1-N_t/K)$ | $N_t = K/(1 + [(K - N_o)/N_o] * e^{-rt})$

$dN/dt = rN(1-N/K)$ | $\frac{N_{\text{captured and marked initially}}}{N_{\text{total}}} = \frac{N_{\text{marked at recapture}}}{N_{\text{total recaptured}}}$ | $dU/dt = \Lambda o\varpi\varepsilon/U$

$dN/dt = rN$

Multiple guess. Pick the best answer. [4 points each, 40 pts total]

1. We began our discussion of population distribution and abundance with the graph to the right (page 175 in your text). Which of the following best describes the graph and how it represents a good study in the field of "population ecology"?
   a. Urchins do not affect kelp density, and this is a poor example of population ecology.
   b. Urchins affect kelp density, and this is a good example of population ecology.
   c. Kelp affects urchin populations, and this is a good example of population ecology.
   d. Kelp does not affect urchin populations, but this is a poor example of population ecology.
   e. All of the above.



ECOLOGY, Figure 8.2

2. If a population dispersion pattern is analyzed and we discover that the variance to mean ratio (s^2/mean) is far greater than unity (that is one, which happens when s^2 = mean) then we would conclude that the population is
   a. decreasing
   b. increasing
   c. dispersed in a clumped pattern
   d. randomly dispersed
   e. uniformly dispersed
3. What is the doubling time of a population that grew 700 to 800 individuals in one year?
   a. 5.2 years.
   b. 3.9 years.
   c. 4.8 years.
   d. -8.2 years.
   e. it will never double because of density-dependent regulation.
4. The best measure of "fitness" is
   a. the number of offspring produced by an individual.
   b. the rate at which individuals survive to reproductive age.
   c. the absolute number of offspring produced by individuals of a species relative to other species.
   d. the absolute number of offspring produced by individuals relative to the number produced by other members of the species.
   e. the relative survival rate of individuals compared to other members of the species.

5. Imagine you are estimating a population of mice in the Arboretum using the mark-recapture technique. On the first capture you catch and mark 120 mice with little yellow dots and then release them. On the second capture you get 125 mice and find 20 are marked. You estimate the population but then discover that the mice actually liked being captured so that those that were marked were more likely to be captured and unmarked mice. What is your original estimate of the population and your interpretation of that estimate given your discovery? -2

a. 750, but it's an overestimate of the population (there are really fewer mice in the population).

+2 b. 750, but it's an underestimate of the population (there are really more mice in the population).

c. 20, but it's an overestimate of the population (there are really fewer mice in the population).

d. 20, but it's an underestimate of the population (there are really more mice in the population).

e. 2400, but it's an overestimate of the population (there are really fewer mice the population).

f. 2400, but it's an underestimate of the population (there are really more mice in the population).

6. Humans exhibit which survivorship curve? (TB: 199 – 200, Lecture)

a. Type I

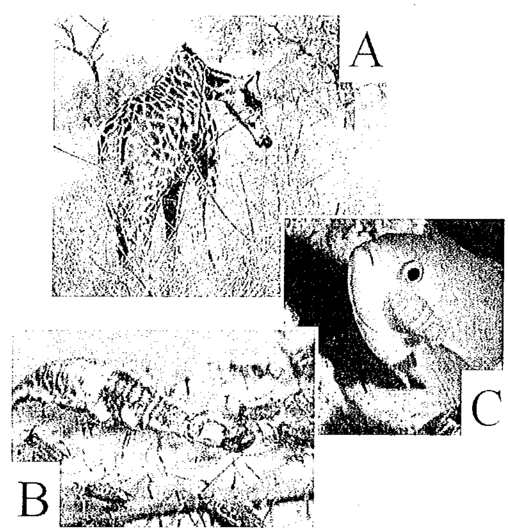
b. Type II

c. Type III

d. all of the above.

e. none of the above.

7. Identify correctly the three types of consumers in the figure. Note the consumer in A = the big thing, B = the big thing, and C = the small thing on the fish's face. (Figure 12.3)



a. A = herbivore, B = predator, C = parasite

b. A = herbivore, B = predator, C = parasitoid

c. A = herbivore, B = competitor, C = predator

d. A = predator, B = predator, C = predator

e. all of the above are correct.

8. Which of the following biomes would most likely be found at a very low latitude?

a. Taiga.

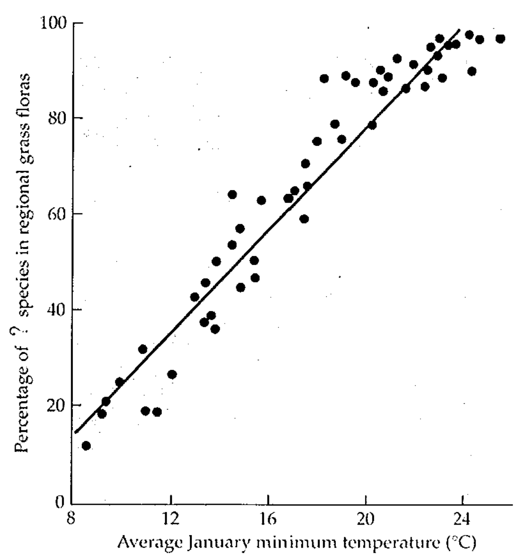
b. Tundra.

c. Temperate deciduous forest.

d. Tropical rain forest.

e. Temperate evergreen forest.

9. Which of the following photosynthetic pathways tends to give plants a competitive advantage under relatively warm and dry conditions? (Austrailian grassland communities shown in Figure 5.12 and concept discussed in lecture)



a. C3

b. C4

c. C5

d. all of the above over CAM

e. a and b only

10. What is population at time t = 10 ($N_{t=10}$) if $N_{t=0}$ = 233, and $N_{t=1}$ = 245?

a. 141

b. 353

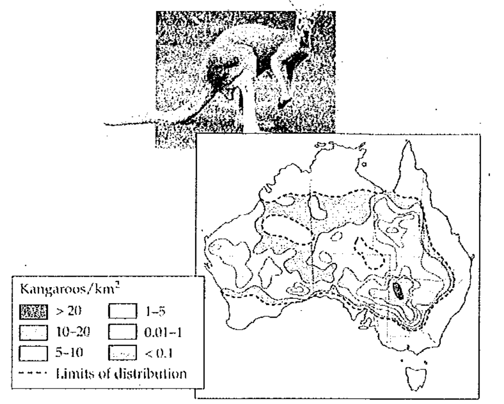
c. 385

d. 2489

e. or $N_{t=10}$ = __________

Answer **TWO** short answers questions. **CIRCLE THE NUMBER** FOR ME TO EVALUATE (10 pts each, 20 pts total)

1. Your book suggests that populations often exhibit different densities over their ranges, such as is seen in one species of kangaroo in Australia (pg 185). List four plausible, ecologically-related reasons (non-human) this variability might happen in kangaroos (think about the PoEs!).



ECOLOGY, Figure 8.15

a. topography

b. food availability

c. temps / diff climates

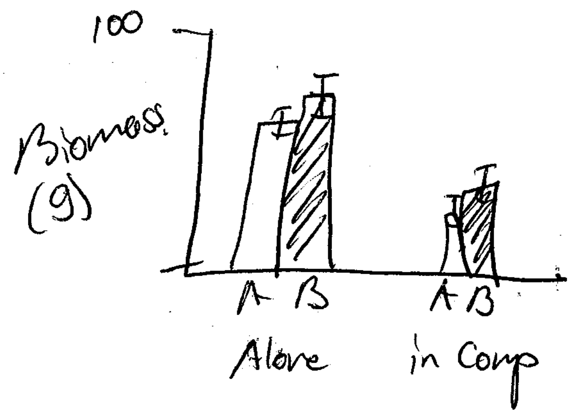
d. predation

parasites

water availability

unsuitable habitats

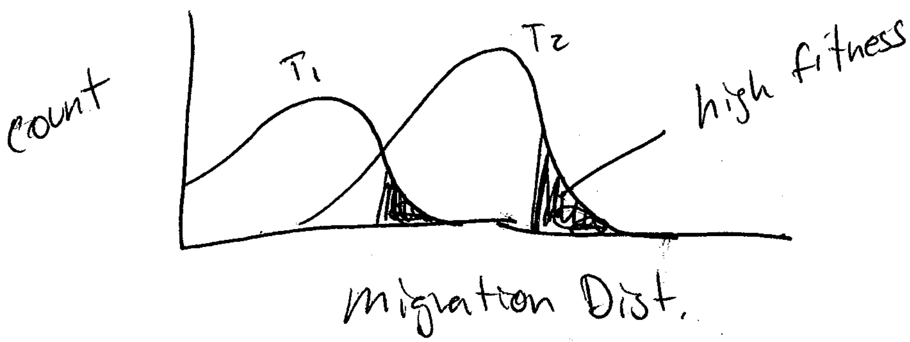
2. Provide a graph of hypothetical or real data (units not necessary) that could come from an experiment that would support competition having occurred between two species of rodents. Be sure to provide explicit labels (scales can be flexible) for x- and y-axis variables.



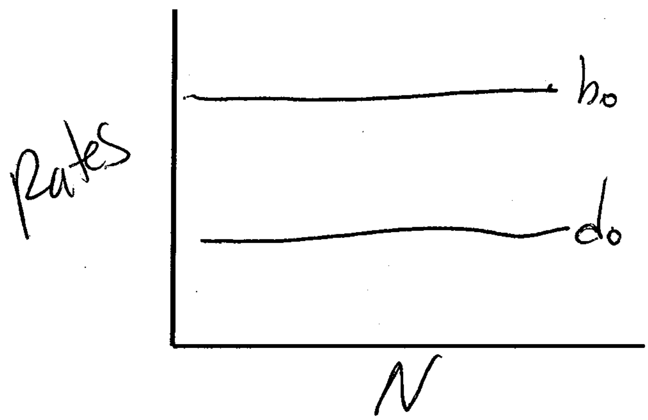
3. We talked a lot about ways prey might avoid predation. Provide a graph of real or realistic data that are consistent with one way prey avoid predation. Briefly explain your graph.

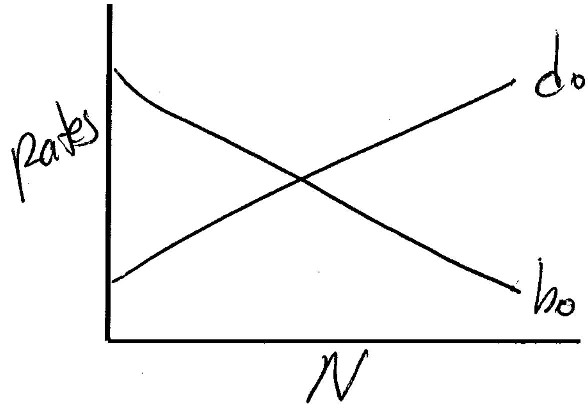
variable

4. Given what you know about natural selection briefly discuss how annual bird migrations in the northern latitudes (tropical birds migrate to the north during summers) might have evolved using a graph that shows this selection process over time. Note that a good graph of this would include both the frequency of phenotypes/genotypes and fitness.

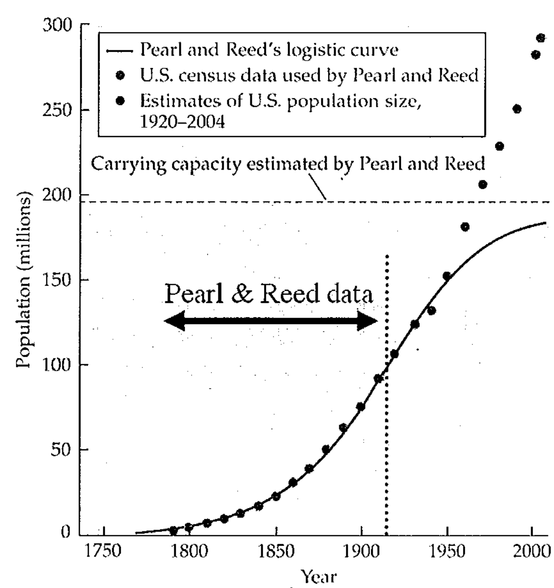


5. Provide two graphs of <u>birth and death rates versus density</u>: one for density-independent growth (left) and a second graph for density-dependent growth (right). Be sure to label all lines and axes on both graphs. [pg 209]





6. The logistic growth equation was used by Pearl and Reed (1920) to predict that the US population would level off at about 200 million people around now. They were wrong! (Figure 9.19 from your text).



a. Provide two reasons they were wrong, based on your reading and/or principles of ecology?

Data based on smaller area

Medical advances

b. Provide an ecologically-based reason why the logistic model is still taught and used in ecology, despite its shortcomings (not because Hartvigsen is evil).

It's a great place to start thinking about dens. dep. regulation + how it affects growth rates

Two Ecology Models. Answer everything that follows. (15 pts ea., 30 pts total)

1a. **Analyze the points** on the left graph below. (1 pt ea., 5 pts total)

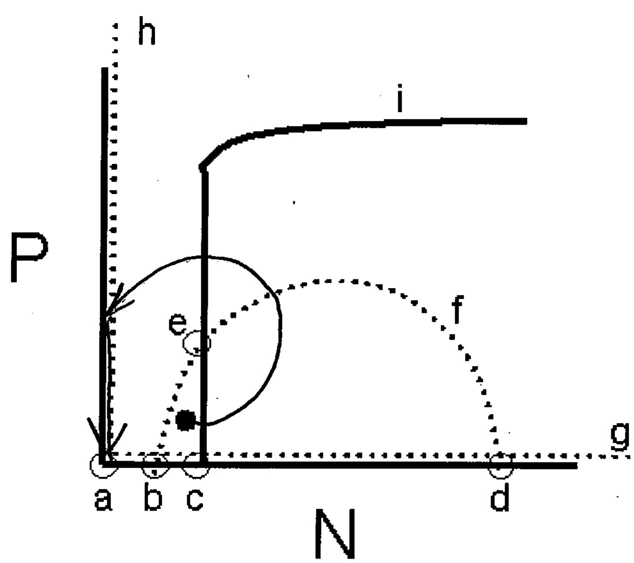
a. LSE
b. USE
c. Not EQ
d. USE
e. USE

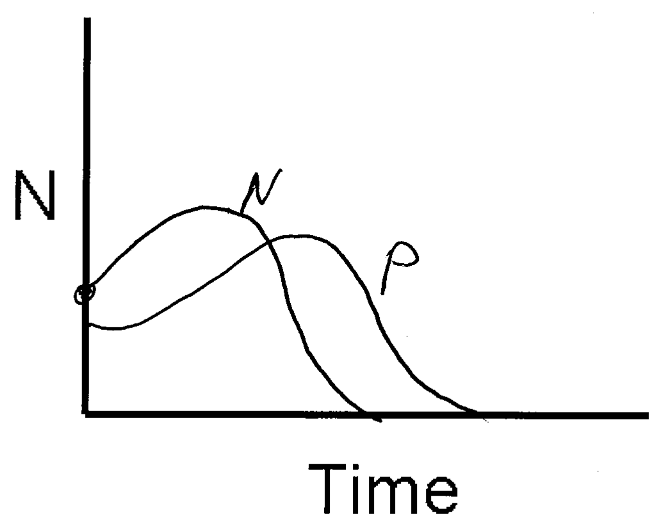
1b. Describe, preferably with an equation, **the lines** on the graph below. (1 pt ea., 4 pts total)

f. $dN/dt = 0$
g. $P = 0$ or $dP/dt = 0$
h. $N = 0$ or $dN/dt = 0$
i. $dP/dt = 0$

1c. The dark dot in the left graph represents the initial condition (starting place). On the left graph draw the trajectory until it reaches an equilibrium point. (4 pts)

1d. Draw this trajectory for both species (from 1c above) from start to finish on the graph on the right. (2 pts)





2a. Identify the model in the left graph below by name: (1 pt) Lotka-Volterra Competition

2b. **Analyze the points** of the left graph below. (1 pt ea., 4 pts total)

a. Not EQ

b. USE

c. USE

d. Not EQ

2c. Provide the equation for **the lines** below. (1 pt ea., 4 pts total)

e. $dN_2/dt=0$

f. $dN_1/dt=0$

g. $N_1=0$ or $dN_1/dt=0$

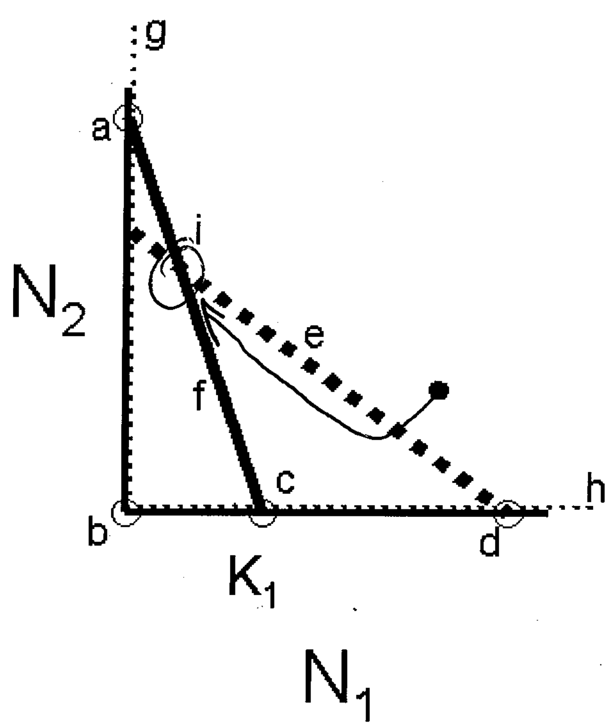
h. $N_2=0$ or $dN_2/dt=0$

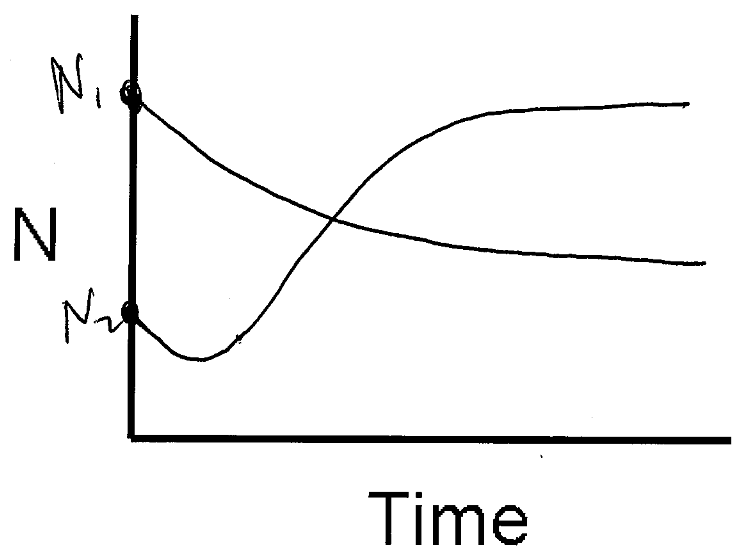
2d Analyze the point "i" at the intersection of lines "e" and "f": (1 pt)

LSE

2e. The dark dot on the left graph represents the initial starting populations for species 1 and 2. On the left graph draw the trajectory for this point until it reaches an equilibrium point. (3 pts)

2f. Draw this trajectory (from 2e above) on the graph on the right. (2 pts)





Mandatory questions. (15 pts total).

1. What are the four easily observed characteristics of natural selection? (5 pts; 1 pt each but -2 for first missed)

   a. ____________________
   b. See syllabus
   c. ____________________
   d. ____________________

2. If a population grows with the following Leslie matrix, what will the population be in each of the next three time steps (N_1, N_2, and N_3)? Write your answers in the columns provided. The provided population is from time step zero. Showing your work allows the potential for partial credit. (10 pts)

$$
\begin{array}{cccccc}
\text{Leslie Matrix} & & N_0 & N_1 & N_2 & N_3 \\
\begin{bmatrix} 0.5 & 1.5 & 1.0 \\ 0.7 & 0.0 & 0.0 \\ 0.0 & 0.5 & 0.0 \end{bmatrix} & &
\begin{bmatrix} 20 \\ 30 \\ 40 \end{bmatrix} &
\begin{bmatrix} 95 \\ 14 \\ 15 \end{bmatrix} &
\begin{bmatrix} 83.5 \\ 66.5 \\ 7 \end{bmatrix} &
\begin{bmatrix} 148.5 \\ 58.45 \\ 33.25 \end{bmatrix} \\
 & & & \text{4 pts} & \text{1 pt} & \text{1 pt}
\end{array}
$$

Calculate λ for the following time steps

a. 0-1 1.38 (2 pts)
b. 1-2 1.27 (1 pt)
c. 2-3 1.53 (1 pt)

Extra Credit

1. What organism, discussed in your book as being very tolerant of desiccation, was sent into the vacuum of space, returned to Earth, and was successfully revived? (2 pts) Tardigrade
2. Provide up to two assumptions of geometric growth that differ from assumptions of exponential growth (1 pt ea.)
   a. discrete time
   b. non-overlapping generations
3. If you (and I mean you) eat meat you are best referred to as what ecological term? (1 pt) Scavenger
4. "Self-thinning" in plants would best be modeled using the following equation(s): (2 pts)

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

Score = ________ / 105 pts = ________