Ecology 203, Exam II. 10-19-05. **Print name:**_____

Rules: Read carefully, work accurately and efficiently. If you are concerned please leave marginal comments for me.

$N_t = N_o\lambda^t$ $\quad$ $N_t = N_o e^{rt}$

$dN/dt = r_oN(1-N/K)$ $\quad$ $\frac{N_{\text{captured and marked initially}}}{N_{\text{total}}} = \frac{N_{\text{marked at recapture}}}{N_{\text{total recaptured}}}$

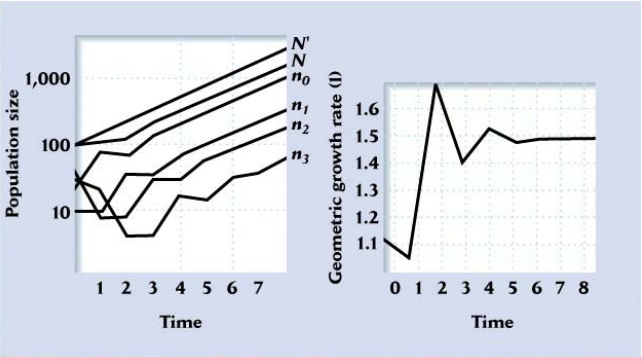
$dp/dt = cp(1-p) - ep$ which suggests the equilibrium proportion of occupied patches $p = 1 - e/c$

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

Multiple choice. (4 pts each; 40 pts total)

1) What is the doubling time of a population that grows from a starting population of 50 to 60 in just one year? [L, TB: 281]
   a) 3.8 years
   b) 3.5 years
   c) 5 years
   d) 6.2 years
   e) 10 years
2. We discussed the following three related but different models for populations. These were the metapopulation model, the source-sink model, and the landscape ecology model. They are all similar except for which of the following characteristics: [L, TB: 259]
   a. populations are divided into patches.
   b. some patches are occupied while others are not.
   c. individuals are able to move amongst the patches.
   d. some patches are better than other patches.
   e. none of the above (the characteristics above apply to all three models).
3. If a population is growing with a lambda (λ) = 1.2 then r =
   a. -1.2
   b. 0.18
   c. 0.2
   d. 0.22
   e. 1.2
4. A population that is growing strictly according to the logistic equation
   a. increases slowly at first, then quickly, then slowly.
   b. decreases to carrying capacity like a decelerating car.
   c. does not change.
   d. all of the above.
   e. none of the above.
5. To achieve the highest possible level of fecundity, male dragonflies will (after fertilizing the female's eggs): [FG: 371]
   a. Practice mate guarding and contacting guarding to help ensure the deposit of the eggs.
   b. Practice predator mobbing to keep away any animal that would consume the female.
   c. Do nothing because after eggs are fertilized, they naturally have a high chance of survival to the next phase of life.
   d. Do nothing because most male dragonflies are not aggressive.
   e. do all of the above.

6. The graph on the right represents which of the following: [L; TB: 276]
   a. Both exponential and geometric growth.
   b. Logistic growth.
   c. Geometric growth with age-classes.
   d. Linear growth with intrinsic, biotic regulation.
   e. None of the above.



7. If a population is growing according to the logistic growth model then it is [TB: 286-; L]
   a. unregulated.
   b. regulated by abiotic factors.
   c. regulated by instraspecific competition.
   d. regulated by predators.
   e. all of the above are reasons we see logistic growth.
8. A species, living in three patches, has a patch extinction probability of 0.5 per year. What's the probability that the species will persist one year? [L]
   a. 0.0.
   b. 0.125.
   c. 0.5.
   d. 0.875.
   e. 1.0.
9. Andrewartha and Birch (1954) argued that populations of *Thrips* (insects) were regulated primarily by [L]
   a. abiotic intrinsic factors.
   b. abiotic extrinsic factors.
   c. biotic intrinsic factors.
   d. biotic extrinsic factors.
   e. all of the above work interactively to regulate *Thrips*.
10. Population ecology is best described as the study of
   a. groups of individuals.
   b. the dynamics of groups of individuals over time.
   c. how individuals change over time.
   d. how populations change over time.
   e. how species change over time.

Please provide brief, succinct answers **3 of 5 questions**. Use only the space provided. (10 pts each; 40 pts total)

1. Your professor has growth rate parameters for two populations. Species A grows with $\lambda = 1.25$ while species B grows with $r = 0.25$. If both start off with 500 individuals what will their populations be over the next 5 years? Note that we start at N_o and that you need to iterate these up to N_5. Fill in the table. ***Provide just one graph*** of N vs. time that shows both species on it. Be accurate - use your calculator and clearly label your axes.

Year	Species A	Species B
0	500	500
1		
2		
3		
4		
5		

2. Draw a map in the box below of the dispersion pattern for a single population that is random, uniform, and clumped **at different scales** (this is not three different patterns in different parts of the map). Please provide dots that indicate the location of each individual. Indicate **very clearly** where the three patterns exist in your single map. (key words = "dispersion pattern" and "scale") (TB: 256-261, L)

3. Provide a graph and explanation of self-thinning in plants. [L; TB: 289]

4. You wish to estimate the population of eastern cottontails in the Arboretum. You decide to use the Lincoln-Peterson mark-recapture method you learned in Ecology 203. You set up bunny traps in open patches, catch 50, mark them with yellow paint, and release them. One week later you trap bunnies in a similar way and catch 150, 40 of which are marked.

   a. What is your estimate of the bunny population in the Arboretum? (5 points)

   b. Between sampling periods there is an "Were-Coyote" that can smell yellow paint. Marked bunnies suffer higher mortality rates than unmarked bunnies. Describe numerically how this would have affected your estimate of the population. (5 points)

5. Provide a graph of the trait "migration distance," showing how selection probably led to the evolution of this trait in our neotropical migrant birds.

The type of selection is _____

Provide three factors that might have led to this selection.

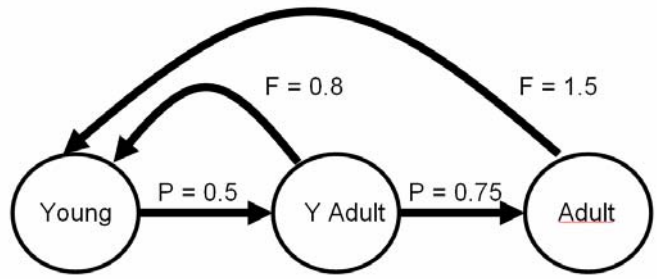
a. _____

b. _____

c. _____

Mandatory questions (3). Please provide brief, succinct answers. (30 pts total)

1. Population growth based on life history data (15 points)
   1a. Provide the Leslie matrix for the data in the figure. Assume that the P represents the probability of surviving to the next size class (young, young adult, and adult) while F represents the age-specific fecundity rates. (5 points)



1b. Using your Leslie matrix from above, calculate the population at time step **4** if at time step **0** there are 25 young, 50 young adults, and 75 adults. Show your work. (5 pts)

1c. The best way to determine λ is to calculate dominant eigenvalue using linear algebra. Describe the next best what to estimate λ. (2 pts)

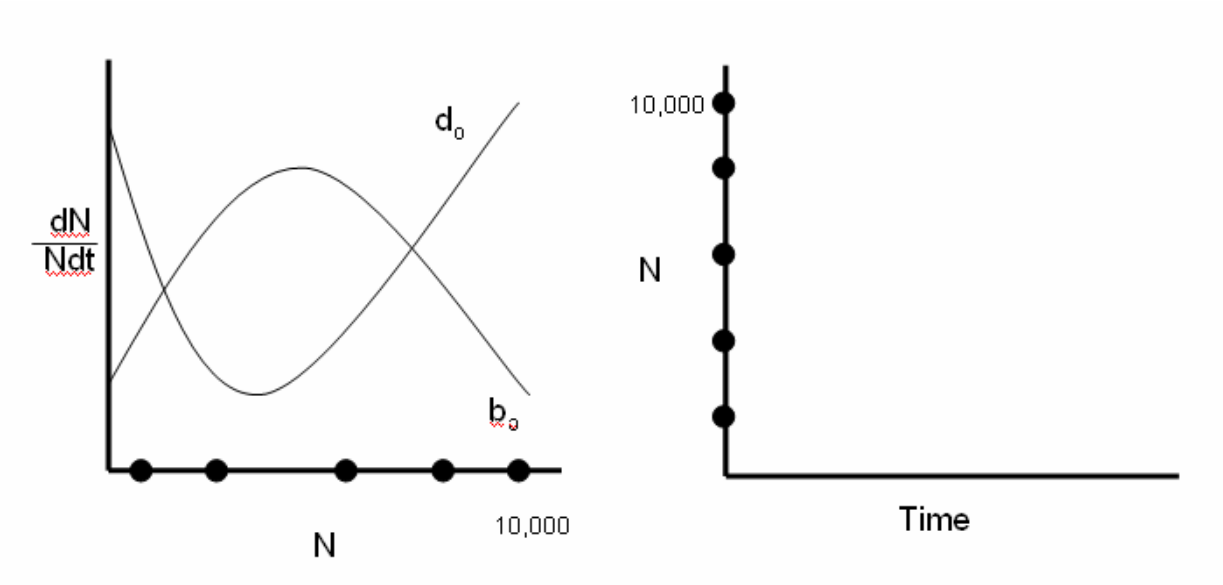
1d. Calculate λ. (3 pts)

λ = _____ (show your work below or above).

2. What are the four, easily observed characteristics of natural selection? (5 pts, minus 2 for the first missing piece)

a. _____
b. _____
c. _____
d. _____

3. **<u>Analyze the graph</u>** on the left and provide a new graph of N vs. time on the right. Be sure to follow each of the different initial population sizes in the graph on the right (dots) until they reach an equilibrium. If there's an Allee Effect, please indicate this clearly. (10 pts)



Extra Credit (5 points each)

1. Predators can function as extrinsic biotic regulating factors of populations. The equation for the prey population in the standard Lotka-Volterra predator-prey model is

   $dH/dt = rH - pHP$

   where r = intrinsic per capita rate of increase of herbivore (H) and p = rate at which the contact between herbivore (H) and predators (P) contact each other, result in eating. Under what two conditions will the herbivore population be in equilibrium?

2. We saw photos of an organism that had not previously been seen alive. What was that organism? (5 pts).