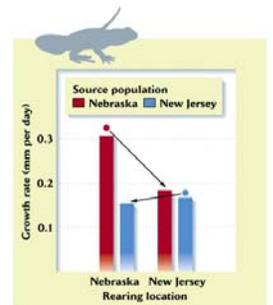


$$N_t = N_0 \lambda^t \quad N_t = N_0 e^{rt} \quad N_{t+1} = N_t + r_0 N_t (1 - N_t / K) \quad N_t = K / (1 + [(K - N_0) / N_0] * e^{-rt})$$

$$dN/dt = r_0 N (1 - N / K) \quad \frac{N_{\text{captured and marked initially}}}{N_{\text{total}}} = \frac{N_{\text{marked at recapture}}}{N_{\text{total recaptured}}}$$

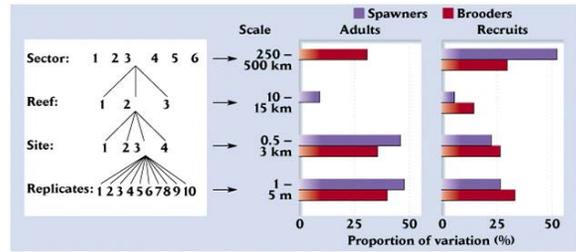
Multiple guess. Pick the best answer. [5 points each, 50 pts total]

1. A p-value in science is important for us to test hypotheses. If you perform an experiment and you conclude that your null hypothesis is not supported then p-value was most likely
 - a. < 0.05.
 - b. ≤ 0.05.
 - c. > 0.05
 - d. ≥ 0.05.
 - e. > α.
2. Sexual dimorphism can result from which of the following:
 - a. dissimilar sexual function in males and females.
 - b. contests between members of the same sex (usually males).
 - c. male choice (often by females).
 - d. all of the above.
 - e. none of the above. This has now been discredited.
3. Cole's paradox is
 - a. the problem that evolution could not possibly take place.
 - b. that plants and animals should not coexist.
 - c. the idea that iteroparity and semelparity are essentially equivalent reproductive strategies.
 - d. the hypothesis that iteroparity should always beat semelparity competitively.
 - e. annual plants should always win in competition.
4. The figure to the right represents data for fence lizards. Interestingly, last week I was in New Jersey and, while you read this, I'm in Nebraska. Which of the following is a correct conclusion from these data?
 - a. On average, lizards from Nebraska are bigger than those from New Jersey.
 - b. On average, lizards in New Jersey grow faster than those from Nebraska.
 - c. There is an interaction between population origin and where the populations are grown for the response variable population size.
 - d. There is an interaction between population origin and where the populations are grown for growth rate.
 - e. Since these represent different populations of the fence lizard at the species level there are no differences in growth rates.
5. The mating system where you can find one male with many females is called
 - a. monogamy.
 - b. polygamy.
 - c. polyandry.
 - d. polygyny.
 - e. mercurity.
6. Three of the below are benefits of living in groups (based on the European goldfinch research, discussed in your book and lecture). Which is not?
 - a. individual birds in larger groups scan for predators less often than those in smaller groups.
 - b. birds in larger groups spend less time handling prey than those in smaller groups.
 - c. birds in larger groups spend more time flying between food patches than birds in smaller groups.
 - d. birds in larger groups are more likely to be killed by predators because predators are more likely to find birds in large flocks.



7. The figure on the right from lecture and your book represents the importance of how scale influences our understanding of ecological systems. Which of the following is based on the data presented in the graph?

- a. there are large differences in coral abundances at small and large scales.
- b. there are small differences in coral abundances at small and large scales.
- c. the abundance of corals is independent of scale.
- d. ecological systems are so complex that we really can't understand anything (the variance should be near zero for us to really understand these patterns).
- e. the population of corals is declining.



8. Imagine you are estimating a population of cats in a city and use the mark-recapture technique. On the first capture you catch and mark 50 cats. On the second capture you get another 50 cats and 20 are marked. Unfortunately you learn that cats absolutely hate being recaptured. What is your estimate of the population and what do you think of your estimate given the above information?

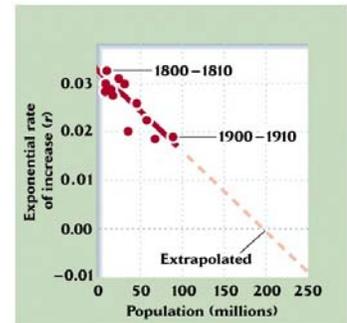
- a. 125. However, that's too many.
- b. 200. That's too many.
- c. 125. That's too few.
- d. 200. That's too few.
- e. None of the above.

9. An endangered population goes from 122 individuals to 87 in one year. What's r over this time period?

- b. -0.34
- d. .29
- a. 0.34
- c. 0.71
- e. other: _____

10. In the diagram on the right are data for the human population in the United States from 1790 – 1910 (pg 284). Which of the following is true?

- a. the population will stop growing when it reaches 250 million.
- b. the population will never stop growing.
- c. the slope of the line is negative suggesting our population is actually going to go extinct.
- d. all of the above.
- e. none of the above.



Mandatory question (10 points).

1. What are the four easily observed characteristics of natural selection? (2.5 each)

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

Choose two of the following three questions. [10 pts each, 20 pts total]

1. Identify the types of interactions in the following table. A “+” indicates it a positive interaction; a “-” indicates negative. (2.5 each)

donor	recipient	Interaction type
+	+	_____
+	-	_____
-	+	_____
-	-	_____

2. The process of “natural selection” is often erroneously labeled as “survival of the fittest.”
- a. Why is this really not right? (6 pts)
- b. Provide a technical definition of “fitness”. (4 pts)
3. Peacock males are birds with big, flashy tail feathers. The females are rather drab. How would you test that the tails are the product of sexual selection?

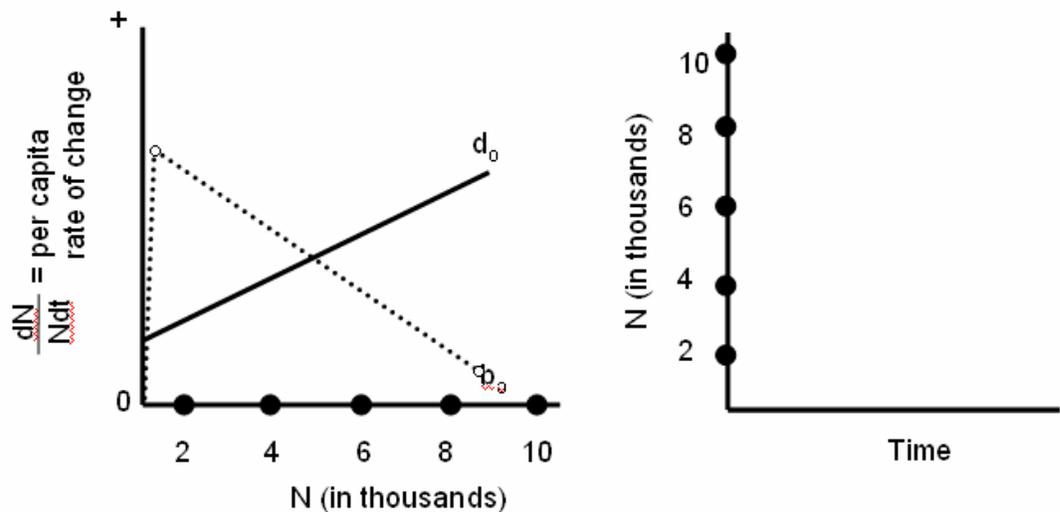
Choose two of the following three (10 pts each, 20 pts total)

1. Most traits respond to natural selection. Relying on our trip to the Roemer Arboretum choose a trait in one of the organisms found there and discuss the follow.
- a. What’s the trait? (1 pt)
- b. What’s necessary for evolution to take place? (3 pts)
- c. Provide a frequency histogram to the right of what might be the result of evolution. Label axes carefully. (4 pts)
- d. What type of selection have you described in your graph? (2 pts)

2. Below please provide a diagram showing the dispersion pattern of plants where, at the smallest scale, plants are clumped, at an intermediate scale plants are random, and at the largest scale they are uniformly dispersed. Note that I am not asking for three different maps showing three different patterns. This is a single map.



3. “Analyze the graph” on the left and complete the graph of N versus time on the right (5 pts each). Use each dot as a starting place for a population. Note that in the left graph the d_0 and b_0 both shoot down to the x-axis when $N = 0$.



Extra Credit

1. Name the person or persons who first described the process of natural selection (must be entirely correct for credit). (3 pts.)
2. In addition to natural selection there are other mechanisms that lead to evolutionary change. For each one correctly identified you will receive one point. If one is wrong you will not get any points.