I. Short Answer Questions

SAQ #1. Please state and BRIEFLY explain the two major objectives of population ecology. Please use a diagram for each, AND write an explanation.

diagram and explain objective 1 - 3 pts.
explain the key "emergent properties" that this objective aims at explaining - 3 pts.
diagram and explain objective 2 - 3 pts.
explain the key "emergent properties" that this objective aims at explaining - 3 pts.

Consider the simple exponential model of single species population growth.

$$\frac{1}{N} * \frac{\Delta N}{\Delta t} = r$$

SAQ #2. What are the principal assumptions of this model? (4 pts.)

SAQ #3. What is the main prediction of this model? (please include a sketch) (4 pts.)

SAQ #4. What are the major problems with the assumptions and predictions of this model – in other words, what are the major ways in which this model clearly departs from ecological reality? (4 pts.)

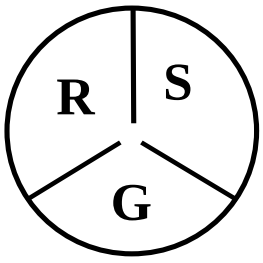
SAQ #5. Please briefly explain the use of the exponential model in the areas of theoretical and applied ecological research that we discussed in class.
theoretical – (8 pts.)
applied –

SAQ #6. Please offer a brief, but precise definition of evolution. (6 pts.)

SAQ #7. Please offer a brief, but precise explanation of how evolution can occur by natural selection. (6 pts.)

SAQ #8. This question will assess your understanding of current life history theory. Please briefly define a "life history phenotype." (6 pts.)

SAQ #9. Current life history theory maintains that "the most fit organism should always adjust the allocation of its limited resources to to **G**, **S**, and **R** each year to maximize the sum of its present reproduction plus its expected future reproduction." Explain this concept in your own words. DO NOT SIMPLY RESTATE THE QUESTION.



(6 pts.)

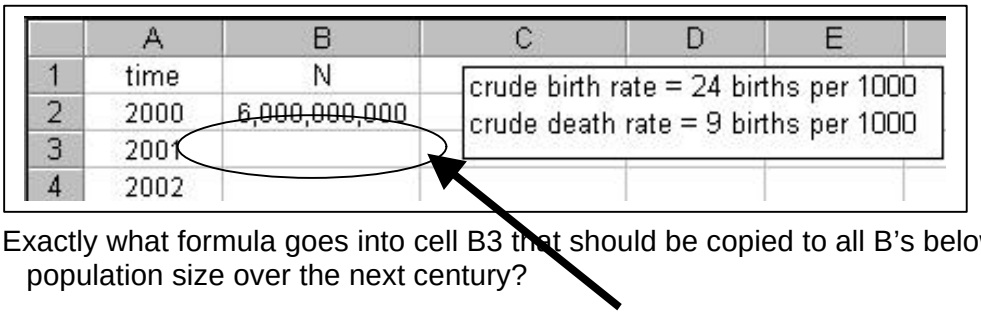
SAQ #10. According to your studies of a population of head lice on a randomly chosen seat in Kirkbride 108, each female louse has 10 female baby lice per week, 1 out of 3 adult females are killed each week, and half of the surviving adult lice jump onto the heads of sleeping students and are carried off each week (but none jump off heads onto the seat). Assume head lice can breed after only one week of life.

If there are 300 adult females alive and breeding now (N_1), how many would there be on the Kirkbride seat in one week from now? {Note 1: ignore the males} {Note 2: you do not need a calculator, since the calculations involve only simple arithmetic.}

how many in one week (N_2)? (8 pts)

PLEASE SET UP THE PROBLEM AND SHOW ALL WORK to get to the answer

SAQ #11. Consider the spreadsheet below:



Exactly what formula goes into cell B3 that should be copied to all B's below to calculate the population size over the next century? (6 pts.)

I. Longer Answer Questions (10 points each)

LAQ #1. This question will assess your understanding of the causes of evolution (other than natural selection).

(a) Please offer a brief, but precise explanation of how evolution can occur by mutation. (2.5 pts.)

(b) Please offer a brief, but precise explanation of how evolution can occur by genetic drift. (2.5 pts.)

(c) Please offer a brief, but precise explanation of how evolution can occur by immigration/ emigration (migration, but not related to genetic drift). (2.5 pts.)

(d) Please offer a brief, but precise explanation of how evolution can occur by meiotic drive. (2.5 pts.)

LAQ #2. This question will assess your understanding of the pros and cons of various fisheries management options that we discussed in class.

(a) Please state two totally different and very important **long term** effects <u>on a population of fish</u> that you should anticipate with the "minimum catch size plan" in which fisherman only keep fish larger than a given size?

1- 2- Q – Is this management plan sustainable? Why or why not?

(b). Please state two totally different and very important **long term** effects <u>on a population o</u> 4 pts. you should anticipate with the management plan to build a fish hatchery to offset the effects of fishing?

1- 2- Q – Is this management plan sustainable? Why or why not?

(c). Please describe the effects <u>on a population of fish</u> that you should anticipate with the mana 3 pts. plan to reduce the number of fish taken by reducing the number of people and or times during which people can fish?

Q – Is this management plan sustainable? Why or why not? 3 pts.

LAQ #3. Your job depends on successful management of a fishery for sport fishing. That means the fish population growth rate must not be negative despite predation by humans.

According to your computer simulations, if you were to impose a minimum catch age of 7 years (that is, all fish 6 years and younger must be thrown back), the fish population growth would be slightly positive (see table). Note that humans can only catch fish that are age 3 and older.

On average, how many fish would a fisherman have to throw back out of a day's catch of 10 fish?

age x	survival px	survivorship lx	stable age dist., cx	fecundity mx
0	0.60	1.0000	0.4079	0.00
1	0.60	0.6000	0.2432	0.00
2	0.60	0.3600	0.1450	0.00
3	0.60	0.2160	0.0864	2.00
4	0.60	0.1296	0.0515	2.00
5	0.60	0.0778	0.0307	2.00
6	0.60	0.0467	0.0183	2.00
7	0.50	0.0233	0.0091	2.00
8	0.50	0.0117	0.0045	2.00
9	0.50	0.0058	0.0022	2.00
10	0.00	0.0029	0.0011	2.00

and the population is growing at a rate of little r = 0.0004

(a). Explain briefly <u>in words</u> how you would obtain this information from the table above: (5 pts.)

(b). Set up the problem and write out the equation that one would use a calculator to solve if you had one; however, I do not need for you to actually end up with a final number. (5 pts.)

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$$\frac{1}{N} * \frac{\Delta N}{\Delta t} = r * \left[1 - \frac{N}{K} \right]$$

LAQ #5. Consider the simple logistic model of single species population growth.

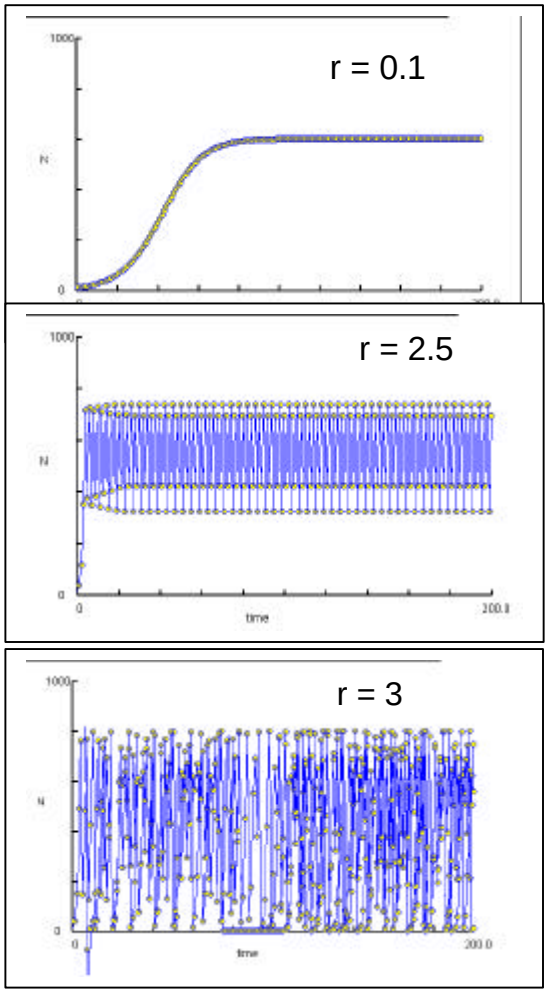
(a). What are the principal assumptions of this model? (3 pts.)

(b). **Without using any math symbols or notation**, explain in words what is the main prediction of this model? (2 pts.)

(c). Draw a little graph below showing the per capita population growth rate vs. the population size for this model. Indicate ALL relevant constants, and LABEL THE AXES! (3 pts.)

(d). Draw a little graph below showing the population size vs. time beginning with an initially large (N >> K) and with an initially small (N << K) population size for this model. LABEL THE AXES AND ALL CONSTANTS! (2 pts.)

LAQ #6. Consider the simple logistic model of single species population growth above. At right is a composite figure of three simulations using K = 600 and increasing the "intrinsic" growth rate parameter "r" from 0.1 to 3.



(a). Briefly describe what is happening as one increases "r" from 0.1 to 3? (4 pts.)

(b). Recall that for the simple exponential model of population growth, the parameter "r" was a perfectly acceptable "fitness criterion." What was the argument for this point of view? (3 pts.)

(c). Given the pattern we see at right that happens as one increases "r" in the logistic model, what implications does this have for our use of "r" as a "fitness criterion" now, and what should we do about it – i.e., what should we use as our criterion for fitness in a population that is growing logistically? (3 pts.)