Ecology – Study Problems for Exam 2
Exam 2 will be on Thursday, March 18. At least 33% of the points possible on this exam will be based on problems selected from those below.

These formulas may be helpful (these will also be provided for the test):

$N_{t+1} = N_t + B - D$
$R_0 = N_{g+1}/N_g$
$dN/dt = rN$
$N_t = N_0 e^{rt}$
$dN/dt = r_{max}N(K-N)/K$
$R_0 = \Sigma l_x m_x$

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1. Rabbits were introduced to Australia from Europe. Without their natural predators, competitors, and diseases, the rabbit population grew exponentially. Thomas Austin brought 24 wild rabbits from England in 1859 and released them on his property in Australia. If the annual per capita rate of population growth was 1.2, how many rabbits would there have been by 1869? Show formula(s) and your work.

2. A young ecology student predicts that a population of fruit flies will produce 100 new fruit flies per week until the fruit fly bottle is full, at which point the population will crash. Using your understanding of population dynamics, explain two reasons why this prediction would be false.

3. The Cactus finch population in the Galapagos Islands has been the subject of a long-term study by Peter and Rosemary Grant. They compiled survival data by annually censusing a cohort of 90 female fledglings born in 1978. The census data are shown below.

year	age (x)	number alive (a_x)	l_x	d_x	q_x
1978		**90**			
1979		**39**			
1980		**33**			
1981		**30**			
1982		**29**			
1983		**27**			
1984		**16**			
1985		**8**			
1986		**5**			
1987		**5**			
1988		**3**			
1989		**2**			
1990		**0**			

a. Fill in the empty columns in the life table. Show your work.
b. During which age class are Cactus finches at the greatest risk of mortality? Explain.
c. Construct a survivorship curve for this population.

4. A hypothetical set of life table data for a population of snails is presented below

age (x)	a_x	m_x		
0	**500**	**0**		
1	**400**	**1.0**		
2	**40**	**2.0**		
3	**0**	**1**		

a. Calculate R_0 for the snail population. Show formula(s) and your work.
b. Is this population growing, shrinking, or stable? How do you know?

5. Once established, Rio Grande cottonwoods can live to be well over 100 years old. However, they experience very high rates of mortality as seeds, which only germinate in conditions that occur very unpredictably in time and space. Female cottonwood trees produce about 25 million seeds annually and could produce up to two and a half billion seeds during a lifetime.

a. Draw a survivorship curve for Rio Grande cottonwoods.
b. Explain why the survivorship curve looks the way it does.
c. Draw an age distribution that is likely for an established population of Rio Grande cottonwoods (do not include seeds).
d. Explain why the age distribution looks the way it does.

6. Blanding's turtles are considered "threatened" in much of the upper Midwest. These turtles live in swamps and ponds, but lay their eggs at some distance away from the water. They reach reproductive maturity at 18 to 22 years of age and can live 60 or more years. An adult female can produce around 8-12 eggs at a time, but doesn't reproduce every year. These turtles are omnivores.

a. Based on the above information, and what you know about population dynamics, propose a conservation plan for Blanding's turtle. In your plan, specifically address birth, death, migration, and carrying capacity.
b. How does this conservation plan differ from a conservation plan you might propose for the endangered desert pupfish? Desert pupfish are omnivorous and can tolerate a wide range of physical stress – they occur in a few springs and streams in the desert southwest. They mature quickly (2-3 months), lay many eggs, and have a short lifespan (6-12 months). How would your two conservation plans be similar?

7. On an expedition to the tropics you survey populations of two sympatric species of *Heliconius* butterflies for color markings and find the trends illustrated below. Five specimens of *Heliconius erato* are shown in the top row while five specimens of *H. melpomene* are shown below. Each pair of similar-looking butterflies occurs in a different geographic location.

H. erato

H. melpomene

a. How could you distinguish whether the two species are involved in a Mullerian mimicry system or a Batesian mimicry system?
b. If the population of *Heliconius erato* located in Central Brazil were to go locally extinct, what would happen to the fitness of individuals of *H. melpomene* at this location? Explain.