(1). Please state and BRIEFLY explain the two major objectives of population ecology. Please use a diagram for each, but leave sufficient room for your explanations.
state and explain objective 1 - state and explain objective 2 -

(2). According to your field notes on a population of squirrels in southeastern PA, each female has four female babies per year, two out of ten adult females die each year, none leave, and none arrive. Assume squirrels can breed as one year olds.

If there are 50 adult females alive and breeding now (N_0), how many would there be in one and two years from now? {Note 1: ignore the problem of males} {Note 2: you do not need a calculator to find the numerical values asked for. The calculations involve only simple arithmetic.}

SHOW ALL OF YOUR WORK!!

how many in one year (N_1)? how many in two years (N_2)?

(3). This question will asses your understanding of single species population growth.

a. Describe three specific emergent properties of populations that occur when age-specific survival rates (p_x) and fecundities (m_x) are fixed.

b. Sketch the survivorship curve, l_x, for a population with a much lower juvenile mortality than adult mortality. Also, LABEL THE AXES!

c. When is the exponential growth rate constant, "little r," a **good** measure of the fitness of a "life history phenotype" (i.e. an individual with a particular set of p_x and m_x schedules)?

d. When is the exponential growth rate constant, "little r," a **poor** measure of the fitness of a "life history phenotype"?

(4). This question will test your understanding of evolution.

a. Please offer a brief, but precise definition of evolution -

b. Please explain exactly what exact conditions are required for evolution to occur by natural selection? {Hint: there are 3}

condition 1 - condition 2 - condition 3 -

c. Please list and Very Briefly Define three ways that evolution can occur besides Natural Selection - 1 - 2 - 3 -

(5). 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.

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

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

a. Explain briefly **in words** how you would obtain this information from the table above:

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.

c. To implement this plan what will you need from the public and how should you get it?

d. What are two key **long term** problems that you should anticipate with this plan?

(6). This question will assess your understanding of two of the principal means by which wildlife managers can act - restrict predation or use artificial means to offset losses due to people.

a. What might be the specific long term effects on a population of fish of a plan to build fish hatcheries to offset the effects of fishing? Please explain three different effects.

b. How "sustainable" is this plan?

c. What might be the long term effects on the population of fish of a plan to restrict fishing (high license fees, short season, etc?).

d. How "sustainable" is this plan?

e. Why might "sustainability" be an important management objective?

(7). Consider the simple logistic model of single species population growth.

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

a. Describe this model by explaining what <u>all</u> of the terms mean to the left and right of the equals sign, and list what are the principal ecologically relevant assumptions?

b. Without using any symbols, what is the main prediction of this model?

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!

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

(8). According to Dr. David Reznick, who has studied life history evolution in guppies that live in streams on the Caribbean Island of Trinidad, there are major differences in guppy life history for mountain vs. lower elevation populations.

Reznick found that <u>at upstream sites</u> a small predatory fish is very common and is a voracious predator of smaller guppies, and that larger guppies have few predators. In contrast, <u>at downstream sites</u>, a different species of large-bodied predatory fish is very common and is a voracious predator of larger guppies, but that smaller guppies are not eaten.

Given these different predation regimes, what life history characteristics would you expect to evolve in the <u>guppies</u> at the high and the low elevation sites? Specifically address your predictions about the relative differences at each population regarding:

juvenile and adult mortality: juvenile individual growth rate:
average adult body size: body size at sexual maturity:
age of sexual maturity: egg size:
number of eggs per clutch: reproductive life span:
brightly colored males and elaborate adult social behavior:

(9). This question will assess your understanding of current life history theory.

a. What are two ways in which increasing present allocation to storage affects future reproduction?

b. What are two ways in which increasing present allocation to growth affects future reproduction?

c. What are two ways in which increasing present allocation to reproduction affects future reproduction?

d. How should the optimal life history phenotype allocate its limited assimilated energy (i.e., its net production) to maximize its fitness?