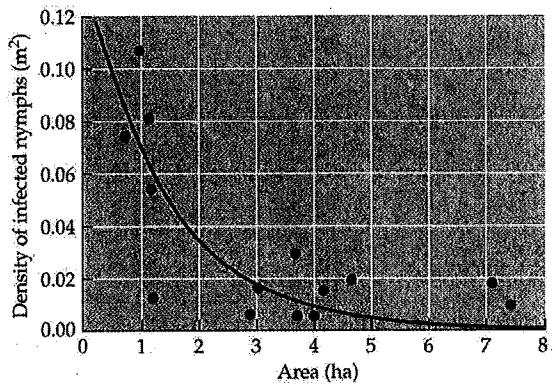
Principles of Ecology (PoE). Exam IV. Dec. 15, 2008: **Name:** Key

The test is worth 195 pts + 10 extra credit opportunity points. Note choices. Please provide the point value for this exam. Pick any integer between 100 and 250. If you leave it blank or provide a value outside this range it is worth the default 150 points.

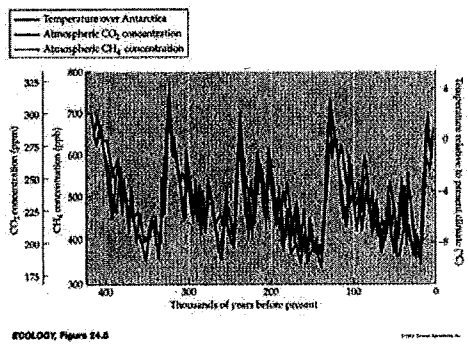
$N_t = N_o\lambda^t$	$dN/dt = rN - cNP$	$dN_1/dt = r_1N_1(K_1 - N_1 - \alpha_{12}N_2)/K_1$
$N_t = N_oe^{rt}$	$dP/dt = acNP - dP$	$dN_2/dt = r_2N_2(K_2 - N_2 - \alpha_{21}N_1)/K_2$
$H' = -\Sigma [p_i * \ln(p_i)]$	$dN/dt = rN(1-N/K)$	$dU/dt = L_oV*E + e^c*O\lambda O*G^y$
$dS/dt = -B\,SI - dS;$	$dI/dt = B\,SI - dI - \alpha I - \nu I$	$dR/dt = \nu I - dR$

1. The graph to the right (from your textbook and from lecture) was used to suggest what about the Ixodes tick?
   a. Ticks become rare as their range increases.
   b. Increasing habitat size actually increases tick density.
   c. Humans are less likely to encounter ticks if they have bigger yards.
   (d.) Humans are more likely to be infected by Lyme disease with increasing habitat fragmentation.
   e. all of the above.



ECOLOGY, Figure 23.13

2. The graph to the right (from text and lecture) shows the dynamics of temperature over Antarctica and atmospheric concentrations of methane and carbon dioxide over the last 400,000 years. Which best summarizes the result <u>from the graph</u>?
   a. Temperature causes CO2 and CH4 to change.
   b. CO2 and CH4 cause temperature to change
   c. CO2, CH4, and temperature are independent of each other.
   (d.) Temperature, CO2, and CH4 simply change together (we don't know which causes which to change).
   e. All of the above.

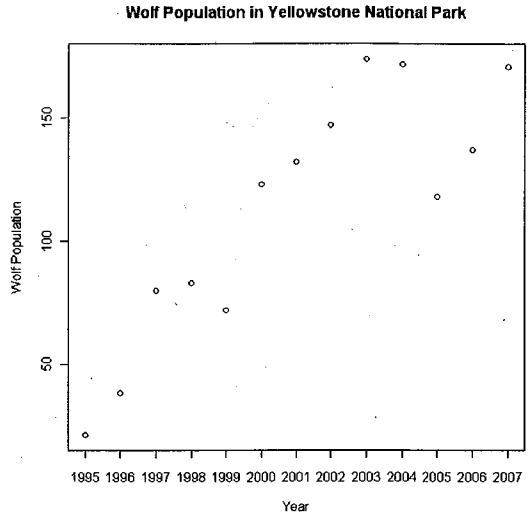


ECOLOGY, Figure 24.5

3. You want to estimate how many ants are in a nest. You collect 25 ants, mark them and then release them. You assume none die, none are born, and they mix randomly in the nest. You return the next day and observe the first 600 that come out of the next and find that 5 are marked. You estimate the size of the ant colony but realize that the ants that you marked are probably not a random sample. Which of the following is your best answer?
   a. There are about 120 ants but it's an underestimate.
   b. There are about 120 ants but it's an overestimate.
   (c.) There are about 3000 ants but it's an underestimate.
   d. There are about 3000 ants but it's an overestimate.
   e. There are many more ants and we can't estimate them.

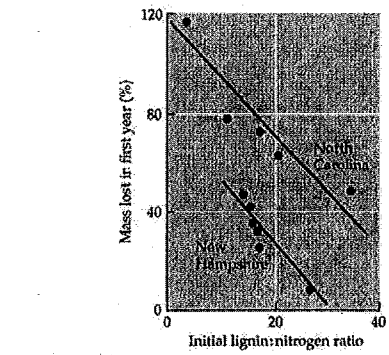
4. We discussed the results from cutting all the trees down in a watershed at Hubbard Brook (New Hampshire). Which of the following was not found?
   (a.) CO2 emissions decreased due to soil temperature increases.
   b. Total nitrate output from the watershed increased by a factor of 60.
   c. Stream flow (water loss) increased by 40%.
   d. The primary soil nutrients studied increased their rate of loss from the watershed.
   e. All of the above were found.

5. The graph to the right shows the wolf population in Yellowstone from 1995 to 2007 (since its reintroduction). The ecological model that best summarizes its population growth pattern is
   a. exponential growth
   b. geometric growth
   c. logistic growth
   d. negative bionomial growth
   e. log-linear growth.



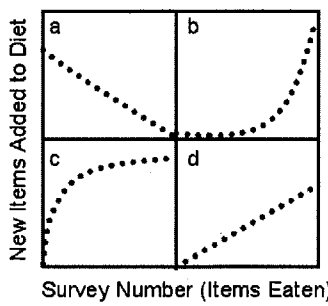
6. Persistent compounds such as DDT and methyl mercury tend to do which of the following in food webs?
   a. Increase in amount as they move up through food chains.
   b. Increase in concentration as they move up through food chains.
   c. Increase with decreasing rates of photosynthesis as they move up through food chains.
   d. Decrease with increasing rates of photosynthesis as they move up through food chains.
   e. They do all of these.

7. The data in the graph to the right (from your book and lecture) suggest that leaf decomposition rates are
   a. higher in warm, moist soils.
   b. higher in warm, dry soils.
   c. lower in cool, nitrogen-rich soils.
   d. lower in cool, nitrogen-poor soils.
   e. higher in cool, moist soil.



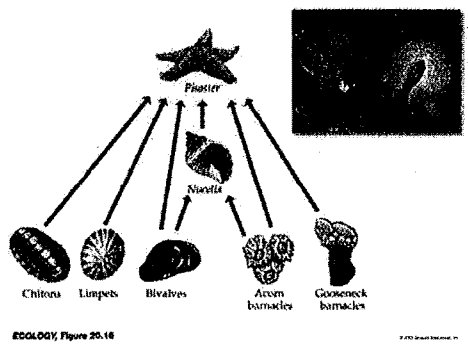
8. We saw data that suggested a positive dependency of which of the following on terrestrial plant primary productivity?
   a. Herbivore biomass productivity.
   b. Total herbivore biomass.
   c. The consumption rate of plant material by herbivores.
   d. All of the above.
   e. None of the above.

9. The figure to the right shows four different accumulation curves for food in the diet of an animal being studied. The researcher is interested in determining the diet of individuals within a species (e.g., a scorpion in the desert, as studied by Gary Polis). Which accumulation curve suggests we have observed the species enough to understand what its role is as a predator in a food web?
   a. — accepted
   b.
   c.
   d.
   e. None of these show this.



10. The figure to the right shows a simple food web. The starfish at the top of the diagram is important in this food web. What is such an important organism/species called (note, this is a principle of ecology)?

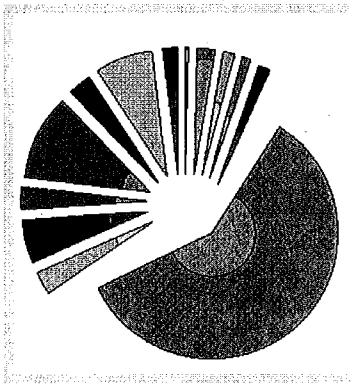
Keystone species



11. According to the 1960 classic paper by Hairston, Smith, and Slobodkin, which of the following is correct about the factor(s) that regulate herbivore and predator populations?
    a. Herbivores are regulated by predation and predators are regulated by herbivory.
    b. Herbivores and predators are both regulated by competition.
    c. Herbivores and predators are both regulated by predation.
    d. Herbivores are regulated by competition and predators are limited by their predators.
    e. Predators are limited by competition and herbivores are limited by predators.

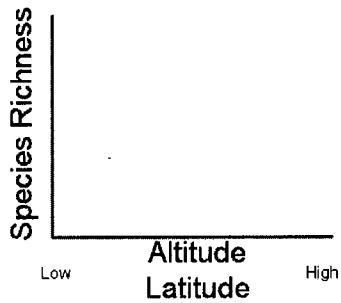
12. Sunlight in eastern deciduous forests is converted in new plant biomass (net primary productivity). What percent of sunlight energy results in NPP?
    a. 0.01%
    b. 0.1%
    c. 1%
    d. 10%
    e. 100%

13. The diagram to the right represents the estimated species richness for 13 groups of organisms on Earth. Which group from below is represented by the largest slice of the pie? (this diagram is from lecture)



    a. insects
    b. bacteria
    c. plants
    d. mammals
    e. crustaceans

14. Species richness is generally found to do which of the following? (Use the graph to the right to put in the patterns and then answer the question. You must be able to transfer what you graph to the correct answer.)



    a. decrease with increasing latitude and increasing altitude.
    b. decrease with increasing latitude and decreasing altitude.
    c. decrease with decreasing latitude and increasing altitude.
    d. decrease with decreasing latitude and decreasing altitude.
    e. remain unchanged over broad ranges of latitude and altitude.

15 Which came first, the chicken or the egg? (Note that the old adage refers to a chicken egg.) Answer AND explain based on at least one PoE.

Egg! Evolution is the Δ gene freq. over time which happens during reproduction, This doesn't happen durin egg hatching

16. What are the four, easily observed characteristics of natural selection? Answers must be **precise**. (-2 pts for first wrong, -1 thereafter.)
    a. see syllabus
    b. _____
    c. _____
    d. _____

17. Which of the below affects decomposition rates?
    a. Temperature
    b. pH
    c. moisture
    d. C:N ratio
    e. all of the above.
    f. none of the above.

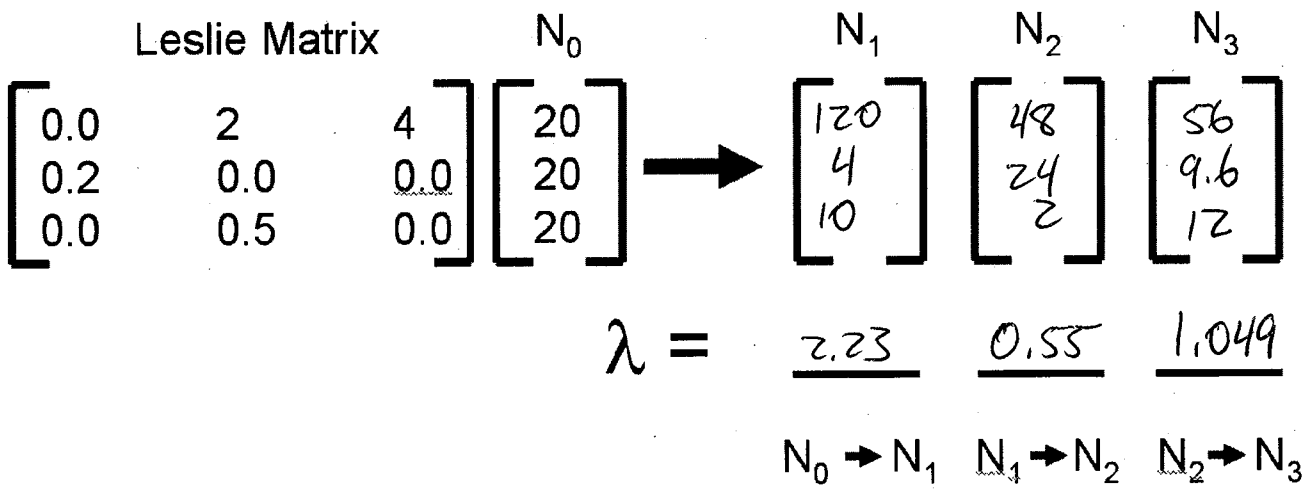
18. Many **PoEs** are formalized mathematically. Using the geometric equation $N_t = N_o \lambda^t$ what is λ for each year if a population grows from 55 to 75 over two years (e.g., populations are for years 1995 and 1997).
   a. 0.733
   b. 0.856
   c. 1.167
   d. 1.36
   e. none of the above

19. Which of the following is not a frontier of conservation biology (currently an active area of research in the field)?
   a. How many species do we have on Earth?
   b. How long will a species remain without going extinct?
   c. If we're going to develop (e.g., build a Wal-Mart) where's the best place to put it ecologically?
   d. Studying the changes in decomposition rates due to global warming.
   e. None of the above (they all are current topics in conservation biology).

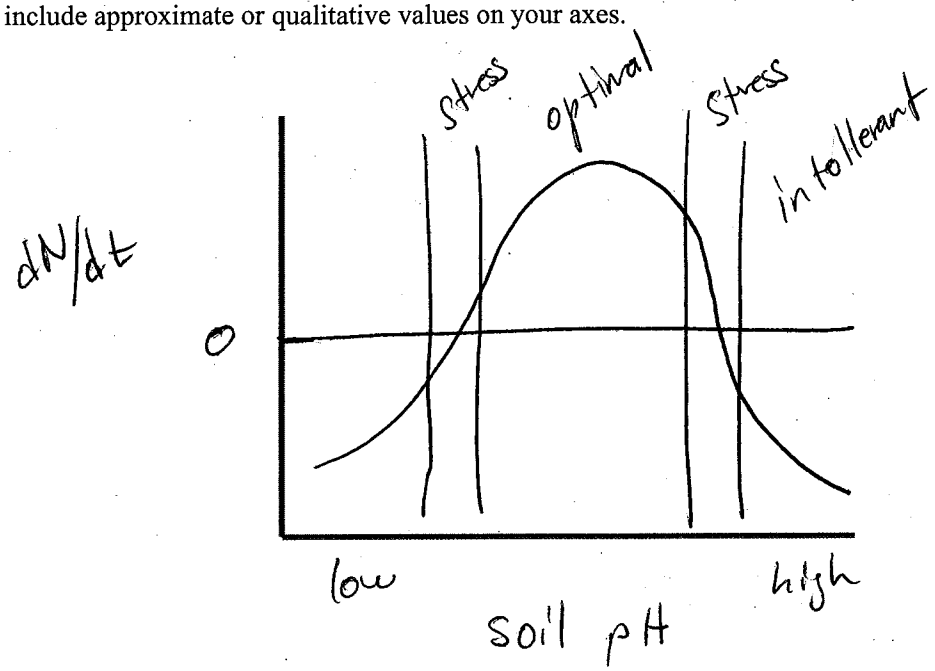
20. Which of the time intervals below is the closest to the actual doubling time of a population if it grows from 555 to 599 individuals in one year?
   a. 5 years.
   b. 6 years.
   c. 7 years.
   d. 8 years.
   e. 9 years
   f. it will never double because of density-dependent regulation.

Short Answer Questions. Answer SEVEN of NINE. Circle CLEARLY those you want me to evaluate.

1. If a population grows with the following Leslie matrix, what will the population be in each of the next three time steps (N_1, N_2, and N_3)? (7 pts) The provided population is from time step zero (N_o). Provide also the values for λ for each of the three time steps shown. (3 pts) Showing your work will allow partial credit.



2. Draw a graph of the expected population growth rate (dN/dt) for the ladyslipper orchid (a native from around here, rare, and very sensitive to environmental conditions) as a function of soil pH (assuming pH is a continuous variable from acidic to basic). Label all zones on the graph. Label axes clearly. Be sure to include approximate or qualitative values on your axes.



3. Provide a graph of the intermediate disturbance hypothesis. Include an ecological example on at least one axis and label all axes completely.

4. We discussed the Millenium Ecosystem Assessment summary for decision makers. We discussed the many ecosystem services that promote human "well-being."

a. What is the problem that this document addresses?

Biodiversity

b. Identify three causes of the problem.

various

c. Identify two actions that the document suggested are solutions.

various

5. What are the three factors that lead to seven forms of rarity? Include the two levels of each factor. Note that a "factor" is something like "gender" and the two levels of gender are "male" and "female".

	Factor		Level #1	Level #2	
a.	habitat specificity	1pt	high	low	(levels = 1/2 pt ea.)
b.	size of local pop	1pt	large	small	(levels = 1/2 pt ea.)
c.	sp. range	1pt	large	small	(levels = 1/2 pt ea.)

Example of a species that is not rare and why it isn't terms of the forms of rarity: (2 pts)

varied

Example of a species that is rare and why it is in terms of the forms of rarity: (2 pts)

varied

6. Provide **three** of the "10 solutions for climate change" provided by Scientific America and discussed in lecture. Provide one example for each. (5 pts each)

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a. See reading

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b.

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c.

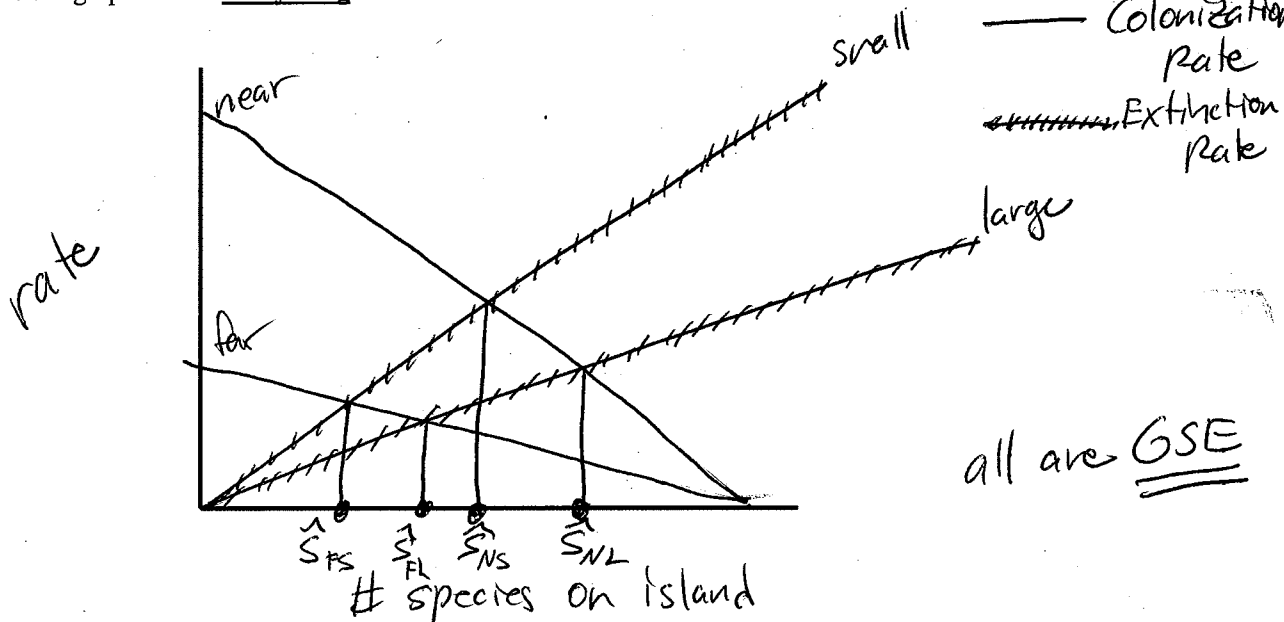
7. The following data represent the number of individual insects from five species found in two trees.

Tree 1	Tree 2
20	30
30	30
50	30
40	30
10	10

Provide the following measures of diversity:

	Tree 1	Tree 2	
Species Richness =	5	5	(2 pt)
H' =	1.49	1.55	(8 pts)

8. Provide the graph of the Theory of Island Biogeography. Portray four islands on the single graph and analyze the graph. Label **everything**.



9. Using the SIR model, when will a disease be in equilibrium within the host population? Show both trivial and non-trivial equilibria mathematically.

Trivial: $I = 0$

Non-trivial: $S = \frac{d + \alpha + \nu}{\beta}$

Ecology Models. Answer <u>one of two</u>. (15 pts ea., 45 pts total)

1a. **<u>Analyze the points</u>** on the left graph below. (1 pt ea., 5 pts total)

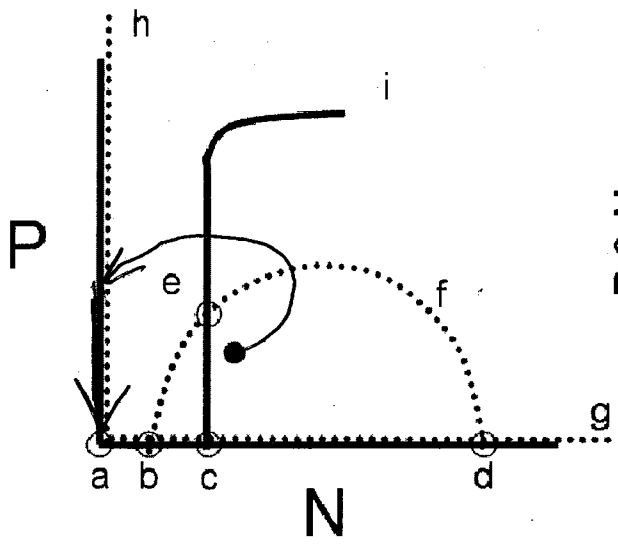
a. LSE
b. USE
c. Not EQ
d. USE
e. USE

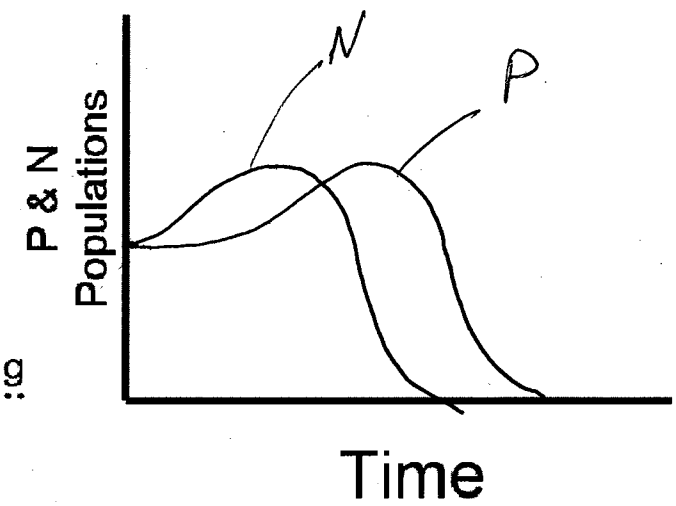
1b. Describe, preferably with an equation, **<u>the lines</u>** on the graph below. (1 pt ea., 4 pts total)

f. $dN/dt = 0$
g. $dP/dt = 0$
h. $dN/dt = 0$
i. $dP/dt = 0$

1c. The dark dot in the left graph represents the initial condition (starting place). On the left graph draw the <u>trajectory</u> until it reaches an equilibrium point. (4 pts)

1d. Draw this <u>trajectory</u> for both species (from 1c above) from start to finish on the graph on the right. (2 pts)





2a. Identify the model in the left graph below by name: (1 pt) Lotka-Volterra Competition

2b. **Analyze the points** of the left graph below. (1 pt ea., 4 pts total)

a. LSE
b. USE
c. Not EQ
d. LSE

2c. Provide the equation for **the lines** below. (1 pt ea., 4 pts total)

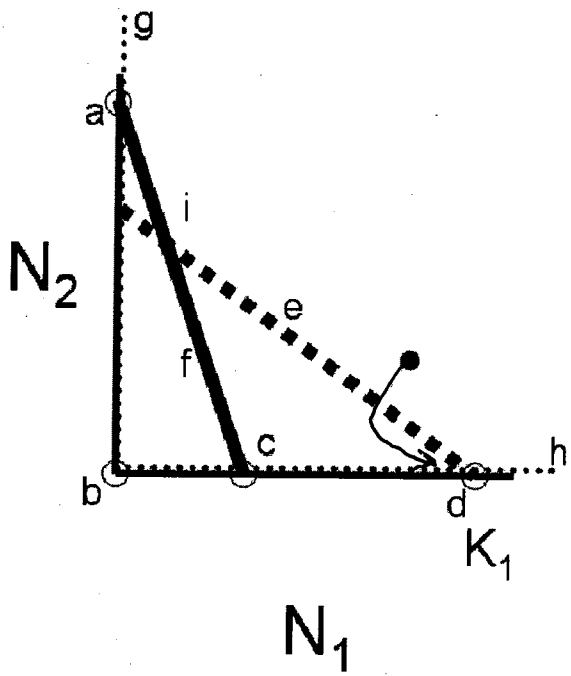
e. $dN_1/dt = 0$
f. $dN_2/dt = 0$
g. $dN_1/dt = 0$
h. $dN_2/dt = 0$

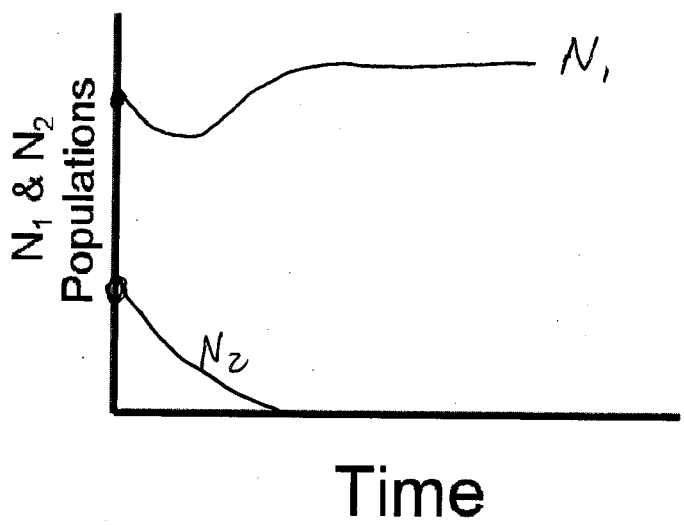
2d Analyze the point "i" at the intersection of lines "e" and "f": (1 pt)

USE

2e. The dark dot on the left graph represents the initial starting populations for species 1 and 2. On the left graph draw the trajectory for this point until it reaches an equilibrium point. (3 pts)

2f. Draw this trajectory (from 2e above) on the graph on the right. (2 pts)





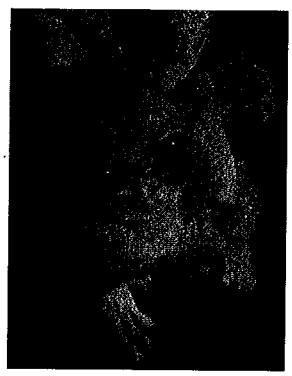
MANDATORY: Below is the last paragraph from Darwin's 1859 The Origin of Species (reproduced from your syllabus). Clearly identify three (3) PoEs (each unique) from the passage (circle and number) and describe them below (3.33 pts each, 10 pts total)

It is interesting to contemplate an entangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent on each other in so complex a manner, have all been produced by laws acting around us. These laws, taken in the largest sense, being Growth with Reproduction; Inheritance which is almost implied by reproduction; Variability from the indirect and direct action of the external conditions of life, and from use and disuse; a Ratio of Increase so high as to lead to a Struggle for Life, and as a consequence to Natural Selection, entailing Divergence of Character and the Extinction of less-improved forms. Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved.

a. _____

b. _____

c. _____



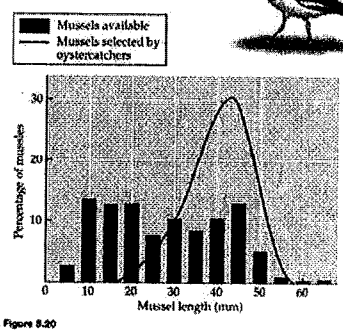
Extra Credit (up to +10 pts).

1. What is the significance of the DMZ ecologically? (2 pts)
   Unique undisturbed (60 yrs) habitat.

2. Name the rascal to the right (recently rediscovered in Indonesia). (2 pts)
   Tarsier

3. The CERN accelerator was shut down until next summer. If it worked some people feared what might happen? (2 pts) Earth would be gobbled by black hole

4. Briefly explain why oystercatchers (the bird) take only some mussels (under the curve) when the bars represent the abundance of mussels over a large range of sizes. (4 pts) Economics – marginal value theorem.



ECOLOGY, Figure 8.20