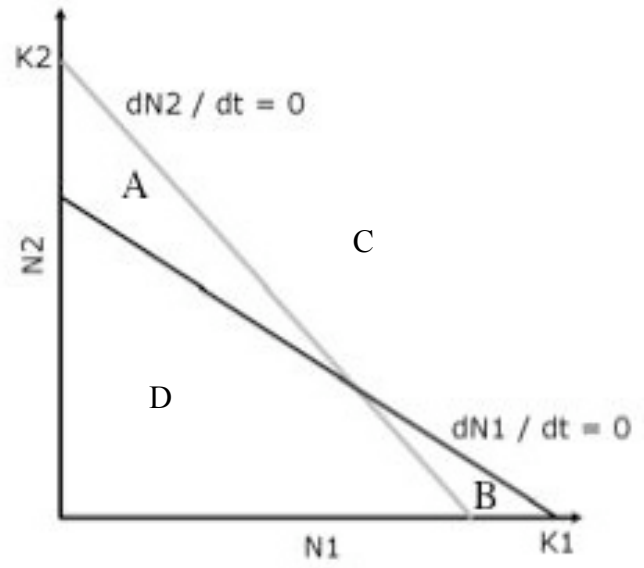
Your name: _____

EEB 122b PRACTICE SECOND MIDTERM

Your name: _____

1. You are interested in conducting an experiment with two competing species of plants. Below are the zero-growth isoclines for the two species.



a) Draw the vectors that describe how N1 and N2 change at points A, B, C, and D on the graph above. (4 pts)

b) Is the competition coefficient for N1 ($\alpha_{1,2}$) greater than, equal to, or less than 1? (2 pts)

c) Is inter- or intraspecific competition stronger for species 1? (2 pts)

d) If you planted many individuals of each of these species in a field together and observed the community over many generations, which of the two plant species (if either) would you expect to go extinct? (2 pts)

e) Why? (2 pts)

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2. During a survey conducted in October 2003, separate populations of a threatened endemic rodent species were found in each of several habitat patches around Lake Naivasha, Kenya. Each year storms flood burrows in an average of 40% of the occupied patches, causing local population extinctions. Despite the high level of disturbance caused by the storms, a survey conducted in October 2007 revealed that the rodent species has persisted in this region of Kenya.

a) Describe how the rodent species may be able to persist in this region, despite frequent destruction of much of its habitat. (4 pts)

b) Do these habitat patches constitute a metapopulation? (1 pt)

c) Why or why not? (2 pts)

d) What two major patch characteristics account for the colonization and extinction rates of local populations? (2 pts)

Below is the life table of the rodent population found in one of the patches.

x	p_x	l_x	m_x	$l_x m_x$
0	0.1	1	0	
1	0.8		4	
2	0.5		4	

e) Calculate R_0 by filling in the missing values in the table. (2 pts)

R_0 = _____

f) Is the population a sink or a source? (1 pt)

g) Why? (2 pts)

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3. Imagine a lake community consisting of algae, zooplankton (which eat the algae), and detritivores (or decomposers, which eat all dead material in the lake).

   a) Draw a food web that explains the interactions among these three trophic levels. (2 pts)

   b) What would you expect to happen to this system if you added a large amount of phosphorous to the lake? (2 pts)

   c) Why? (2 pts)

   d) Is the response seen in part (b) a consequence of top-down or bottom-up control? (2 pts)

   e) What would you expect to happen to this system if you added fish (which eat zooplankton) to the lake? (2 pts)

   f) Why? (2 pts)

   g) Is the response seen in part (d) a consequence of top-down or bottom-up control? (2 pts)

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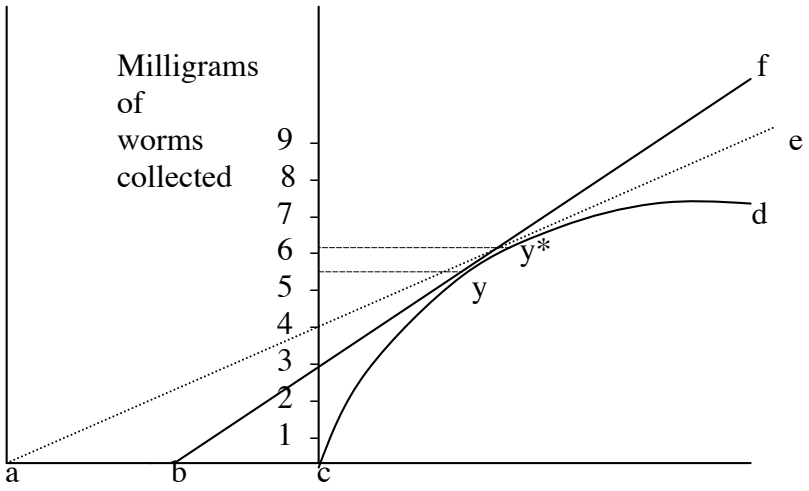
4. Marginal value theorem.



The graph above represents foraging time for two American robins collecting worms for their broods. The robins can start either from a nest at point a or from a nest at point b. Line a-e is tangent to curve c-d at point y*, and line b-f is tangent to curve c-d at point y.

a) What does curve c-d represent? (3 pts)

b) About how many milligrams of worms should the robin starting from the nest at point b collect if it is foraging optimally? (2 pts)

c) Do robins that travel longer distances collect a greater or smaller weight of worms than robins that travel shorter distances? (2 pts)

d) Why might this be? (3 pts)

e) Which robin collects more milligrams of worms per minute: the one starting at point a, or the one starting at point b? (2 pts)

5. The distribution of species around the globe is not even. In general, most of the world's diversity is found in the tropics. As you move away from the equator, the diversity of plants, fish, reptiles, amphibians, insects, and mammals declines.

   a) Many hypotheses proposed to explain the latitudinal biodiversity gradient focus on the availability of abiotic factors such as sunlight and water. How does amount of available sunlight affect levels of biodiversity? (3 pts)

   b) Another theory proposes that the variability of a climate has more of an impact on biodiversity than average climatic conditions. How does a stable climate promote increased biodiversity? (3 pts)

c) Give an example of how human-induced global climate change is changing the patterns of biological diversity on the planet. (3 pts)

d) From the economic view, what is biodiversity worth? (3 pts)

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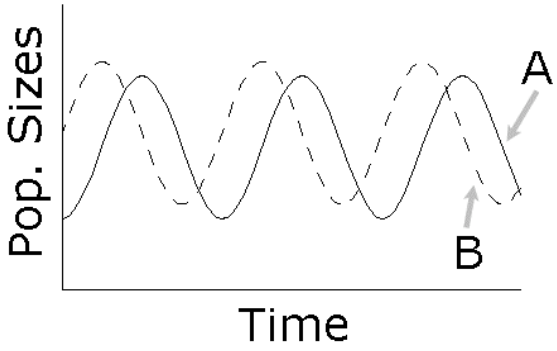
6. A population of foxes has been feeding preferentially upon the abundant squirrel population in a particular area where both squirrels and rats are available as potential prey. After one rough winter, the squirrel population declines steadily due to a lack of acorns.

   a) Draw a graph of the proportion of rats in the foxes' diet versus the proportion of rats available. Label the pre- and post-rough winter conditions on the graph. (4 pts)

   b) Would you expect the foxes to switch to eating rats as the proportion of squirrels in the community decreases? (2 pts)

   c) Why or why not? (2 pts)

Consider this graph of two species, A and B. One species eats the other. The growth of both species is well-described by the Lotka-Volterra predator-prey model.



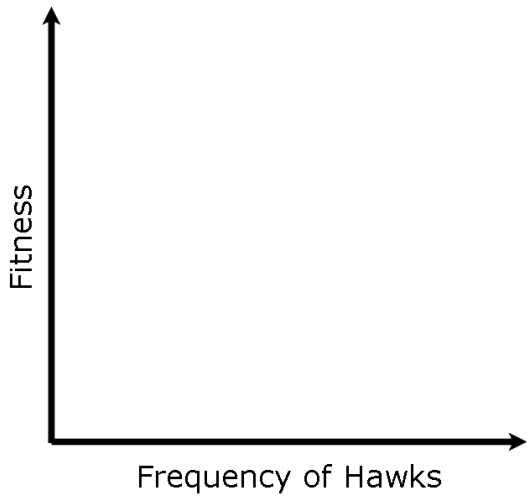
   d) Which species, A or B, is the predator? (1 pt)

   e) How can you tell? (3 pts)

7. In the Hawk-Dove game of competition over resources, let B be the fitness benefit of the resource and let P be the fitness cost that a winning hawk inflicts on a losing hawk.

    a) If hawks and doves coexist at equilibrium, what is the relationship of B to P? (2 pts)

    b) If the stable equilibrium for hawks and doves is 75% hawks, 25% doves, draw a graph of the fitness of hawks and doves as a function of the frequency of hawks. Label your plotted curves (6 pts).



Now imagine a new variant arises, chickenhawk, which plays the following strategy: against hawks, it acts like a dove; against doves, it acts like a hawk. Consider the evolution of a population of hawks, doves, and a few chickenhawks.

    c) Would the chickenhawk strategy replace hawks? Why? (2 pts)

    d) Would it replace doves? Why? (2 pts)

8. Foregoing one's own reproduction to help raise another's offspring, as in birds that help at the nest, can be explained several ways.

   a) Give a group selection explanation for helping behavior (3 pts)

   b) State one reason why group selection is implausible. (3 pts)

   c) An alternative to group selection is kin selection. How might kin selection explain helpers at the nest? (3 pts)

   d) In the Pied Kingfisher in Kenya and the Scrub Jay in Florida, what ecological constraint helps to explain the evolution of helping behavior, and how does it do so? (3 pts)