PRACTICE MIDTERM EXAM BIOL121 SECTION 123--KEY

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Biology 121 Section 123 Sept28-Oct8, 2013

Practice MIDTERM 1
Instructor: Pam Kalas

FAMILY/LAST Name: _____ **FIRST Name:** _____

Student number: _____

Instructions:

1. This exam has 8 pages including this page. Look over the exam to make sure no pages are missing. Also before you begin, read over the whole exam first and see how much each question is worth. Plan your time accordingly.
2. Answer all questions in the space provided. Material written on the backs of pages, or anywhere other than in the space provided, will not be read or marked unless a student has obtained special permission from an instructor or TA during the examination.
3. All writing should be in ink. If you choose to write in pencil, there will be no chance of having your exam remarked even in the case of an addition mistake on the part of the markers.
4. Answers may be in sentences or point form.
5. No electronic devices are permitted during the exam.
6. No one may leave the examination during the final 15 minutes of the 50 minute exam period.
7. Students suspected of any of dishonest practices will be immediately dismissed from the examination and will be subject to disciplinary action.
8. No memory devices are permitted. Please turn off your cell phone and leave it in your bag.
9. Students may not speak or in any other way communicate with other students while in the examination room.
10. Students may not expose their written paper to other students. The excuse of accidental exposure, forgetfulness, or ignorance will not be accepted.
11. Following completion of the exam, the one-page note sheet must be turned in with your exam and must have your name and student number written at the top.

I have read and fully understand these instructions.

Student signature _____

Mark allocation:

Question	Marks possible	Your mark	Suggested time
Read over the exam			5 min
1.	14		13 min
2.	4		7 min
3.	8		8 min
4.	6		10 min
5.	7		7 min
Total	**39**		45+5 minutes

1. Skunks (*Mephitis mephitis*) and raccoons (*Procyon lotor*) are medium-sized mammals commonly seen in most Vancouver neighbourhoods. Both of them are omnivores; they eat a variety of plant products such as berries, leaves, nuts and roots, as well as invertebrates such as arthropods and earthworms, plus mushrooms, eggs, and occasionally small rodents (mice and squirrels) or birds.

   a) Consider a stable community that includes skunks, raccoons, walnut trees, blackberry shrubs, earthworms, soil bacteria and mushrooms.
   i) Draw a food web that represents the energy flow among these organisms (do so by adding the appropriate arrows to the figure below) **(4 marks)**
   -0.25 for each incorrect or missing arrow (arrows form bacteria to skunk or raccoon are OK since raccoons and skunks may end up eating bacteria. These arrows are not required but not incorrect).

   No negative marks.

   Make sure
   1) all organisms have arrows that go towards mushroom, earthworm and bacteria [mushrooms and bacteria are decomposers and earthworms detritivores, as depicted in the food web seen in class and in the textbook, and similar to the content of one of the Vista quiz questions].
   2) No arrows go towards the two plants, as they are primary producers!
   3) Skunk and raccoon "receive" arrows form the two plants, mushroom and earthworm, since their diet is described in the question.

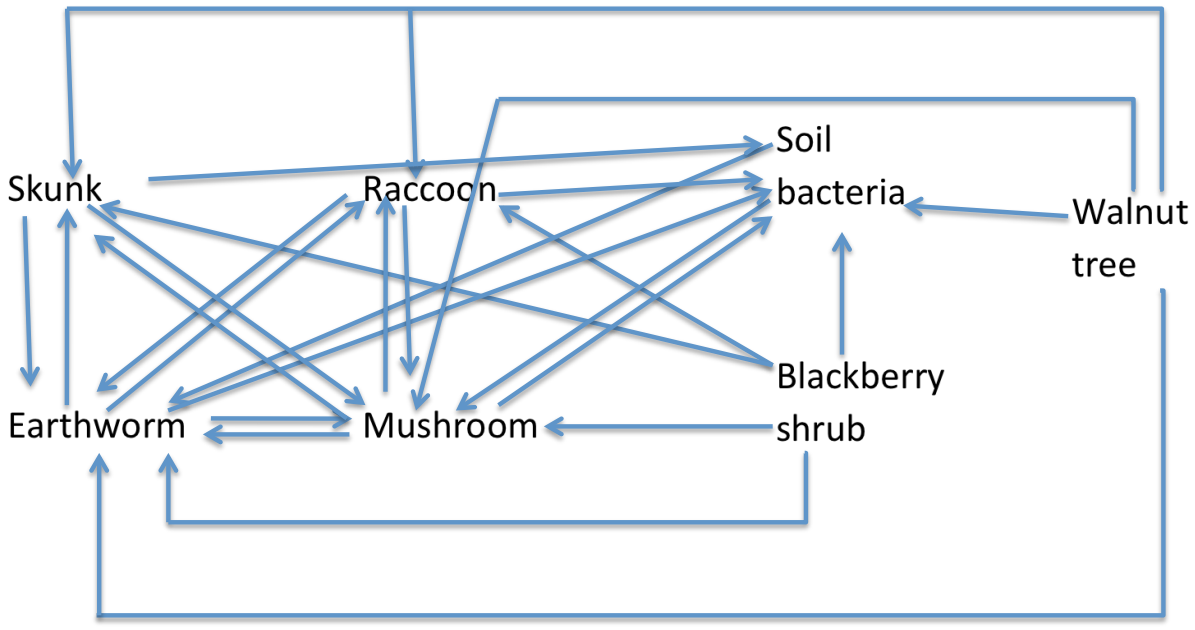

Figure 1. Proposed food web for the community described in part a).

ii) What organism or organisms from the stable community described in a) do you expect to have the largest biomass? Briefly explain your answer. **(3 marks)**

The walnut trees and blackberry shrubs (1) because they are both primary producers/they are at the lowest trophic level (1) and since energy transfer is not 100% efficient (0.5), the group of consumers, decomposers and detritivores in the community needs a biomass of producers larger than its own to sustain itself (0.5).

(extra 0.25 off for including irrelevant, inaccurate information).

b) Consider the same community as in part a) and identify two potential examples of inter-specific competition (competition between organisms of different species). For each example indicate the two species involved as well as the specific resource that they would be competing for. Each species can only be used in one example. **(2 marks)**

0.5 mark for each interaction and 0.5 mark for what the two species compete for in each case.

Examples: Raccoons and skunks (0.5) may compete for [insert here specific food item e.g. earthworms, blackberries, etc.] (0.5) No marks for just saying "food", since specific food items that both raccoons and skunks eat are listed in the question.

Blackberry shrubs and walnut trees (0.5) may compete for space OR substratum OR sunlight OR water OR inorganic nutrients (0.5). [THEY DON'T COMPETE FOR FOOD, SINCE THEY DO NOT GET ENERGY FROM FOOD].

Mushrooms and soil bacteria (0.5) may compete for inorganic nutrients OR for dead matter as energy source (0.5).

Mushrooms and walnut trees OR blackberry shrubs (0.5) may compete for space OR substratum OR inorganic nutrients or water (0.5).

0.25 off for including inaccurate information (e.g. plants compete for food).

c) The population of skunks in Stanley Park is increasing very quickly. A population ecologist is trying to estimate the carrying capacity of Stanley Park for skunks. What are two of the factors/parameters that she should measure in order to get an estimate of carrying capacity? (Note: you do not need to justify your answer). **(2 marks)**

1 mark per factor/parameter (MUST be measurable in some way)

Examples:
Habitat size
Abundance of food resources (OR name of specific food item)
Abundance/presence of predators
Mean amount of resources (food, space, etc) used per individual skunk
Abundance of competitors (e.g. raccoons)
Size of skunks/size of skunk dens.
Habitat shape is OK if one proposes a way to measure it (e.g. area/perimeter ratio), otherwise ½ marks.

Extra 0.25 off for including inaccurate info or internal inconsistencies (e.g. say "competition for space" and then give examples of food items).

d) What would happen to the skunk carrying capacity of Stanley Park if the raccoon population started to increase very quickly? Explain your answer. **(3 marks)**

The skunk carrying capacity would decrease (1). Skunks and raccoons live in the same area/share the same habitat (0.5) and compete for/eat the same food sources (0.5), so an increase in the population of raccoons will result in fewer resources left for the skunks (0.5), meaning that Stanley Park will be able to sustain a smaller population of skunks than without/with fewer raccoons (0.5).

Note for students: many people in previous years (when this was a real midterm question) said that carrying capacity is a constant and therefore won't be affected. This is inaccurate; it is a misconception: recall that carrying capacity is the maximum number of individuals of a species that an environment can support over a long period of time. Recall how, if the environment changes or the population changes its habits, carrying capacity will change! If you are confused about this concept, make sure to review it and/or to ask for clarification before your real midterm.

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1. 2. *Lacerta bilineata* ("the lizard with two lines") and *Lacerta viridis* ("the green lizard") are two species of reptile found almost exclusively in Europe. Below are a map of the main biomes and a map showing the distribution of these two species throughout most of Europe.

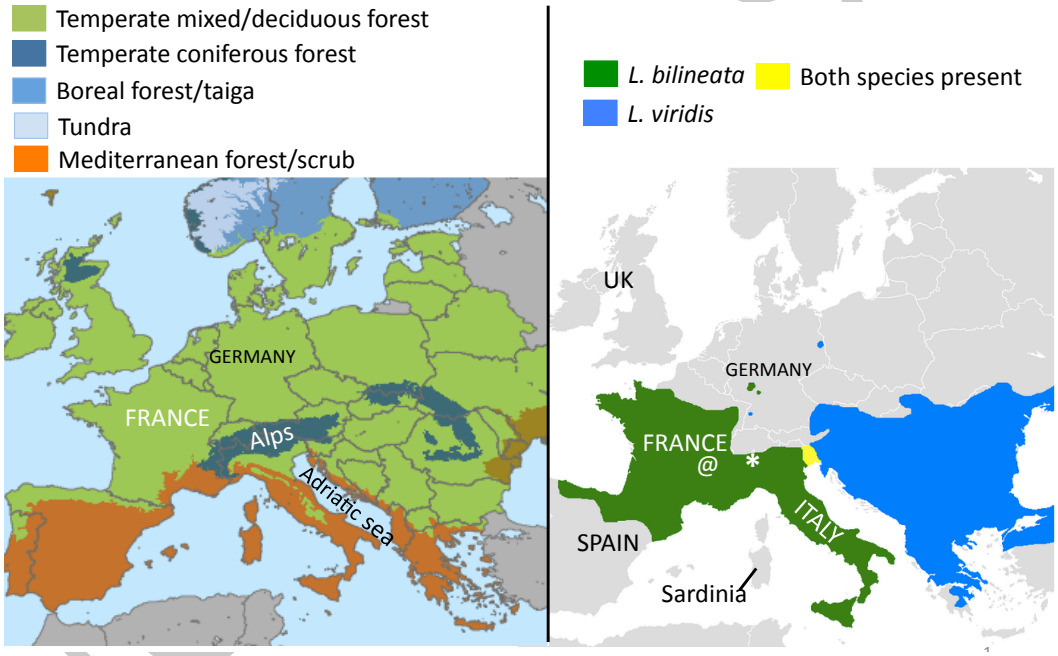


Figure 1. On the left: The main terrestrial biomes found throughout Europe. On the right: The distribution of two species of lizards, *Lacerta bilineata* and *Lacerta viridis*, throughout Europe. The asterisk (*) and the "@" symbols indicate the specific locations of two populations referred to.

a) Propose one abiotic factor that could be responsible for the Northern-most limit of the distribution of both lizard species, and explain how this factor could affect the growth and reproduction of the two lizard species? Be specific! **(1 mark)**

Example: temperature (0.25)

Note: when the question asks for ONE factor or ONE explanation, provide ONE and one only. Otherwise, points will be divided by the number of factors you provide (because one could write a whole list of things and hope that one is correct).

In addition, the question asks for differences and similarities in the distribution of the two species… not in their abundance (which we can't tell anyway from the info given), not about their preference, not about their ability to survive. Make sure that you answer the question!

***Example explanation* for temperature:**
Temperatures in Northern locations are generally lower (0.25), and the lizards may not be able to tolerate them (0.25) because they are ectotherms and at low temperature their metabolism may not function efficiently enough to ensure survival and growth (0.25).

OR: Temperatures in Northern locations are generally lower (0.25), and the lizards may not be able to tolerate them (0.25), which will result in higher death rate/death of the eggs/death of the young, so we won't find populations of lizards up North. (0.25).

b) In some regions of France (indicated with the symbol "@" on the map) *Lacerta bilineata* is found at very low density. In contrast, very large and dense populations are found in Southern Switzerland (location indicated with an asterisk, *). Propose one biotic factor (or biotic interaction) that could explain this difference, and explain how this factor could affect the density of *Lacerta bilineata* in France and Southern Switzerland?
(1 mark)

Example: competition for food/space/resources/ with other species (0.25)
OR: predation by a carnivore (0.25)

***Example explanation* for competition:**
If in France (but not in Southern Switzerland) there are other species that compete with *L. bilineata* for food or space, (0.5) fewer resources are left for *L. bilineata*, so the environment can sustain a smaller population. (0.25)

OR (predation):
In France there could be a predator, absent in S. Switzerland, that has *L. bilineata* as part of its diet (0.5). This would prevent the population in France form reaching high density (0.25).

c) Notice how neither lizard is present in Sardinia. Propose a coherent and consistent explanation for this phenomenon.
(1 mark)
Example:
If the two lizards species established their populations after Sardinia became separated from the mainland, it would have been difficult for them to spread (disperse) onto the island, which is miles away from the mainland.

3. Two separate locations in the temperate rainforest ecosystem (called "site A" and "site B") have experienced severe fires during the same two weeks. As a result, all the organisms that used to live at those two sites have been killed, but the soil has remained in place. The abiotic conditions at the two locations are comparable. Site A is located very close to two other forested areas which were not affected by the fires. Site B, on the other hand, is very isolated, surrounded mainly by rocky terrain and a small freshwater stream.

a) Many years after the fires, several organisms establish populations at site A and site B. What are <u>three characteristics</u> necessary for a species to be the first one to establish a population at site A after the fire? **(3 marks)**

Any three of:
- Need to disperse there/get there from nearby environment
- Ability to tolerate the abiotic conditions/survive in the environment
- Ability to sustain itself in terms of energy (may say autotroph, photosynthetic, able to get energy from matter in the soil…)
- Ability to reproduce in the conditions/environment in question
- Quick reproductive cycle
- Other answers possible (if they make sense)

(1 mark for each, maximum 3 points—if more than three characteristics, -0.5)

b) Before the fires, site A and site B were inhabited by the same types of communities. Based on the information provided about these two sites, and on your knowledge of population and community ecology, which of the two sites is expected to reach a late successional stage first? Briefly explain your answer.
[You *must* make a choice between site A and site B, and explain your choice. Marks will be divided by two if you don't.] **(2 marks)**

Site A is expected to reach a late successional stage first (0.5). This site is located near a forest and it will be more likely/easier for organisms that live in the forest to disperse into site A (0.5). Fewer organisms live around/close to site B, so it will be less likely/it will take more time for these organisms to disperse into site B (0.5), so the succession should reach any given stage later. (0.5)

OR:
Site B is expected to reach a late successional stage first (0.5). Organisms living in the harsh, rocky environment around site B (0.5) will be more likely to tolerate the conditions present at the disturbed/burned site. (0.5) The succession will start earlier at site B, so it should reach any given stage earlier. (0.5)

NOTE: must make a choice between site A and site B—can't argue it both ways

c) Two species of lizards that have recently dispersed into site A, making it their home. Consider the characteristics of these two lizard species shown in the table below, and predict which one is most likely to establish a population at site A first? Justify your answer. **(3 marks)**

	Diet	**Predators**	**Nesting sites**	**Reproduction characteristics**	**Survivorship**
Lizard species 1	Small insects, worms, carcasses of dead animals	Birds, small mammals, coyotes, bear cubs	In trees (close to the ground) or holes in the ground	Start reproducing at 3 months; produces up to 60 eggs.	About 1 in 5 eggs survive and 1 in 10 newborn makes it to adulthood.
Lizard species 2	Small insects, worms carcasses of dead animals	Birds, small mammals, coyotes, bear cubs	In trees (any height) or holes in the ground	Start reproducing at 6 months; produces hundreds of eggs.	About 1 in 10 eggs survive and 1 in 10 newborn makes it to adulthood.

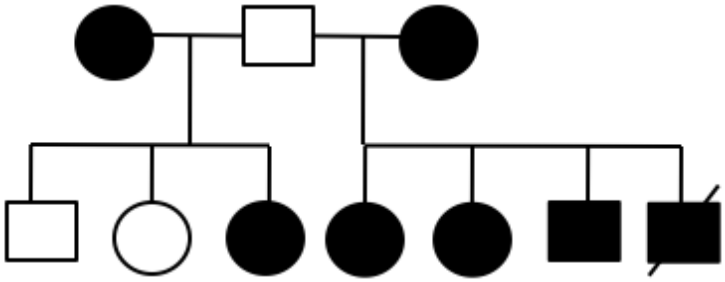
Species 1 (1) because it has the same resource requirements as species 2 (same niche) (0.5) and a similar reproductive output (comparable number of offspring that will make it to adulthood) (0.5), but starts reproducing at a younger age than species 2 (0.5) thus starting to populate the site earlier (0.5).

Also acceptable:
Species 2 (1) because it has the same resource requirements as species 2 (same niche) (0.5) and, although it starts reproducing a an older age than species 1, the lizards that dispersed into Site A may be all adults who are well into their reproductive age and therefore can start reproducing right away (0.5). Because the reproductive output of species 2 is overall slightly higher than that of species 1, I predict that it will establish a population first (0.5).

4. The UBC campus squirrels, known as Eastern Grey Squirrels (*Sciurus carolinesis*) come in two colours: grey and dark brown. They are native of the East Coast and considered an invasive species in Vancouver as they are mercilessly outcompeting our local Douglas squirrel.

a) A male grey squirrel mated with two separate dark brown females. The first mating resulted in three baby squirrels, one grey male, one grey female and one dark brown male. The second mating gave four baby squirrels: two dark brown females, and two dark brown males, but one of the males died right after birth from some unexplained injuries. Draw a pedigree of this extended squirrel family! **(3 marks)**

Black symbols: dark brown
White symbols: grey
1 mark for defining use of colours/symbols
2 marks for accurate pedigree



b) While in Vancouver we see both grey and dark brown Eastern Grey Squirrels, in Northern Ontario they are almost exclusively dark brown, and in the Southern parts of North Carolina they are almost all grey. Explain, as a biologist would, the process that might have lead to these differences among the Vancouver, Northern Ontario, and North Carolina populations. **(3 marks)**

0.5 mark for possible reason, e.g.:
- dark fur better at retaining heat
- camouflage (darker habitat in Northern Ontario)
- protection from predators (N.O. predators better at seeing grey)

- etc.

2 marks for explanation, example for "temperature":
In North Carolina the climate is warmer than in Vancouver, and much warmer than in Northern Ontario therefore, dark brown squirrels may have a big advantage over their grey counterparts in Northern Ontario, where they would be more likely to be able to survive the harsh winters and make it to the reproductive season (0.5),
This way, dark brown squirrels would then be more likely than the grey ones to pass on their alleles that code for dark brown fur (or, "to pass on the dark brown fur trait to their offsprings"), (0.5) resulting in an increase in the proportion of dark brown squirrels (0.5).
In North Carolina, the "warmer" dark fur may be a disadvantage given the hotter climate, so dark brown squirrels may have a lower chance of reproducing and passing on their trait, (0.5) while in Vancouver neither fur would give a noticeable advantage and both types of squirrels would have equal chance of reproducing and passing on their traits (0.5).

5. The figure below shows the number of individuals in a deer population over 12 years.

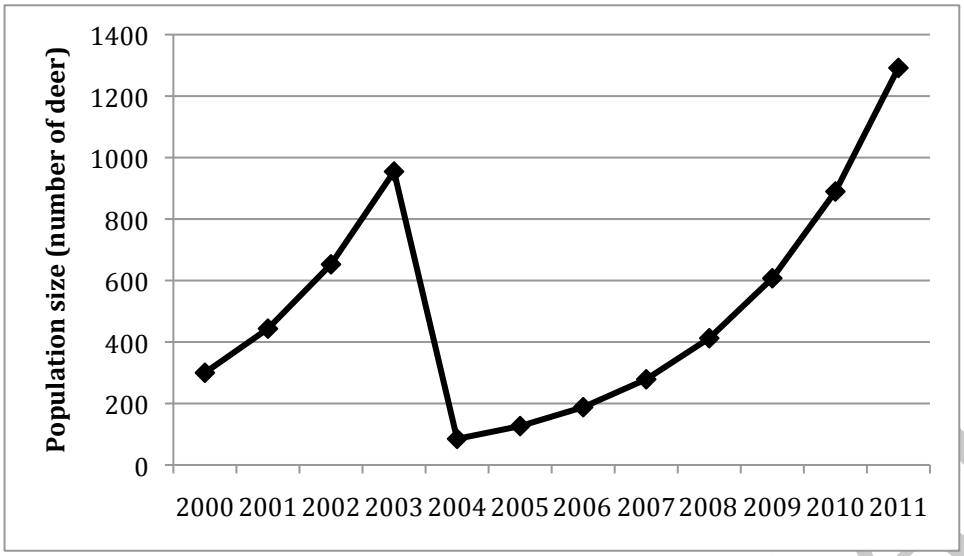


Figure 1. Size of a deer population (in number of individuals) at the start of each year, from 2000 to 2011 in a secret location.

a) Describe the growth of this deer population between years 2000 and 2011. Your description should be specific and include any patterns, trends and anomalies observed. **(2 marks)**

The population shows exponential growth from 2000 to 2003 (0.5). This is followed by a sudden drop/"crash" between 2003 and 2004 (0.5), where the population decreases to a smaller number of individuals than there were in 2000 (0.5-may express this in different ways). In 2004 the exponential growth resumes and continues until 2011. (0.5)

b) Deer are relatively large herbivorous mammals. They generally have small litters and live up to 10 years. You have been asked by a deer conservation group to predict what will happen to the deer population shown in the graph over the next 12 years (that is, between now and 2023).
What additional pieces of information would you want to have, and why is that piece of information crucial to make an accurate prediction in this specific scenario? **(3 marks)**

Pieces of info:

- carrying capacity of the habitat! (0.5)

→ crucial because it will allow to calculate when and how much population growth will decrease, which is necessary to know in order to make a prediction (1)

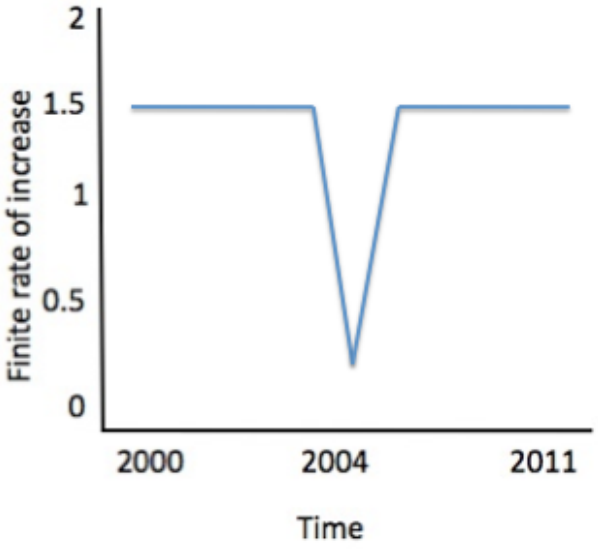
- presence of predators/predicted disturbances/any other relevant factor (0.5)

→ explanation of why crucial (1)

[must have carrying capacity and one other "thing"]

c) On the template below, sketch a graph that shows population growth, measured as the finite rate of increase on the Y-axis as a function of time (on the X-axis) for the deer population between years 2000 and 2011. **(2 marks)**

Example of acceptable answer:



Requirements:

- finite rate of increase is constant up to 2004 and after the "crash" (0.5)
- finite rate of increase (outside the "crash year") is above 1, as population is growing! (1)
- finite rate of increase in the "crash year" goes down very low below 1 (population is decreasing!), but NOT below 0 (it can't be 0 if the population size has never been zero) (0.5)