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Biology 180 Exam 4
12/11/2017

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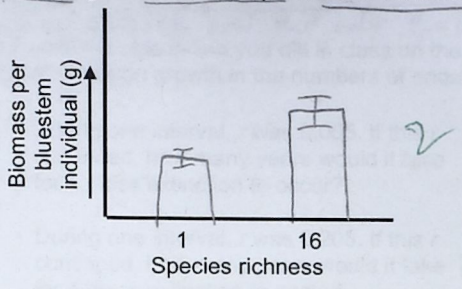
1. In the experiment you analyzed in class on the relationship between species richness and productivity in prairies, bluestem grass is a particularly "big producer." (10pts)

a. Graph the data you expect to see if bluestem has MUCH higher niche overlap with itself vs. other species.



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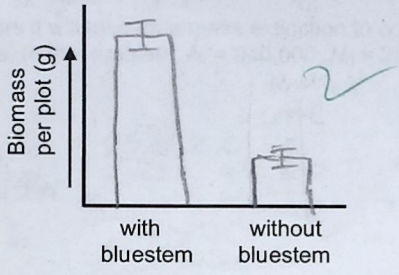
b. Graph the data you expect to see if bluestem is responsible for a sampling effect (a bar graph).



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c. Now consider the data on species richness and productivity that you analyzed in lab. For each bulleted point, explain the rationale. When John Parks set up this experiment, he was careful to:

- Create 40 replicates of each treatment. (How would you criticize an experiment with 1 replicate in each treatment?)
  If there was only 1 replicate in each treatment, the results could be due to just having a unique individual that has strange results. By having 40, this makes sure that the results represent the population, and are not just skewed from one unique individual.
- Place the flats of seedlings from different treatments in random locations in the greenhouse.
  Randomization of location ensures that differences in soil, sunlight, and other uncontrollable factors are equalized in both treatment groups, so that the results are due to differences in treatment, not differences in other variables.
- Plant the same total number of seeds in each flat.
  One thing we measured is plant number in each flat. In this case, total number of seeds planted should be a controlled variable that is equal in each plot, because we are measuring how other factors like species richness affects how many of these seeds survive as plants. Thus, must control seed number.

2. Consider sexual selection in nootka rose plants that are pollinated by bees. (5pts)

a. Explain why there will be heritable variation in plant traits associated with "courtship" (obtaining mates).
Plants must have characteristics that attract bees for pollination and therefore increase likelihood in courtship. Traits such as smell and color of flower are based on the genes of the plants. These genes are passed on from parent to offspring, so the traits are heritable. The variation will exist because there is variation in the combination of genes due to crossing over, mutations etc.

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b. Explain why rose plants could experience differential success in obtaining mates, based on heritable variation.
Plants are required to attract pollinators in order to successfully reproduce. Plants born with brighter flowers or better smelling flowers will be able to attract more pollinators and reproduce, while other plants that do not have these traits will not be able to. The successful plants will pass on these traits to their offspring, and the offspring will also have it. Successful plants have higher success rate.

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3. Consider some issues in conservation biology. (9pts)

a. The Amur leopard is down to 30 individuals in the wild; the 30 are showing signs of low fitness. In response, some conservationists propose that individuals bred in zoos be introduced to the wild population. In terms of genetics, explain the logic behind this proposal.
When small populations are isolated, they have inbreeding, which lowers fitness. This is because there is genetic drift that leads to loss/fixation of alleles, and there are more deleterious homozygotes in the population. By introducing different populations, this is artificial gene flow that would increase genetic diversity and would prevent further inbreeding and its consequences.

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b. When habitat is fragmented, populations of the same species are isolated. Will these populations become new species with time, or go extinct? State your prediction and explain your logic.
These populations will probably go extinct. The new species will be small and isolated from one another. There will be no gene flow. This means that genetic drift will have a bigger impact and will lead to the loss/fixation of alleles. Additionally, inbreeding will occur which will lead to increased homozygosity, which causes inbreeding depression due to these deleterious alleles being more present. Due to these things, there will be very low genetic diversity in these populations, this will make them unable to adapt to quick environmental changes and therefore they will be susceptible to things like natural disasters, they will be unable to adapt and will go extinct.

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4. Consider some other issues in conservation biology. (11pts)

a. Invasives are not native, but often out-compete native species. Research has shown that in many or most cases, invasives in the new habitat lack the pathogens and herbivores found in their original habitat. Use this information to explain the success of invasives in their new habitat.

In Native species, pathogens and herbivores are abiotic forces that inhibit the growth of plants. Predation and disease both negatively affect native plants, so they are limited to how much they can grow; Invasive species do not have pathogens or predators so they can grow much more than the native species, and their only limiting factor on growth is the total amount of resources available

b. Recall the calculation you did in class on the number of years it will take for a mass extinction to occur, based on IUCN's data on growth in the numbers of endangered species. In that problem, N_t = 940,000; N_0 = 25,062. 12

$N_t = N_0 \lambda^t$ $\lambda = e^r$ $N_t = N_0 e^{rt}$

- During one interval, r was 0.005. If this r continued, how many years would it take for a mass extinction to occur?

$940{,}000 = 25{,}062\, e^{0.005t}$ $\frac{940{,}000}{25062} = e^{0.005t}$ $t = \frac{724.9}{2} \times 725$ years

- During one interval, r was 0.205. If this r continued, how many years would it take for a mass extinction to occur?

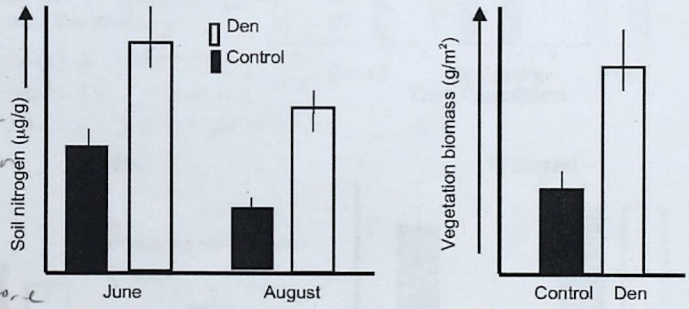
$\frac{\ln(\frac{940000}{25062})}{0.205} = t$ $\frac{\ln(\frac{940000}{25062^2})}{0.005} = t$ $t = \frac{17.7}{2} \times 18$ years

- Which estimate do you think is more likely? Explain your reasoning.

The second estimate is more likely. Due to massive destruction of habitat by humans as a whole, the r value should be very high. This means that it should take less time for more species to go extinct. +2

5. Arctic foxes are predators in the harsh, cold tundra; they raise their young in underground burrows (dens). Tundra plants must grow and reproduce in 3 months (June-August). Researchers examined two experimental treatments: plots without a fox den (control) and plots next to fox dens. (14pts)

a) In 1-2 sentences, explain the relationship between fox dens and plant growth (use the information in **both** graphs).



In the plots next to the fox den, there becomes a lot of nitrogen in the soil, compared to regular, control, soil. Nitrogen is an important resource for plant growth, and as a result, the plot by the den has a greater biomass than the control. Therefore the fox den increases plant growth. 4

Complete the chart below regarding the costs and benefits of the interaction. Please use five words or less per box.

Organism	Cost	Benefit
Fox	Should be little to no cost. Maybe increased nitrogen levels drive prey away	Should be little or no benefit, Maybe vegetation could aid in the hunting of prey
Tundra plants	Because they are stuck in an area at the edge of the den, they might be stepped on.	There is nitrogen in the soil so they are able to grow much better.

c) What type of interaction occurs between the fox and the plants? Explain using 1-2 sentences. 3

Commensalism, Commensalism is an interaction where one species receives a positive fitness advantage while the other species is unaffected, for this interaction, plants are able to grow more due to the nitrogen in the soil, which is positive, and the foxes are unaffected.

d) Would the plant species near fox dens have traits typical of early successional or late successional species? Explain in 1-2 sentences.

Probably late successional species. Late successional species usually cannot tolerate extreme conditions and need sufficient resources to survive. They are also much better at competing than early successional are. (Early successional can tolerate more extreme environments, though), Therefore the plants will have traits of late successional; larger, longer life, lower dispersal than early successional plants. 0

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6. Mistletoe is a plant that taps into the tissue of a tree on which it grows to "steal" water and nutrients. Mistletoe also produces berries with sticky pulp that are consumed and dispersed by birds. (14pts)

a) Complete the chart below regarding the costs and benefits of each interaction. Please use five words or less per box.

Interaction	Cost to ...	Benefit to ...
Bird-mistletoe	Bird: Birds have to use energy to fly over to the berries to get food	Bird: Birds are given a food source that they can eat
Mistletoe-tree	Mistletoe: Its growth is limited to scope of tree, must use energy to tap into tree,	Mistletoe: Mistletoe gets water and nutrients from the host tree.
Mistletoe-tree	Tree: The water and nutrients are lost from mistletoe taking it away.	Tree: ~~Birds eat mistletoe~~ instead of the tree, which is good for tree.

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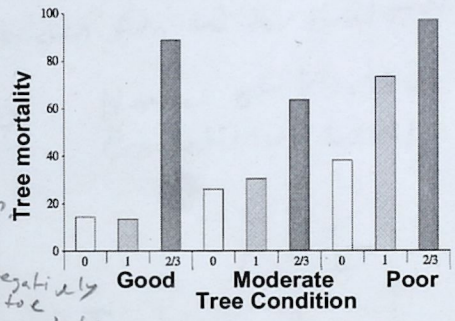
b) What kind of interaction exists between the bird and the mistletoe? Explain your logic in 1-2 sentences. 2
The interaction is mutualistic, because both species are benefiting from the relationship. Birds get a source of food and nutrients, while the seeds of mistletoe are dispersed by birds pooping which reduces intraspecific competition.

In a study of the mistletoe-tree interaction, tree health was binned as good, moderate, or poor. Mistletoe infection level was quantified as 0=none; 1=low; 2/3=moderate/high. Mortality refers to the percent of trees that died.

c) How does the level of mistletoe infection influence tree mortality? 2
If the mistletoe has a higher level, then trees have even less resources, so the mortality will be high.

d) How does tree health impact the mortality associated with mistletoe infection? 0
If the tree is healthier, mortality is lowest for level 0 infection. This is shown by the bar chart. If the tree is poor health, tree mortality is highest for all levels of infection.



e) What kind of interaction exists between the mistletoe and the tree? Explain in 1-2 sentences. 2
This is a parasitic relationship. The fitness of tree is negatively affected while mistletoe fitness is increased. The mistletoe does not kill the tree, just uses it for resources, so not predation.

7. Spike grass (*Distichlis*) is an early successional salt marsh species. Two researchers hypothesized that *Distichlis* can facilitate colonization by rushes (*Juncus*) depending on the level of salt stress in the environment. To test this, they created bare patches in the salt marsh, manipulated plant interactions, and reduced salt stress by adding fresh water. They also left some areas as controls, where they did not do anything to reduce salt levels. (9pts)

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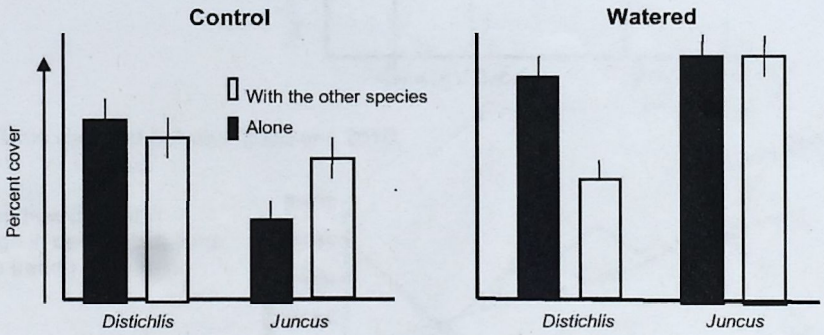

a) Under which condition (control or watered) did *Distichlis* facilitate *Juncus*? Using the graphs, explain in 1-2 sentences. 1
Control condition. Juncus grew much more when it was with Distichlis than it did by itself. In facilitation, being with Distichlis should increase Juncus growth. This is shown by the higher % cover of Juncus when the plants were together. 2

b) Under what conditions did *Juncus* outcompete *Distichlis*? Using the graphs, explain in 1-2 sentences.
Watered condition. Distichlis and Juncus both grow well when they are by themselves in watered conditions, with about equal percent cover. However, when they are grown together, percent cover of Distichlis has a big drop while Juncus remains the same, a much higher percent. This means Juncus is outcompeting it. 1

c) Is this an example of asymmetric or symmetric competition? Asymmetric Explain your reasoning. 1
In Asymmetric competition, one species is much better at competing at another species in a certain niche. The species bad at competing often must find a new niche to exploit as a result. In the watered graph, we see that Juncus has a much higher percent cover and is way better at competing than Distichlis is, which shows Asymmetric competition. If it was symmetric, they would have the same percent cover when grown together.

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8. Bracken ferns produce a potent poison (hydrogen cyanide) when young fronds are damaged. In addition, they constantly produce chemicals that a) cause rapid molting in insects, and b) prevent the establishment of seedlings nearby. (27pts)

a) Complete the chart below regarding bracken fern defenses: 7

	Benefit	Cost
Standing	Is preexisting so it is able to always deter predators. Defense is always up. 2 Also deters competition.	It uses a lot of energy and resources in order to construct and sustain a standing defense 2
Inducible	After initial damage, the poison prevents further herbivory by predators. 2 can use defense when need ed, so uses less resources	Plant is susceptible to initial damage by the predator because the defense is induced and not always there. 1

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b) Predict whether the chemicals that prevent seedling establishment are more effective in intra- or interspecific competition. Explain your logic. 3

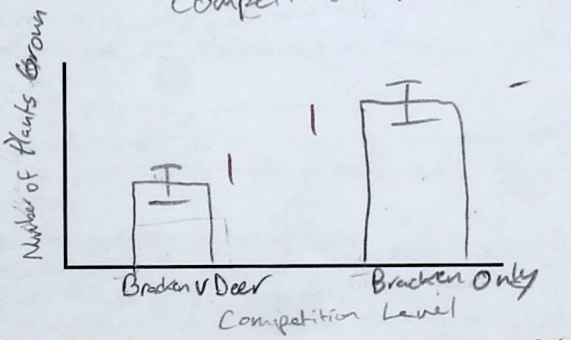
The chemicals are probably more effective in interspecific competition. Plants of the same species should be more resistant to it, because they do not want to inhibit their own growth. Thus, it will be more effective for interspecific, when they compete against other species.

c) Design an experiment to test your answer in part b. (Hint: the deer fern is another species of fern that grows in similar habitats but does not have chemical defenses. It is a favorite food of herbivores like deer.) 6

Treatment Groups: plot with only bracken fern, plot with bracken fern and deer fern together 1 1

Response variable: Number of Plants that Grew successfully 2

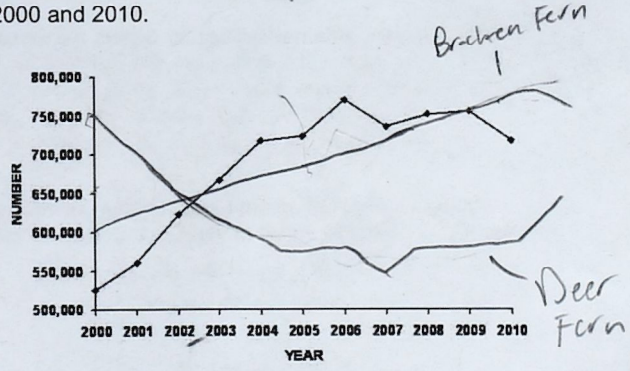
Draw a bar graph (with error bars) predicting the experimental results if your hypothesis is correct.



This graph shows how deer populations in Ohio changed between 2000 and 2010.

d) Add a labeled line to the graph, predicting how deer fern populations in Ohio responded to the change in deer populations. (Don't worry about the scale—just draw the trend.) 2

e) Add a labeled line to the graph, predicting how bracken fern populations in Ohio responded to the change in deer populations. (Don't worry about the scale—just draw the trend.) 2



9. What is the most important thing you learned this quarter, about yourself? (1pts)

That I can able to think critically about science and apply it

********** Please hand your exam to your TA. Enjoy a good winter break, and Go Dawgs! **********

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