Ecology C - Ecology C - Rickards Invitational Div. C SATELLITE - 11-04-2023
Answer Keys for Grading (/rickards/ES/AnswerKeys?tid=000DOZ)

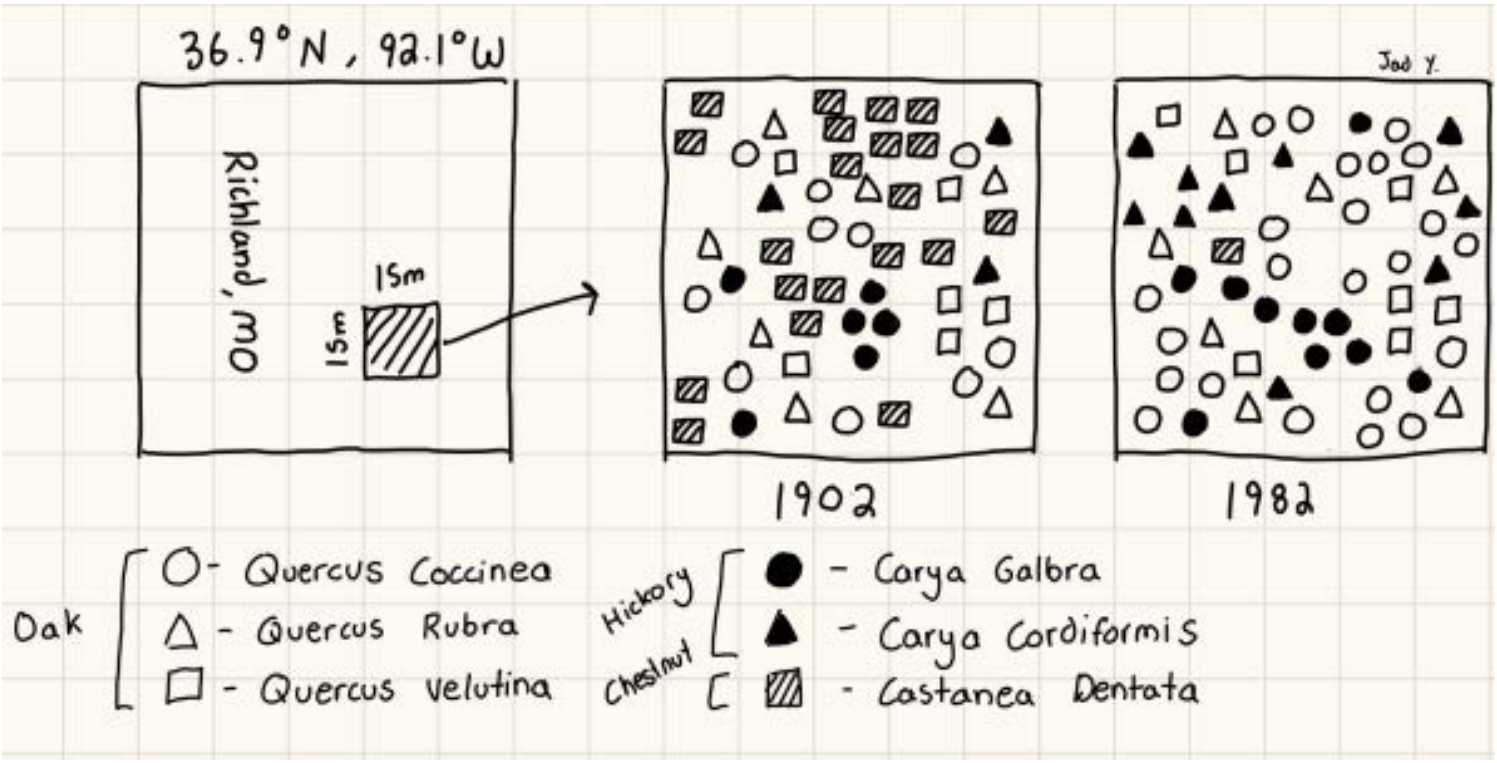
Hey test-takers! We know this looks like a lot, so we recommend focusing on just a couple sections. CS1 and CS3 *will consume the most amount of time,* CS4 and CS7 are the *shortes*

CS1: Missing Chestnuts

Questions 1 - 30 utilize the following information.

Lily, a graduate student at Florida State University, aims to focus their thesis on the Asian Bark Fungus *(Cryphonectria parasitica)* and how it impacted American forest ecology after i was introduced to the nation in the early 19th century. The fungus targeted a variety of different tree species, including the American Chestnut, which used to dominate temperate deciduous forests east of the Mississippi river. Now, the American chestnut population is considered **critically endangered** by the IUCN. Lily needs quantitative data of the impact th parasite had on the American Chestnut and, consequently, forest ecology as a part of her research, and as an intern in her lab, you were sent off to the Ozarks of Missouri to collect that data :)

After you arrive in the "Show-me State," you get in contact with a forester from southern Missouri who provides you with the following data about a plot of land his father monitored. For the purpose of this problem, assume the parasite started infecting American Chestnut before 1982 and after 1902.



1. (1.00 pts)
A study of the entire population of trees in the Ozark region would be ideal, but is logistically impossible. Ecologists instead have to result to sampling methods to get an estimate of the entire population's makeup. What sampling method did the forester use to collect this data?

- A) Simple randomized design
- B) Stratified sampling
- C) Cluster sampling

D) Observational study
E) Convenience sampling
F) Experimental study

2. (1.00 pts) What type of limiting factor was the fungal infection?

A) Density-independent
B) Density-dependent
C) Physical
D) Natural Disaster
E) Both A & C
F) None of the above

3. (1.00 pts)
Before any data manipulation, you get a phone call from Harold, a geologist from University of North Carolina, Chapel Hill, who wanted to ask you about the **eluviation** of the **mollisc** in the forest you are surveying. He also wants to know what changes you might have noticed with the soil there. Bewildered, you respond with which of the following inappropriate (and incorrect) responses?

A) You explain how the high level of organic material in the A layer may influence leaching
B) You sent a photo of the soil horizon and pointed out a soil horizon below the A horizon
C) You discuss the unusual red coloration that this soil seems to take on
D) You use a soil testing kit to see how much nutrients the soil maintains after rainfall
E) You point out how farmers have been converting the land due to its high fertility
F) You discuss how much this soil has mixed its layers over time, or pedoturbidation

4. (2.00 pts)
After setting up camp near the woods, you decide to gather some baseline measurements to check how productive the forest actually is. Which of the following statistics are correctly assigned to how you could measure them?

(Mark **ALL** correct answers)
A) GPP, amount of chemical energy garnered by the plant via photosynthesis and is typically represented by $g_C\ m^{-2}\ yr^{-1}$
B) NPP, amount of biomass plants generate via the sun's energy per year & area
C) GPP, amount of chemical energy garnered by the plant via photosynthesis minus the amount of energy used in maintenance and cellular respiration
D) NPP, amount of useful energy the plant actually creates without maintaining its own needs or respiration, per year & area
E) Standing crop, the amount of biomass in an ecosystem, often represented in kilograms
F) Standing crop, the amount of chemical energy the trees are using to sustain themselves

5. (1.00 pts)
Finally, time to do some data analysis! In order to perform some of your other calculations, you need the amount of trees in the plot during each year. Write the number of trees present in 1902 and 1982 in the boxes below, with 1902 first.

52 | 58

6. (4.00 pts)
Next, find the density of trees per km^2 during the 1902 and 1982 sample survey. List the density for 1902 first, and round to the nearest whole number (half-trees aren't real).

231111 | 257778

7. (1.00 pts) What was the percent change in American Chestnut population from before and after the fungal infection? Report your answer to the nearest whole number.

-95

8. (2.00 pts)
Thinking back to your time with Lily, you recall that species richness is one method of quantifying environmental change. Does the species richness change from 1902 to 1982? Explain.

Expected Answer: No the species richness does not change from 1902 to 1982 (1). The species richness stays constant both years at 6, because all 6 tree species shown are present both years. (1)

9. (2.00 pts)
The forester, along with the town historian, asked you to find the species abundance of *Quercus Velutina*. This tree, or black oak, was used by the town for commercial purposes, so the historian hopes the species abundance in 1902 could offer insight on the economic activity of the town compared to now. Calculate the relative species abundance and the relative species abundance compared to all other oak species in 1902. Round the nearest hundredth.

0.12 0.26

10. (2.00 pts)
While you were flying to St. Louis, Lily sent you a sheet full of the measures she wanted you to gather about the species diversity of the region. Which of the following are incorrectly matched with their definition?

(Mark **ALL** correct answers)

- [ ] A) Species richness: the proportion of individuals of a certain species in a sample
- [x] B) Shannon: quantifies the uncertainty in the species identity of an individual that is taken from random from the sample
- [ ] C) Simpson: quantifies the diversity of the species based on the natural logarithm of the relative species abundance
- [x] D) Relative species abundance: the proportion of organisms that belong to a certain species in an ecosystem
- [x] E) Gini-Simpson: quantifies the probability that two randomly selected individuals will be the same species

11. (1.00 pts) Choose the diversity index from the previous question that represents a higher species diversity when the value is lower.

- ○ A) Shannon-Wiener
- ○ B) Gini-Simpson
- ◉ C) Simpson
- ○ D) Relative Species Abundance
- ○ E) Species Richness
- ○ F) None of the above

12. (4.00 pts)
Because of a future measure you want to calculate, you decide to go with the Shannon-Wiener diversity index. Calculate the index for both the 1902 and 1982 sample and round to the nearest hundredth.

1.62 | 1.55

13. (1.00 pts) That was the toughest calculation yet! Based on those results, when did this forest have a higher species diversity?

- (●) A) 1902
- ( ) B) 1982
- ( ) C) Neither

14. (2.00 pts) The diversity can be measured in one more way, evenness. Calculate Pielou's Evenness Index for both years, and round to the nearest hundredth.

0.90 | 0.87

15. (5.00 pts)
Using all the data presented and the calculations you have performed, decide which year the ecological diversity of the ecosystem was highest. Also, decide which ecosystem was likely to be more resilient to future parasitic epidemics. Explain your reasoning.

Expected Answer: The ecosystem in the year 1902 had the highest species diversity in general (1), as both the Shannon diversity index and the Pielou's evenness index in 1902 was higher than in 1982 (2). A Simpson diversity index is a more general representation of the species diversity, while the evenness measures if there is a dominant species that overwhelms the ecosystem. Since 1902 did better in both metrics, it also was a more resilient time against a parasitic infection due to the higher biodiversity (2).

Congratulations! You just sent in your statistical report of the ecosystem based on the data you got from the forester. Lily is impressed by your work, and you are almost done surveying the Ozarks. Before you leave, you need to 1) figure out if conditions stay consistent to your statistical report on the sample and 2) when the Asian Bark Fungus arrived in Missouri and 3) how other trees reacted to the loss of the American chestnut. Keep pushing!

16. (1.00 pts)
The forester doesn't have a similarly detailed diagram for the other regions of the Ozarks, but he was able to at least record the **species richness** in some other plots near Richland. Each plot has the same dimensions of the sample above (15m x 15m). The shaded plot was the sample plot used in the previous set of questions. Assume that the same 8 species are encountered throughout the sample plots.

How many species were recorded in **plot D1?**

- ( ) A) 4
- (●) B) 5

C) 6

D) 7

E) 8

17. (3.00 pts)
You recall that alpha, beta, and gamma diversity are metrics used to quantify changes in diversity in a larger region. Explain what each of these three terms means and how they relate to each other.

Expected Answer: 1. Alpha diversity is basically the species richness in a smaller area (1) and tends to be the most common metric for species diversity 2. Beta diversity describes the rate diversity changes throughout an ecosystem (1), and is calculated by dividing the gamma diversity by the alpha diversity. (Explaining that it "connects" alpha and gamma works too) 3. Gamma diversity is the species richness, or the total amount of species, across the larger landscape

18. (1.00 pts) What was the mean alpha diversity across all 25 plots? Report to the nearest hundredth.

5.84

19. (1.00 pts) Calculate the gamma diversity for all 25 plots that the forester reported on.

8

20. (2.00 pts) Calculate the beta diversity for the entire 25 plots the forester reported on. Report your answer the nearest hundredth.

1.37

21. (4.00 pts)
Use the diversity values you just calculated to approximate how species diversity changed throughout the forest. Is it possible to conclude that the results we measured in plot D4 could apply to the majority of the forest?

Expected Answer: The beta diversity we measured was between 1-2, which is a relatively low value. This means that the difference between the gamma diversity, or the species richness of the entire forest, was comparable to the alpha diversity in our plot. (1) Therefore, species diversity likely did not change much throughout the entire forest. (1) We can likel conclude that the species diversity we measured in plot D4 did not change much in other plots, so it is possible to conclude that the results would also apply to other plots too (2).

22. (2.00 pts)
To figure out when the fungus started attacking American chestnut, you decide to consult old records of the Native Americans in the region to see if they recorded any changes in the forest. This is an example of utilizing the traditional ecological toolkit, or TEK. Which of the following apply to knowledge derived from the TEK?

(Mark **ALL** correct answers)

- [x] A) Emphasized oral methods of sharing knowledge
- [ ] B) Based on law and theories
- [ ] C) Focuses on quantitative data

- [x] D) Depends on generations of data collection
- [x] E) Tends to utilize a holistic approach to environmental issues
- [ ] F) Often hierarchical and compartmentalized

23. (2.00 pts) After searching through Springfield's archives, you managed to put together this timeline.

1900: Christmas festival in neighboring town goes extremely well, with roasted chestnuts being gathered by the children becoming a hit.
1902: The forester's father compiles a diagram of the species in Richland
1908: An indigenous woman falls ill and is treated with a traditional medicine using an edible nut and herb, though the identities of both items was not recorded.
1910: Houses during this time shifted to be made primarily with Oak, due to its newfound extremely rapid growth.
1917: An American farmer notes a lot of rainfall and a good growing season.
1924: Farming increases as a whole.
1934: Infection was officially noted by Missouri to have decimated the American Chestnut population.
1962: Christmas festival continues, but roasted chestnuts are not consumed this time around.
1972: Loss of American chestnut officially replaced with Oak and Hickory in Ozarks
1982: Forester recreates report of plot sample that his father chose.

Which year is the earliest possible date that the infection could have started?

1910

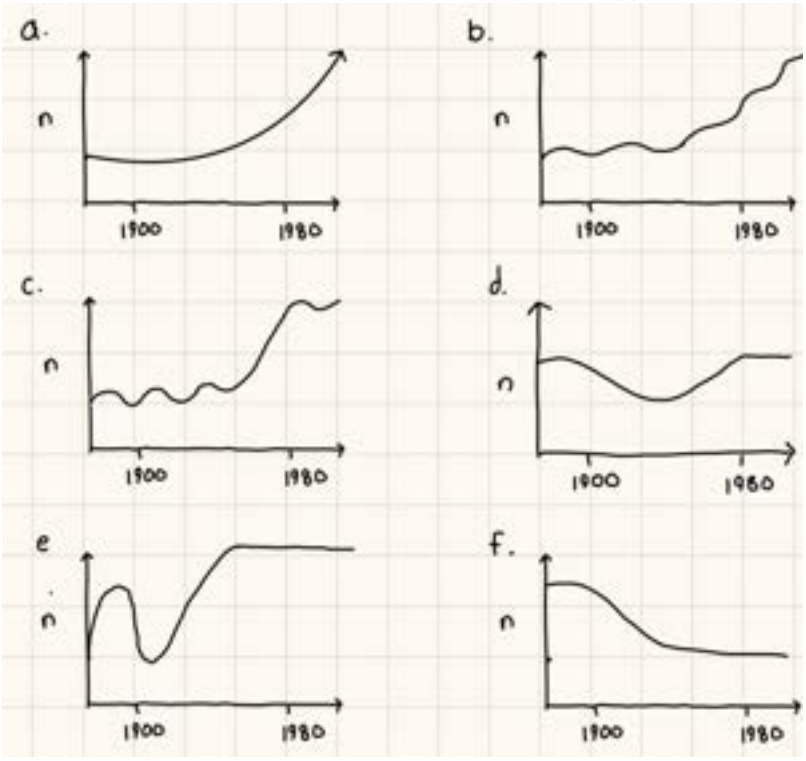
24. (1.00 pts)
Lastly, you need to quantify the impact the loss of *Castanea Dentata* had on *Quercus Coccinea* (scarlet oak) in the Ozarks. To get an idea for how the scarlet oak population changed calculate the percent change in its population between 1902 and 1982.

130

25. (1.00 pts)
Based on the percent increase you calculated, you reasonably assumed that Scarlet Oak did better when the American Chestnut was infected. What community interaction is most reasonable for this relationship between the two species?

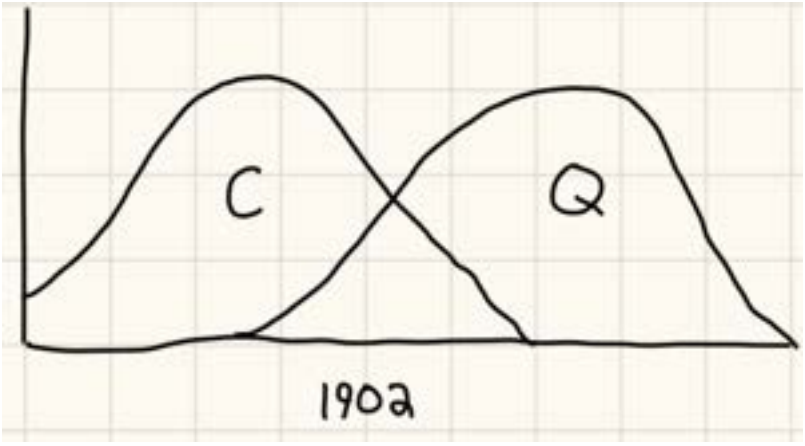
- ( ) A) Interference Competition
- ( ) B) Apparent Competition
- (•) C) Exploitative Competition
- ( ) D) Amensalism
- ( ) E) Mutualism
- ( ) F) Commensalism

26. (2.00 pts)
If *n* corresponds to the number of *Quercus Coccinea*, which of the following graphs most likely represents the situation in the Ozarks?



- A) A
- B) B
- C) C
- D) D
- E) E
- F) F

27. (2.00 pts)
Your partner drew this simple diagram representing the two niches of the Scarlet Oak (Q) and the American Chestnut (C) before the fungal infection. Identify and explain what principle explains why the two curves are not overlapping more.



Expected Answer: Gause's Law, Competitive Exclusion Principle (1) --> The two niches need to segregate each other because both tree species cannot occupy the same niche (1)

28. (1.00 pts)
The coworker who made this diagram, Jeff, is a mathematics student at UGA. He loves playing around with n-dimensional hypervolumes, whatever that means. He created the diagram of both realized niches with a statistical analysis of the trees environmental conditions needed to survive, and stated that this type of niche was pretty similar to the Grinnellian niche. You reason that the niches in this diagram are...

Hutchinsonian

29. (1.00 pts) Which type of niche partitioning was most likely responsible for the two niches separating like this?

- A) Predator
- B) Competition-predation trade-off
- C) Resource
- D) Conditional
- E) None of the above

30. (1.00 pts) Nonetheless, the two species continued to coexist. What condition needed to be met to maintain the overlap between the two niches in the diagram above?

- A) The inter-specific competition must have been higher than the intra-specific competition
- B) The intra-specific competition must have been higher than the inter-specific competition
- C) Other tree species present, like the Hickory family, must have kept the two from eliminating each other
- D) Other tree species present, like the Hickory family, probably forced them to collaborate instead of fighting
- E) The time span for tree competition is much too long for one species to ever get out-competed

31. (2.00 pts) Explain what would happen the Q-curve in 1982. Would this be closer or farther from the Scarlet Oak's fundamental niche?

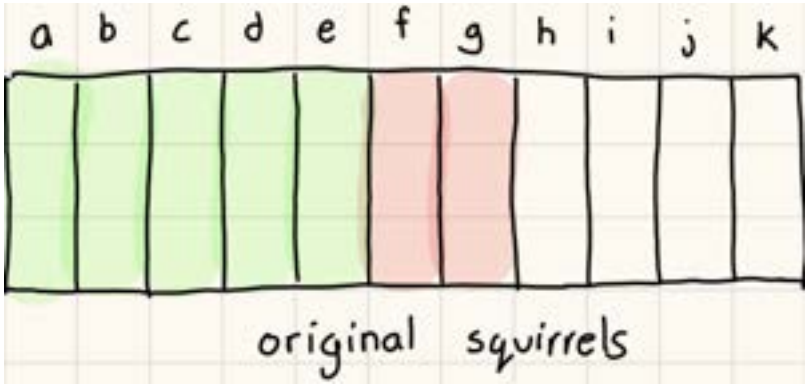
Expected Answer: The Q-curve would likely broaden to encapsulate some of the area that the C-curve used to take up (1). This would shift the the Scarlet Oak to be closer to its fundamental niche in this environment. (1)

CS2: S.I.M.P.

Questions 32 - 53 utilize the following information.

After an embarrassing incident during the graduation ceremony, the dean of University of Oregon tasked Humphrey, an ecology student, to find a way to rid the campus of squirrels. Humphrey knows there are at least 5 squirrels on campus, but he estimates that there could be hundreds. The principal threatened to call an extermination squad just to rid the campus of them, so Humphrey needs to work quickly to find a way to reduce the squirrel population ethically.

First, Humphrey reasoned that he needs to at least figure out how many squirrels reside on campus. Maybe he wouldn't even need to lower the population if the incident was just a fluke. After a lot of hours and acorns, Humphrey managed to capture 11 squirrels and wraps a brown silicon band around each squirrel's arm. Some straps were randomly assigned with either a green or pink dot. A layout of the band assignment to squirrels a-k is shown below.



32. (1.00 pts) What strategy is Humphrey trying to use to measure the squirrel population?

- ○ A) Tag and release
- ◉ B) Mark and recapture
- ○ C) Plot sampling
- ○ D) German tank sampling
- ○ E) Distance sampling
- ○ F) None of the above

33. (2.00 pts)
Humphrey was considering using a florescent colored band instead of just a dot so it would be easier to notice. Explain how this might have shifted the population count. Would the estimated population be an overestimate or underestimate?

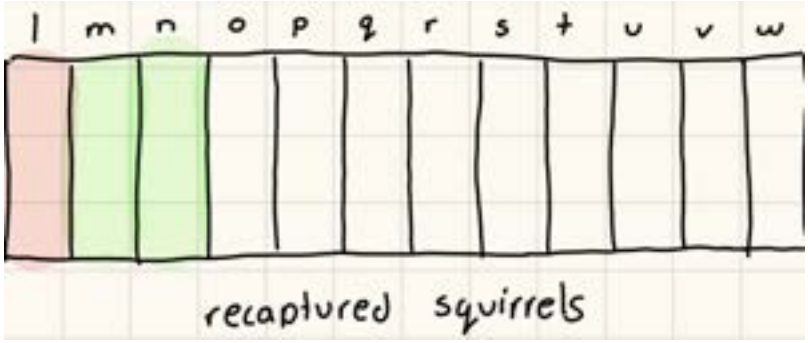
Expected Answer: Squirrels are the prey for a variety of species, so a florescent colored band would have actually made them easier to notice by these predators. This would eliminate squirrels would colored bands at a higher rate than brown bands. (1) When Humphrey recaptures these squirrels, he will notice a much smaller proportion of his group bein marked and assume the overall population is much higher than it actually is. (1)

34. (2.00 pts) What conditions must be fulfilled for this type of population counting strategy to work?

(Mark **ALL** correct answers)

- ☐ A) Humphrey has to go to a different location to capture the squirrels again
- ☑ B) The squirrel population should not be growing or shrinking dramatically
- ☐ C) The squirrel population cannot be strongly impacted by community interactions
- ☐ D) Humphrey has to gather a large amount of squirrels so that all the banded squirrels reappear
- ☐ E) Humphrey has to gather a small amount of squirrels so none of the red bands appear
- ☑ F) Humphrey should wait for the squirrel population to disperse after he marked them

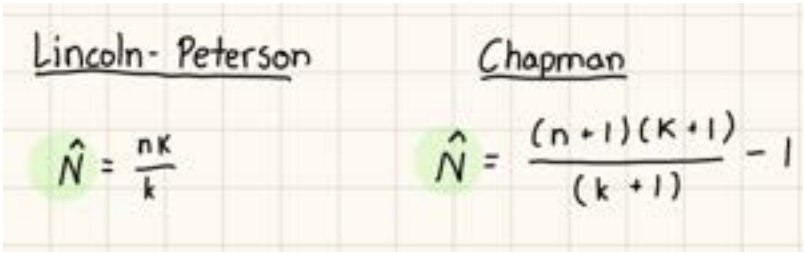
35. (1.00 pts)
After one week, Humphrey recaptures a new batch of squirrels and marks the following layout of bands.



Which marked group should he use for his calculations for the most accurate result?

- A) Red
- B) Green
- C) Red + Green
- D) Green - Red
- E) Red * Green
- F) Green / Red

36. (2.00 pts) For his initial calculations, Humphrey decides to use the red-banded squirrels.



Ecologists use both of these formulas to calculate the predicted population size, or the green N with the little hat on it. Identify the variables n, K, and k in this contex

Expected Answer: K, the total amount of squirrels captured the second time k, the total amount of squirrels marked with red the second time n, the total amount of squirrels marked with red the first time (1) for explaining what each variable means, (1) for explaining it in context

37. (1.00 pts) Calculate population size using the Lincoln-Peterson method. Truncate to the whole number (half-squirrels don't exist).

24

38. (1.00 pts) Calculate the predicted population under the Chapman method. Truncate the nearest whole number (half-squirrels still don't exist).

19

39. (2.00 pts)

Humphrey feels uncomfortable with how different these two numbers are. He recalculates both methods using all squirrels banded instead of just red or green ones. Input the difference between the predicted population using red or all banded squirrels using the Lincoln-Peterson method.

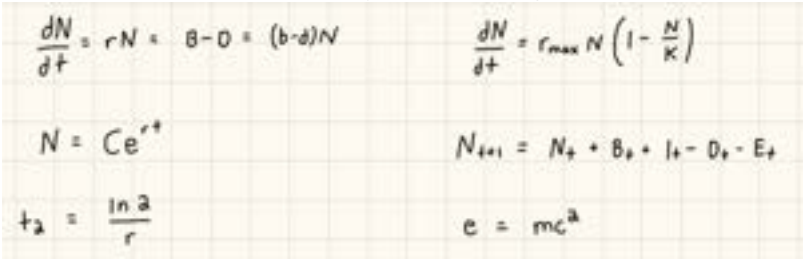
4

40. (2.00 pts) Do the same for the Chapman method.

7

With all of these different numbers, Humphrey decides to consult his favorite ecology professor. They tell him the true number of squirrels on campus is around 54, and that some squirrel enthusiasts attached extra bands to squirrels in the wild to ruin his survey. Annoyed, Humphrey moves on to discovering the dynamics of the squirrel population.

For this section, the professor has provided you with the following formulas. He is obsessed with memory matching games, so he left off everything else for you to remember :)



41. (1.00 pts)
With all the complaints Humphrey is getting from the dean, he starts with the assumption that the squirrels is not experiencing density-dependent forces on their population. Which type of growth curve should the squirrels follow?

- A) Stable
- B) Logistic
- C) Quadratic
- D) Plateau
- E) Exponential
- F) None of the above

42. (2.00 pts) He also notes that the squirrel's tend to distribute themselves like this.

What is the name of this type of distribution, and what interspecific interaction causes it?

- A) Clumped, Exploitative Competition
- B) Clumped, Amensalism
- C) Uniform, Adaptive Competition
- D) Uniform, Territorialism
- E) Random, Commensalism
- F) Random, Mutualism

43. (2.00 pts)
After consulting the university's librarian, he puts together the following data.

Birth rate (per month): 18
Death rate (per month): 6
Emigration (**2022, aggregate):** 1
Immigration (2022, aggregate): 1
Favorite Squirrel Color: White

Ignoring his suspicion over how the librarian knew all this, he believes this is enough to predict how the population will grow in the future. What is the instantaneous growth rate of the population in squirrels per month?

***Note:** we can use mean value theorem to state that the instantaneous rate of birth rate was 18 sometime during the month, so we can use that value to calculate the instantaneous growth rate. The same applies to death rate.

12

44. (1.00 pts) Using these values, predict how large the population will be after 3 months of time.

- A) 95
- B) 100
- C) 105
- D) 110
- E) 115
- F) 120

45. (1.00 pts)
Seeing this number, Humphrey starts to panic. Even though this is an only an estimate, he believes that the population will skyrocket. Before he alerts the dean, however, he waited one more month to see how the population would change. The population did grow by around 10 the first month, but the population only grew by an average of 4 squirrels the second month. He quickly switches to a logistic growth curve in the hopes that the squirrel population is reaching carrying capacity. How did he make this conclusion?

- A) Populations tend to stop changing when they reach carrying capacity
- B) Carrying capacity depends on the status of the population, so a slowing population will create a lower carrying capacity
- C) The lower growth rate means the population is likely closer to reaching an ecological overshoot, which occurs at a population below carrying capacity
- D) The lower growth rate means the population most likely begin to oscillate around the carrying capacity
- E) Carrying capacity is incredibly easy to control, so Humphrey is just being hopeful here

46. (6.00 pts)
Let's assume that when Humphrey first calculated the growth rate, the squirrel's were growing the fastest they could. Find the carrying capacity of this population. Truncate to the nearest whole number (half-squirrels will never exist).

*** Note:** We can also use the mean value theorem here to state at some time during the month, the instantaneous growth rate was 4 squirrels / month, so assume that that for this calculation.

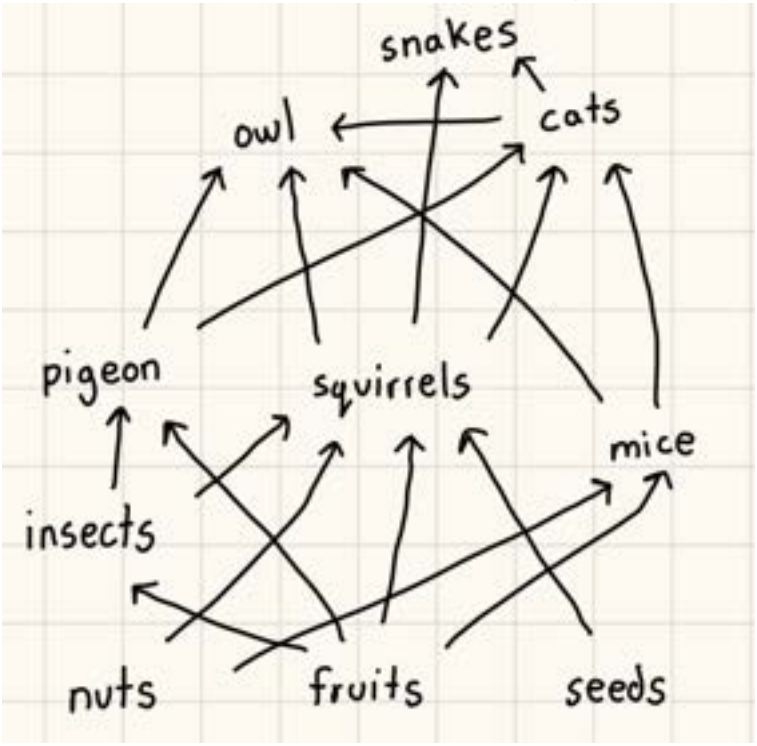
81

47. (2.00 pts)
Knowing the population will eventually taper down, our ecology student breathes a giant sigh of relief. The squirrel population would slow its growth, and eventually will stop growing much at all. Unfortunately, Humphrey needs to reduce the current squirrel population from what it already is, so he still has to find a way to reduce their numbers. Which of the following methods could permanently reduce the squirrel population?

(Mark **ALL** correct answers)

- [x] A) Reducing the amount of food students feed the squirrels
- [ ] B) Letting the exterminators do their work
- [ ] C) Perform a rain dance and hope the squirrels' habitats get flooded
- [x] D) Cutting down the trees the squirrels use as shelter
- [ ] E) Telling students to catch them and release them outside campus
- [x] F) Introducing predators that could hunt the squirrels

Humphrey has one month left before he has to present his plan to the dean, so he decides to find the impact of reducing the squirrel population and hopefully find the best method to do so. After a discussion with one of his peers, he makes the following food web to analyze the impact this move would have with some other common animals that live on campus.



48. (1.00 pts) Which of the following would have the most impact if this was a top-down control ecosystem?

(Mark **ALL** correct answers)

- [ ] A) Squirrel
- [ ] B) Pigeon
- [ ] C) Mice
- [x] D) Cat
- [x] E) Owl
- [x] F) Snakes

49. (1.00 pts)
The cat population on campus consists primarily of stray cats. Since pigeons can fly and squirrels are fast, these cats primarily consume mice. Assume the number of mice is around 45 due to an extermination campaign. Out of the numbers given below, which is a reasonable guess for the amount of stray cats on campus?

- A) 102
- B) 72
- C) 61
- D) 9

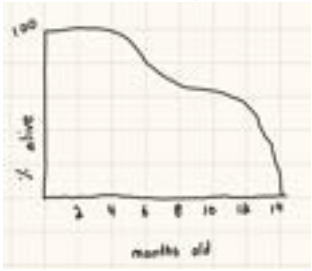
50. (4.00 pts)
Explain what could happen to the apple trees on campus, the pigeons that live on the roof, and the snakes that bites students at night if the dean carried out his plan. Think long-term not short-term. Is it still a good idea for the campus to reduce the squirrel population?

Expected Answer: 1. The apple trees would increase in number due to more of their fruit not being consumed by the squirrels. (1) 2. The pigeon population would also increase because they wouldn't have to in an competitive (adaptive and exploitative) relationship with the squirrels anymore. (1) 3. The snake population would probably decrease due to the loss of one of their main food sources. No, it is not a good idea, unless the university wants a lot more pigeons, mice, and new trees on campus or Yes, it is a good idea if the university wants less snakes present. (1)

51. (1.00 pts)
Today is the day of your presentation! You wake up, brush your teeth, and get ready to reveal your plan the dean. Right before you can leave, you notice a little note tucked underneath the doorway. The "squirrel enthusiast" that ruined your squirrel banding turned out to be the librarian! She also was responsible for feeding the squirrels and maintaining their high birth rate. In shock, you run over to the library and see a bag of a certain food item laying on her desk with her letter of resignation. You are given the choice to continue her role, or continue to presentation to the dean. First, assuming only the squirrel population benefited from this food item, what food did the librarian leave?

- A) Apples, bananas, and some red grapes
- B) A variety of different nuts, including acorns and some conifer cones
- C) Hardy seeds that can survive the winter
- D) None of the above

52. (1.00 pts) On the back of her resignation letter, the librarian left you this graph. What could this curve tell you about the species of squirrel that lives on campus?



(Mark **ALL** correct answers)

- [x] A) These squirrels most likely only have a few children, but value them like we do
- [ ] B) These squirrels are r-selected
- [x] C) These squirrels could have larger bodies than the average squirrel
- [ ] D) These squirrels most likely change population quickly when environmental factors change, like when the librarian retired
- [ ] E) These squirrels likely have a lot of children to sustain such a high birth rate
- [ ] F) This curve cannot possibly apply to the squirrels on campus

53. (0.00 pts) **This question is not worth any points, just want to see what you guys will do :)**

Do you continue the librarian's work?

- (●) A) Yes
- ( ) B) No

CS3: Nebraska's P

Questions 54 - 68 pertain to the following scenario:

A farmer from the town of Ord, Nebraska (pictured below) noted that no matter how much fertilizer they incorporate into their soil, their crops will still show symptoms of a phosphorous deficiency. Even worse, nearby ponds and lakes are becoming eutrophic at a much more rapid rate.

The location of Ord is marked by a red pin:

54. (2.00 pts) Describe why plants, like the farmer's crops, need sufficient levels of phosphorous to thrive. Phrase your answer in a biochemical perspective.

Expected Answer: Phosphorous is a necessary component of many of the cell's macromolecules, specifically nucleic acids. Without phosphorous, organisms would not be able to produce and sustain their genome (DNA), protein synthesis (RNA), or energy storage (ATP) (1). Additionally, phosphorous has an important role in electron carriers, like NADPH, and therefore is a key component of the light-independent phase of photosynthesis (1).

55. (2.00 pts) Which of the following could be other sources of phosphorous other than the farmer's fertilizer?

(Mark **ALL** correct answers)

- [ ] A) The atmospheric pollution from Sioux Falls
- [x] B) Any rock formation that exists in Nebraska, if any do

- [ ] C) Corn and other common crops in Nebraskan agriculture (but mostly corn)
- [ ] D) Lakes, ponds, and the North Loup river
- [x] E) Human waste from nearby communities
- [ ] F) None of the above

56. (2.00 pts)
A member of the water treatment facility in Lincoln, Nebraska believes the cause of this phenomenon could be an issue with leaching. Describe the process of leaching and describe what about phosphorous makes leaching either a possible explanation or not applicable to this situation.

Expected Answer: Leaching is the process of soil losing water-soluble nutrients through water seeping through it. Leaching could be responsible here because phosphorous's primary form in soil is often phosphate. Phosphate is ionic, meaning it's extremely water soluble and can leach extremely easily.

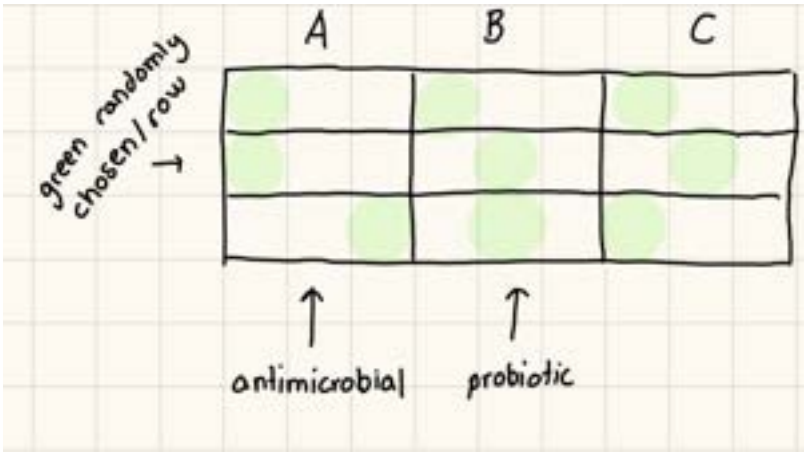
57. (3.00 pts)
In an attempt to make more naturally sustainable ways of water resource management/treatment, a Kansas based water treatment company called BioMicrobics is utilizing microorganisms instead of traditional filtering processes to treat wastewater in their FAST® systems. Explain how sustainable resource management practices are important in minimizing environmental impact.

Expected Answer: reduce dependence on freshwater ecosystems, stop expelling pollution and contamination, ensure availability of human-safe water in a way that relies less on extracting water from the environment

Two opposing scientists, from the rival universities of University of Michigan and The Ohio State University, believe that the cause behind the situation lies in different ecological factors. The UMich researcher believes the ability for the corn crops to receive phosphorous from their roots has been severely diminished due to a lack of microorganisms in the O horizon of the farmer's soil. The OSU researcher believes that the increase in air pollution from neighboring communities could have caused rain to become more acidic and increase leaching.

58. (1.00 pts)
First off, you decide to test the hypothesis of the UMich researcher. With permission from the farmer, you section off three plots of land. One plot of land will be treated will be isolated and treated with a solution that reduces the microorganisms in the soil. The second plot of soil will be exposed to nutrients that sponsor microbial growth. The third plot of land was kept the same as prior conditions. Each plot was also split into rows, and the corn plants sampled were randomly chosen out of those rows. All three plots of land are otherwise treated exactly the same by the farmer, so application to fertilizer, crops grown, and tillage are kept constant. In order to best test this hypothesis, which factors need to be monitored?

A diagram of the experimental setup is provided below.



(Mark **ALL** correct answers)

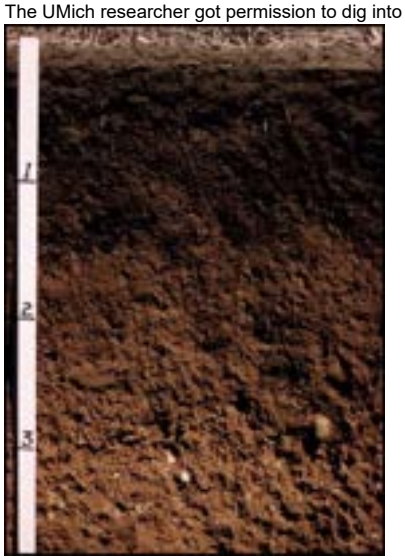
- [ ] A) Soil pH
- [x] B) Biological activity
- [ ] C) Nitrate concentration
- [x] D) Phosphate concentration
- [ ] E) Soil moisture
- [ ] F) None of the above

59. (1.00 pts) What type of statistical study is this?

- (●) A) Randomized Block Experimental
- ( ) B) Retrospective Observational
- ( ) C) Prospective Observational
- ( ) D) Simple randomized sampling
- ( ) E) Stratified
- ( ) F) Cluster

60. (1.00 pts)

The UMich researcher got permission to dig into the following soil horizon on the farmer's land. Which numbered layer should the researcher treat in this experiment?



1

61. (2.00 pts)
The OSU researcher claims that removing microorganisms from the environment could inhibit certain nutrient cycles that keep the plants alive, creating a confounding factor in this study. Which of the following nutrient cycles should the UMich professor watch out for in plot A?

(Mark **ALL** correct answers)

- [x] A) Nitrogen
- [ ] B) Hydrologic
- [x] C) Carbon
- [ ] D) Rock
- [x] E) Oxygen
- [x] F) Sulfur

62. (3.00 pts) Assuming the the UMich researcher has the correct hypothesis, what should we expect from this experimental setup?

Expected Answer: The plot with the most biological activity, or the one with artificially added microorganisms, should have the most phosphate present in the soil as time goes on (1 The plot which represents current conditions, however, should mimic the plot with the lowest biological activity with low phosphate levels (1). This is because the current situation has extremely low phosphate levels even with fertilizer added, so the hypothesis would assume that's because of low biological activity. (1)

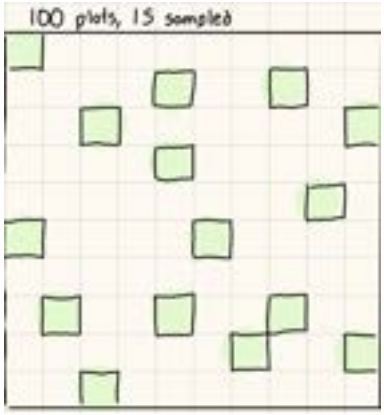
After three weeks of regular ol' farming, the Ord farmer reports the following values for biological activity levels, phosphate levels, soil moisture, and soil pH.

	Antimicrobial	**Normal**	**Probiotic**
Bioactivity	low	high	high
Phosphate concentration (mg P/kg soil)	62	48	23
Soil moisture	medium	medium	medium

Soil pH	6.9	6.4	5.8

63. (1.00 pts)
After that, you decide to test the hypothesis of the OSU researcher. You section off the farmer's field into 100 patches using florescent red tape. You also set up a makeshift weather station that records rainfall, air pollution and wind speed. The farmer, somewhat exasperated, decides to let you use that part of the field for 2 months. The same system for measuring biological activity, phosphate level, soil pH, and soil moisture remains after the previous experiment. Every two weeks the weather station compiles a summary of the previous two week's weather patterns and the farmer randomly chooses 15 plots to sample. What other crucial factor needs to be recorded to test this hypothesis?

A diagram of the experimental layout is shown below. The green plots were the ones that were used for sampling.



- A) Air temperature
- B) Air moisture
- C) Rain pH
- D) Rain temperature

64. (1.00 pts) What type of study is this?

- A) Stratified
- B) Cluster
- C) Randomized Block Experimental
- D) Prospective Observational
- E) Retrospective Observational
- F) None of the above

65. (2.00 pts) If the OSU professor is right, what should happen in this experiment?

Expected Answer: Every two week period with more rain, or more acidic rain, will cause phosphate levels in the soil to decrease more than phosphate levels during more dry or alkaline conditions.

After two months, the farmer kicks you off his land and provides you with his last data table.

	Rain (in)	Rain pH	Wind Speed (mph)	Nitrate Level (mg / kg soil)	Air Temperature (F)	AQI	Soil pH	Phosphate Level (mg / kg soil)
Week 1/2	4	6.3	2	450	72	32	6.82	42
Week 3/4	1	6.1	3	342	70	78	6.79	50
Week 5/6	0.5	6.5	10	672	75	10	6.75	52
Week 7/8	8	5.9	2	333	71	113	6.6	23

66. (2.00 pts)
A nearby farmer has noted a much higher rate of acid deposition in his farmland after the 4 weeks of rain. What does he mean by this? Did a similar effect occur with our farmer?

Expected Answer: A higher rate of acid deposition means that the precipitation was much more acidic than normal and "deposited" acidic compounds on the farmer's soil. (1) This farmer also experienced a similar effect because the farmer's soil had a lower pH after the 4 weeks. (1)

67. (4.00 pts)
The UMich professor claims that when phosphate, the primary form that phosphorous takes in soil, needs to be charged in order to be leached through the soil. Acid rain decreases the pH of the soil, therefore adding protons to the phosphate and converting them to uncharged, insoluble forms. He argues that since the phosphate is being converted to an insoluble form and won't be leached to the same extent, acid rain won't impact the plant's ability to uptake this phosphorous as much. What is wrong with this statement? Is this statement reflected in the farmer's data?

Expected Answer: The leaching part is correct, but the part about plants being able to take up the insoluble phosphate is incorrect. (1 for ID). Plants can only absorb phosphate in the soil when it is not precipitated, or in a dissolved form. When the acid precipitates the phosphorous, the phosphorous is unavailable for use by the plant, and they still experience a phosphorous deficiency. (1 for explanation). This statement does not reflect in the farmer's data (1), as the phosphate levels did go down when the rain was more acidic <-- only because they were being converted to other forms than phosphate (1)

68. (14.00 pts)
As you fly back to Minneapolis, your hometown, you start writing your final scientific report to turn in to your ecology professor.

First, you have to decide which scientist you should agree with.

Second, you need to explain to your professor how the data the farmer gathered supports that researcher's hypothesis.

Third, you need to provide a scientific explanation to why that scientist's theory would have caused the phosphorous deficiency and increased eutrophication.

Lastly, you need to suggest sustainable solutions the state of Nebraska could try to prevent further further eutrophication in their water bodies. The assignment is due as soon as you land, which is in 50 minutes, so get writing!!

Expected Answer: 1. The OSU researcher has the correct hypothesis here. (2) 2. In the first experiment, the more microbial activity present in the soil, the less phosphate was present in the soil. This directly counters the UMich researcher's hypothesis. (2) In the second experiment, however, there was a clear association between the air pollution levels, precipitation level, and phosphate level that supported the OSU researcher's claim. (2) 3. Acid rain both inhibits the soil's ability to retain phosphorous through leaching (1) and converts phosphorous to insoluble forms that plants cannot absorb (2). Both of these factors would cause a phosphorous deficiency in the farmer's crops. Eutrophication is often caused from phosphorous leaving the farm through runoff, and a major source of that runoff is leaching. (2) 4. Whatever sounds reasonable here. Ex. Introducing negative monetary incentives for industry complexes in major cities to reduce air pollution. (2)

CS4: Butterfliessss

Questions 69 - 74 pertain to the following information

The North American monarch butterfly's seasonal migration is a unique and amazing phenomenon that passes right through Kansas. As the days grow shorter and temperatures fluctuate, the butterflies' bodies enter reproductive diapause and begin preparing for the arduous flight south. When their milkweed host plants begin to yellow and dehydrate, the monarchs begin flying down to warmer areas in search of nutritious foliage to support them and their offspring.

69. (1.00 pts) Based on the information provided above, the 3 major reasons for animal migration are:

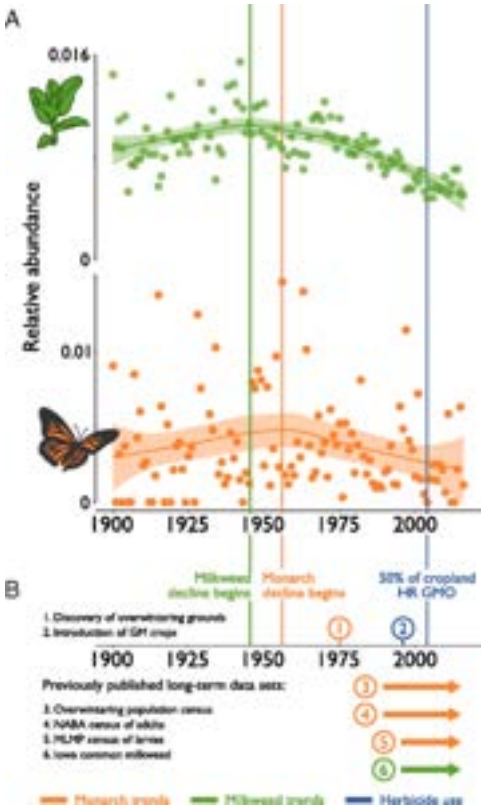
(Mark **ALL** correct answers)

- [x] A) to search for food
- [ ] B) to conserve energy during adverse weather
- [x] C) for reproductive needs
- [x] D) in search of better climatic conditions
- [ ] E) habitat destruction

70. (1.00 pts) Adult monarch butterflies pollinate milkweeds, while monarch caterpillars feed on the plants' leaves. This type of relationship is known as:

- ( ) A) Parasitism
- (•) B) Mutualism
- ( ) C) Commensalism
- ( ) D) Amensalism

71. (3.00 pts)
The most popular explanation for the decline of monarch butterfly populations is due to the monarch's symbiotic relationship with their milkweed host plant. Explain what the general idea of this theory is and whether or not it is supported by the graph below. Your answer should include the type of symbiosis involved and the relationship between the monarch/milkweed populations.



Expected Answer: mutualism, as the milkweed population falls the butterfly population will fall as well since they depend on each other for survival, the graph shows a decline of the milkweed population that is followed by a decline in the butterfly population as well which lines up with what we expected

72. (2.00 pts)
One theory blames genetically modified crops and GM-related herbicides for the decline of the milkweeds, citing the same graph from above. Is this supported or not supported by th graphs? Please refer to specific parts of the graphs in your answer.

Expected Answer: no; the population decline starts way before the introduction of gm crops/herbicides.

73. (2.00 pts)
A different study, however, claims that the decline in milkweeds does not fully explain the rapid decline of monarch butterfly populations in migration. While the abundance of milkweeds has certainly diminished, it is nowhere near as large as the huge decline seen in the number of monarch butterflies making it back to Mexico. Additionally, the rapid rebound of butterfly populations after returning to the United States suggests that our milkweed supply may not be the problem. What else along their long, arduous migration route could be a contributor to the problem?

Expected Answer: parasites, invasive predators, disease, habitat loss, lack of food, climate change, etc.

74. (2.00 pts)
As always, things are kind of complicated. While milkweeds may not be the entire source of the problem, they certainly still could be a contributor. Describe how the milkweed population decline could play a role in your answer from above.

Expected Answer: the lack of milkweeds along the route could provide a lack of sustenance, making the butterflies more susceptible to disease or like parasites answers will vary, must make sense and fit with previous answer

CS5: Lost Up North

Questions 75 - 87 pertain to the following scenario:

Your local Canadian, Kaitlyn, works at a research lab stationed in Northern Québec, a province of Canada. Her research is focused on how snowfall in Canada's tundra and taiga have shifted with warming global temperatures. She spends half her time in the tundra, at Station Koksoak, and half her time in the taiga, at Station Baie. The locations of both stations are pictured below.

You both went to the same high school, and this year, you were in charge of organizing the high school reunion. Kaitlyn used to post occasionally on her Facebook, but hasn't for the past couple of weeks. You found her phone number on the laboratory's website, but she didn't respond even after calling a couple times. Worried, you check the laboratory's logs and find that she's been missing for a week! As a world-famous detective, you spontaneously decide to book a flight to Montréal and figure out where she is yourself.

A map showing her two research stations. The last recorded appearance of her was on the red pin, in Station Baie.

75. (2.00 pts) While on the plane ride there, you decide to look more into Kaitlyn's research. Which of the following are known effects that climate change has on tundras?

(Mark **ALL** correct answers)

- [x] A) Average temperatures in Northern Canadian tundras have increased more than the global average
- [ ] B) New tree species are arriving in these regions at a lower rate than usual
- [ ] C) A negative feedback loop has been created with melting soil permafrost and global temperatures
- [x] D) Organic material decomposes much quicker than usual, and soil quality has increased as a result
- [x] E) The albedo of these regions have decreased
- [ ] F) There have been less wildfires in the tundra due to increased moisture

76. (1.00 pts) Which of the following species will likely perform the best in Canadian taiga if we continue boosting the greenhouse effect?

- A) A pine tree that has competitors that do better in soils with more nutrients
- B) A species of shrub that has a low cation-exchange capacity and falls prey to leaching
- C) Crustaceans that live in the neighboring Hudson Bay
- D) A bird that depends on their eyesight to see prey on the ground through tree cover

Once you arrive in Montréal, you are given a report full of everything Kaitlyn sent the university before she went missing. Each log in her journal seems to point to her location being i either Station Baie, in the taiga, or Station Koksoak, in the tundra. Unfortunately, Kaitlyn absolutely sucks at dating her logs, so the university isn't sure how reliable these dates are. Identify the following notes based on where Kaitlyn was at the time, or if she wasn't near either station.

77. (1.00 pts)
06/02/2023: Woah! The soil is super, super acidic here. I have never encountered such acidic soil before! I think you could even perform a titration using some of this stuff. The soil here also kind of sucks, quality-wise. There aren't really many microbes in this soil, although there are a bit of lichen and moss.

- A) Koksoak
- B) Baie
- C) Neither
- D) Both

78. (1.00 pts)
06/03/2023: I drove past the timberline! The transition was a little more severe than I thought it would be, honestly. Next time, I need to grab more samples from the ecotone there. For now, I still need to study this biome.

- A) Koksoak
- B) Baie
- C) Neither
- D) Both

79. (1.00 pts)
06/03/2023: Ew! The land here is super boggy, almost like a marsh. Even though it doesn't rain much, the precipitation seems to be at a high this time of year. The water doesn't seer to be able to percolate through the soil much. No wonder Iqualuit never got into farming.

- A) Koksoak
- B) Baie
- C) Neither
- D) Both

80. (1.00 pts)
06/04/2023: I crossed the treeline again, and the increase in biodiversity was obvious. Unlike the other biome, precipitation seemed to be more prominent than evaporation.

- A) Koksoak
- B) Baie
- C) Neither
- D) Both

81. (1.00 pts) **06/05/2023**: There are actually a lot of endotherms here. Interesting. The salamanders are cute though.

- A) Koksoak
- B) Baie
- C) Neither
- D) Both

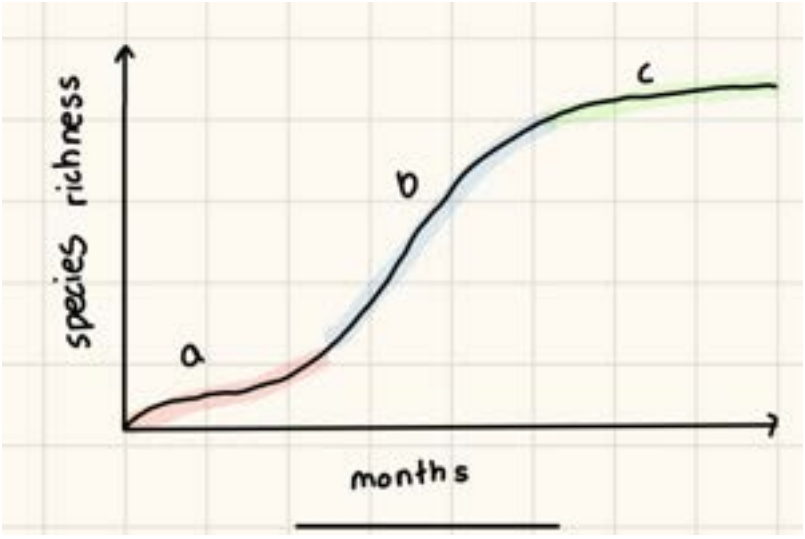
82. (1.00 pts)
06/05/2023: There's a huge fire here, like a huge one! This could convince our parliament to enact more measures against climate change. If anything, a giant burning piece of Canadian land will probably do the trick. Hopefully I'll be okay.

- A) Koksoak
- B) Baie
- C) Neither
- D) Both

83. (2.00 pts)
After reading the last statement, you ask the university for a live map of wildfires in the nation. You find out that Station Baie is nearby a huge wildfire that claimed thousands of hectares of forested land two weeks ago. Anticipating the worst, you ask the university for a means of transport and arrive there the same day. When you arrive, the research station looked normal. Curious, you knock on the door and Kaitlyn comes out, almost nonchalantly. Seeing your shocked expression, she explains that her antennae broke and her source o communication was cut off. The wildfire already stopped a couple of days ago, so Kaitlyn is exploring how the forest will recover. What is the name of the process she's studying? Thi term has two words, so put each word in a different box.

secondary | succession

84. (1.00 pts)
Kaitlyn once observed a similar phenomena when a glacier near station Koksoak revealed a piece of land for the first time. She noted the species richness every month and created graph with this shape. What type of species occupied the ecosystem during the phase marked *a*?



- A) Initial
- B) Forager
- C) Pioneer
- D) Seral
- E) Climax
- F) None of the above

85. (2.00 pts) What was happening in the portion marked *b?*

(Mark **ALL** correct answers)

- [x] A) The organic matter content of the O-layer was increasing
- [ ] B) New species of lichen and moss consisted of a majority of the new species
- [x] C) Shade-intolerant species of trees dominated the ecosystem
- [x] D) The soil became began to follow the characteristics of podzol
- [x] E) The average growing time of the trees dominant during this time period is faster than at climax

86. (1.00 pts)
Due to limited soil nutrients and soil moisture constantly disturbing the ecosystem, the portion labelled *c* does not follow the typical definition of an ecological climax. Actually, there are multiple climax communities that this ecosystem could follow in the surrounding region. What type of climax is this ecosystem most likely following?

- ○ A) Climatic
- ◉ B) Edaphic
- ○ C) Catastrophic
- ○ D) Disclimax
- ○ E) Subclimax

87. (4.00 pts)
You point out, with your amazing detective skills, that this situation is fundamentally different from what will happen the burned forest around Station Baie. You can already see one of the differences! In the glaciated ecosystem, the first species to colonize the land needed to survive in much harsher conditions than the species you noticed are colonizing this piece of land. Explain why this occurs.

Expected Answer: The previous study was an example of primary succession, where the soil of the ecosystem was incredibly low quality (1). Species that colonized this land neede to be able to survive in extremely rocky, low nutrient soil and break it down for further succession to occur (1). Meanwhile, the recently burned ecosystem near Station Baie already has a good soil quality because the fire didn't destroy the soil (it probably helped it actually) (1). Therefore, pioneer species here won't need to face terrible quality soil (1).

CS6: Small Town Woes

Questions 88 - 96 pertain to the following scenario:

The quaint small town of Erihs, New Hampshire, just won a large subsidy from the US government to replace all of their energy production with renewable sources. With such a large amount of money, the town quickly forms a committee consisting of five key groups to the community.

1. **Farmers:** This group values the growth of the agricultural sector in the community. This means opening up more land for livestock use and protecting the supply of water to crops.
2. **Naturalists**: Erihs is a small, beautiful town on the Atlantic coast. The naturalists want the preserve how picturesque the town and reduce the impact the townspeople have on the local environment.
3. **Medical**: The local hospital needs an energy source that works constantly due to the amount of patients that depend on electrical devices to live. They do have a backup generato but they would prefer to use it as little as possible.
4. **Board Members:** The members of the town government want to maximize the energy production the new solution could provide while consuming as little money and resources as possible. This group also wants to minimize any risk the town takes, including new large infrastructure projects.
5. **Townsfolk:** The regular citizens of the town seek an energy source that doesn't endanger their health in any way shape or form.

Erihs was given the following new energy sources to choose from. This town likes to keep things to simple, so the town will only choose one of these options.

~ **Established:** Wind, Solar, Hydroelectric, Nuclear, Bioenergy
~ **Experimental:** Marine, Hydrogen, Geothermal

88. (2.00 pts) While one of the most common, hydropower's status as a "renewable" energy source is often debated. Which of the following are reasons why this might be?

(Mark **ALL** correct answers)

- [x] A) Dams can block fish from reaching their spawning grounds
- [ ] B) The energy generated through hydropower is dependent on the hydrologic cycle.
- [ ] C) The construction of dams can result in injury or loss life.
- [ ] D) Hydropower can be expensive.
- [x] E) Reservoirs can change the flow/loads of rivers and degrade their water quality.

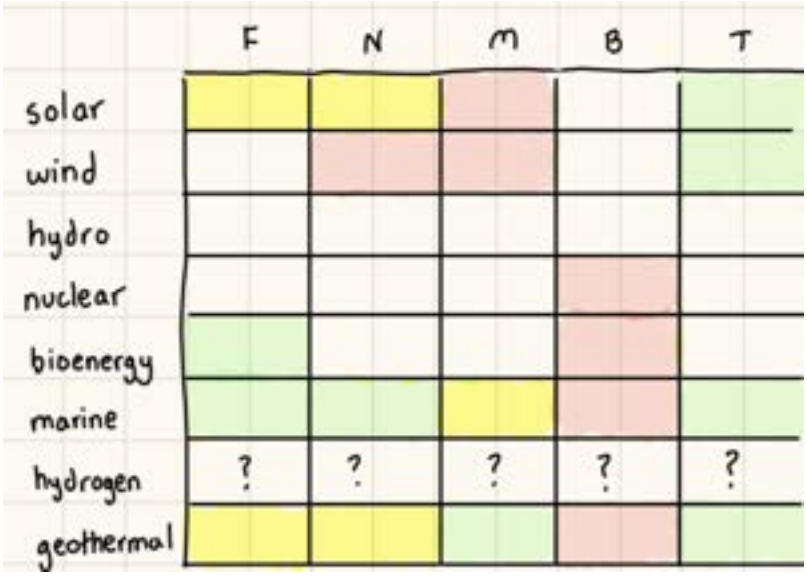
89. (1.00 pts)
The farmers decide to have a separate conference on the side to coordinate their efforts. As a board member, you predict that the energy source they will reject the most will be...

- ( ) A) Wind
- ( ) B) Geothermal
- (•) C) Hydroelectric
- ( ) D) Nuclear
- ( ) E) Marine
- ( ) F) None of the above

90. (1.00 pts)
You also form a small meeting with some of the other board members to decide on which energy source the group should push. In the current economy, which energy source should your group push for?

- (•) A) Solar
- ( ) B) Hydroelectric
- ( ) C) Offshore wind
- ( ) D) Marine
- ( ) E) Geothermal
- ( ) F) Nuclear

91. (1.00 pts)
Today is the day of the first town meeting! At this meeting, each group will state their opinion about each of the renewable energy sources to hopefully, eventually arrive at some sort of consensus. Unfortunately, you had a terrible breakfast and was stuck in the bathroom for a decent portion of the meeting. With the information you heard, you were able to create the following chart.
A green box means that group feels comfortable choosing that option, a yellow box means the group is fine with it, and the red box means the group would prefer not to. The white boxes are unknown, and hydrogen energy was not voted on due to a lack of clarification.



Explain why bio energy was still popular with the farmers, even if the source of production consumes a lot of land.

Expected Answer: A major source of bio-energy actually comes from crops, and there are various chemical reactions that can convert the cellulose in plants to usable fuels. Any response that connects crops with biofuels will get the point.

92. (1.00 pts)
Hydrogen energy was the only renewable fuel that was not voted on whatsoever due to none of the groups actually knowing what it means. Which of the following do the best job explaining it?

- A) The usage of hydrogen fusion to produce energy, similar to the interior of stars
- B) The use of hydrogen gas in fuel cells to produce electricity
- C) Electrolysis of water molecules to produce electricity
- D) The combination of hydrogen and oxygen to fuel processes, similar to how rockets work

93. (1.00 pts) Which group likely will support hydrogen the least?

- A) Farmers
- B) Medical
- C) Townsfolk
- D) Naturalists
- E) Board members
- F) Everyone will support it

94. (2.00 pts)
In a fiery display, you overheard one of the naturalists convince a townsfolk to vote against nuclear energy due to the negative effect radioactive material could have on both the local ecosystem and the people of Erihs. As a board member, you aren't very keen on the high startup cost and infrastructure needed, but you strongly disagree with the claim the naturalis made. How come?

(Mark **ALL** correct answers)

- [ ] A) Nuclear energy does produce a bit a radioactive waste, but its pretty simple to discard it
- [ ] B) The mechanism behind nuclear energy captures the radioactivity of the uranium and converts it to electricity
- [x] C) Nuclear energy has no effect on the environment whatsoever unless there is a meltdown
- [x] D) Nuclear energy produces energy through heating water to turn turbines, and not through the radioactivity itself
- [ ] E) Nuclear energy meltdowns occur somewhat often, but there are a lot of ways to remediate the damage
- [ ] F) Everything above actually supports the naturalist's view

95. (1.00 pts)
The medical group has stayed relatively silent for most of the session, but suddenly decides to speak up near the end. They emphasize that the energy source the town chooses needs to be stable, and abrasively tells the town that they will only vote yes on three energy sources. Which three sources will they choose?

(Mark **ALL** correct answers)

- [ ] A) Solar
- [ ] B) Wind
- [x] C) Hydroelectric
- [ ] D) Hydrogen
- [x] E) Geothermal
- [x] F) Nuclear

96. (6.00 pts)
The town is now moving into its second team meeting, where the renewable fuel source will be chosen. Erihs has agreed to limit the options to solar, wind, hydro, nuclear, and bioenergy due to other methods being too experimental to be trusted in rural New Hampshire. Using the table, the interactions you had with other groups, and how you predict each group will vote, figure out which renewable energy source the town will choose. Once you choose a predicted vote, explain how each group will feel about that energy source. *Assume that your conversation with the naturalist and the townsfolk convinced them to go green on nuclear. Also, assume the positions will not change.*

If you're struggling, try assigning each color a value, like (-1, 1, and 0) for (red, green, and yellow). If you provide a good argument/breakdown for any of the five, you can earn at leas 5/6 points.

Expected Answer: Nuclear will be most likely chosen here. (1) The farmers will feel comfortable with it because it doesn't inhibit their land usage or their ability to access water for their crops. (1) The naturalists will feel good about it knowing that the environment won't be impacted in any way shape or form and the town won't look all too different if the nuclear power plant is tucked away. (1) The medical group will feel good about because nuclear power is constant. (1) The board members will hate it due to the high upfront costs and large infrastructure project needed. (1) The townspeople will feel good about it because it doesn't impact their health in any way shape or form. (1) Note: There is a degree of subjectivity with this question, so 5/6 points should be given for reasonable answers for the other four. however.

CS7: Flowerssss

Questions 97-102 pertain to the following scenario:

Nick, an ecology student, is trying to start a garden in his backyard that will hopefully attract some cool pollinators and benefit the ecosystem. He decides to take a walk around the neighborhood, looking for some ideas.

97. (2.00 pts)
While walking along the lake, Nick notices groups of all sorts of pollinators whizzing around a huge, overgrown bush of sweet-smelling gold and white flowers. His phone identifies the plant as Japanese Honeysuckle, a plant considered invasive to his area. Should he plant this in his garden? Why or why not?

Expected Answer: no; it is invasive, will proliferate past his garden and choke out native species. even though they do smell very nice, they are not great to plant.

98. (3.00 pts)

Nick sees a couple purple petunias planted in a small pot, with a couple bees whizzing around them. These petunias are indeed non-native to his area, but they don't seem to be classified as invasive. Is it still safe for Nick to plant them in his garden? Why or why not?

Expected Answer: Yes; petunias are not native but not invasive either and pose no threat to native plants. bees love em also. and they look cool

99. (2.00 pts)

Nick also wants to plant some of Kansas' state flower, the sunflower; these flowers are characterized by large stalks, prolific seed heads, large taproots, and their tendency to grow in large clusters. Based on this information, how could sunflowers benefit local wildlife?

Expected Answer: seed heads are food, habitat for small animals, large roots introduce more stuff into soil to help stuff grow,

100. (1.00 pts) Nick has noticed that honey bees never visit the tomato plant in his garden, even when it flowers. Which of these is a possible explanation?

- (●) A) Honey bees don't know how to shake the pollen out of the tomato flower
- ( ) B) Bees don't visit and pollinate flowers when no nectar is provided
- ( ) C) The pollen released by buzz pollination is harmful to honey bees
- ( ) D) Since tomato flowers are self-pollinating, honey bees have not formed the same symbiotic relationship like with other flowers

101. (3.00 pts)
Nick notices a patch of dandelions growing in his backyard, indicating that his soil may be compacted and low in calcium. What is an indicator species? Why are they useful?

Expected Answer: An indicator species is an organism who is sensitive to a particular environmental condition; their presence, absence, or abundance can indicate the quality of a biotic or abiotic factor (or signal a change), and can therefore be used to diagnose the health of an ecosystem by its conditions. In this case, the dandelions are indicating the soil health of Nick's backyard.

102. (3.00 pts) Nick is trying to revive an empty spot in the corner of his yard. Why is it important for him to plant native plants in this restoration?

Expected Answer: restore local ecosystem, establish biodiversity and habitat for wildlife, filter water and keep soil in place, usually are lower maintenance

CS8: Boothbay Harbor - Catfishing

Questions 103 - 108 pertain to the following scenario:

Luna, a cat living on the docks in Boothbay Harbor, Maine, was enjoying her life pretty well until a new group of reckless fishermen started fishing off the coast near the harbor. This new group was careless and negligent in their practices, and the consequences soon became evident; it seemed as though the fish had vanished, and the once vibrant sportfishers sat lifeless by the shore. When the older fishermen start struggling to leave even a couple sardines in her bowl, Luna decides to take things into her own paws.

Determine for each case whether Luna should take the boat down or not and explain how the practice is sustainable/unsustainable.

103. (2.00 pts)
The first morning, Luna waits by the dock and jumps at the last second onto the deck of a leaving boat. On the trip, the fishermen are using old-fashioned rods and reels in conjunction with rope nets. While they do yell pretty loud, Luna is unsure whether these practices contribute to the recent drastic declines in fish population.

Expected Answer: No; the practices are sustainable. good biodegradable rope nets and rodreel fishing reduces bycatch

104. (2.00 pts)
The next morning, Luna boards another fishing boat. This crew, however, is much quieter and certainly not as chaotic as the previous boat. Instead, they just throw a large net down the side of the boat, and pick it back up after dragging it across the sea bed for a bit.

Expected Answer: Yes; this is called bottom trawling, and can destroy habitats and sea beds and hurt populations; also large nets increase the risk of bycatch

105. (3.00 pts)
After a long day at sea, Luna heads back to the docks and falls asleep in one of the smaller boats. However, she wakes up to two quiet voices as the boat slowly trudges out of the harbor. The two fishermen drive out, checking an assortment of small wooden box traps; they navigate beautifully, seeming to know exactly where every trap is. Luna watches as the fishermen release some of the smaller (as well as older) looking lobsters who have been stuck in the net, and only take a couple back to shore.

Expected Answer: No; the maine lobster fishing industry is very sustainable because of the absolutely awesome lobster fishermen; the older breeder lobsters and juvenile lobsters are let out of the cages and the design of the trap reduces bycatch

106. (2.00 pts)
The next morning, however, is not as relaxing. Luna climbs into a new boat and watches from the bow as the fishermen stop over a large school of fish. Suddenly, something explodes and Luna gets soaked in fishy seawater; the fishermen appear to be throwing dynamite directly down into the water and waiting for the dead fish to rise up to the surface.

Expected Answer: Yes; dynamite is extremely unsustainable as it destroys habitats and is super wasteful, as many of the dead fish bodies will just sink to the bottom. shards from the explosives also polllute the water

107. (3.00 pts)
Luna decides to investigate one more boat that she feels suspicious about. Compared to the previous explosive fishing, this new boat seems very calm; the crew simply drives out to an area where large nets are floating gently near the surface. The nets are almost invisible with very tiny holes, and she sees a portion of the net that looks like another section has been torn off.

Expected Answer: Yes; drift netting is quite unsustainable; the torn off part of netting is a ghost net that now serves as a threat to other speceis and a pollutant in the ocean; the small holes make it so that even the young, unsellable fish cannot escape; other species of fish (like endangered fish) can easily get trapped in these nets; bycatch is huge

108. (2.00 pts) Which of these are feasible ways to keep fishing sustainable?

(Mark **ALL** correct answers)

- [ ] A) Government subsidies that support the fishing industry
- [ ] B) Practicing proper IUU fishing
- [x] C) Enforce fishing regulations
- [x] D) Establishing certification programs

Thanks for taking our test! Please let us know how we did by completing this form: https://docs.google.com/forms/d/e/1FAIpQLSdqDi3tJew-Lv4bdOTLnLr1ZX6cNulDu7pOYQ5ZHGmjD3Fj_A/viewform?usp=sf_link. (https://forms.gle/G6A1QmYT8NTz1KXH9.) Good luck on your other events :)

P.S. For anyone who didn't understand why CS2 was named SIMP, check out this video https://www.youtube.com/watch?v=5WzswZXTMZQ. (https://www.youtube.com/watch?v=5WzswZXTMZQ.)