

The questions in this worksheet were adapted from old final exam questions given in BIOL121. Please note that there is not space provided on the worksheet to answer questions, you can answer on a separate page.

The purpose of this answer guide is to help you understand how to approach exam questions in a logical, systematic way and to include all of the expected components in your answer. On your final exam, you will be given different scenarios. You should focus on 1) procedures and 2) how concepts are applied to a particular situation. You should not expect to be able to copy answers from this guide and use them for the exam. First, copying answers from a key and presenting them as your own work is plagiarism, second, the scenarios will be new and may examine different types of interactions.

1. *Stipa neomexicana* is a grass that occurs in grasslands of Arizona at altitudes of ~1000 to 2000 m above sea level. This grass reproduces only by seed but individual plants can live for many years (they are perennial). These grasslands are relatively dry environments. Small hills are present in these grasslands. *S. neomexicana* is most abundant on the tops of the hills in areas with overall low grass abundance. The sides of the hills and the depressions between hills are dominated by other grass species and have higher grass abundance.

The soils on the tops of the hills are very dry. The sides of the hills have more moisture. The bottoms of the hills have the highest moisture.

The table below shows the % ground cover (a measure of plant density) and the aboveground dry biomass (a measure of plant productivity) for *S. neomexicana* and other grass species.

	Top of the Hill	Side of the Hill	Bottom of the Hill
% Ground Cover			
<i>S. neomexicana</i>	20.5%	8.5%	3.0%
Other Grasses	12.0%	35.5%	47.5%
Aboveground dry biomass (g/m ²) ± 95% confidence interval (a measure of variation)			
<i>S. neomexicana</i>	139.2 ± 15.7	75.8 ± 10.2	0.8 ± 1.1
Other Grasses	16.2 ± 7.4	111 ± 18.0	281.9 ± 27.1

- a. Based on the data in the table, describe in your own words the trends in % ground cover and aboveground dry biomass for *S. neomexicana* and other grasses.

Recall from class, when describing a figure (or data from a table) you need to include three components:

- Trend
- Numerical Values
- Discussion of statistics (if available)

The simplest approach is to separate out % ground cover and aboveground dry biomass and deal with each individually.

What are the major trends (including numerical values) for % cover?

The % cover of *S. neomexicana* is highest at the top of the hill and decreases dramatically towards the bottom. The % cover of *S. neomexicana* is 20.5% at the top of the hill and decreases 8.5% at the side and to only 3.0% cover at the bottom.

The trend in % cover for other grasses was the opposite to the trend for *S. neomexicana*, the % cover of other grasses increased from the top to the bottom of the hill. The % cover of other grasses was 12.0 % at the top of the hill and increased towards the sides (35.5%) and bottom of the hill (47.5%).

Considering all species, the tops of the hills had lower % cover of all grasses and the % cover increased towards the bottom of the hill. The total % coverage was 32.5% at the top and 50.5% at the bottom.

No information was given on statistical tests.

Please note that the question asked only for description of the data, not conclusions. A discussion of conclusions, mechanisms or hypotheses for the cause of the pattern were not part of the question asked and would not be worth credit in this question. If you added extra discussion beyond trends, you would take time away from answering other questions and possibly lose marks for incorrect information or discussion that is confusing.

Please note that as part of the inclusion of numerical values, the units were also included.

Given this model, you should be able to describe the trends for the aboveground dry biomass.

Dr. Jessica Gurevitch performed experiments to understand what factors contribute to the local distribution of *S. neomexicana* in these environments. She hypothesized that *S. neomexicana* was competitively excluded from the sides and bottoms of hills by other

grasses. The alternative hypothesis was that the fundamental niche of *S. neomexicana* was the dry environments found on hilltops.

Six types of plots were established. Plots were established at three locations on hills: top of the hill, side of the hill and bottom of the hill. For each location, two treatment plots were established: (1) sites that were undisturbed and contained both *S. neomexicana* and other grass species that were present prior to the beginning of the experiment and (2) sites where grasses other than *Stipa* were removed. The aboveground biomass of *S. neomexicana* and other grasses was measured by cutting the aboveground parts of the plants, drying them and weighing them.

- b. What is the name of the experimental treatment for sites that were undisturbed and contained both *S. neomexicana* and other grass species. (1 mark)

These are control plots

- c. If the fundamental niche of *S. neomexicana* is the dry environment found on hilltops, create a figure showing the expected biomass of *S. neomexicana* in the six plots. You can use Figures 1 and 2 as a guide for figure style. (3 marks)

This is a common type of question on exams where you are asked to outline predictions for a particular hypothesis.

To answer this question you need to understand the concept of a fundamental niche.

You are told to use figures 1 and 2 as a guide for figure style. You should look at the kind of graphs, the axis labels and make sure you include data for all six plots.

Your graph should show biomass for *S. neomexicana* only on the tops of hills.

The data for aboveground biomass for *S. neomexicana* and other grasses is shown in the figures below.

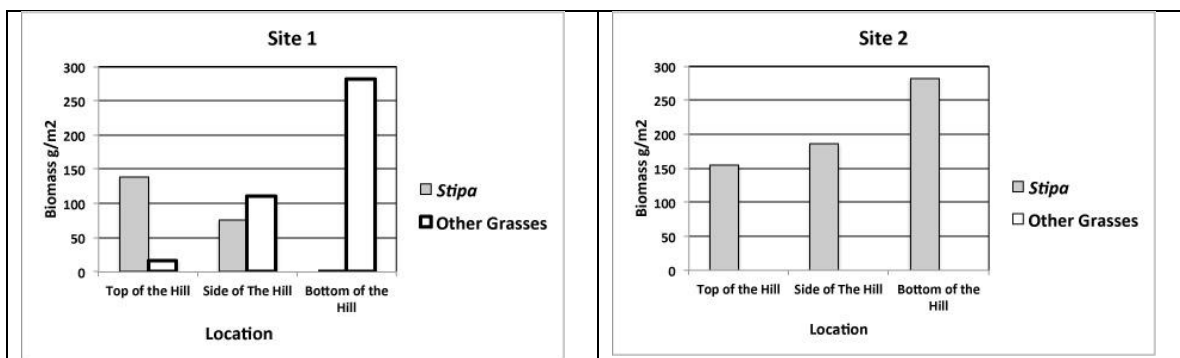


Fig. 1 Biomass of <i>Stipa</i> and other grass species .	Fig 2. Biomass of <i>Stipa</i> at a site where other grass species have been removed.
--	---

- d. Based on the figures, briefly describe the trends in the biomass of *Stipa* in Site 1 and Site 2. Include relevant values in your description.

This is the same type of question as “a” above. You should be able to follow the guidelines outlined previously to answer this question. You will need to read values from the figures. It is acceptable to include approximate values as the figures are not set up to read values with a high degree of accuracy.

In addressing this question, it may be easiest to split up the treatments into site 1 and site 2 and include a statement comparing trends. Recall, you are being asked to describe trends not to draw conclusions about the cause of the trends (you will do this in the next part of the question)

- e. Given the information from the study, what is the fundamental niche of the *Stipa*? Briefly explain your reasoning.

To answer this question, you will need to understand the concept of the fundamental niche.

Following the claim evidence and reasoning model for creating an argument, your answer could take the following form.

Claim – “The fundamental niche of *S. neomexicana* is the top, side and bottom of hills. The fundamental niche is defined by the range of abiotic conditions that are tolerated by *S. neomexicana* in the absence of competition.

Evidence – “In the absence of other grasses, *S. neomexicana* grows well on the top of the hill, side of the hill and bottom of the hill. The average biomass of *S. neomexicana* in the absence of competitors is 150, 175 and ~275 g/m² on the top, side and bottom of the hill. The biomass of *S. neomexicana* is higher in the absence of competitors at all sites then when other grasses are present.”

Reasoning – “Since *S. neomexicana* grows well in all locations on the hill in the absence of competition, this indicated that these locations are within the fundamental niche of *S. neomexicana*.”

- f. Given the results of this experiment, what can you conclude about the factor(s) that affect the distribution of *S. neomexicana*? Your answer should be clear, logical and legible. It is recommended that you use the “claim, evidence and reasoning” model.

To answer this question, you will need to understand the concepts of the fundamental and realized niche.

Following the claim evidence and reasoning model for creating an argument, your answer could take the following form.

Claim – “On the hills in Arizona, the primary factor affecting the distribution of *S. neomexicana* is competition with other grass species.

Evidence – “When other grass species are present, the biomass of *S. neomexicana* at the bottom of the hill is $\sim 0 \text{ g/m}^2$. When other grasses were removed, the biomass of *S. neomexicana* at the bottom of the hills was $\sim 275 \text{ g/m}^2$.

Reasoning – “The dramatic increase in biomass of *S. neomexicana* when other grass species were removed indicates that competition with other grass species restricts the distribution of *S. neomexicana* to the tops and sides of hills.”

- g. Imagine an additional experiment where the biomass of other grasses was measured on hills where *Stipa* has been removed. The biomass of the other grasses at each of the three locations on these hills was not different from hills where *Stipa* was present. What factor most likely affects the growth of other grasses on the tops of hills? Briefly justify your answer.

To answer this question, you will need to understand the concepts of the fundamental and realized niche.

You should follow the claim evidence and reasoning model for creating an argument. Using the approach from “f” above, you should be able to make reasonable predictions and generate a reasonable argument.

You might think about the following questions?

If other grasses were competitively excluded from the tops of hills by *Stipa*, what would you expect to see if *Stipa* was removed?

If other grasses are largely restricted from the tops of hills due to abiotic conditions, what would you expect to see if *Stipa* was removed?

- h. Climate change is expected to result in greater variability in rainfall, more severe and frequent droughts. Briefly describe how you might expect the distribution of *S. neomexicana* and other grasses to change and justify your reasoning.

To answer this question, you will need to understand the concepts of the fundamental and realized niche and make predictions about how changes in climate could impact the abiotic conditions in the grasslands.

You should use the claim evidence and reasoning model for creating an argument.

You should consider the following questions:

- 1) How do you think greater variability in rainfall and more severe and frequent droughts will affect the environments of the tops, sides and bottoms of the hill?
- 2) How might changes in the environment affect where (physically the fundamental niches of *Stipa* and other grasses occurs)?
- 3) How might changes in the environment affect competition between the species?