The effect of sunlight on biomass

Introduction

Biomass is the weight of living organisms in a given area. Biomass can differ due to a variety of factors, such as exposure to sunlight, proximity to human activity, mineral nutrient levels and water availability. The first, sunlight exposure, will be the subject for this investigation.

Research Question: How does sun exposure affect above ground dry biomass of grass?

In this experiment, the independent variable is sun exposure and the dependent variable is dry biomass, measured in grams (g).

There are other variables that affect the biomass of grass, other than sun exposure. These include the amount of water each area of grass receives, proximity to footpaths and sidewalks, and the amount and mass of water in the grass. To control the last two variables, both areas sampled were the same distance from the main sidewalk and were left to dry before being measured.

Ex: Definition limited, here it should be referred to as above ground biomass.Limited scientific context. Research question not focused.

PE:Investigation remains trivial in content. Not much sign of engagement by the candidate.

Ex: Limited explanation of the method. How long? Where?

Materials

- 1 meter squared quadrat
- 10 centimeter squared quadrat
- 10 plastic resealable bags
- Scale

Method

1. Two 1-meter^2 grass areas around the school campus were chosen; one exposed to the sun throughout the day and one under the shade of a tree throughout the day. Each meter squared area was 5 meters from the front sidewalk of the school, controlling the variable of proximity to sidewalks.
2. Once the areas were chosen, 1 meter^2 quadrat was placed in each area.
3. Each meter^2 was divided into 100 quadrats, each being 10cm x 10cm. Once it was divided into 100 quadrats, they were numbered 1-100, left to right, starting from the upper left corner.
4. Using a random number generator, 5 numbers were picked for each site (5 for the meter^2 in the sun and 5 for the meter^2 in the shade).
5. The numbers generated represented the numbered quadrats. Samples of grass were taken from the quadrat numbers that were randomly generated and placed resealable plastic bags. A standard for collecting the sample was established; the grass was pinched at the stem right above the ground, and then plucked, leaving the roots intact in the soil.
6. Once 5 samples were collected from each square meter, the grass was then left to dry for two days. Drying out the grass allows the dry biomass to be taken. This controls the variable of different amounts of water in the grass.
7. After two days of drying, the mass of each sample of grass was taken.
8. Once the masses were recorded, the t-test was performed to determine the average mass of grass in each area and to determine if the difference in masses were statistically significant, or due to chance.

Comm: Method could be repeated though some details are missing.

Ex: No consideration of safety ethics or environmental impact

Ex: Sample area controlled

Ex: No details of the distance of the tree or what species it is?

Ex: Sampling shows some elements of control.

Ex: OK though cutting with scissors would probably be more consistent.

Ex: The sample size is limited and small. Insufficient data collected.

Ex: This is better than the fresh mass but it ought to have been specified that it is above ground biomass.

An: Appropriate method of analysis chosen.

Results

An: Insufficient data to support the conclusion fully.

An: Difficult to believe a precision of ±0.mg!

An: Appropriate analysis (averages).

Comm Layout could be improved but not incomprehensible

Comm Notation OK

Comm Conventions OK

An: Qualitative observations made but what about the influence of the tree?

1 meter

1 meter

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Figure 1: Diagram of 1 meter squared quadrat divided into 100 ten meter squared quadrats. Yellow highlighted quadrats represent location of sun samples and the blue highlighted quadrats represent the location of shade samples

Sun Exposed	
Sample & Quadrat number	Ma
Sample 1 Quadrat 52	8.1
Sample 2 Quadrat 41	9.6
Sample 3 Quadrat 74	11.
Sample 4 Quadrat 5	7.7687
Sample 5 Quadrat 34	10.2805
Average Mass	9.5628

Table 1: Biomass of grass in the sun

Shade Area	
Sample & Quadrat number	Mass/g ± 0.0001
Sample 1 Quadrat 100	8.6943
Sample 2 Quadrat 21	3.2373
Sample 3 Quadrat 80	5.9215
Sample 4 Quadrat 96	9.3583
Sample 5 Quadrat 2	5.7696
Average Mass	6.5962

Table 2: Biomass of grass in the shade

Additional Observations
• Grass in the shade was more patchy • More dead grass in the sun exposed area • Grass in the sun exposed area was wetter than the grass in the shade •

Table 3: Observations

Statistical analysis

P value: 0.058
P> 0.050
Accept null hypothesis
(difference is due to chance and is not statistically significant)

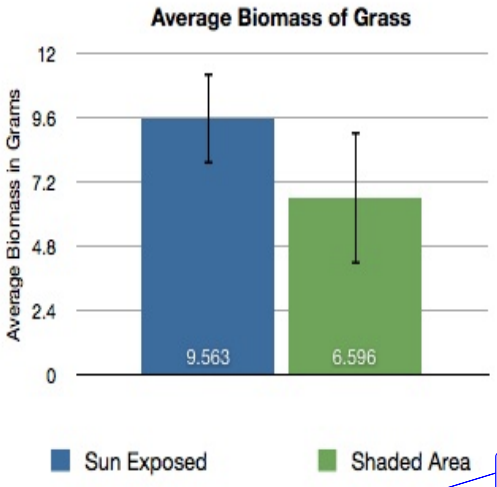

Figure 2: Average biomass of grass in sun and shaded areas. The error bars represent ± 1 standard deviation

Comm: Graph fairly clear

An: Uncertainties (error bars) drawn well and explained.

Comm: Conventions appropriate

This is not easy to follow. Is it a t-test?

An: Methods of analysis seem appropriate but they are difficult to confirm because too many processing steps are missing.

Ev: Uncertainties calculated as Standard deviations (shown on the graph) but that's all.

Conclusion

The data supports the null hypothesis that there is no difference in biomass of grass in the sun and in the shade.
A possible explanation is as follows. Grass is a primary producer of biomass because it can fix inorganic matter (carbon dioxide). Biomass is therefore an indirect measure of productivity of an area. Grass in the sun receives more sunlight to use for photosynthesis. During photosynthesis, light energy is converted into chemical energy. When there is more light, more light energy is absorbed and used for the production of more chemical energy. Productivity can then said to be greater in the area with a greater biomass. In this experiment, the results did not show a statistically significant difference in biomass. Even though the average biomass of the grass in the sun was greater than that of the shaded area (table 1 and 2) , it was not significant. This could be due to the role of other variables, such as amount of water and limited sample size.

An: Interpretation weakened by poor presentation of the analysis.

Comment [PB18]:
Ev: conclusion set in scientific context

Comment [PB19]:
Ev: Relevant conclusion but difficult to support from the limited data

Comment [PB20]:
Ev: Consideration of uncertainties is too vague.

Limitations

There are other variables that may have affected the biomass of the grass in each area. The amount of water each area receives could not be controlled. Quite often, there are sprinkles watering the grass. The amount of water each area receives can affect the rate of photosynthesis, which will affect grass growth. If the grass in either area received more water, the results could be an over estimation. In my procedure, the sample size was sufficient, however not large enough to show significant results. The data in the shaded area was mare variable than the data in the sun exposed area (Figure 2). The variation could possibly be decreased if the sample sized was increased. Additionally, the 10cm^2 quadrats were sometimes difficult to determine and measure precisely. The shade sampling area was near a recreational area, where a cement 4-square court is built. The shade area may experience more direct human contact and trampling, resulting in less grass. The grass was patchier. This could result in an under estimation of the biomass of the grass in the shade. Also, due the warm tropical climate and frequent sun, the shade area may be used more than the sun-exposed area for shade to avoid sun exposure.

Ev: Not clear. Was the sample size big enough or not? Clearly the evidence suggests that it was not.

Ev: Ought to refer to standard deviations

Ev: Identifies a number of factors that may also influence the outcome.

Modifications

To be more precise with measurements, I would construct a meter-squared quadrat that is pre-divided into 100 ten centimeter squared quadrats. This would allow much more uniform precision, decreasing human error. When biomass was taken, some grass samples were still moist, and did not dry fully. In order to ensure that water mass was not a factor affecting grass biomass, the grass would have been left longer to dry, if time permitted.
An experiment that controls the amount of water each area receives, as well as human contact, with more precise measuring methods would be ideal and more accurate in determining if there is a difference in biomass of grass in the sun and the shade.

Ev: The modifications do not concern most of the weaknesses identified.

Ev: Did not consider the impact of management other than irrigation.

Ev: Or use an oven and repeat the measurement of mass until it is constant.

Ev: Too vague. Lacks concrete suggested improvements e.g. put a fence around the areas to keep out humans.