TED ANKARA COLLAGE

INTERNATIONAL BACCALAUREATE PROGRAMME

BIOLOGY EXTENDED ESSAY

<u>A PICNIC OR A MASS MURDER</u>

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<u>RESEARCH QUESTION:</u> How does human behavior affect the distribution of the number of "*Lolium perenne*" in Lake Eymir ecosystem in May?

ABSTRACT

In this experiment the effect of non-industrial direct and indirect. human activities are investigated for any signs of destruction on plants and "*Lolium perenne*" is chosen to be the indicator. A local lake, Lake Eymir, having both the quality of being away from the industry zone of Ankara, and hosting human activities regularly, is a suitable area for this experiment. Also, despite the regular human visit, the area is extremely active ecologically. The number of "*Lolium perenne*" in the woods, lakeside, restrooms and in the parking spot is determined by stratified sampling method and then analyzed statistically first by ANOVA: single factor and then t-Test Two-Sample Assuming Unequal Variances. As the P-value is "6,67462E-14" and the α is "0,05" and α is bigger than the P-value; it can be concluded that human activity do effect the plant distribution and in Lake Eymir.   (142 Words)

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INTRODUCTION

One of the most essential skills needed for survival is to be harmonized with the environment. Us, *"Homo sapiens"* have been and are very talented in this skill specifically. Our success was predictable even at our early times. We found places that are safe, made and used tools to get along with what we have "outside" and hunted and gathered our food from the Mother Nature. Our harmony was not unlike any other organisms. We had predators to fear, and we were predators to be feared. But there was something with us that was different. We were constantly "upgrading" our knowledge and passing it to the next generations. Our development became extremely rapid compared to the other species. The number of threats to be feared of was decreasing while the number of species we dominated over was increasing. We no longer needed to find safe places but we were creating them. We domesticated the animals we used to fear, we raised the plants we used to spend all day to collect. Of course, naturally, as we became more powerful, the other species around us needed to adapt to us. We were changing the environment to be harmonized and the other species were following. Those who couldn't; didn't had a chance. We started to realize the fragility of the situation after the industrial revolution, when things get more serious. Our ambition for development grew with more power and we didn't realize that what is productive for us is becoming destructive for the diversity of the species. Bringing forests to the ground; polluting the seas, lakes and rivers; releasing excessive and polluting gasses to the air; the harm we had been doing to the rest of the living in Earth became irreversible. Obviously the biggest harm was and is being done to the plants, ironically, in which we are desperate for

their presence for their nutrient production. The reason is clear: They cannot change their places. This caused a great decrease in the plant diversity globally. A question started to occur in our minds: Are we destroying our fellow neighbors (any other species) and their environment?

Not only industrial activities, but our actions as individuals started to do a lot of harm to the plants as industrial materials took their place in our daily life. One of the most common activities of ours that harm the plants most is unfortunately the one we love the most: Picnic. Our way of having a picnic evolved in to a ritual in which we don't care what happens to the place after us. By throwing our in-dissolvable wastes everywhere; by pouring our chemicals in waters nearby or to the soil or by setting up fires which we can't control; we turn our picnics nearly into a mass murder.

During one of my routine walks around a local lake, Lake Eymir, I have noticed the uneven distribution of the grass in the whole area covering the lake and became curious why. It seemed to me that this uneven distribution is caused by the human activities performed around the lake. Aiming to examine the effect of non-industrial human activities on plant species, I have decided to perform this experiment and used "*Lolium perenne*" as an indicator to the aforementioned effect.

Lake Eymir, is about 20 kilometers south of the Ankara's center within the district of Gölbaşı at about 39°49′N 32°49′E39.817°N 32.817°E." . It is one of the most ecologically "active" areas near Ankara and hosts more than 20 endangered species from plants to birds.The altitude of lakes surface with respect to sea level is about 969 meters. It is an alluvial set lake and its length is about 4.2 km. The average width is 250 m. Also, the average depth of the lake is 3.8 meters in dry season and 5.0 meters in wet season. The lake has two entrances to the east and west, and it

is open for public use, just like a natural park. Only cars with a special permit are admitted inside the lake. Human visit is intense especially during spring and summer days and unfortunately the care given for the cleanness of the lake and its surroundings is low. There are some restaurants by the lake and a public restroom is located near the area. The main action of humans in this habitat is having a picnic. Fortunately, it is illegal to set up a fire in the area but despite a fire, there are much more other actions that humans can do as mentioned in the earlier parts.

Picnic wastes can be spotted throughout the lakeside and the lake itself. It is especially dirty near the restrooms because of the lack of care. The parking lot, however (which is also located near the lake and the restaurants) is relatively cleaner because there is nothing that people do around it except parking their car. Going a little further away from the lake, the woods are the second most preferred picnic areas after the lakeside. Even it is the second most popular picnic spot; there is a big difference between the woods and the lakeside. The greatest challenge grasses can face around the lakeside and the woods is the picnic; and excessive pH values and humidity in the soil around the restrooms. Overall, there are different homogenously grouped areas in Lake Eymir.

Graminoids, or grasses, are known as one of the most common plants around humans, which facilitate the human influence on them. The success of the grasses lies in part in their morphology and growth processes, and in part in their physiological diversity. Most of the grasses divide into two physiological groups, using the C3 and C4 photosynthetic pathways for carbon fixation. The C4 grasses have a photosynthetic pathway linked to specialized Kranz leaf anatomy that particularly adapts them to hot climates and atmospheres low in carbon dioxide. The C3 grasses are referred to as "cool-season" grasses, while the C4 plants are considered "warm-season" grasses; they may be either annual or perennial. "*Lolium perenne*", one of the perennial (lives more than 2 years) C3 grasses, is the species of grass which is intense at the lake Eymir.

"*Lolium perenne*" or Perennial Ryegrass, is a worldwide known and common species of plant. Belonging to the family Poaceae, "*L.Perenne*" have hollow stems called culms plugged at intervals by solid leaf-bearing nodes. Grass leaves are nearly always alternate and distichous (in one plane), and have parallel veins. Each leaf is differentiated into a lower sheath hugging the stem and a blade with entire margins. The leaf blades of many grasses are hardened with silica phytoliths, which discourage grazing animals; some, such as sword grass, are sharp enough to cut human skin. A membranous appendage or fringe of hairs called the ligule lies at the junction between sheath and blade, preventing water or insects from penetrating into the sheath. Flowers of Poaceae members are characteristically arranged in spikelets, each spikelet having one or more florets. The spikelets are further grouped into panicles or spikes. A spikelet consists of two (or sometimes fewer) bracts at the base, called glumes, followed by one or more florets. A floret consists of the flower surrounded by two bracts, one external—the lemma—and one internal— the palea. The flowers are usually hermaphroditic and anemophilous or wind-pollinated. The perianth is reduced to two scales, called lodicules, that expand and contract to spread the lemma and palea; these are generally interpreted to be modified sepals. This complex structure can be seen in the image on the right, portraying a wheat spikelet. Grass blades grow at the base of the blade and not from elongated stem tips. This low growth point evolved in response to grazing animals and allows grasses to be grazed or mown regularly without severe damage to the plant.

As "*Lolium perenne*" has the ability to easily continue its life around human and its activities, any significant decrease in "*Lolium perenne*" number would indicate a significant problem for other plant species in a natural environment. This is why it can be considered dangerous if the "*Lolium perenne*" number is extremely few.

The clearest damage that picnic wastes can do to the grass leave is to isolate it from the light. Disadvantageous by being small, the leaves can easily be separated from the sunlight by any warping paper or packaging left on the soil. The packages and the wrapping papers can also block the air needed for the plant. Beside this simple yet deadly cause, alcohol spilled on the soil especially right on the area of a group of grass, is also a big problem. Beverages containing around more than %10 ethanol can stop the growth of or even kill the plants and when the small size of a single grass leave is considered, even spilling a glass of these beverages can be very damaging for the grass. Also considering the restroom area, urea mixed soil creates a unsuitable environment mostly because of the low pH. Of course direct physical harm done by either us directly or by the materials we use is also indispensable.

In the light of this information, people may have different effects on the distribution of "*Lolium perenne*" by different behaviors in different locations. Therefore in this study, investigation of effects of the human behavior in different locations in Lake Eymir on "*Lolium perenne*"s distribution was conducted; aimed to be able to interfere in the locations where the "*Lolium perenne*" number is very few and regulate the area to make it habitable. To be able to have performed a controlled and manageable investigation, the experiment was conducted in May. Locations that are used as independent variables were the lakeside, the woods, the area near the parking lot and the area around the restrooms. The indicator of the human effect would be the number of the "*Lolium perenne*" leaves within the randomly placed quadrat in the areas mentioned as the independent variables. The exact places of the areas and their sizes are given in the map.

Accordingly, my research question is: How human behavior during picnic affect the number of "*Lolium perenne*" in Lake Eymir ecosystem in May?

HYPHOTESIS

According to the investigation conducted by David Tilman and Clarence Lehman in 2001 at The National Academy of Sciences named "Human-caused environmental change: Impacts on plant diversity and evolution", a great environmental change can and is being done by humans. A change in levels of phosphorus, soil nitrogen, pH, calcium and atmospheric CO_2, herbivore, pathogen, and predator densities, disturbance regimes, and climate can be seen in the environment that undergo human activity, the result of this investigation reveals. Even extinction can be seen because of the human behavior. By shaping my ideas according to the findings of this investigation, my hypothesis is: The change in locations which are representatives of human activities, creates a significant change in the number of "*Lolium perenne*" leaves in Lake Eymir.

METHOD AND DEVELOPMENT

Because the effect of human activity on the "*Lolium perenne*" distribution is going to be examined in this study, the most suitable independent variables that can reflect the human activity are the locations where activities are held. Changing the locations where the number of "*Lolium perenne*" leaves are counted will also change the number "*Lolium perenne*" leaves dependently. That makes the "*Lolium perenne*" the dependent variable.

To be able to focus on the effect of human activities more efficiently, the species which is counted should be the same for every measurement and should be "*Lolium perenne*". "*Lolium perenne*" has been chosen because it is one of the most common plants in the habitat of Lake Eymir and can easily be spotted. Also it is known for its adaptable nature and presence in most of

the areas around human inhabitation. This gives "*Lolium perenne*" the opportunity to be the indicator for my experiment.

For being able to minimize the effect of the climate on the specie, the counting is done in 21st of May which is a national holiday which makes the human activity more intense. And to be able to maximize the potential number of the leaves the counting is done in spring.

Lake Eymir is preferred in this investigation because of its quality of being away from the urban city and welcoming human activities at the same time. This gives the opportunity to focus on human activity except the harm done by industry. Starting from April, the intensity of human activities had been observed and the most distinguishable homogenous areas are determined. The 4 areas which are the independent variables are chosen and formed as a result of this observation.

As for different locations, the parking lot, the woods, the lakeside and the restrooms were used (see Appendix A). The parking lot as an independent variable had been chosen because although there are always humans around it, there are no activities they do there. Apart from the exhaust gas, this makes the spot a suitable one for comparing with spots hosting more human activity. The woods as an independent variable had been chosen because after the lakeside, it is the second most popular picnic spot. The lakeside spot as an independent variable had been chosen because it is the place where the picnickers are most intense. Being the most popular spot which has a nice view and a dock near, this spot is capable of supplying data about the human effect. The restrooms as an independent variable had been chosen because apart from the picnic wastes, there are more "human wastes" at the spot and probably the harm which is done by our organic wastes are much more powerful than the inorganic wastes of picnics.

The quadrats used are 50cm^2 because the average "*Lolium perenne*" leaf is 2-5 cm long and 5mm to 1cm wide. Also considering the chosen spots, the most accurate data could be obtained by a 2,5m^{2}quadrat.

The areas which are represented as my independent variables are approximately 10m^2 wide. In this account, every marked spot in the plan is taken 100m^2. To be able to collect a scientifically appropriate data, the all 100m^2 spots are treated as squares and virtually divided into 40 equal 2,5m^2 sub squares and numbered in line starting from 1 to 40. By the help of a software, 5 random numbers from 1 to 40 are chosen for each independent variable; and the sub squares corresponding the number is chosen as a trial spot. This method is stated as stratified sampling.

MATERIALS AND PROCEDURES

Materials

- A 2,5m^2 quadrat

    a) 4 straight sticks of 50 cm

    b) Adhesive

    c) Strings

- A notepad

- Random number generating software

- A camera

Procedure

1. A Quadrat of 2,5m^2 is made.

   a) Bind 4 straight sticks of 50cm with each of them having the angle of 90° with the ones attached to it, and form a square.

   b) Measure and mark every 10cm of the sticks.

   c) Using a thin string, link the marked points facing each other, in order to get parallel and perpendicular lines and artificial smaller squares inside the big one.

2. All independent variable areas are bounded into 100m^2 virtual squares and then divided into 40 equal sub squares.

3. All sub squares are numbered in line

4. The area of the woods is taken into consideration

5. 5 random sub squares are chosen by the help of a random number generator for the woods area

6. Quadrat is placed on chosen 5 2,5m^2 areas in the woods picnic area

7. Results are noted or taken a photo to count &note later.

8. 4th step and the steps after it are repeated with changing the initial independent variable areas; the lakeside, the parking lot and the restrooms respectedly

   Note: The data collection must be done quick enough to be able to collect all the data in one day. This is essential to minimize the unwanted variables such as any other animal (including human) damage.

DATA COLLECTING AND PROCESSING

Qualitative data: Leaves I've counted in the parking lot were the ones that were looking the healthiest among all while the ones near the restrooms were the unhealthiest. Also in every location, the leaves were grouped and not scattered evenly.

Raw data Table:

LOCATİON	TRİALS	# of l. *Perenne*	total area for each location	total sampled area for each location	Size of quadrat	Day	Season	Lake
Parking Lot	1	420	100 m2					
	2	343						
	3	439						
	4	402						
	5	396						
Woods	1	307	102 m2					
	2	346						
	3	291						
	4	306						
	5	300		2,5 m2	2,5m2	21st of May	Spring	Lake Eymir
Restrooms	1	17	99m2					
	2	41						
	3	9						
	4	3						
	5	50						
Lakeside	1	90	101 m2					
	2	102						
	3	112						
	4	86						
	5	80						

Table 1) Table displaying the raw data collected from Lake Eymir

Descriptive Statistics:

	Woods±0,5	Lakeside ±0,5	Parking lot ±0,5	Restrooms ±0,5
Mean	310	94	400	24
Median	306	90	402	17
Mode	-	-	-	-
Variance	445,5	166	1297,5	420
Standard Deviation	21,1068709	12,88409873	36,02082731	20,49390153
Range	55	32	96	47
Standard Error	9,43927963	5,761944116	16,10900369	9,16515139
t	2,77644511	2,776445105	2,776445105	2,776445105
%95CI	26,2076417	15,99772154	44,72576445	25,44653971

Table 2) Table showing the means, the medians, the modes, the variances, the SD's, the ranges, the SE's, the t value and the confidence intervals for each dependent variabe effected by independent variables.

DATA ANALYSIS

As it can be understood from the Table 2, the maximum mean number of "Lolium perenne" leaves are in the parking lot area since it is the least preferred place for picnic. The woods is containing the second max mean number of "Lolium perenne" leaves since it is hosting more humans than the parking lot but less than the lakeside. The most preferred picnic area, the lakeside, is the second most unsuitable place among the investigated ones because nearly all of the human activities are conducted there. Despite the intense human activity conducted in the lakeside, the most disastrous $10m^2$ area among the Lake Eymir's human effected areas is the restrooms. The high acidic soil in the area and the excessive walking which is the most intense in the whole lake area combined with a soil that is more like mud prepares the most unsuitable area for "Lolium perenne".

To be able to determine whether there is a statistically meaningful difference between the mean numbers of "Lolium perenne" leaves in different locations, Anova is applied;

H0: There is not a statically significant difference between the mean numbers of "*Lolium perenne*" leaves in different locations.

H1: There is a statically significant difference between the mean numbers of "*Lolium perenne*" leaves in different locations

Anova: Single
Factor

Summary

Groups	Count	Sum	Average	Variance
Woods±0,5	5	1550	310	445,5
Lakeside ±0,5	5	470	94	166
Parking lot ±0,5	5	2000	400	1297,5
Restrooms ±0,5	5	120	24	420

ANOVA

Source of Variance	SS	df	MS	F	P-value	F crit.
Between Groups	470580	3	156860	269,4031773	6,67462E-14	3,238871517
Within Groups	9316	16	582,25			
Total	479896	19				

Table 3) Anova resuls of the number of "*Lolium perenne*" in each independent variable area; woods, lakeside, parking lot and restrooms.

P-value=6,67462E-14

α=0,05

Hence, α is bigger than the P-value. This means that H1 is accepted and there is a statically significant difference between the mean numbers of "*Lolium perenne*" leaves in different locations.

To be able to see the difference and make statements easily the graph comparing the mean leaf numbers of "*Lolium perenne*" for each different independent variable spots is made. Again, the graph shows that , the maximum mean number of "Lolium perenne" leaves are in the parking lot The woods is containing the second max mean number of "Lolium perenne" leaves since it is hosting more humans than the parking lot but less than the lakeside. The most preferred picnic area, the lakeside, is the second most unsuitable place among the investigated ones because nearly all of the human activities are conducted there. And the most disastrous $10m^2$ area among the Lake Eymir's human effected areas is the restrooms.
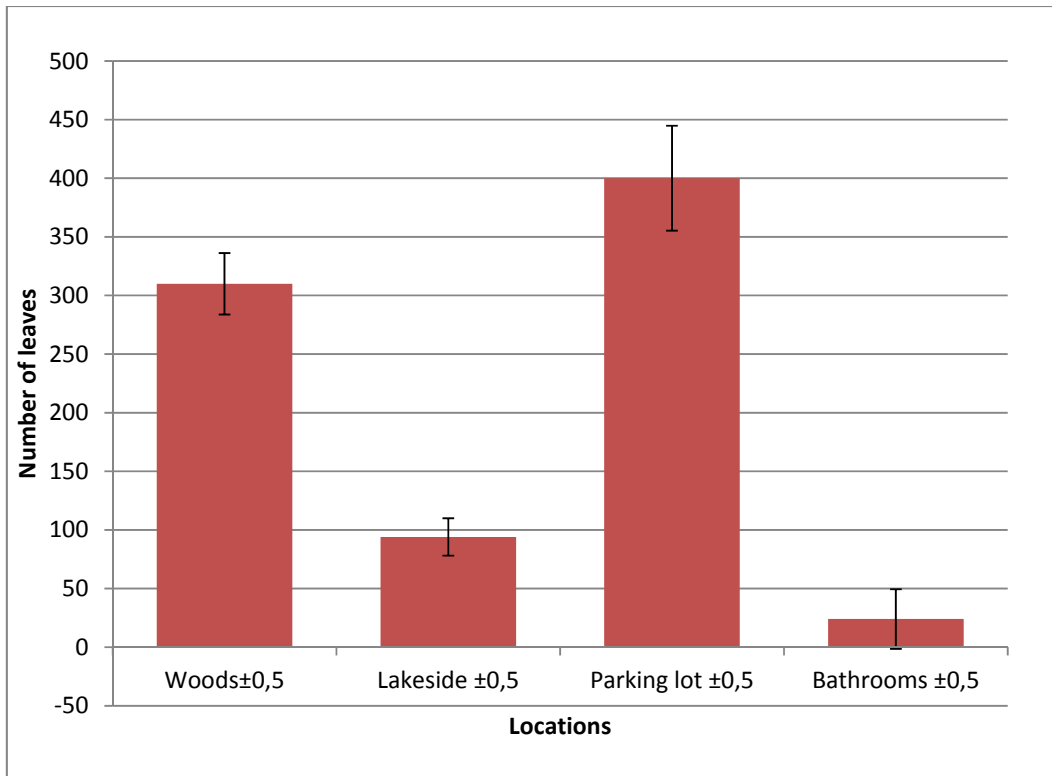
Table 4) Column graph comparing the mean leaf number of "*Lolium perenne*" for each different independent variable spots.

To be able to identify the source of the difference, independent sample t-Test was applied between every data set;

t-Test: Two-Sample Assuming Unequal Variances

	Parking lot *±0,5*	*Restrooms* *±0,5*
Mean	400	24
Variance	1297,5	420
Observations	5	5
Hypothesized Mean Difference	0	
df	6	
t Stat	20,28731041	
P(T<=t) one-tail	4,66041E-07	
t Critical one-tail	1,943180281	
P(T<=t) two-tail	9,32083E-07	
t Critical two-tail	2,446911851	

Table 5) t-Test result comparing the number of "*Lolium perenne*" leaves counted in the quadrats near the parking lot and near the restrooms

t-Test: Two-Sample Assuming Unequal Variances

	Lakeside *±0,5*	*Restrooms* *±0,5*
Mean	94	24
Variance	166	420
Observations	5	5
Hypothesized Mean Difference	0	
df	7	
t Stat	6,465978172	
P(T<=t) one-tail	0,000172509	
t Critical one-tail	1,894578605	
P(T<=t) two-tail	0,000345019	
t Critical two-tail	2,364624252	

Table 6) t-Test result comparing the number of "*Lolium perenne*" leaves counted in the quadrats near the lakeside and the restrooms

t-Test: Two-Sample Assuming Unequal Variances

	Lakeside ±0,5	*Parking lot* ±0,5
Mean	94	400
Variance	166	1297,5
Observations	5	5
Hypothesized Mean Difference	0	
df	5	
t Stat	-17,88586981	
P(T<=t) one-tail	5,01519E-06	
t Critical one-tail	2,015048373	
P(T<=t) two-tail	1,00304E-05	
t Critical two-tail	2,570581836	

Table 7) t-Test result comparing the number of "*Lolium perenne*" leaves counted in the quadrats near the parking lot and near the lakeside

t-Test: Two-Sample Assuming Unequal Variances

	Woods±0,5	*Restrooms* *±0,5*
Mean	310	24
Variance	445,5	420
Observations	5	5
Hypothesized Mean Difference	0	
df	8	
t Stat	21,73789563	
P(T<=t) one-tail	1,0573E-08	
t Critical one-tail	1,859548038	
P(T<=t) two-tail	2,11459E-08	
t Critical two-tail	2,306004135	

Table 8) t-Test result comparing the number of "*Lolium perenne*" leaves counted in the quadrats near the woods and near the restrooms

t-Test: Two-Sample Assuming Unequal

Variances

	Woods±0,5	Parking lot ±0,5
Mean	310	400
Variance	445,5	1297,5
Observations	5	5
Hypothesized Mean Difference	0	
df	6	
t Stat	-4,82035272	
P(T<=t) one-tail	0,001469508	
t Critical one-tail	1,943180281	
P(T<=t) two-tail	0,002939017	
t Critical two-tail	2,446911851	

Table 9) t-Test result comparing the number of "*Lolium perenne*" leaves counted in the quadrats near the woods and near the parking lot

t-Test: Two-Sample Assuming Unequal

Variances

	Woods±0,5	Lakeside ±0,5
Mean	310	94
Variance	445,5	166
Observations	5	5
Hypothesized Mean Difference	0	
df	7	
t Stat	19,53172148	
P(T<=t) one-tail	1,15077E-07	
t Critical one-tail	1,894578605	
P(T<=t) two-tail	2,30154E-07	
t Critical two-tail	2,364624252	

Table 10) t-Test result comparing the number of "*Lolium perenne*" leaves counted in the quadrats near the woods and near the lakeside

What t-Tests shows clearly is that every data set taken from each locations has a statistically meaningful difference between them as the "P(T<=t) two-tail" value is smaller than α=0,05. As data from each location have a statistically meaningful difference, we can conclude that human actions during picnics in the locations do have an impact on the plants distribution.

DISCUSSION

The aim of this experiment was to determine the human effect in Lake Eymir on "*Lolium perenne*" to indirectly evaluate the human effect on an average plant species in the lake area and make regulations in the area if necessary. Accordingly, the research question of the experiment is "How human behavior during picnic affect the number of "*Lolium perenne*" in Lake Eymir ecosystem in May?". Statistical analyzing methods ANOVA: single factor and then t-Test Two-Sample Assuming Unequal Variances were used. ANOVA was used to decide if there is a statistically meaningful difference between the numbers of leaf of "*Lolium perenne*" in different areas; and t-Test was used to decide if the difference between any two different data set is statistically meaningful or not.

P-value and the α were "6,67462E-14" and "0,05" respectively in the ANOVA and because α is bigger than the P-value. This H1 is accepted and there is a statically significant difference between the mean numbers of "*Lolium perenne*" leaves in different locations. As for the t-Test Two-Sample Assuming Unequal Variances; every data set taken from each locations has a statistically meaningful difference between them as the "P(T<=t) two-tail" value is smaller than α=0,05. So data from each location have a statistically meaningful difference.

As a result of the experiment, it is proven by Anova and t-Test: Two-Sample Assuming Unequal Variances; that there is a statistically meaningful difference between the mean leaf numbers of "*Lolium perenne*" in 4 areas hosting human activities, especially during picnics. The means on the other hand, prove that the maximum mean number of "*Lolium perenne*" leaves are in the parking lot. The woods is containing the second max mean number of "*Lolium perenne*" leaves . The most preferred picnic area, the lakeside, is the second most unsuitable place among the

investigated ones because nearly all of the human activities are conducted there. The most disastrous 100m^2 area among the chosen human effected areas is the restrooms.

A mean of 400 leaves are present in the parking lot area. This is the greatest mean number among all and the parking lot area is the least human effected area. With 310 mean leaves, woods is following the parking lot area. Woods is also the second least human effected area, because the lakeside is more preferable for picnic and used more. The lakeside, with a mean of 94 "*Lolium perenne*" is the second most unsuitable place and the most crowded picnic area too. The lowest mean leaf number among all areas chosen as independent variables is 24. The data collection in the restroom area, which is the most miserable area among all, has the mean number of 24. Despite not being a picnic area, as all the picnickers use it, the most intense human effect is applied on it. All this information shows that number of "*Lolium perenne*" decreases as the intensity of human activity increases.

Certain precautions must be taken especially around the restrooms and around the lakeside for the welfare of the "Lolium perenne" and other plant species. It is clear that picnics and the actions that they bring to the areas they are held at are destructive. Limitation of the picnic to specified areas or specified times can be a solution but the permanent solution lies in our sensibility. We must look after the nature, as it also looks after us.

LIMITATIONS AND SUGGESTIONS

Although my experiment resulted in meaningful interpretations, there were also limitations. As lake Eymir is a big area covering nearly 8km^2, it is very difficult to collect a set of data that covers most of the lake in a time less than a week so it had to be decided to whether collect enough data but in a long time, or collect less data but eliminating the unwanted effects that can affect the number "*Lolium perenne*" over time.

I also could have taken more data from each location and plus, collecting data regularly on a weekly basis could have had resulted in a significantly more accurate conclusion; as I would have had the chance to observe the human effect throughout the season or the year.

Quadrat size could have been discussed to determine the right size and the suggested independent variable areas' created lots of confusions because it is hard to limit the areas having the most similar characteristics, but I believe I have limited them as accurate as possible.

Unfortunately (or fortunately) the lake is a living and constantly changing habitat so even collected in a day, the data is not collected in even conditions.

If I would have the chance to further investigate this issue, I would want to collect data from various other lakes and then compare them in order to fully focus on the effect of the humans with eliminating the environmental differences. This would show a much more clear result and would help the plant diversity to be re-aroused.
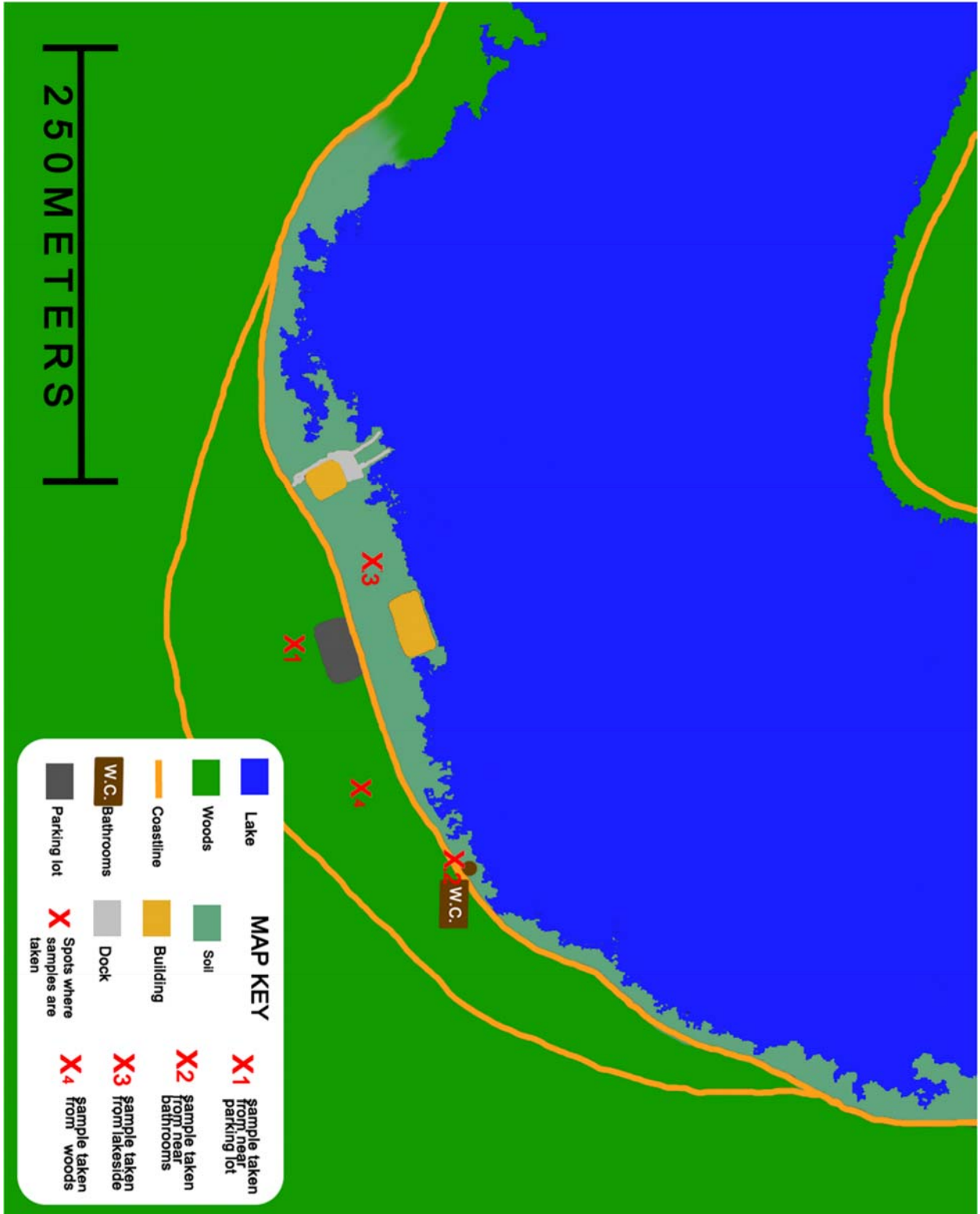
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Figure 1) Illustritive map showing the lake and the areas that samples are taken from.

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