An investigation of the effect of a named abiotic factor upon Marram grass distribution in a sand dune system

Aim: to investigate the effect of a named abiotic factor upon Marram grass distribution in a sand dune system

Background information: Marram grass is a xerophytic plant, meaning that it is a plant that is adapted to living in a dry arid habitat. Therefore it is most likely to be found on sand dunes, where the water is minimal and also where, closer to the shore (if the sand dunes are by the sea), there is a higher salt content, lowering the water potential. Marram grass has many adaptations to living in the sand dunes, for example its leaf blades curve with the stomata on the inside, to reduce evaporation due to heat or wind (transpiration), also this provides a moist microclimate around the stomata (ref. Biozone international). Marram grass blades also have leaf hairs, which hold moist air around the leaf to prevent evaporation. Marram grass has an extensive root system to gain as much water as possible from the water deficient habitat. Furthermore Marram grass has a thick waxy cuticle, reducing water loss by evaporation and also, because it is shiny, reflects some of the heat.

Sand Dune Succession

Sand is deposited by the sea on the shore, and the sand is blown by the wind away from the sea, an object on the beach causes eddy currents and thus the sand is deposited around the object, the sand dune has began. The youngest dunes will be closest to the sea, in these dunes there aren't likely to be any plant, as the dune has no water, or its water potential is too low due to the minerals from the seawater. Further on we come onto pioneer stage dunes, also called the foredunes, this is where pioneer plants begin to grow, yet it is unlikely that we will find any Marram grass here, due to the conditions. Next there are the white dunes, this is where the Marram grass community is likely to be found. Here the Marram grass stabilizes the dunes, through its roots; clumps of Marram grass are continually being buried only to regrow again. The sand dunes go on to become stable dunes and then we get dune scrub, finally having a woodland. In the lower areas of the dunes or in between, there are very likely to be slacks, these are wet areas where there is little vegetation, if the water is too salty, thus having a low water potential, which affects transpiration, or maybe the water is suitable for plant growth yet no Marram grass grows there.

Proposed Method

Based upon the above information, I can conduct an experiment that will allow me to investigate an abiotic factor upon Marram grass distribution. We know that Marram grass is a xerophyte, and therefore has adaptations in order for it to lower its transpiration rate, and thus reducing water loss. Therefore, it is sensible to investigate an abiotic factor, which causes the plants to loose water. Hence, I can either investigate the salt content causing a difference in water potential, meaning that it would be hard for the plant to draw water through its roots, or I cou ld investigate the temperature, and its effects on the Marram grass distribution.

After careful consideration of the above abiotic factors and others as well, for example humus content, or pH, I have decided to investigate the effect of temperature. The reason for this is that at the sand dunes, the temperature varies greatly because it is an uneven surface, causing shades and sunny spots in different areas. Also I can use a digital temperature meter to determine the temperature in which the Marram grass

grows thus gaining data up to a few decimal places, making my investigation more accurate.

Equipment needed

Temperature probe/meter
One meter squared quadrat
Table of results
Tape measure
Point marker sticks

I shall carry out this investigation at Sefton Coast Sandhills, near Formby, I have chosen this location because there are natural sand dunes, and also because it is a reserve aiming at sustaining the sand dunes. Because the sand dunes are not greatly disturbed, we can clearly see the sand dune and ecological succession; ecological succession is where we can see how the plants are growing along the sand dunes, as we go further away from the sea, starting at pioneer plants, going to Marram grass going to fast growing trees and ending up at slow growing trees.

For this investigation, I have selected to use quadrat sampling, as it is the most useful at determining populations, and also it allows for a systematic approach. Upon arriving at the sand hills, I shall get a one meter squared quadrat. I will place the quadrat at the beginning of a white dune, ignoring a pioneer dune, as there aren't likely to be any Marram grass populations. When I have placed my quadrat down, I shall use a temperature probe to record the temperature, I shall place the probe into the grass as to get the exact temperature, that Marram grass is living in. Then I shall estimate the population of Marram grass in that quadrat in percentages, for example if the quadrat is half full with Marram grass, the estimate is going to be 50%. Unfortunately, I cannot separate the quadrat into fractions, because the holes in the fractions (made by a string) would be too small for the Marram grass to fit through, nevertheless it would mean that I would get a more accurate estimate. I shall record my estimate in a results table. Subsequently I shall flip the quadrat to the right, whilst keeping the right side firmly on the floor, and flipping the left side, repeating the above procedure, finally I shall flip to the right again and repeat the method. This makes sure, that the estimate and the temperature for that area is accurate, allowing me to work out an average. From that point, I shall get a tape measure, and shall measure out 30m, placing a point marker stick at that point, there in a straight line to the first measure, I shall repeat the above procedure again three times, and then shall adavance 30m again. I shall repeat this until I have at least 15 sets of three results. Because this will then allow me to analyze the data closely and also I will be able to carry out a statistical test, a Spearman rank correlation test. This is a measure of the strength of a correlation (on a scatter graph). We can correlate two variables, allowing us to see the effect of the variables, and how closely related they are.

There are factors in this investigation which need to be controlled, in order for me to get accurate results. For example, it is logical that I cannot carry out the experiment if there is a slack where I was supposed to measure, therefore I will ignore this slack and move next to the slack, carrying out the procedure there. Also, I must be careful not to place the probe directly close to the stems on the grass, close to the floor, as this is likely to be the coldest place, yet not being the overall average temperature, thus providing me with an inaccurate measure. Therefore, I will try to place the probe into the middle of the grass, on the grass, if the floor is not hollow, giving me a better estimate. Next, when estimating the coverage, I must be careful not to overestimate or underestimate, and in my analysis I must be aware of human error. Next I must also

be careful that I flip the quadrat correctly, where one side remains on the floor, allowing me to again get a better estimate, and furthermore the data is going to be closely related. Finally the last major variable which I must be aware of is the distance between the dunes, as it needs to be as close to 30 meters as possible if I encounter a slack.
I have selected the above method, due to the reason that it is quiet kind to the environment as I am not damaging it. However I must still be careful not to affect the sand dunes greatly as this is also a habitat for not only plants but animals.
Measuring every 30 meters at 3 sets of each means that the data is accurate and valid, and having about 15 sets means that I can carry out a greater analysis of the data such as graph plotting, and investigating the correlation, using a spearman rank test to analyze the strength of the correlation between the variables. I will be able to analyze the effect of the temperature more deeply. Below is a clear and an accurate table of results that I am going to use:

Quadrat set	Quadrat number	Temperature (degrees C)	Marram grass estimate(%)
1	1	?	?
1	2	?	?
1	3	?	?
2	1	?	?
2	2	?	?
2	3	?	?
3	1	?	?
3	2	?	?
3	3	?	?
4	1	?	?
4	2	?	?
4	3	?	?
5	1	?	?
5	2	?	?
5	3	?	?
6	1	?	?
6	2	?	?
6	3	?	?
…	…	…	…

Null hypothesis

I predict that the temperature will not affect the Marram grass distribution, due to the reason that as the plant is xerophytic, it is adapted to living in harsh environments, for example it curls up to stop transpiration, it has hairs which hold moist air around the plant to stop evaporation and also it has a reduced number of stomata meaning that there is not going to be as much evaporation, all to counter the effect of temperature so therefore it will occupy the same area even when the temperatures vary. So the temperature will not be closely related to the growth rate of the grass. This means that the grass will grow evenly throughout the sand dune system, in places where the grass is exposed to a lot of sun and in places where there is a lot of shade. I predict that the spearman rank test will not show any strong correlation between the variables of temperature and growth distribution, and that a scatter graph and particularly a kite graph will both have no gradients, as the temperature has not effect.