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A Comparison of Water Availability in Coastal Live Oak (*Quercus agrifolia*) and California Bay (*Umbellularia californica*) at Top and Bottom of Hillsides at Malibu Creek State Park, California

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Abstract

This investigation serves to show whether moisture content is different in plants at the top of hills versus bottom of hills, specifically comparing values of *Quercus agrifolia* and *Umbellularia californica* in Malibu Creek State Park. By acquiring six branches of each species on a hill at intervals of twenty feet, the moisture content can be obtained and analyzed by using the Scholander Hammel pressure chamber. This allows us to determine whether there is a correlation between moisture content and plant position on hills.

Introduction

The Pepperdine campus is located in the Santa Monica Mountains area, a region affected by fast, dry winds, periods of drought, and fires caused naturally or by human interference. Because of these conditions, wildfires occur more frequently and are difficult to put out. It has become a major problem for firefighters and is extremely alarming to communities located in these areas. These events have attracted a large amount of attention from biologists.

When trying to control wildfires, the availability of water to the plants is an important factor to consider, especially because dry shrubs provide better fuel than do plants with higher moisture content (Witter, 2007). With so many hills and canyons surrounding our campus, we consider position on a hill as a factor that can impact the water available to plants. In a situation where it is raining, the water is partially absorbed by where it falls. However, gravity also takes effect and draws a lot of the water towards the bottom of the hills. Thus, plants at the bottom of a hill should have higher moisture content than plants located at the top of a hill because there is more water available to them. We investigate whether plant location on a hill affects its moisture content.

Materials and Methods

We performed our study at Malibu Creek State Park. From there we located an area at the top of a hill and at the bottom of the hill in order for us to record our data with the necessary plant samples. We then collected six samples of Coastal Live Oak and six samples of the California Bay Tree at the top and bottom of different hillsides. Then, we measured the moisture content of the plant species selected, and recorded data.

The Materials we used consist of a cooler with ice, baggies, clippers, a porometer, and the Scholander Hammel Pressure Chamber. The clippers allowed us to cut off the samples of leaves, the baggies kept the samples organized, and the cooler allowed the samples to stay cold so they could be testable. We collected samples both at predawn and midday. After getting the samples back to the lab, we used the Scholander Hammel Pressure Chamber to measure the moisture content in the samples that we collected. We also went back to the site and used a porometer to measure stomatal conductance. We used the acquired data and presented it in graphs.

Study Site

![Study site, Malibu Creek State Park, CA. Note brown leaves on hillsides.](image)

Figure 1: Water potential at predawn and midday for *Quercus agrifolia* and *Malosma laurina* at the bottom versus top of a hill. At both times of the day, plants were drier at the top of a hill. Error bars represent ± 1 SE, n = 6. Letters denote significant difference by one-way ANOVA followed by a Fisher’s LSD test at P < 0.05.

Discussion

As shown in figure one, the results presented measuring the water potential of two distinctive plant species; *Quercus agrifolia* and *Umbellularia californica*, supports our hypothesis, stating that plants located at the top of the Santa Monica Mountain hillside will be a lot dryer than those located at the bottom. These results representing the water potential of these two plants species measured at predawn, and also at midday expressing a large variation in results. Plant species (*Q. agrifolia, U. californica*) located at the top of the hill have a smaller water potential value than those located at the bottom, as indicated by the height of the blue bars compared to the two plant species represented by the red bars. Figure two represents the stomatal conductance of the two plant species at midday. The graph shows that the rate at which water leaves the plant is higher at the top of the hill rather than at the bottom. We concluded that because the plants at the top of the hill are dryer there is less water available to leave the stomata. Therefore, the plants at the bottom of the hill, with more water available, have more water leaving. A one-way ANOVA test determined that the plant species at the bottom are not significant enough to be compared to each other, but each one can be compared to either one at the top. We also determined that the two plant species at the top cannot be significantly compared to each other, but can be compared to either one at the top.

Conclusion

Vegetation is greatly harmed and can even change if plant species do not sprout after fires. Animal habitats are also damaged as a result. Firefighters are always looking for techniques that will allow them to put out fires more quickly. If plants at the top of hills have lower moisture content then they would need more attention when putting out fires because they would be the ones to make the fire increase in size. By comparing the moisture content of native trees in the Santa Monica Mountains relative to their position on a hill, a new method of where to start spraying water on fires could develop. We can also conclude that it would be more beneficial to build homes at the bottom of the hill than at the top because there is a lower risk of a fire occurring since the drier plants are located at the top of hills.

References


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