

Evaluation of Growing Conditions for *Rhodiola integrifolia* in the Ouray and San Miguel County Region

A Bridal Veil Living Classroom Project
Telluride Watershed Education Project

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July 11, 2009- November 15, 2009

Abstract

The purpose of this study is identification of optimal growing conditions for the plant species *Rhodiola integrifolia* and *Rhodiola rosea*. *Rhodiola rosea* is a member of the *Rhodiola* genus, and is recognized as an important medicinal herb. In many areas of the world, over harvesting *Rhodiola rosea* is threatening the species. Since *Rhodiola rosea* does not grow in Western Colorado, *Rhodiola integrifolia* was studied as a close replacement. This study was conducted in Ouray and San Miguel counties in July of 2009, to determine the best growing conditions for the *Rhodiola rosea*. Five plots were observed, one as an example of *Rhodiola integrifolia* growing in a controlled farm environment in the Uncompahgre Valley, two in Bridal Veil Basin that mimicked the farm conditions, and two in Bridal Veil Basin that were areas where the plant was growing prevalently.

The high elevation of Bridal Veil Basin was determined to be the most optimal natural growing area. The plants located lower in the basin identified a less desirable growing condition for the plants due to more competition from other plant species. Although the farm is located at a lower elevation than the wild *Rhodiola* plants growing in the region, it proved to provide the most favorable growing conditions.

Introduction

For centuries people have cultivated specific plants for their medicinal properties. All plants have optimal growing conditions, which farms try to mimic. One of the most extensively used medicinal herbs today is *Rhodiola rosea*. This plant originated in Asia (Brown, Gerbarg, and Ramazanov, 2002) and has spread into the North Eastern region of the North American continent (NRSC). Research has revealed that *Rhodiola rosea* contains powerful adaptogens, which has been proven to protect animals and humans from mental and physical stress, toxins and cold. It has also been found to enhance physical and mental performance (Brown, Gerbarg, and Ramazanov, 2002). Large demand has resulted in over harvesting the plant, endangering it in the Eastern U.S.A., and areas in Asia (NRSC & Platikanov and Estatieva). Sustainable cultivation could help to take stress off of *Rhodiola rosea* growing in the wild.

Another plant in the *Rhodiola* family, *Rhodiola integrifolia*, grows in the Rocky Mountains, (NRSC, 2009) and is similar in its growing requirements to *Rhodiola rosea*. They are similar in that they both only grow in northern latitudes, and primarily in alpine ecosystems. They live in areas with similar weather patterns, ground cover content, are sedums, and have similar flower structures (Personal communication Manzagol, 2009).

The objective of this study was to observe the growing conditions where *Rhodiola integrifolia* is growing prevalently in Bridal Veil Basin, about 5 miles southeast of Telluride Colorado (TOPO). Knowledge of optimal growing conditions for *Rhodiola*

integrifolia could potentially be extrapolated to understanding optimal cultivation techniques for sustainable production of *Rhodiola rosea*.

Before starting the study a hypothesis was made that the best growing conditions for *Rhodiola integrifolia* would be on a steep slope with rocky soil, and in direct sunlight at approximately 8,000 feet or above. These assumptions were made because observations showed that the families of *Rhodiola* plants are known to grow best in well drained soil, which both the rocks and the slope provide, and the *Rhodiola* family grows best in full sun at high altitudes. Following are color photographs of the two species.

Methods and Materials

To evaluate the hypothesis of this research project, specific plots with varying growing conditions were selected. Below are descriptions for each plot.

Plot 1 was located at the Shining Mountain Herb Farm, Ouray County, Colorado, where *Rhodiola integrifolia* was being experimentally grown.

Plots 2 and 3 were chosen to be as similar to the farm plot as possible. This translated to the plots needing to be in partial sun, with no slope, and have loamy soil.

Plots 4 and 5 were examples of where *Rhodiola integrifolia* was found growing prolifically. “Prolifically” was defined as where the *Rhodiola integrifolia* plants were very large (average plant height above 15 cm) and growing together densely.

Plots 2 through 5 were chosen based on area reconnaissance and visual observation. All of the plots were broken up into three 1m (meter) x 1m squares, and one, 1m x ½ m square. Subsections within the plots were named A-D from north to south (N-S) (Figure 1). In each subplot the total number of plants were counted and a graph created showing the location of each plant. In addition, the overall plot composition was noted, the percentages were estimated of rock, duff/litter, moss, bare soil and overall plant cover. In subsections A-C ten plants were randomly chosen, and in subsection D five plants were randomly chosen, and the height of the plants were measured in centimeters. For each of the plots the slope was determined using a clinometer, the GPS and elevation were noted, and an approximation of the sun duration the plants received was recorded.

1A
1B

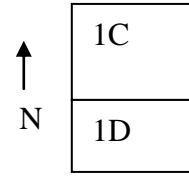


Figure 1

Site Description

Plots 2-5 (identified above) were located in Bridal Veil Basin, a glacial basin southeast of Telluride, Colorado. Plot 1 was located in the Uncompahgre valley one mile south of Ridgway, Colorado. All five plots had a relative N-S aspect. Please refer to Appendices I and II to view topographic maps of the surrounding areas. Please refer to Appendix III to view a graph of the relative elevations of the plots. To view a graph of the plot compositions please refer to Appendix IV. More specific information on each plot follows:

Plot 1

Plot 1 was located on the Shining Mountain Herb Farm in Ridgway, Colorado (38°8'5.4"N, 107°45'6.1"W), with an elevation of 7,050ft. This plot was in a very controlled environment. There was very little slope, the plants were in rows in a raised bed, and there was a shade structure above the plants, providing approximately 50 percent shade. The bed was weeded about once every two weeks, and watered every other day. Compost was added to the soil prior to planting. The *Rhodiola integrifolia* plants were spaced roughly six inches apart.

Plot 2

The GPS coordinates for Plot 2 were: 37°54'44"N, 107°46'11.4"W and was at an elevation of 10,100ft, and completely surrounded by a ring of evergreen growth with a high canopy. There was a dead log bordering the east side, a stream ran about a meter away from the south side. There was a small conifer growing in section 2D, which happened to be the area with the least amount of plants.

Plot 3

Plot 3 GPS coordinates were: 37°54'43.9"N, 107°46'14"W and was at an elevation of 10,110ft. Fewer spruce trees surrounded Plot 3 than Plot 2, thus providing a sunnier environment than Plot 2. Bridal Veil Creek was running about a meter and a half from the northwest corner of the plot. There was a willow growing in subsection 3A. Plot 3 was located at the base of a steep slope. There was diverse vegetation intermixed in the plot.

Plot 4

Plot 4 GPS coordinates were: 37°54'29.9"N, 107°46'15.9"W and was located at 11,013ft. Plot 4 was located on a large boulder in the midst of a rock outcropping area. The slope

was 30° with an incline to the south. There was no running water close by. The plot had little plant diversity. The plant population was mostly *Rhodiola integrifolia* with a few grasses. The plot had a very thin soil layer covered with moss that appeared to help stabilize the soil. The plot was surrounded by bare rock, and received full sun.

Plot 5

Plot 5 GPS coordinates were 37°54'4"N, 107°46'6.9"W with an elevation of 11,900ft. It had a 43° slope with an incline to the north. The plot was located below a large vertical rock outcropping. There were no trees around; the soil was fairly sandy, and at least three feet or more thick. Like Plot 4, there was no running water nearby.

Findings

Plot 1

Plot 1 had the tallest plants, with an average height of 28.7 cm. Since the plot was on a farm, the plants were evenly spaced. The overall density was 87 plants per square meter. On August 13, 2009 (when the data for Plot 1 was collected) the plants were all in different phases of their life cycle. Some were flowering and some had already flowered. Some plants had deformed leaves, which were wilted and much larger than average, but in general, the plants in Plot 1 looked the most robust of all the plots.

Plot 2

Plot 2 had the shortest average plant height at 13.7 cm. It was the least dense, with an average density of 17 plants per square meter. On August 11, 2009 the plants were healthy, but none of the plants were flowering nor was there evidence of buds.

Plot 3

The plants in Plot 3 had an average height of 21.4 cm. The density of Plot 3 was 47 plants per square meter. There was a large willow growing in subsection 3A, which was the least dense of all the plots with only one *Rhodiola integrifolia* plant. Similar to Plot 2, as of August 12, 2009, the plants located in Plot 3 did not have buds or flowers.

Plot 4

The plants in Plot 4 had an average height of 21.4 cm with little diversity in plant height. The density of Plot 4 was 249 plants per square meter. On August 11, when the plot was observed, it was noted that the plants all were changing color, going into hibernation, and completed their flowering phase.

Plot 5

Plot 5 had an average plant height of 18.1 cm. Its density was 169 plants per square meter. On August 12, the plants were predominately in flower, healthy, and very dense.

Please refer to Appendix V for plant density maps, to Appendix VI for a comparative plant density graph, and to Appendix VII for a graph of average plant height.

Conclusion

Prior to the study it was postulated that the best growing conditions for *Rhodiola integrifolia* are on steep slopes with rocky soil, in direct sunlight, and above 8,000 feet. Following please find a summary of information gained through this study.

It was determined that the farm, Plot 1, had the largest plants with the median density. It should be noted that on Plot 1 the plants were planted apart from one another, thus imposing an artificial density. Also, the plants in Plot 1 were only a couple years old, and the ages of Plots 2 through 5 are unknown. Therefore, it is probable that if the plants were given time to establish themselves, they would likely become more dense, with similar densities to Plots 4 and 5. Overall, the controlled farm conditions appeared to provide the best growing conditions. These included: elimination of plant competition, providing nutrient rich soil, adequate water supply, and control of sun intensity.

This study did not analyze the soil chemistry, and it is possible that the plants were tallest in Plot 1 due to the fact that the farm soil was likely more rich in nutrients, than in the sites observed in the Bridal Veil Basin. For plots 2-5—especially plots 4 and 5—exposure to other elements such as high wind and snow cover could have influenced plant height.

Although there appears to be several factors influencing plant growth, it was clear that the *Rhodiola integrifolia* was significantly impacted by plant competition. For example, Plots 2 and 4 both had an overall plant cover of 33%. (Appendix IV. Plot Composition.) The difference was that Plot 4 was a monoculture of *Rhodiola integrifolia*, and Plot 2 was mostly covered by other plant species. Plot 2 had the smallest density and shortest plants.

Rhodiola's inability to compete in locations where diverse plant communities exist may explain why *Rhodiola integrifolia* is found growing in such harsh conditions. Since it is harder to grow exposed, in rocky terrain, and at high altitudes, less competition exists. Thus, *Rhodiola integrifolia* likely has adapted to grow in these "extreme" conditions in order to avoid competition. However, plant growth is enhanced in controlled conditions where other competitive plants, sunlight and/or shade are regulated.

Other factors also affect plant growth. The plants appear to prefer direct sunlight at the exposed high elevation plots 4 and 5. However, communication with the Shining Mountain Herb Farm indicated that they have discovered that heat derived from full

exposure at lower elevations was detrimental to plant development. More recent experiments on the farm suggest that partial shade at lower elevations is beneficial.

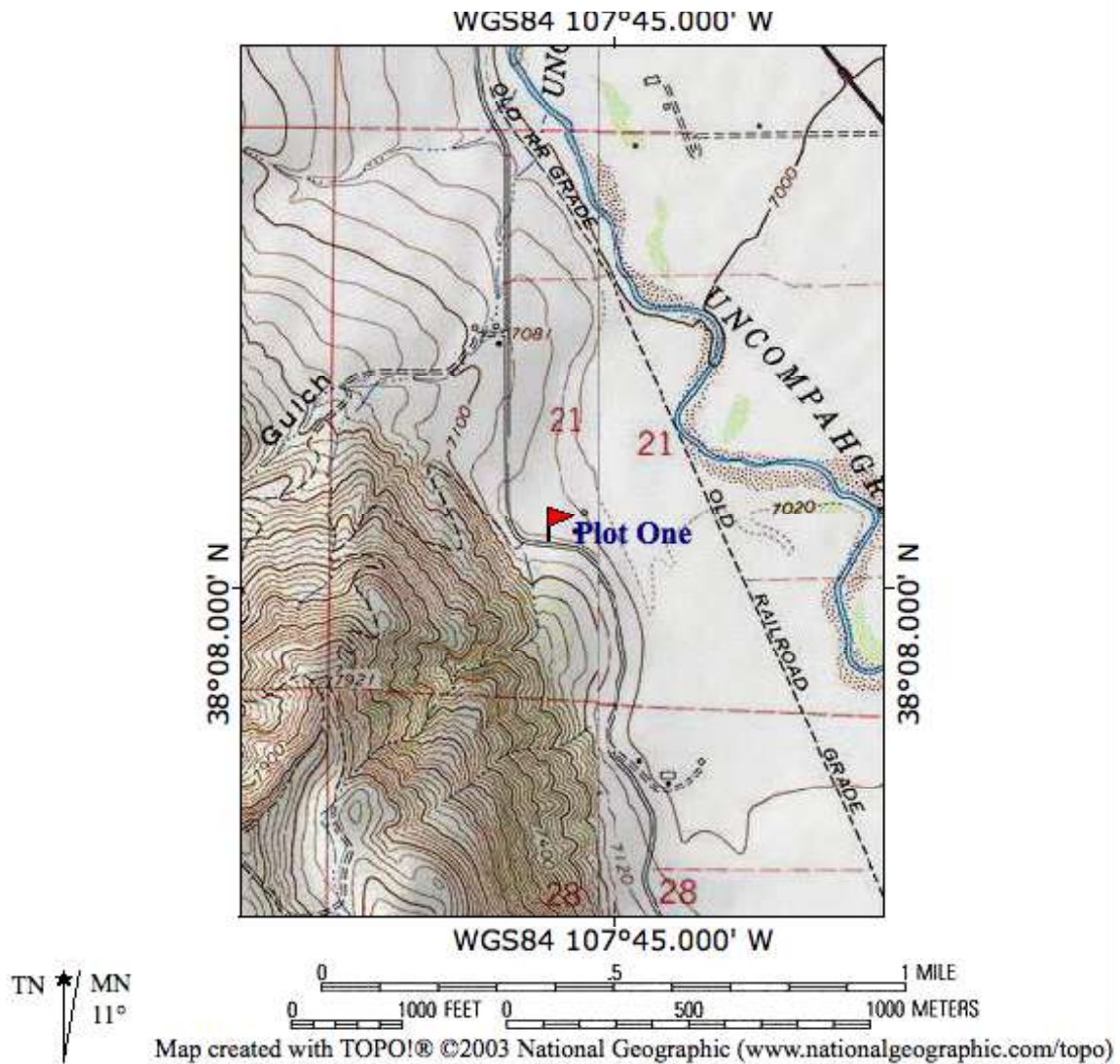
This study did not fully assess the roll of steepness of terrain. Nonetheless, this experiment found that there is a relationship between the steepness of the terrain, and plant competition. The number of species decreases as slope steepness increases.

There does not seem to be a relationship between plant health and rocky soil because plants were prospering in rich loamy soils, as well as rocky soils. Future studies of *Rhodiola integrifolia* should consider conducting a chemical analysis of the soil. Measuring the amount of sunlight the plots received and the amount of water the plants receive through the growing season would also be beneficial.

The medicinal properties of *Rhodiola* are found in its roots. This study did not evaluate the relationship between size or root structures of the plants. Further studies would find it beneficial to study the factors that effect root development within the plant's growing areas. Additionally, knowing the age of the stands would help to determine how long it takes the plants to reach the optimum density. A further study could be performed in which the other vegetation in Plots 2 or 3 are weeded for a few years. This would help determine the importance of competition relative to the other plot growing conditions.

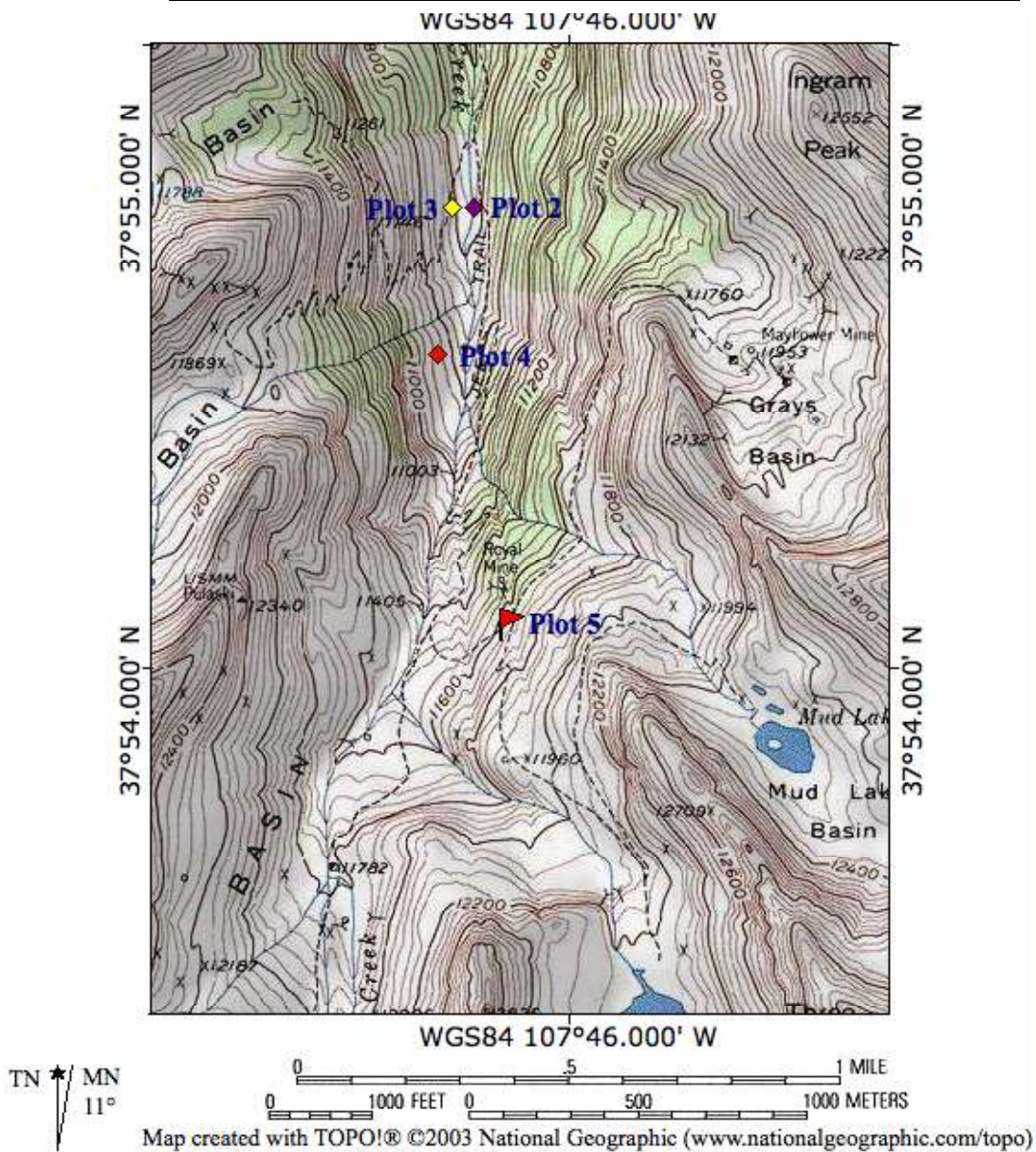
Appendix I.

Topographic Map of Plot 1



Appendix II.

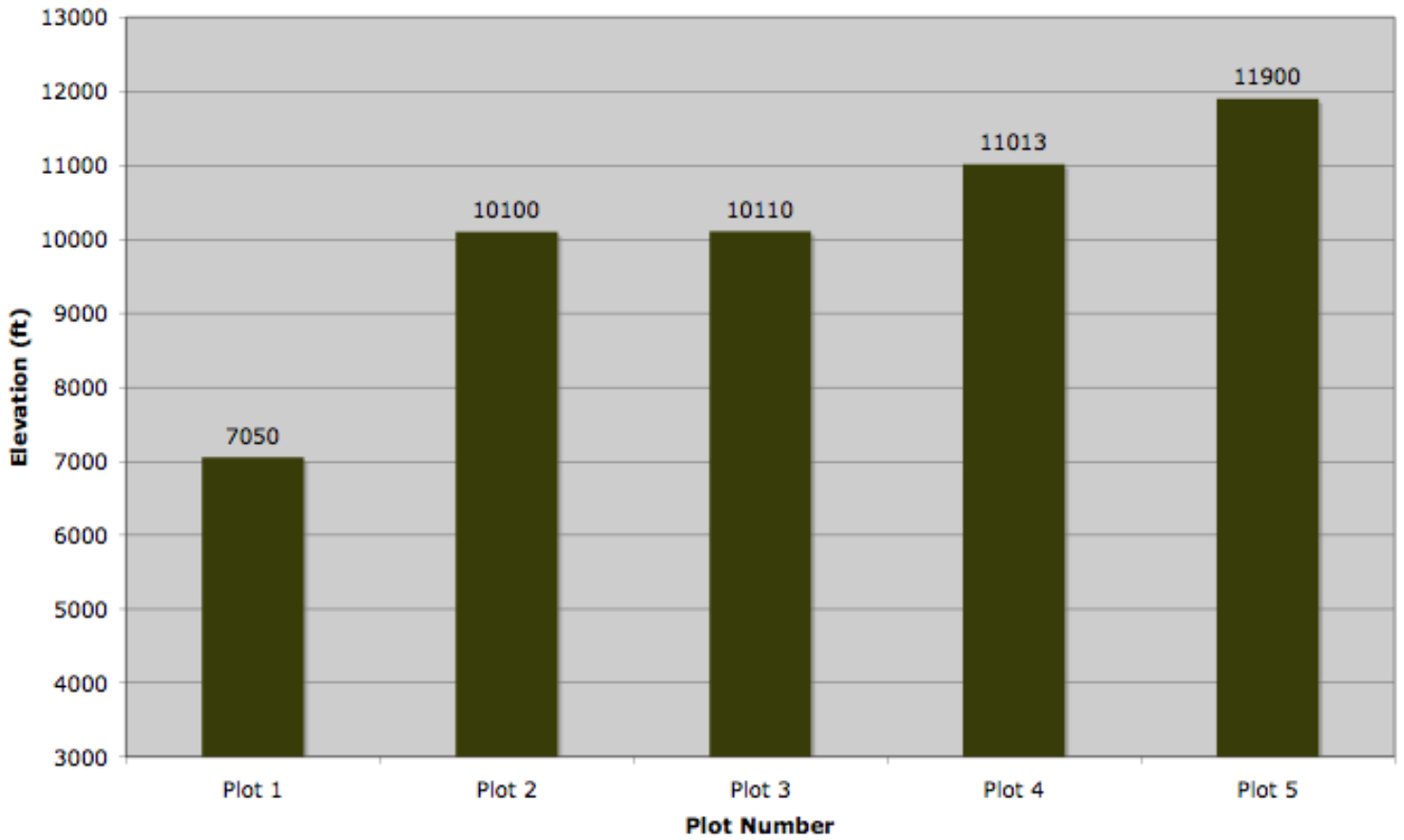
Topographic Map of Plots 2-5



Appendix III.

Elevation of Plots

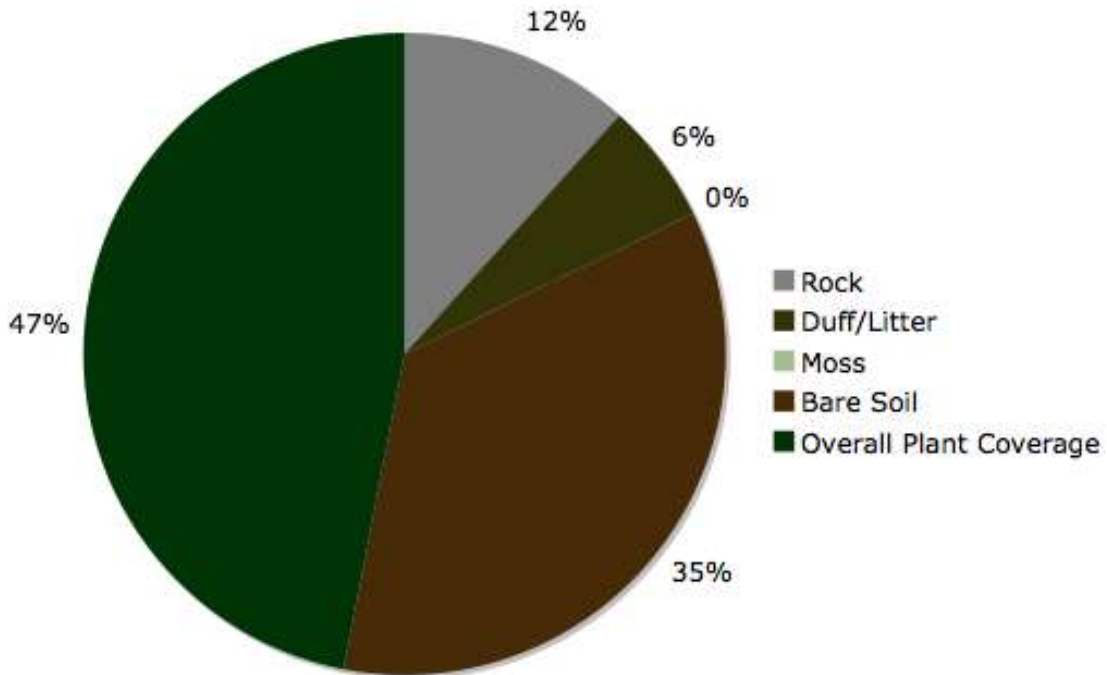
Elevation of Plots



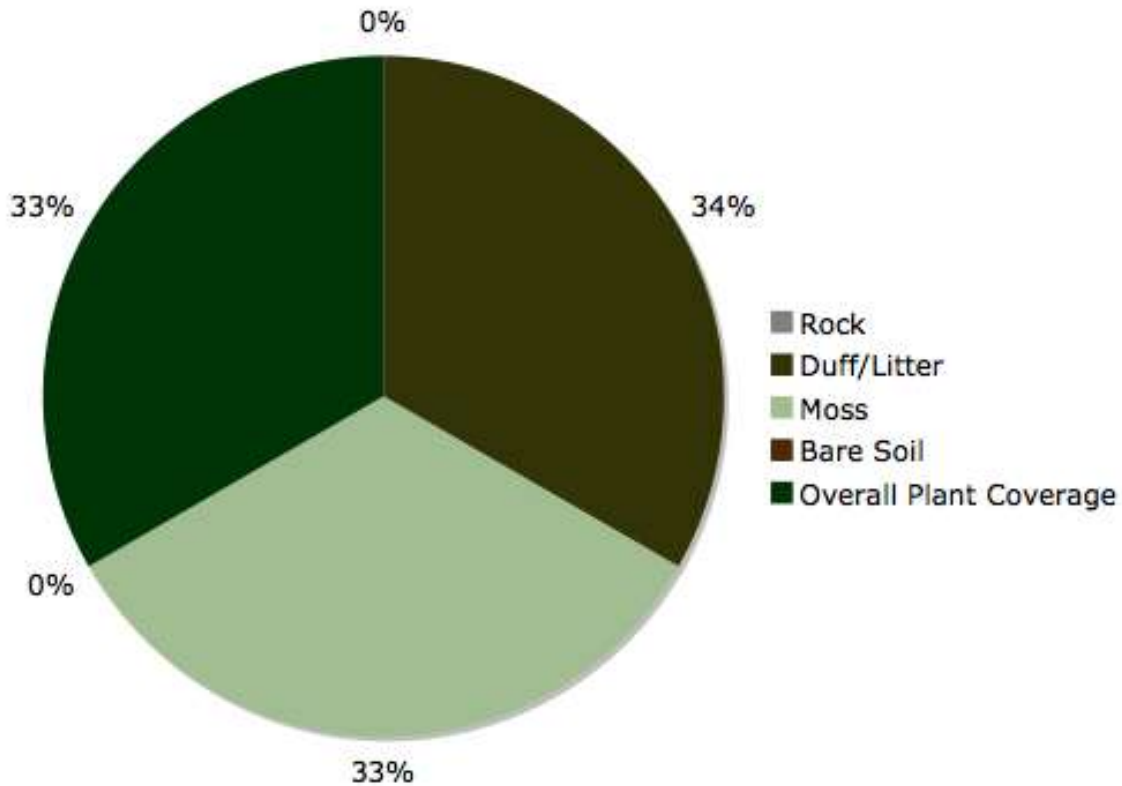
Appendix IV.

Plot Composition Graphs Plots 1 and 2

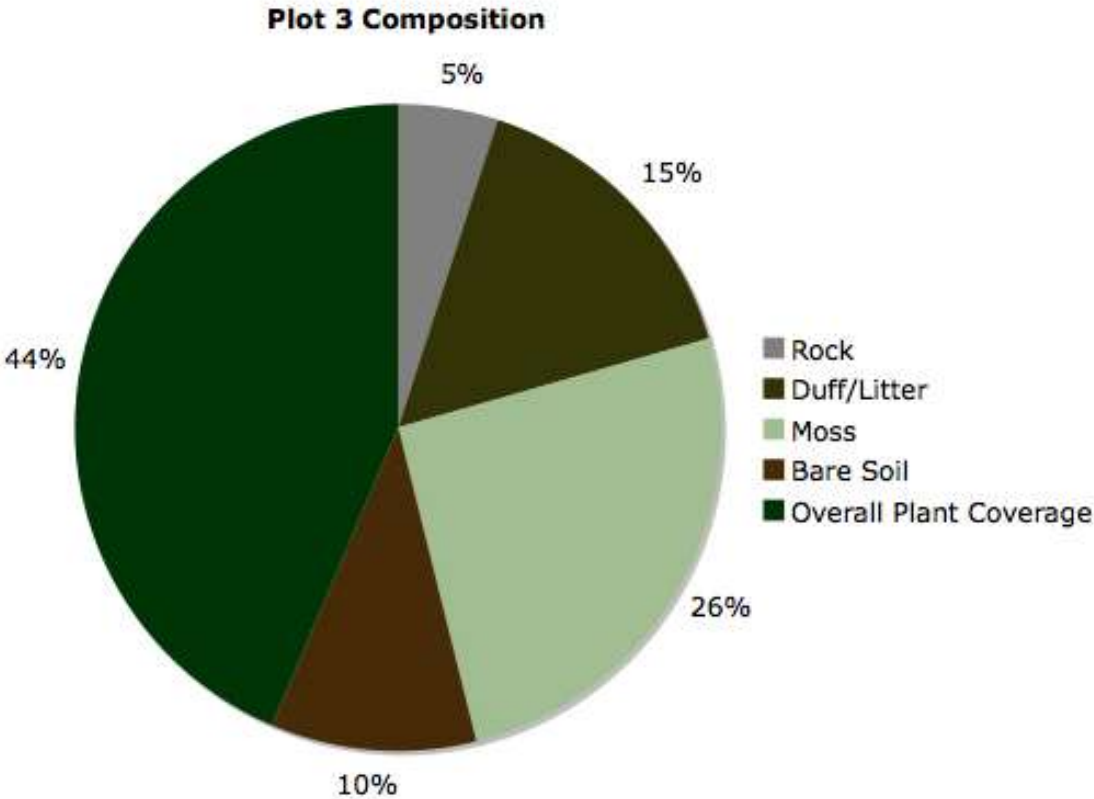
Plot 1 Composition



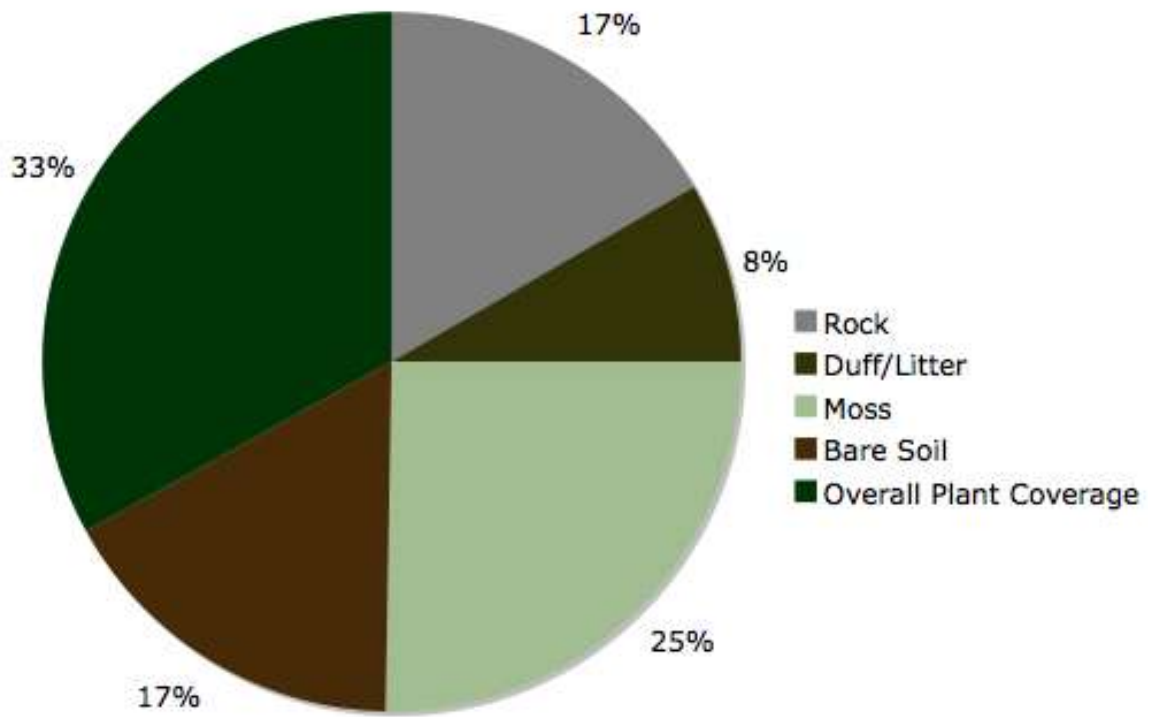
Plot 2 Composition



Appendix IV.
Plot Composition Graphs Plots 3 and 4

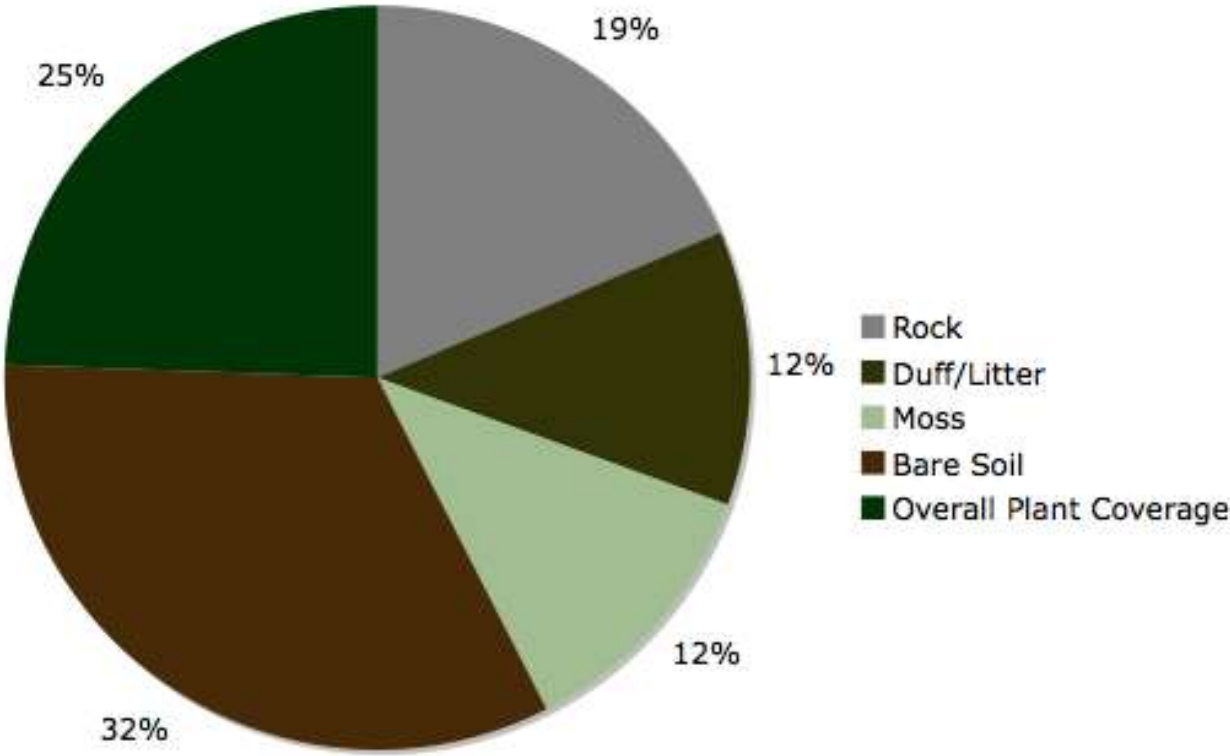


Plot 4 Composition



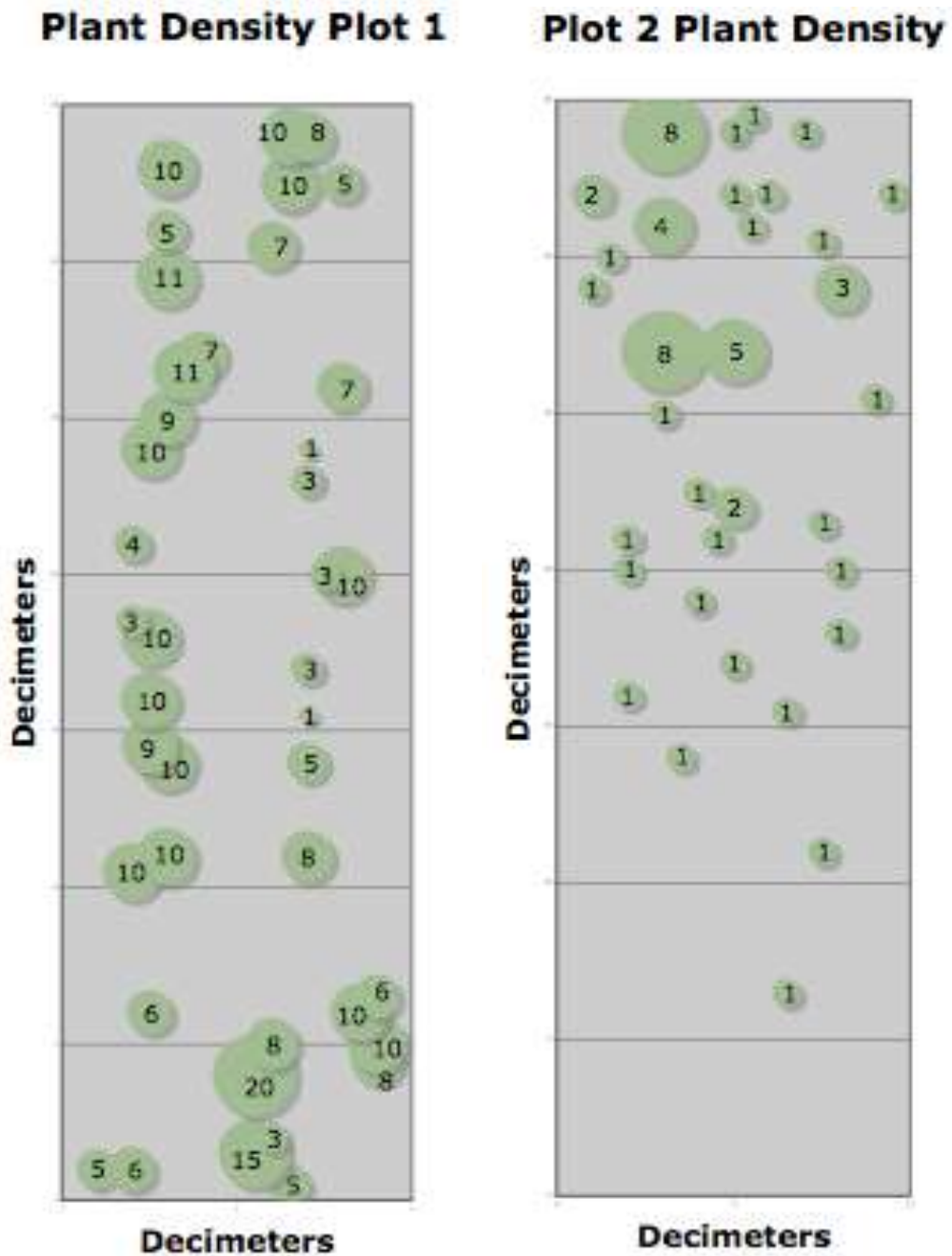
Appendix IV.
Plot Composition Graph Plot 5

Plot 5 Composition



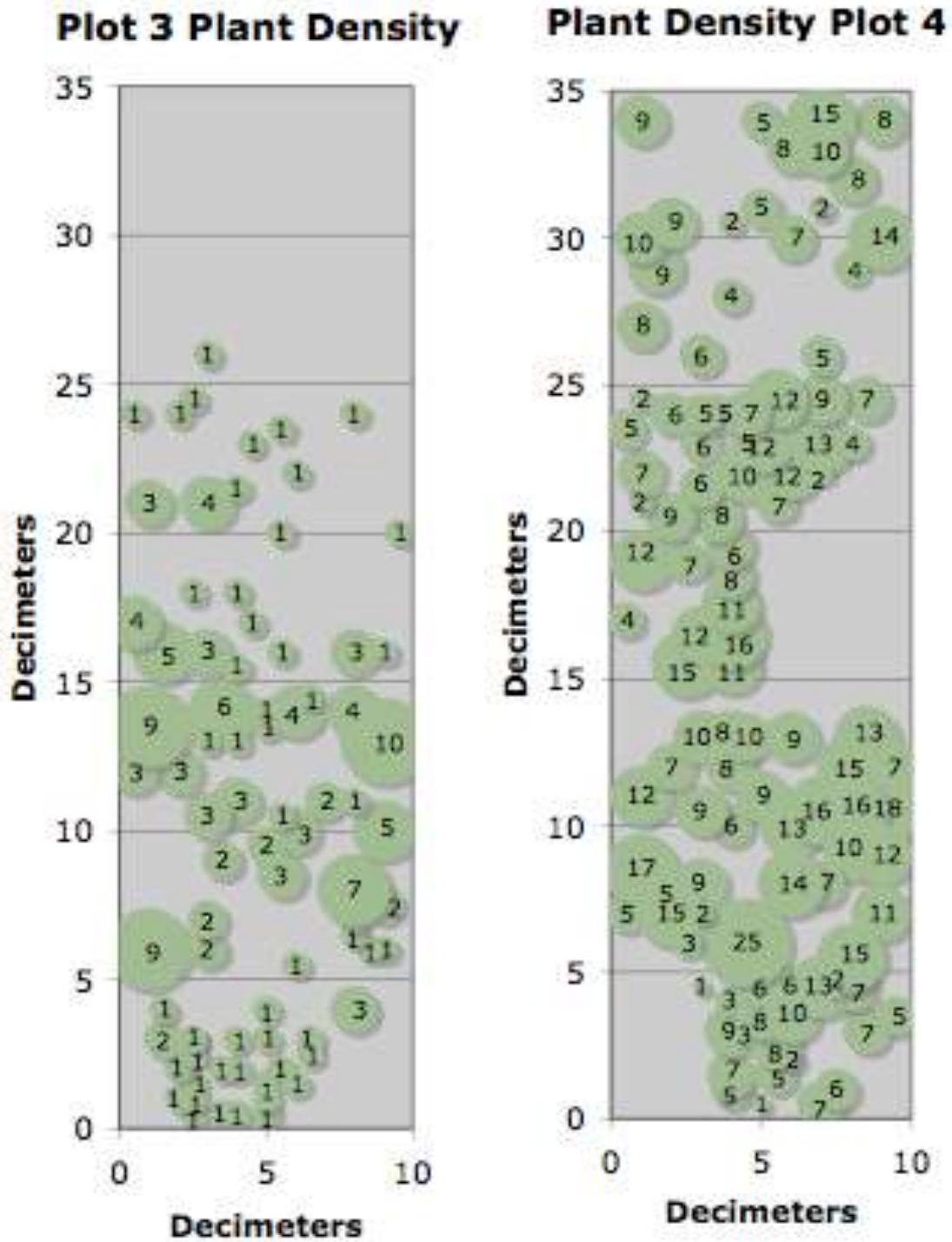
Appendix V.

Plant Density Maps Plots 1 and 2



Appendix V.

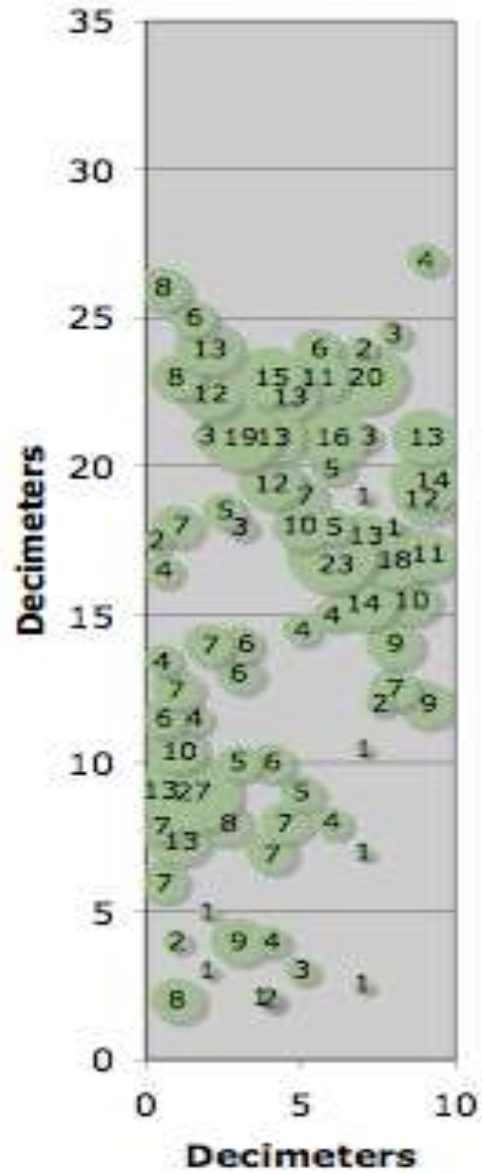
Plant Density Maps Plots 3 and 4



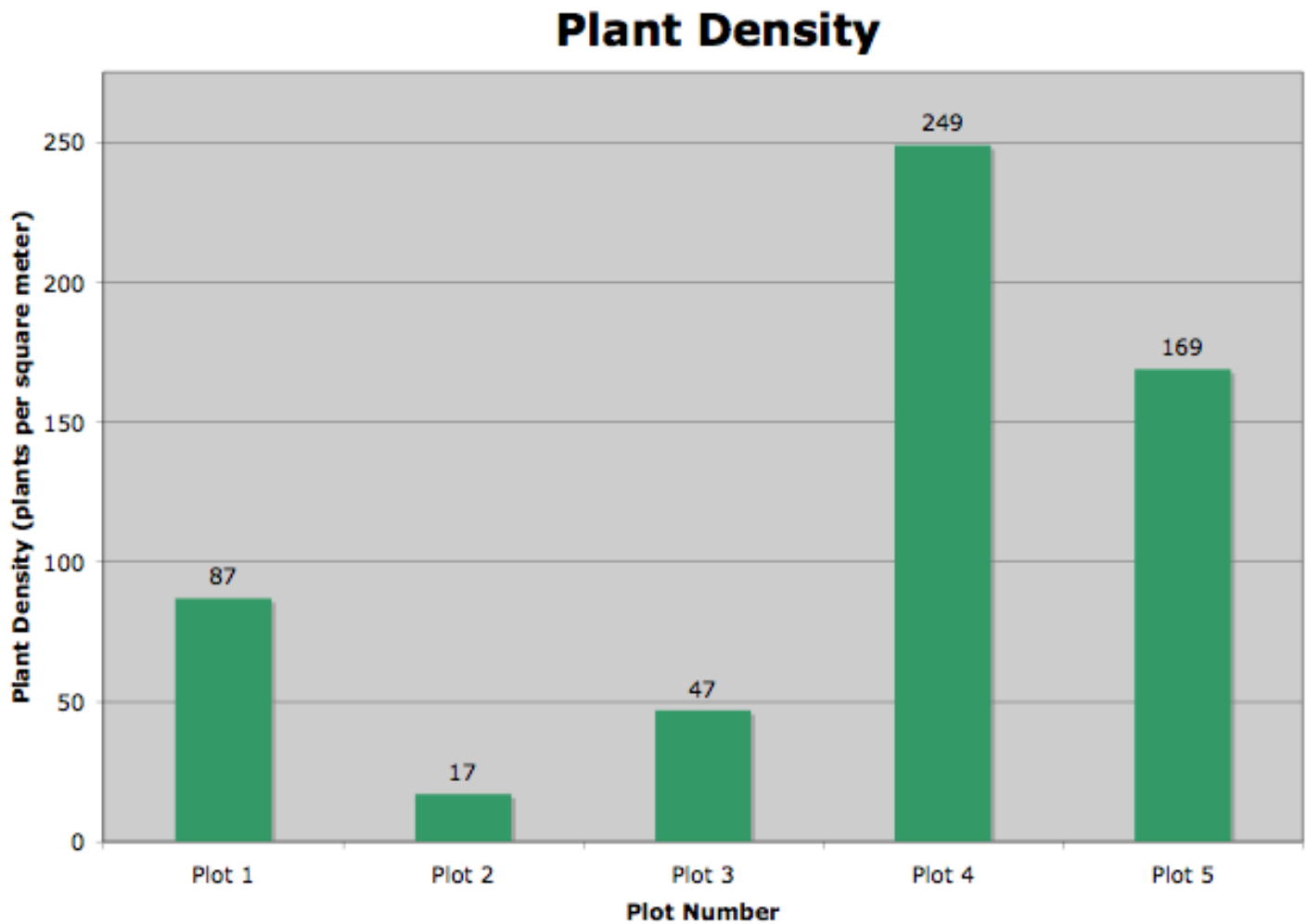
Appendix V.

Plant Density Map, Plot 5

Plant Density Plot 5

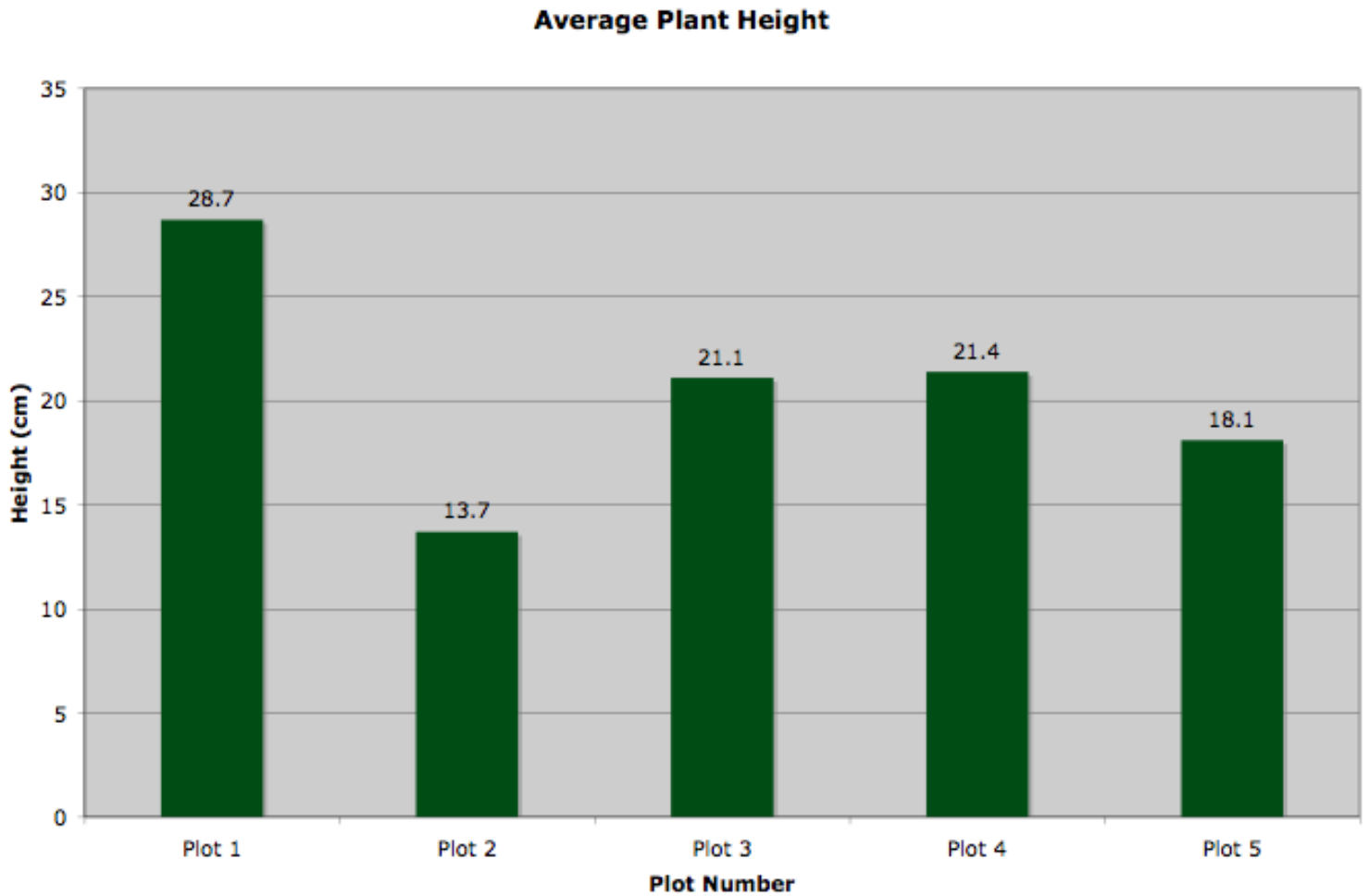


Appendix VI. Comparative Plant Density Graph



Appendix VII.

Average Plant Height Graph



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