



Death in an English Wall Garden: The relationship between plant survival and location

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2016 Research Experiences for Undergraduates Program

Introduction

Monitoring and documentation is used as an attempt to display patterns, changes and factors over time in the gardens at the Chicago Botanic Garden. Through this documentation garden staff can plan and conduct important conservation efforts in the future for each of the diverse gardens. Maintaining and recording detailed records is vital for botanic gardens. The English Wall Garden was designed by an English landscape architect John Brooks; this garden is separated into 'rooms' which depict varying traditional English gardening styles.



Question and Hypothesis

Is there a geographic relationship between removal reasons and plant death location? Are there certain locations with a higher amount of plant deaths recorded? What is the removal reason for all of these plant deaths; is there a certain reason why so many plants have died in the garden?

Hypothesis: There is a geographic removal relationship in plant death in the English Wall Garden. The reason so many plants have died within this garden is due to soil related diseases.

Materials & Methods

ArcMap GIS to map out the data from January 1981 to June 2016. Through building different queries I was able to display the different removal codes and the geographic locations of plant death. Manipulating and visually representing the plant death records along with removal reason I could view spatially where there was a higher vs lower amount of plant death. I collected soil from locations recorded with soil problems, areas that had a high number of replaced plants over the years, and samples from low areas of replaced plants. I tested the nutrients in the soil of each of the samples; these nutrients included: NH₄, P, NO₃, N, and C.

Results

The beds were formed into groups of high and low plant deaths and compared using a chi-squared statistical analysis test. There was a significant difference in the frequency of plant deaths between the high and the low plant death groups ($X^2(1)=5.35, p < .05$)

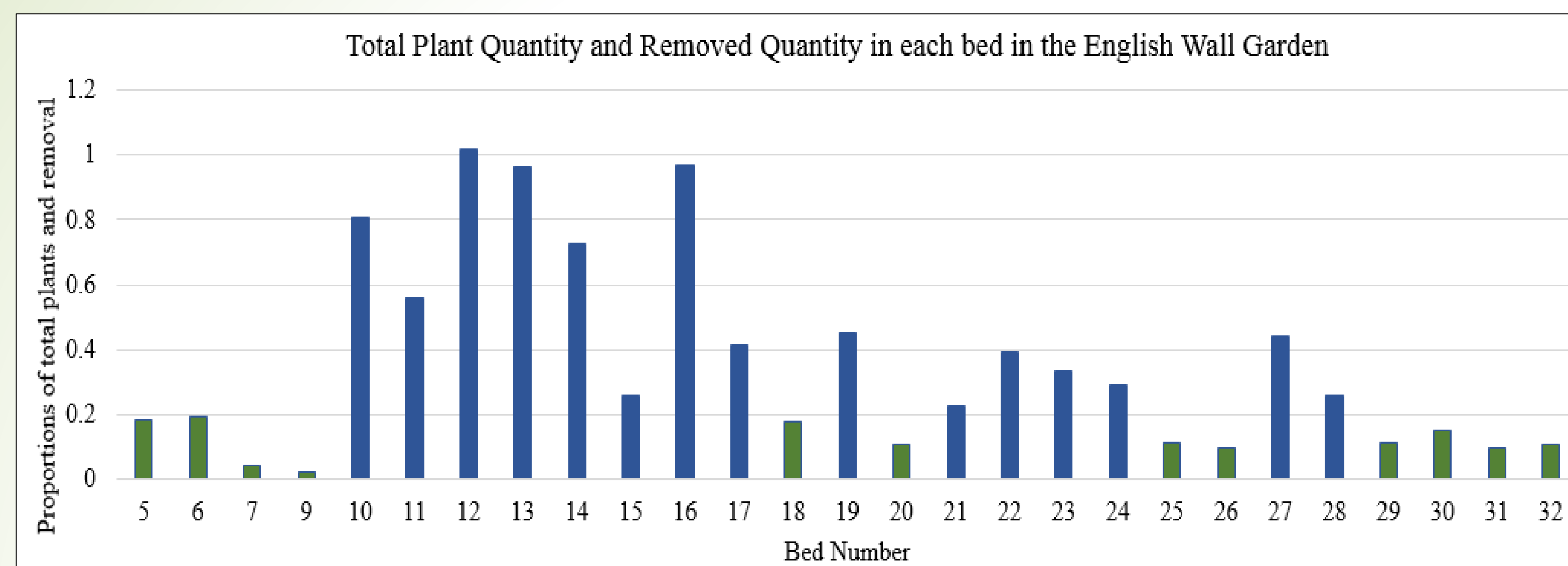


Figure 1: the total plant quantity and removed from the beds. Green: Low Plant Death Blue: High Plant Death

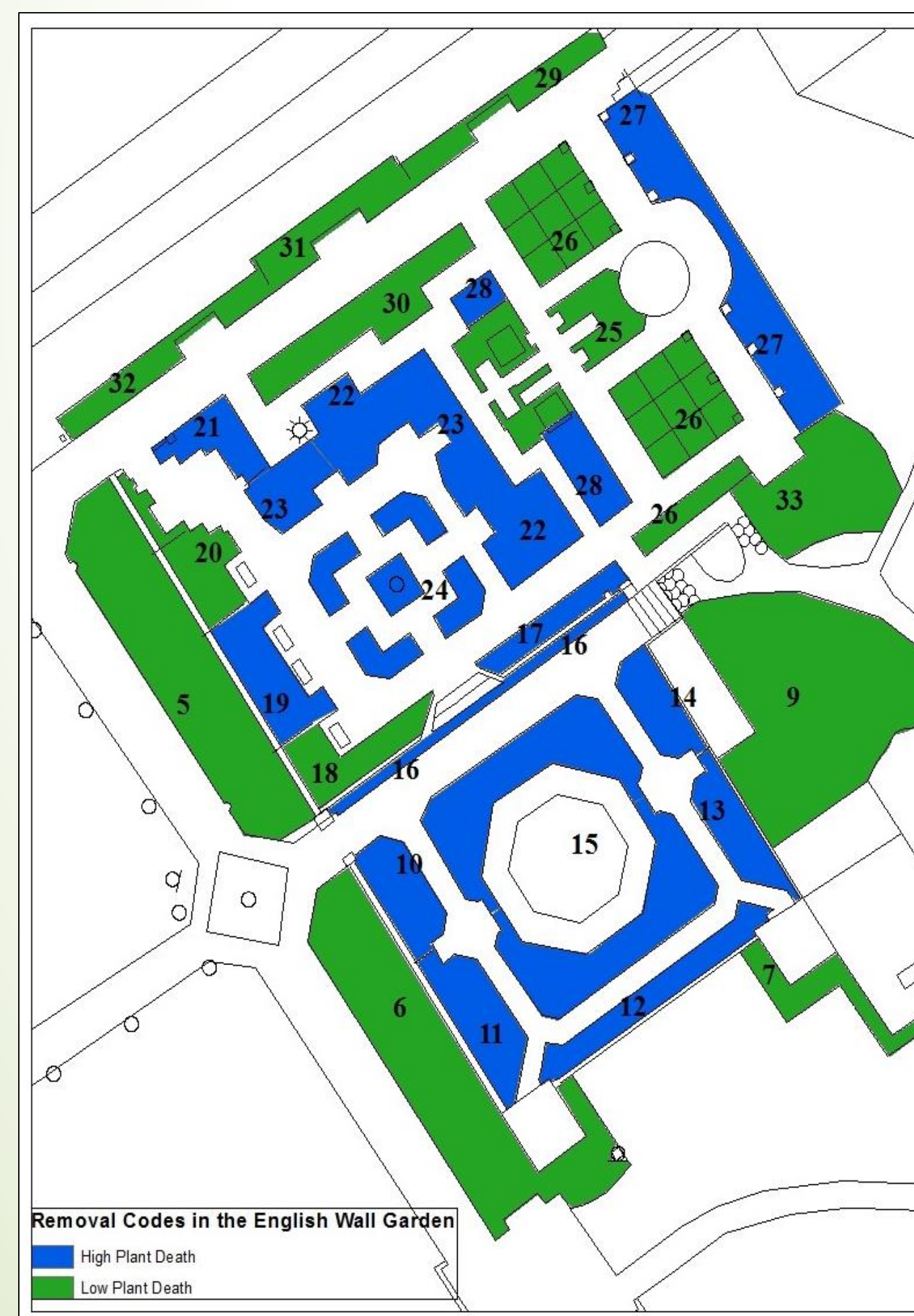


Figure 2: The green indicates low plant death (where the number of plants planted compared to the removed quantity) vs the blue indicating high plant death where a large majority of plants that have been replaced have been replaced.

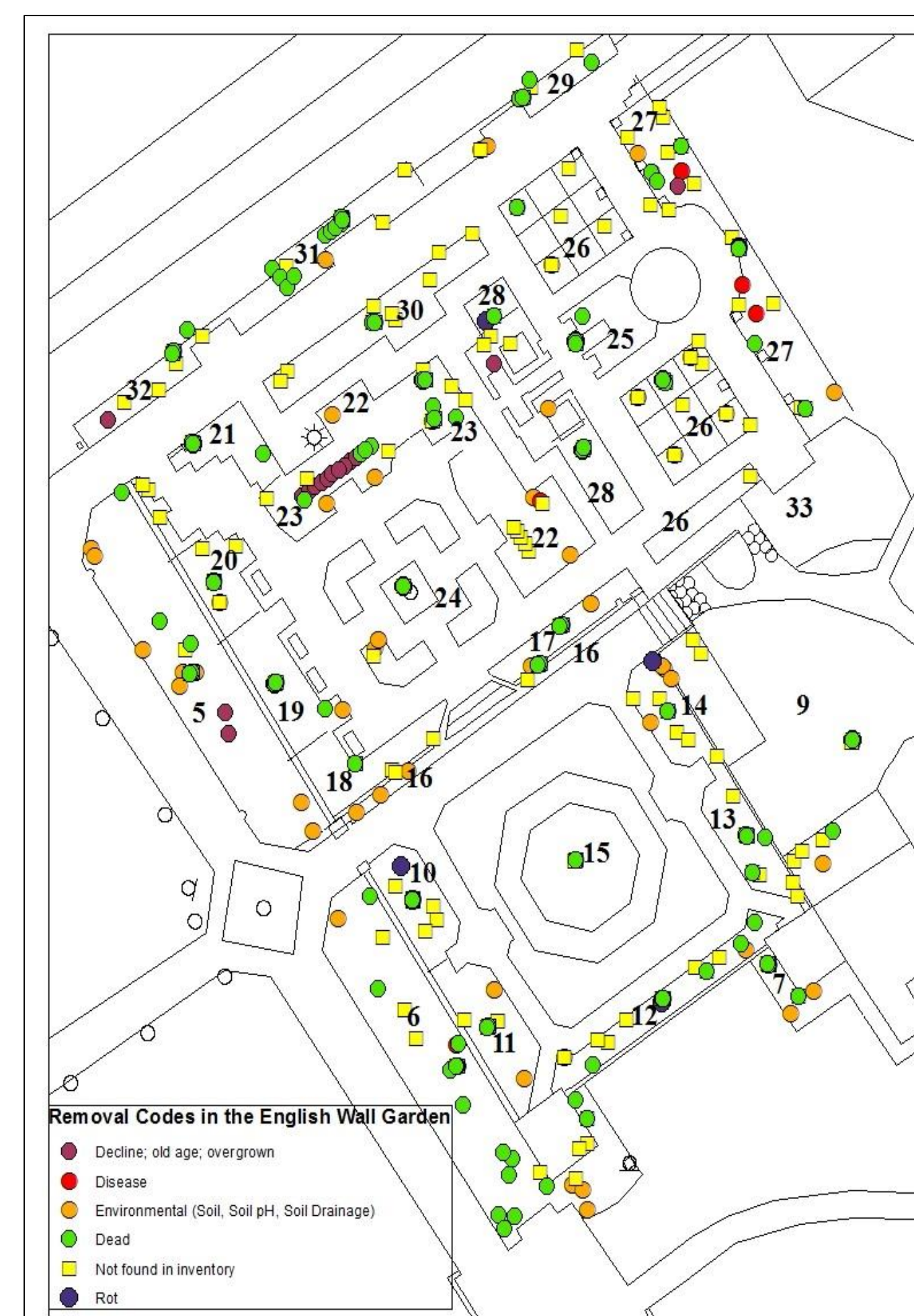


Figure 3: There has been many improvements over the past 20 years for more detailed plant records, yet there still is a large majority still listed as 'dead.' These removal codes could have an underlying issue with soil disease problem

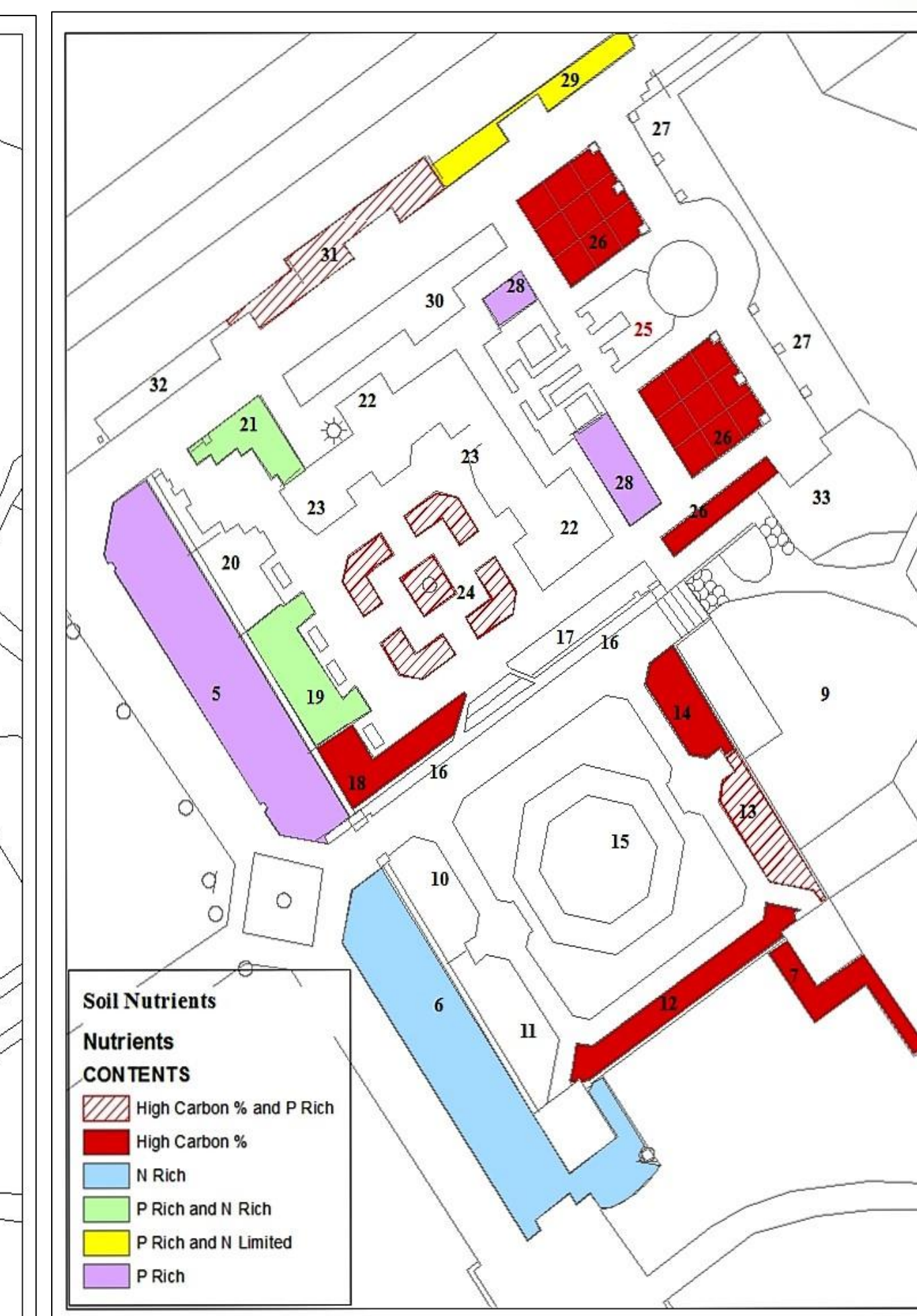


Figure 4: The bed numbers with high or limiting nutrients in the soil. P and N are good for the soil. The high carbon % is almost as much as a tropical rainforest soils level of carbon.

Discussion

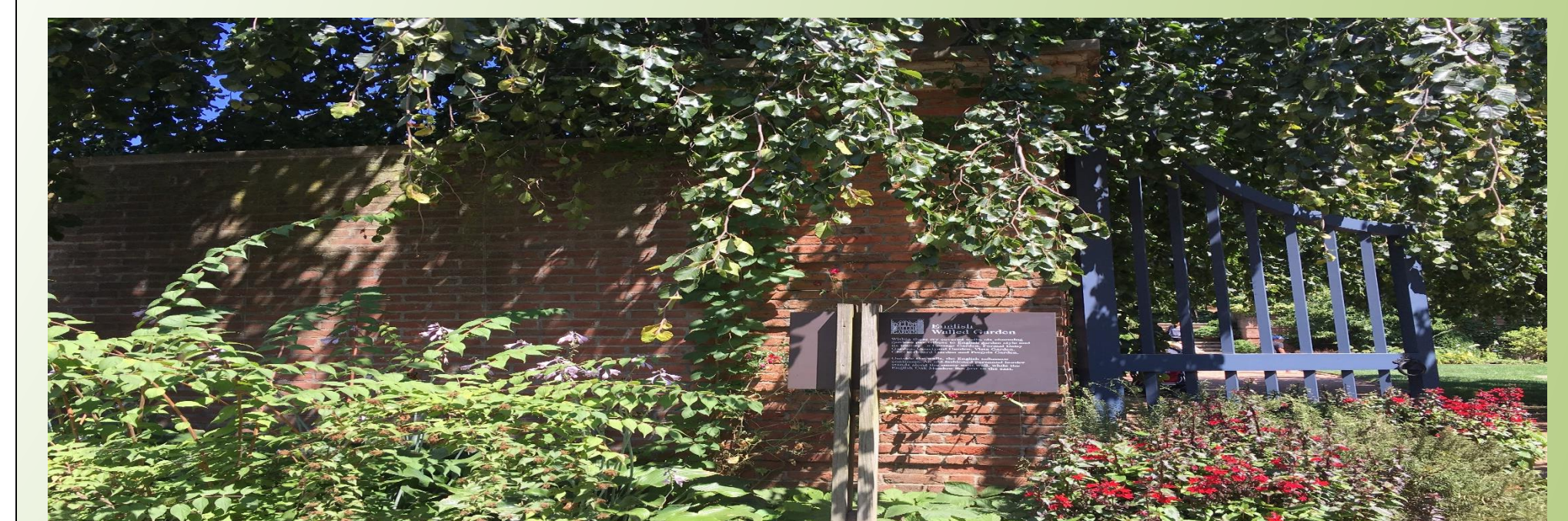
Detailed documentation of each plant death aids in recognizing and preparing preventative measures to ensure the livelihood of the botanic garden. When a plant is listed as 'dead' it actually means that either the record was not detailed or that staff did not know why the plant died. Shrubs that have a long lifespan yet are dying early is a cause for alarm: the *Taxus x media* which create a 'wall' in this garden 10 were planted in bed 22 in 1991 but all had to be replaced in 2014. Twenty three is a young age for this long living shrub. The garden spent \$1,768.15 replacing these shrubs.

Conclusion

There is an enormous variation in mortality amongst plants in the English Wall Garden; some areas have a higher amount of plant deaths from other areas. The exact causes although are unknown; however some theories for this large number of deaths include: soil problems (nutrient deficiencies or excess, pH and drainage), the relationship between the plants root system and the mycorrhizae fungi, or even more variations. The theory on mycorrhizae relationship altering could be due to the higher amount of mulch placed on the soil throughout the year. This excess amount of mulch could alter the percentage of mycorrhizae in the soil, thus increasing a risk for pathogens to enter. The application of mulch should be limited to not exceeding 1-2 inches each application.

Future Work

A entire garden wide study of plant health and location is important for the Chicago Botanic Garden; preparing preventative measures for plant disease will save the garden from purchasing and planting new plants. A study that has begun by Tom Tidden and Louise Egerton-Warburton looking soil samples from all over the garden for mycorrhizae and plant growth has just begun. This will add immensely to the overall knowledge at the Chicago Botanic Garden.



Acknowledgments

I would like to thank: Boyce Tankersly for giving me the support and a chance to learn and grow here at the garden. Veronica Harry-Jackson and Louis Egerton-Warburton for always being willing to help me with my many questions. My college first intern, Alex McDavid for always helping me with collecting my samples. Chicago Botanic Garden REU program for this wonderful opportunity and thank you NSF-REU grant DBI-1461007 for support.

References

Unpublished Records of the Chicago Botanic Garden

REU Site: *Plant Biology & Conservation Research Experiences for Undergraduates - From Genes to Ecosystems* (Supported by NSF award DBI-1461007).