

## INTRODUCTION

Hendricks Forest is best known as an urban forest with a predominantly Douglas-fir composition, however, this may shift as climate change increases the frequency and intensity of natural disturbances. More frequent drought, intensification of weather events, threat of invasive species, and increased risk of disease threaten forest health. The Team has (We) collected data on the health of large trees to help guide present and future management of the forest under the City of Eugene Parks and Open Space, with particular emphasis on public safety and species succession. It is important that local forest management plans reflect the changing needs to meet public safety and ecological preservation. The Hendricks Forest team contends that climate change will play a significant role in the future of Hendricks Park, and considerations of species succession and maintaining biodiversity will be crucial to future decisions regarding understory composition, thinning practices, invasive species removal, and overall forest health.

## METHODS

Tree monitoring protocols established by the Forest Inventory Analysis Program of the U.S. Forest Service were modified and used to analyze large-diameter and "big" trees within the forest. Large trees were defined as trees that measured 36 inches or greater in diameter at breast height (DBH) and big trees were defined as trees that measured 50 inches DBH or greater. Separate protocols were conducted for each of the two size classes. For the first protocol, we mapped and assessed all large-diameter trees within management units 21-34 and OK 1-3, shown below in Figure 2. For the second protocol, big trees in all management units, originally monitored by the 2019 Hendricks Forest Team, were revisited to determine if their condition had changed since the 2019 snowstorm.

- **Data collected for all monitored trees:** a unique tree identification number, GPS coordinates, tree species, DBH, and whether the tree was alive.
- **Data collected for all large-diameter trees:** crown measurements included crown diameter and live crown ratio (shown in Figure 1), density of the crown, percent of crown foliage dieback, dieback type, and tree vigor assessed by the health of the live foliage. Additional data collected was related to soil type, any lean in the trunk, presence of ivy, evidence of wildlife use (e.g. woodpecker cavities, bird nests), bark beetle holes, presence of fungus, and the canopy position of the crown relative to nearby trees.
- **Data collected for all big trees:** whether the tree was still standing; if not, tree length, tree age, an assessment of the roots, and tree fall type data was collected.
- **Indicators of Tree Stress:** fungus, lean, low vigor, low crown density, high crown dieback, bark beetle holes, streaming pitch.

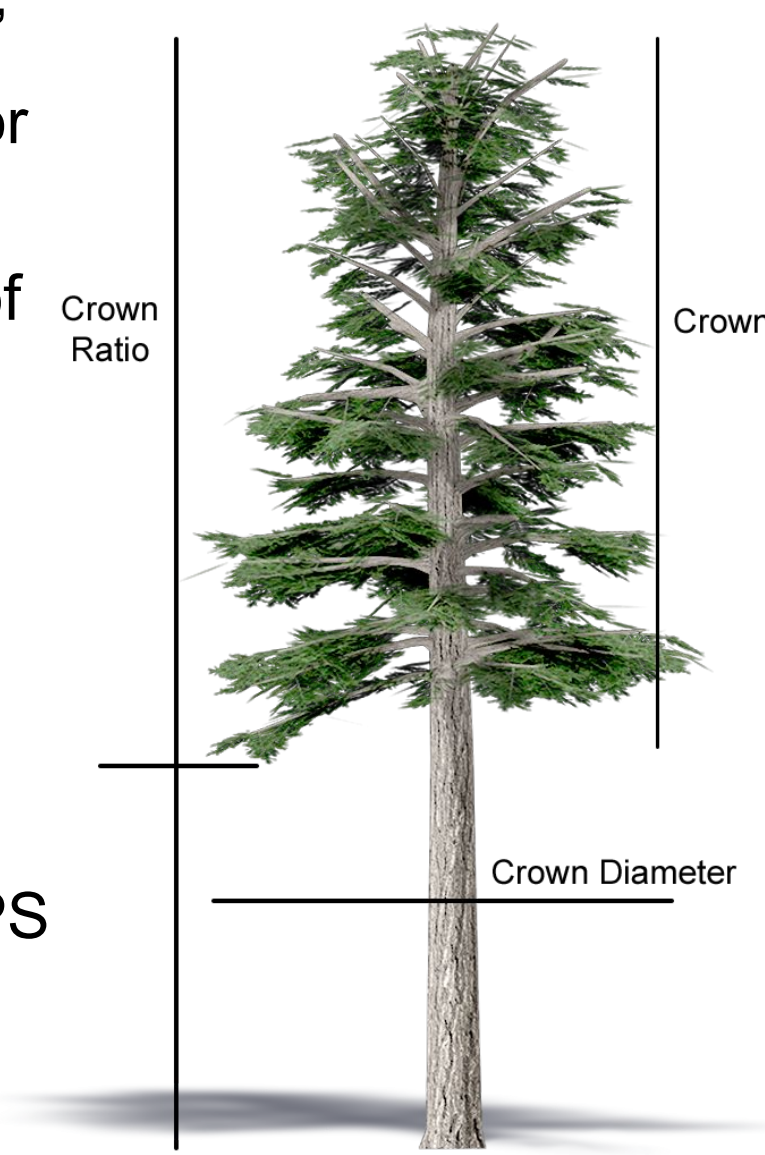


Figure 1. A depiction of a Douglas-fir tree and crown characteristics. Crown density excluded.

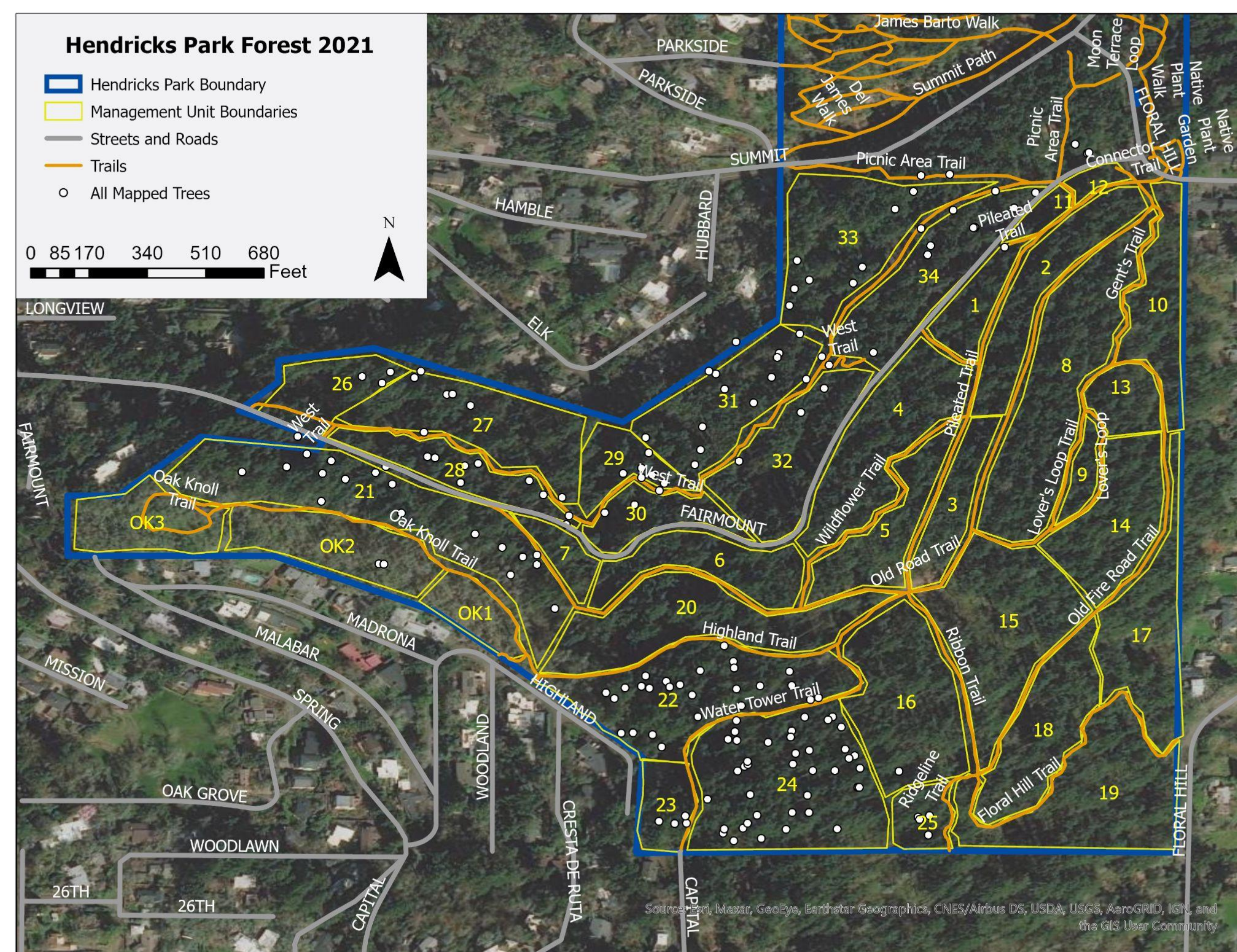


Figure 2. Map of Hendricks Park Forest, with management units (orange lines) and large trees we mapped (white circles) displayed.

## RESULTS

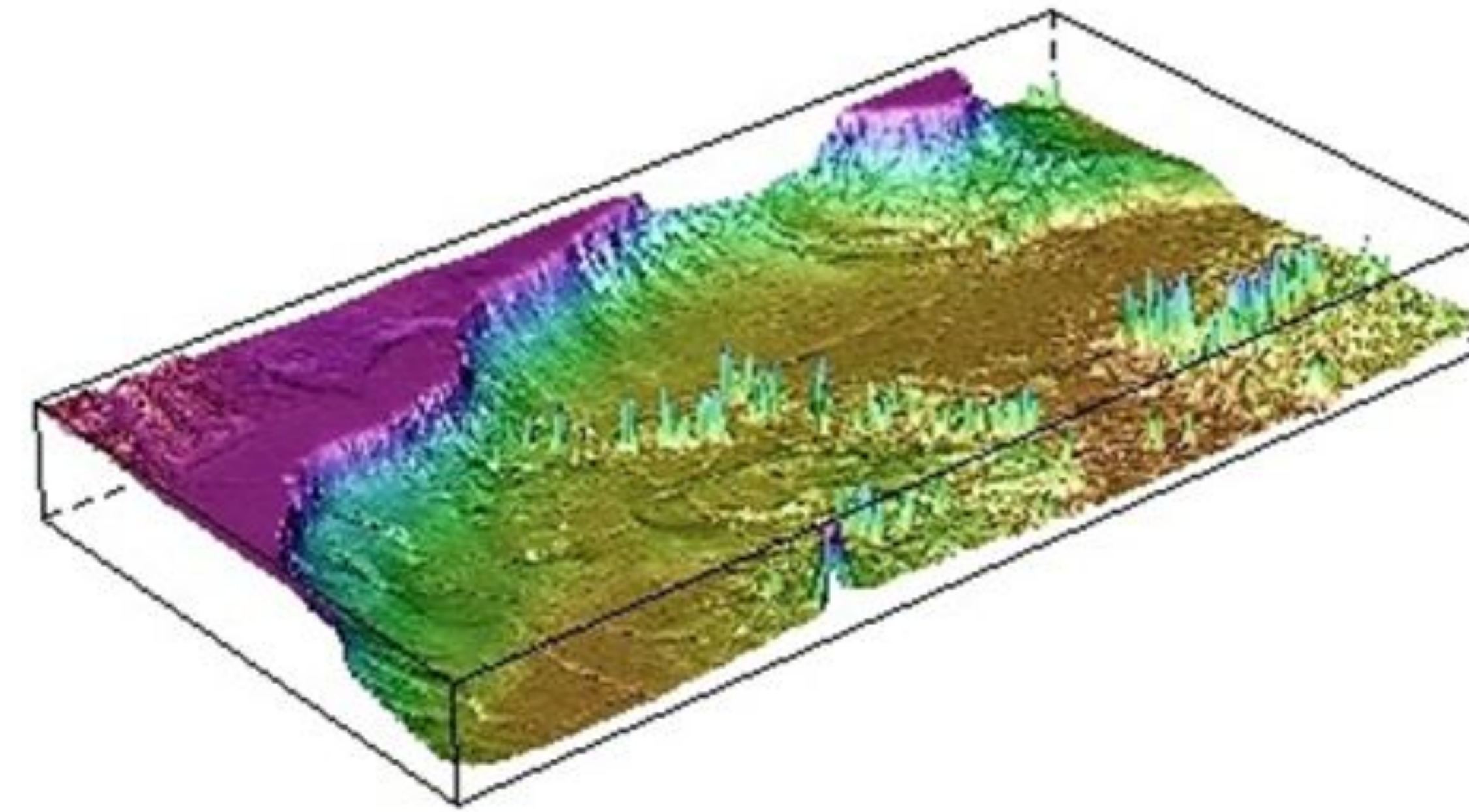


Figure 3. Above is a topographic map of the all units. The base is brownish-tan depicting the effects of warmer climate at ground level. Green, light blue and dark blue illustrate intermediate effects of climate, and purple is high elevation experiencing less effects from climate. The teal plots are the big trees recorded with northward and eastward coordinates.

Figure 3 displays the climate effects on units 21-34 and OK1-3, and shows how temperature can impact the number of big trees in the units. This is interpreted with different colors associated with ground temperature (warm) to colder temperature on higher ground due to altitude. In Figure 4, there is a relatively constant trend in live crown ratio and crown density but variable distribution of crown dieback, with a higher proportion of dieback occurring in units 22, 25-27, and 33. In Figure 5, there is a higher relative live crown ratio in units 23 and 34. In Figure 6, most large diameter trees have a DBH between 36.2 and 48.5 inches and big trees (>50" DBH) are relatively rare. No big trees were observed to have fallen. Almost all trees monitored displayed signs of high activity by Douglas-fir beetles.

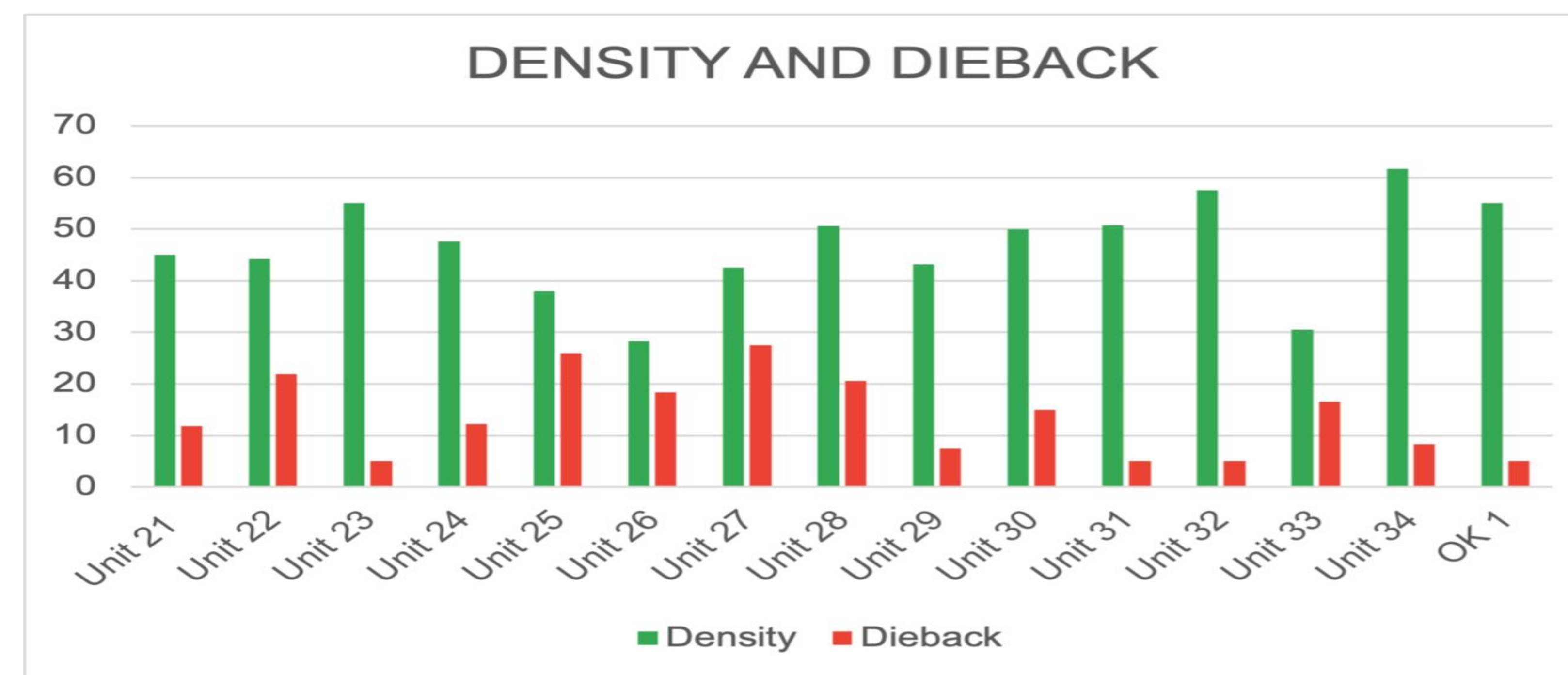


Figure 4. Graph of crown density and crown dieback. Units as a percentage (%). Two important factors that help us gage the health of a tree and a unit as well. The relationship between the two also gives insight into the state of a given unit.

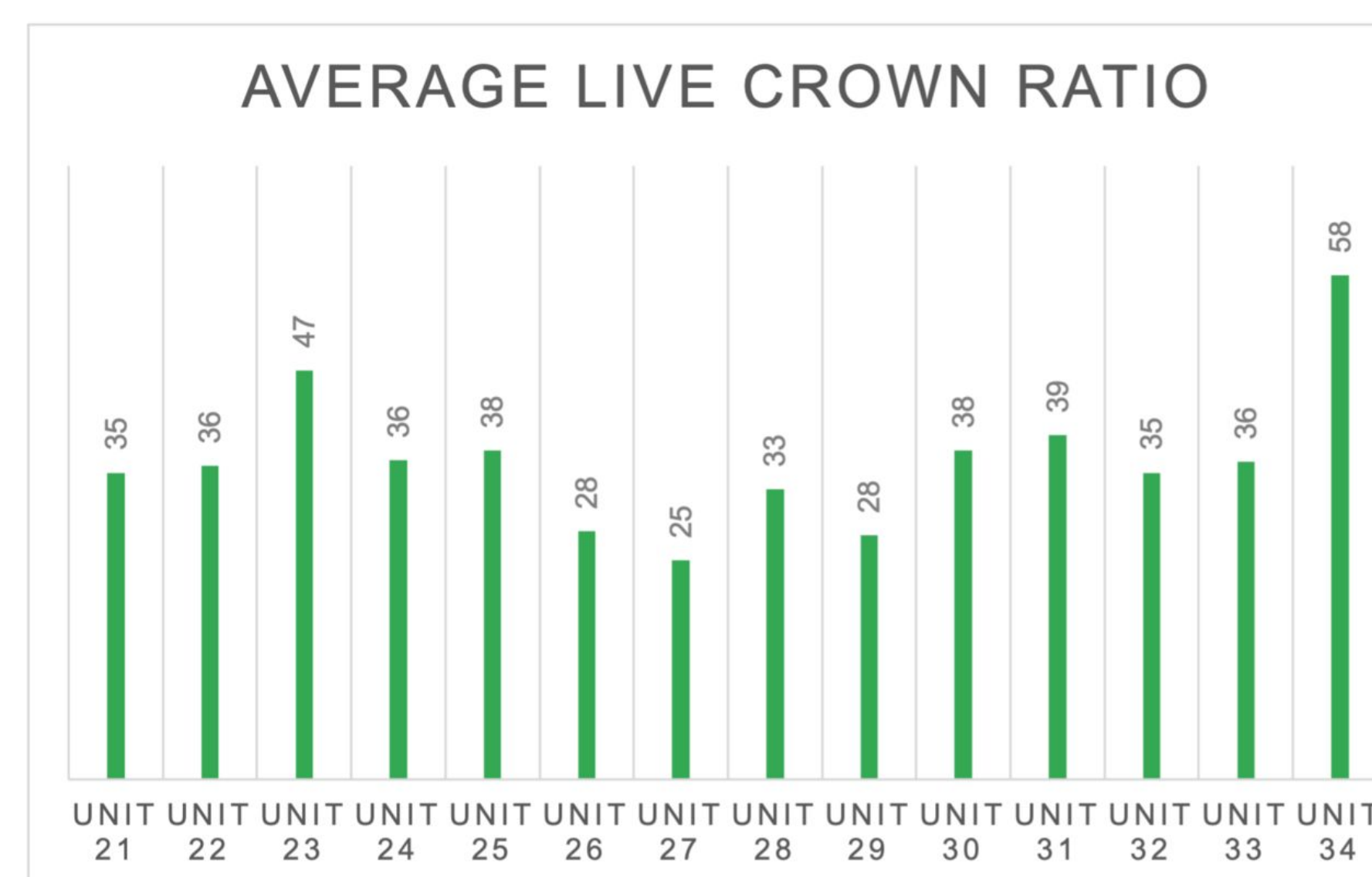


Figure 5. Graph of average live crown ratio by unit. Units in percentage (%). This helps us gauge the crown health of the forest in certain areas.

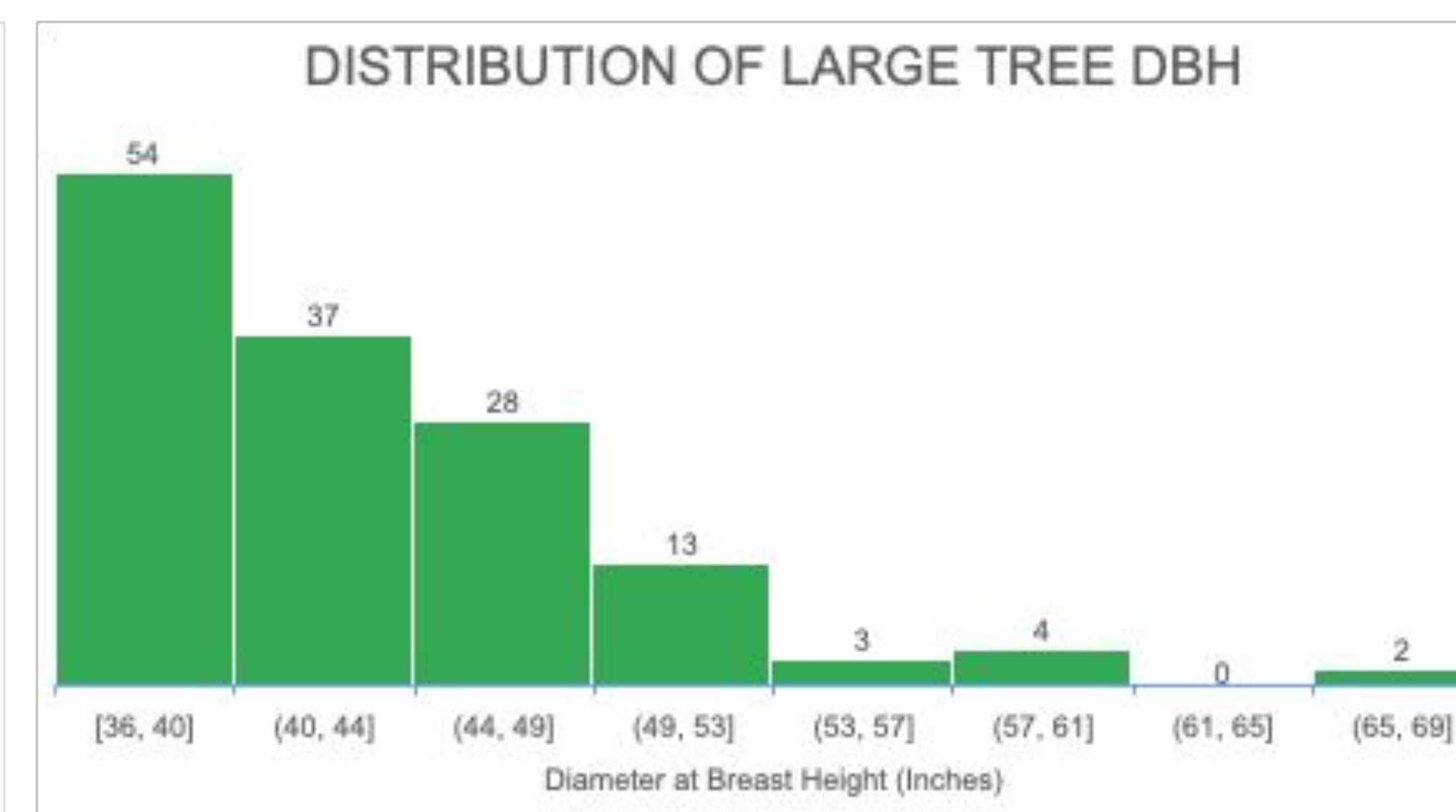


Figure 6. Graph of the distribution of tree diameter. Units in inches (in). This helps us understand how large and old the trees are in Hendricks forest.

## DISCUSSION

Hendricks Forest is expected to persist as a Douglas-fir dominant forest for the foreseeable future barring a catastrophic wildfire event, but the characteristics of the forest are likely to change due to climate change. There is expected to be an increase in the frequency of intense winter storms, summer drought, and wildfire events, and an increase in the reproductive activity of Douglas-fir beetles, all of which contribute to tree stress and threaten the health and survival of Douglas-fir trees. We therefore have several recommendations.

### Recommendations:

- Prioritize future monitoring and treatment for drought stress and Douglas-fir beetles in Units 22 and 24, as these units have many large-diameter and big trees.
- Grind/chip dead Douglas-fir trees to prevent an increase in beetle population.
- Fell non-native Sweet Cherry trees and allow them to decompose in place.
- Leave gaps in the canopy to allow for more sunlight in the understory.
- Replace dead Douglas-firs with Grand Fir, Western Hemlock, and Oregon White Oak.
- Remove invasive species, especially ivy; plant native species.
- Create a contingency plan for a catastrophic wildfire event.
- Restore Oak Savanna habitat wherever possible post-fire.

In general, we recommend that biodiversity be prioritized in management of the forest and that drought and fire resistant species be selected when conducting planting or restoration.

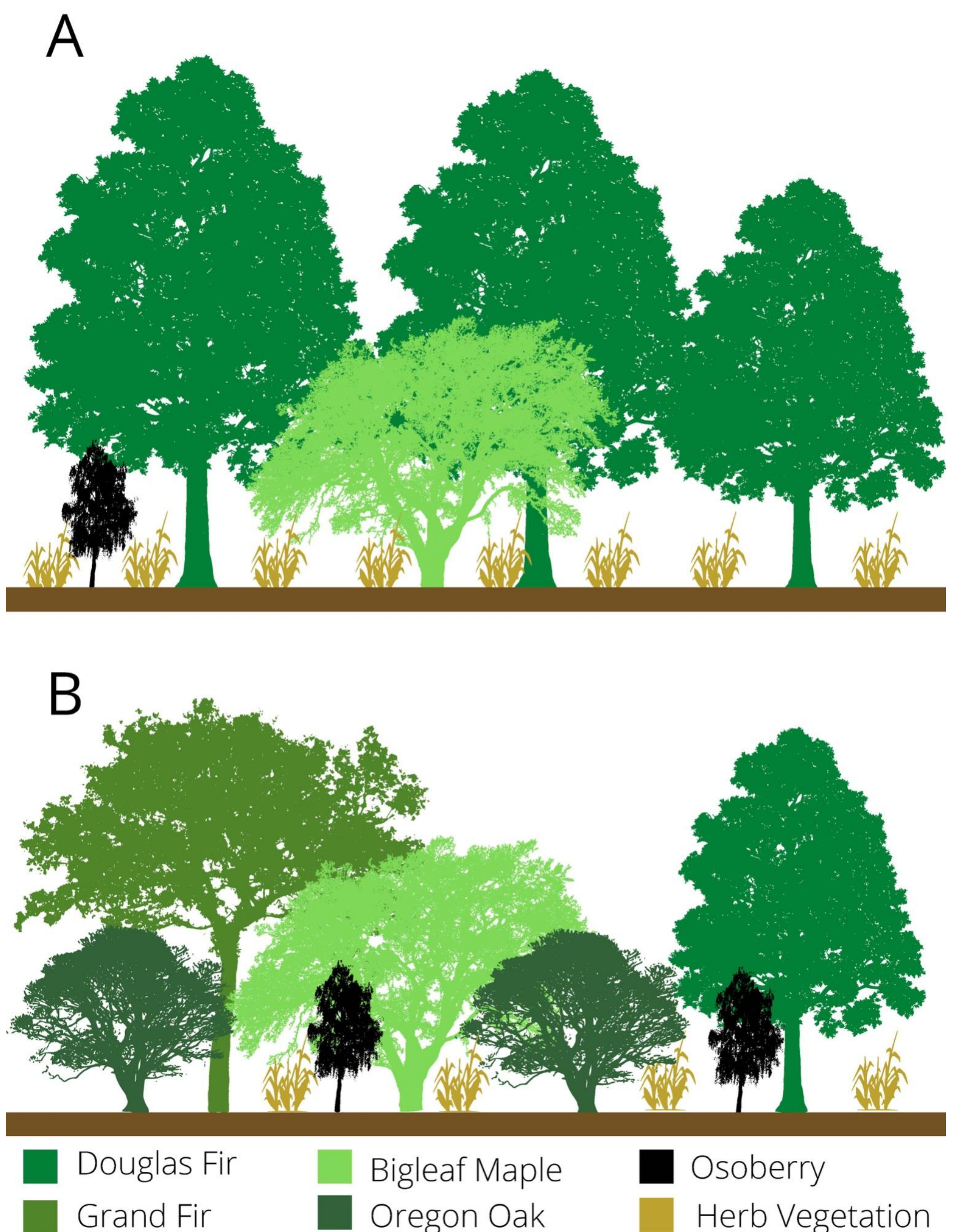


Figure 7. The upper diagram (A) depicts the current composition of Hendricks Forest, with a canopy layer dominated by Douglas Firs and little diversity in the sub-canopy and shrub layers. The lower diagram (B) is the Team's vision of Hendricks Forest in the future, with increased species richness at varying layers.

## ACKNOWLEDGEMENTS

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