Chalk Mountain Plantation and Late-Successional Reserve Variable Density Thinning

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Acknowledgments

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Executive Summary

High-density forests are the main driver for forest health degradation as well as high severity wildfires. There is a need for second-growth forests to be thinned such that the health and productivity of the forests are sustained. The project takes place in plantations on Chalk Mountain of the Shasta-Trinity National Forest. Areas surrounding the plantations have been designated as late-successional reserves in the hopes to balance natural resources for humans as well as for the wildlife that reside in them. The mission of the United States Forest Service (USFS) is to “sustain the health, diversity, and productivity of the Nation’s forests and grasslands to meet the needs of present and future generations.” (Shasta-Trinity National Forest). To do this, an inventory of the forest must be achieved first. Our task for the internship was to conduct common stand exams in order to collect data to further describe the conditions of the forest. The data collected will help to inform management of the present condition of the forested area of interest so that a proper prescription can be applied. Thinning prescriptions are intended to maintain or improve forest health in the areas where data was collected.

Project Objectives

The Shasta-Trinity National Forest is a mixed-conifer forest with ponderosa pine and Douglas-fir being the dominant tree species. The climate in this region is Mediterranean with hot and dry summers and wet and cold winters. In the face of a changing climate, the summers are expected to be longer and drier which can have negative feedbacks for such a complex area. Forest health plays a strong role with respect to water quality and quantity. Much of the forest in the western parts of the United States, including the Shasta-Trinity National Forest, have fallen victim to unsustainable logging operations starting in the mid-1800s. After timber harvest in the mid-1900s, the forest was replanted and stocked at a level much higher than what the forest could possibly sustain. As a consequence, both in plantations and outside of plantations, the western U.S. has succumbed to stand-replacing wildfires as well as large outbreaks of pests and pathogens. The years-long drought has further exacerbated the health of the forest causing pockets of mortality from the western pine beetle on the forest and an additional 110 million more dead trees throughout other parts of California. To mitigate further devastation within the region, the forest must be thinned. Lower density of trees allows for healthy and sustainable growth, resistance to wildfires and other forest disturbances, as well as indirectly influencing the quality and quantity of our most precious resource, water.

This project aims to thin in the Chalk Mountain Plantations using a relative stocking index and species composition as a reference. The species composition within the plantation is mostly ponderosa pine (*Pinus ponderosa*) and Douglas-fir (Pseudotsuga menziesii) in the overstory and black oak (*Quercus kelloggii*) in the middle. The understory is comprised of incense-cedar (*Calocedrus decurrens*), white fir (*Abies concolor*), big leaf maple (*Acer macrophyllum*), and California dogwoood (*Cornus californica*) dominating the understory. Forest inventory using common stand exams will help inform natural resource managers in developing a prescription that will help to reduce high stand densities to a more acceptable level and improve overall forest health. Portions of the Chalk Mountain Plantations will be thinned to accelerate growth rates toward a structure found in late-successional reserves. These reserves aim to provide old forest structures that are crucial for wildlife (e.g. Northern Spotted Owl and Fisher). The project goals were to quantify the current density of the stand (e.g. trees per acre, basal area) as well as to quantify regeneration of trees (e.g. seedlings and saplings).

The Chalk Mountain Plantations are adjacent to the Pit River (Figure 1). This river system houses an elaborate network of hydroelectric facilities (Figure 2) and maintains a healthy population of native aquatic organisms. The energy produced from this system goes into a grid that powers California from the Bay Area, north and parts of Oregon. The Pit River is host to many aquatic species such as the rainbow trout (*Oncorhynchus mykiss spp*.), sculpin (*Cottus spp*.), hardhead (*Mylopharadon* *conocephalus*), Sacramento sucker (*Catostomus occidentalis*), specked dace (*Rhinichthys osculus*), and Sacramento pikeminnow (*Ptychocheilus grandis*) (Weaver and Mehalick, 2008). The water quality and quantity is critical for the survival of all the aquatic species as well as for human consumption and use.

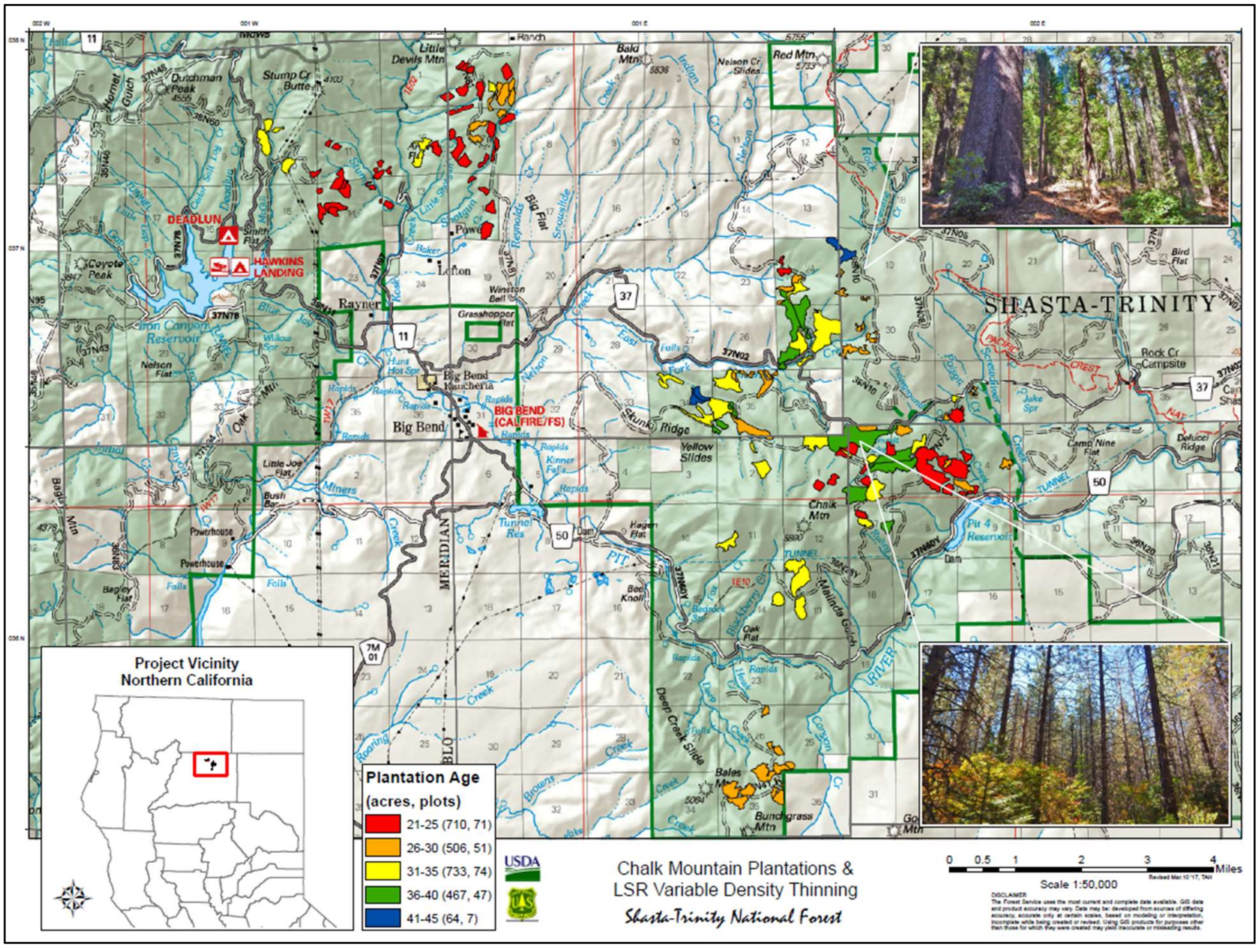

Figure 1. Chalk Mountain Plantation showing age groups. Red is age 21-25. Orange is age 26-30. Yellow is age 31-35. Green is age 36-40. Blue is age 41-45.

Figure 2. Pit River hydroelectric dam called the Pit 2.

Project objectives go beyond forest inventory within plantations. They also included other assignments that helped to understand how forest conditions affect the health of an ecosystem. For example, we participated in amphibian surveys with the USFS fisheries and wildlife biologists. This yearly survey is special because it takes place in the Trinity Alps Wilderness, home of the Cascades frog (*Rana cascadae*). The project is a collaboration between the USFS and the California Department of Fish and Wildlife (CDFW). The Trinity Alps Wilderness is a jewel that sits on the southern edge of the Cascade mountain range. It is the second largest wilderness area in California and is mainly managed by the USFS. This wilderness area is the headwaters for many rivers such as the Trinity and Salmon Rivers. It provides clean air, water and critical habitat for rare and endangered species.

As a forester within the Forest Service, it is their duty to manage forests on a large ecosystem scale, but also on a small individual tree-level scale. We had an opportunity to work alongside the Resource Advisory Committee (RAC) student summer crew to do hazard tree evaluations in campgrounds along Shasta Lake. Evaluating trees that are within campsites are crucial for the safety of the public that decides to camp in USFS managed campgrounds. We examined individual trees for decay agents like white pocket rot (*Phellinus pini*) that rot the insides of trees, root diseases like blackstain (*Leptographium wageneri*) that plug up the tree's water supply, and the differences between successful and non-successful attacks by western pine beetle.

This project allowed for conversation with natural resource professionals such as the USFS forester, fisheries biologist, wildlife biologist and the Pit River Tribe band, Madesi. Introduction with these professionals has brought much enlightenment with respect to my career path. Collaboration with the USFS, CDFW and tribal nations have shown that management of our natural resources is a collaborative effort and should be regarded with high esteem. Working with these professionals have further defined what I would like to aspire to be.

Project Approach

Common Stand Exam

To better understand the condition of the Chalk Mountain Plantations, we conducted common stand exams for forest inventory. The forested areas were arranged into compartments and stands using a “FACTS” corporate database. Each stand was identified by a unique number (e.g. 3-1, stand 3 within compartment 1) and geo-referenced using a Geographic Information System (GIS). Individual plots within each stand were also geo-referenced. There was roughly one plot for every 10 acres of plantation. The plots were systematically arranged along the landscape.

The stand exams were a nested approach. There were two methods used, 1) fixed radius plot sampling and 2) variable radius plot sampling. The seedling and sapling density were captured using the fixed radius plot sampling. The radius was 1/50th of an acre or 16.7 feet. The understory vegetation such as dominant shrub, average height and average cover was also recorded. Any tree species greater than 12 inches in height and less than 4.5 feet tall were considered seedlings and any within the plot radius were tallied. For saplings, any trees greater than or equal to 4.5 feet tall and less than or equal to 10 inches in diameter were tallied in three classes within the plot radius.

To quantify the density of the plantation trees, variable radius plot sampling was used. A 20 Basal Area Factor (BAF) was used to find “in” trees. All trees counted must be greater than 10 inches in diameter at breast height (DBH). Once the “in” trees were found, the species, DBH, total height and total height to crown base (HCB) were recorded. The diameter was obtained using a log tape to the nearest 10th of an inch. The total height and HCB were obtained using a laser range finder. Trees that were dead (i.e. snags) were also recorded along with the condition (e.g. 3= recently dead with fine needles and branches to 7= loose bark, no needles and few branches, top or mid-bole broken, wood at base is not solid).

The project was separated into eight regions: Chalk summit North, Chalk summit N. Central, Chalk summit Central, Chalk summit East, Shotgun Creek North, Shotgun Creek, Stump Creek and Bunchgrass Mountain. The regions were further separated into stands that represent the average age of the trees (e.g. red stand is age 21-25) with plots placed at random but systematically (e.g. Figure 3). After a reconnaissance of most of the regions, we found that Bunchgrass Mountain was a failed plantation and our stand exams would be pointless there. Most of the regions show stands that are very dense and we predict that the data will reflect that. Our goals for the project was to complete stand exams at each of the plots, but due to time constraints, we were unable to visit every stand. There was a total of 300 plots and 100 stands.

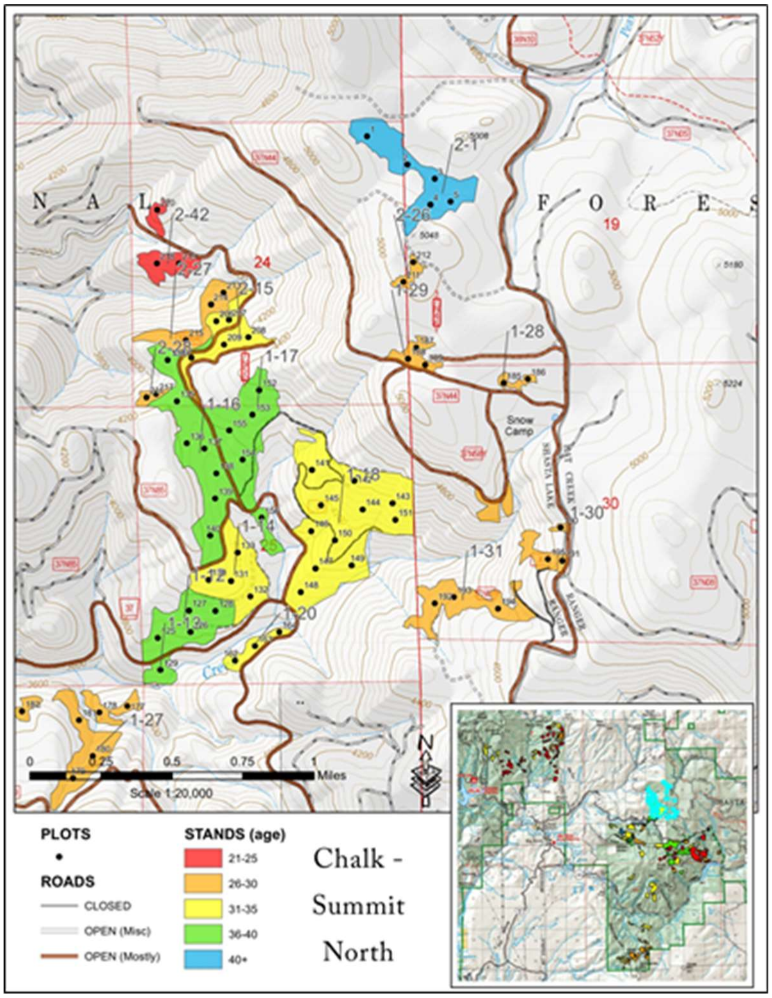

Figure 3. Map of the Chalk-Summit North Region showing stand age, the location of plots and road accessibility.

Amphibian Survey

The amphibian survey consisted of a visual encounter survey (VES) for amphibians and reptiles. We walked along the shoreline of Stoddard Lake and Doe Lake at a steady pace and recorded any encounters with frogs, toads, snakes and salamanders. Tadpoles, juvenile fish and potential eggs of the frogs and toads were also recorded. The data collected will be handed off to the fisheries biologists from the CDFW and fisheries biologist from USFS.

Campground Hazard Tree Evaluations

Shasta Lake has many recreational activities that are centered along the shoreline. The USFS actively manages each campsite at every campground to ensure the safety of its structures for the public. Structures are defined as: roads, parking space, trails, picnic benches, potential tent site, bathroom facilities and fire pits. While working alongside the RAC crew, we were able to visit five campgrounds: Dekkas Rock, Hirz Bay 1 and 2, Moore Creek and Ellery Creek (Figure 4). The evaluations were done in groups of four. Each campsite was visited and every dead, dying or defected tree was evaluated. The total height and DBH was recorded for each tree that was deemed a potential hazard. Large dead branches that had potential to obstruct structures in the campsite were also recorded. Data collected would be given to the district forester and recreation team at the Shasta-Trinity National Forest station and would not be analyzed by us.

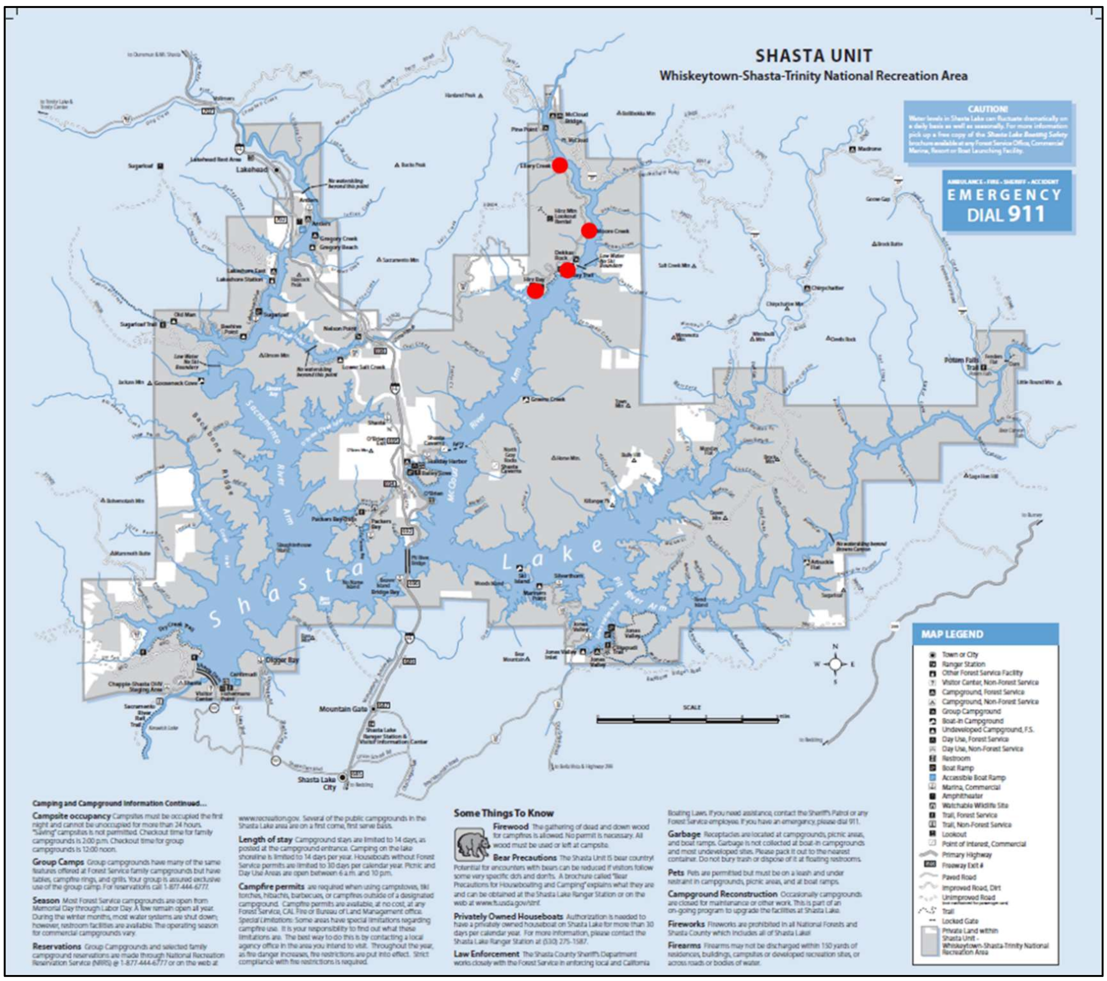

Figure 4. Map of Shasta Lake. Red dots show location of the campgrounds visited for hazard tree evaluations. Source: Forest Service - USDA

Project Outcomes

Stand Exam Results

A total of 38 stands and 108 plots were examined. Each plot was visited according to its accessibility. Access to some plots were not possible due to road damage from the prior winter. Some plots had no data collected due to it being a failed plantation or near an illegal marijuana growing operation(s). Getting to each plot required knowledge in using a compass as well as reading a map. A geographic positioning system (GPS) was also used to get to each plot. These plots were randomly placed within the forest. There were no trails that led to each plot, we essentially "blazed" our own trail to get to each remote location. Trees were not the only species that resided in the forest. Bears, deer, mountain lion, wild turkeys, and cows were present. We found many evidence of the presence of bears by coming across their scat. Scat that was very fresh. Nevertheless, we were able to collect data for a substantial amount of acreage.

Stand 1-17 was analyzed to show the condition of the Chalk Summit North region (Figure 3). There was a total of five plots within stand 1-17. To quantify the density of the stand with respect to tree species, a Trees Per Acre equation was used (eqn. 1) as well as a Stand Density Index (SDI) (eqn. 2).

$$Trees\ per\ acre = \frac{BAF}{(0.005454 * DBH^2)} \qquad Equation\ 1$$

$$SDI = ave.TPA * (\frac{QMD}{10})^{1.77} \qquad Equation\ 2$$

Where QMD is the quadratic mean diameter.

The management objective for ponderosa pine is to have a relative density value between 35-65% of "limiting SDI". The ideal SDI would be approximately 130. Our data show that the TPA for a stand that is generally within the age of 36-40 was 187 TPA with ponderosa pine being a bulk of it at 169 TPA (Figure 6). The SDI for the stand was 401. As predicted, our data show that the stand is dense and a thinning should be done to bring the TPA down to a level that will reduce risk of mortality.

Throughout the internship, we talked a lot about forest succession and biodiversity. About 40 years ago, high value and easily accessible patches were logged. In response, many trees were planted but a lot of what we saw out there was natural regeneration (i.e. stem re-initiation) from shade-tolerant conifers. The density of the vegetation poses a risk for the wildland-urban interface and for resilience to disturbances. There was a natural threshold that the forest maintained prior to European colonization and successful fire suppression efforts. Once the threshold is reached with respect to density, a common response is tree mortality. Mortality can come from pests, pathogens, drought and severe wildfires. However, fires are a natural disturbance that the vegetation has adapted to. Specifically, the ponderosa pine mixed-conifer forests are adapted to a low or moderate-severity fire regime (Odion et al. 2014). The high density of trees within the study area poses a threat because the fire would be more severe rather than moderate. To mitigate the uncharacteristic severe fire, fuels reduction is needed.

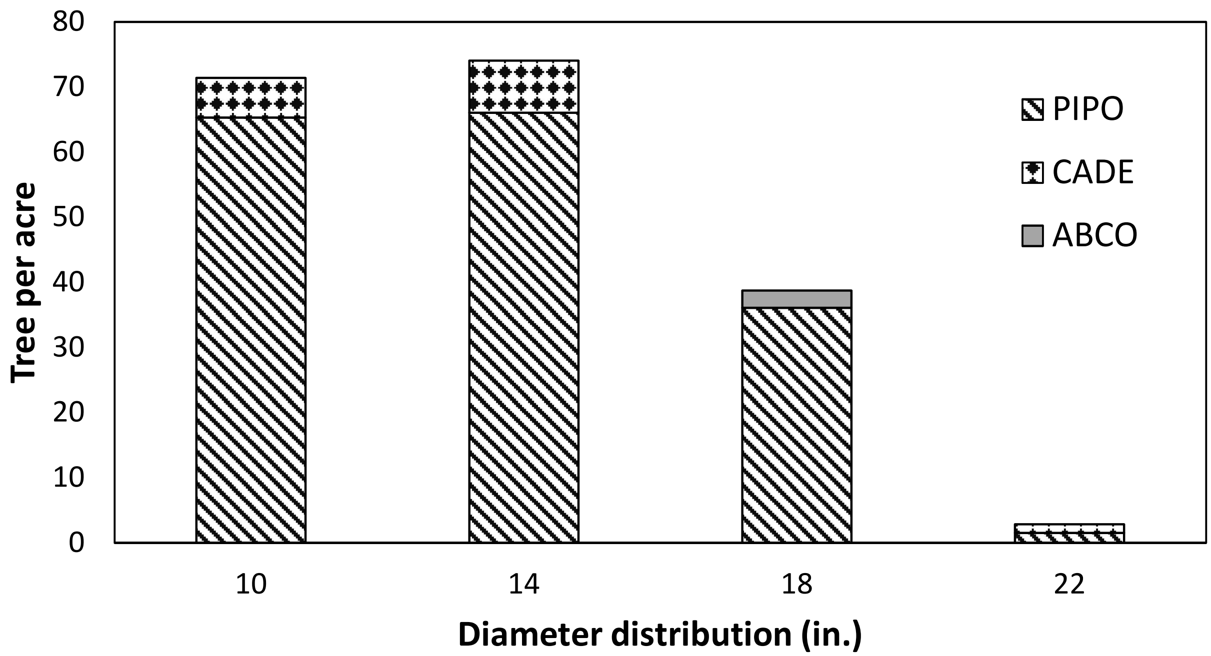

Figure 5. Diameter distribution of stand 1-17.

Conclusions

The Chalk Mountain Plantations have high vegetation densities and must be addressed with the appropriate prescription in order to mitigate the negative feedbacks that occur when forests reach the threshold of tree mortality. Conversations with the Madesi Band of the Pit River Tribe during our internship show that a collaborative effort to deal with this forest type is on its way. Fire is a key element in ecosystem interactions that may aid in the prevention of high-severity fires and recovery of the region. During our internship, we were able to witness pockets of mortality from western pine beetles. The years-long drought has exacerbated the declining health of the forest and the pockets of mortality may spread. The project aimed to describe the current conditions of the area and to describe the potential for economically viable thinning operations (i.e. commercial thinning). We found that there is potential for a commercial thin in some stands that may provide for revenue. However, that is not the main objective for the USFS. The USFS seeks to "...sustain the health, diversity, and productivity of the Nation's forests."

A commercial thin does not only have a monetary value but an ecological one as well. With fewer trees per acre, the residual trees will have more resources such as water, nutrients, and sunlight to grow bigger and faster. Once the forest is thinned to a level that is favorable for fire, the use of fire as a management tool can be used again. Native Americans such as the Madesi Tribe have used fire as a management tool before colonization. However, logging and fire suppression have made using fire as a tool quite complex. That is why it is important to thin the forest by reducing fuels thereby allowing fire back onto the landscape.

This experiential learning internship provided substantial hands-on experience in forest management such as inventory techniques, sampling design, implementation of field work, and collaboration with other agencies and tribal nations. My time in the Shasta-Trinity National Forest has furthered my career opportunities by providing skills necessary for a career in forestry. I look forward to continuing my career path with the USFS or other governmental agency.

Literature Cited

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Appendix

Figure 6. Measuring diameter at breast height of an old-growth Douglas-fir. Cassandra Casares (Left) and Suzan Homsombath (Right).

Figure 7. Using a laser range finder to estimate the total height of a tree. Cassandra Casares with our mentor, Todd Hamilton.

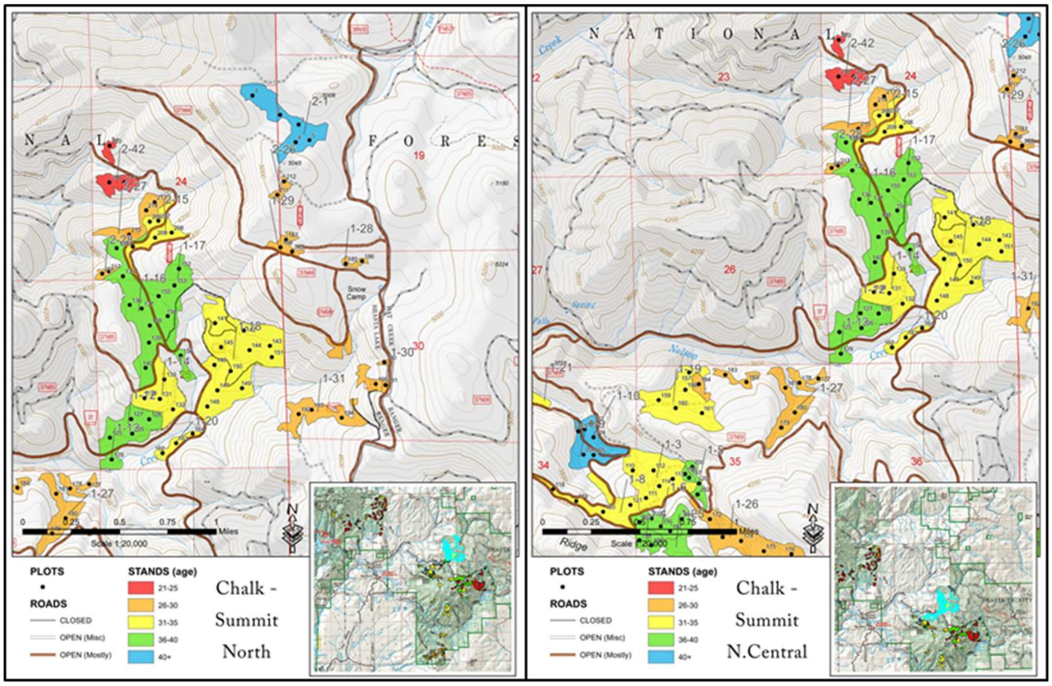

Figure 8. Map of region Chalk-Summit North and N. Central.

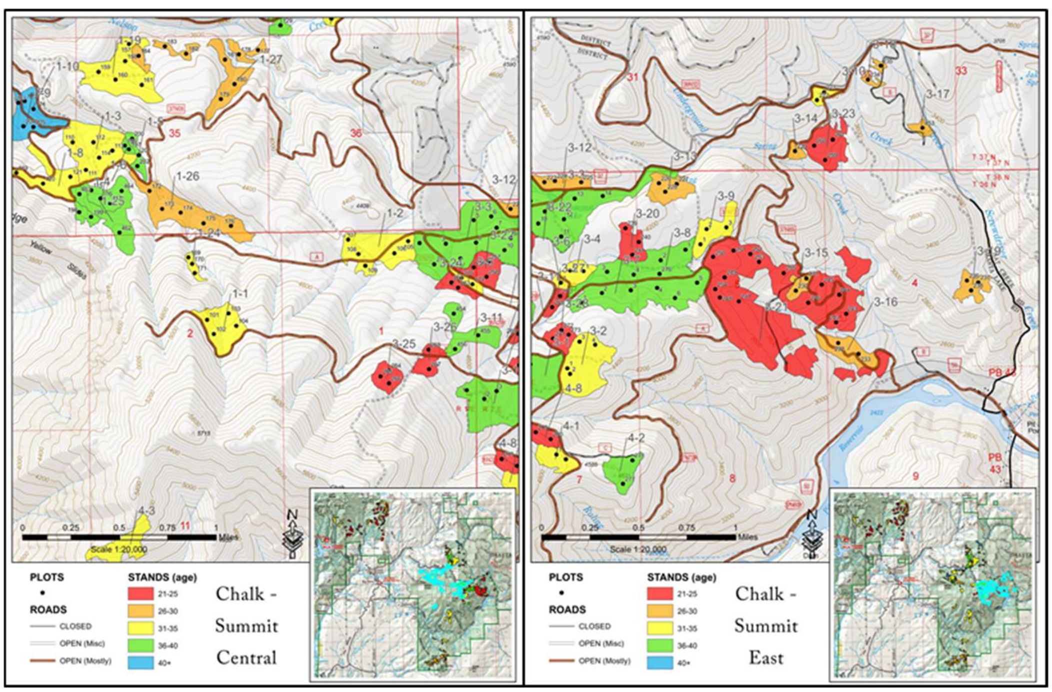

Figure 8. Map of region Chalk-Summit Central and Chalk-Summit East.

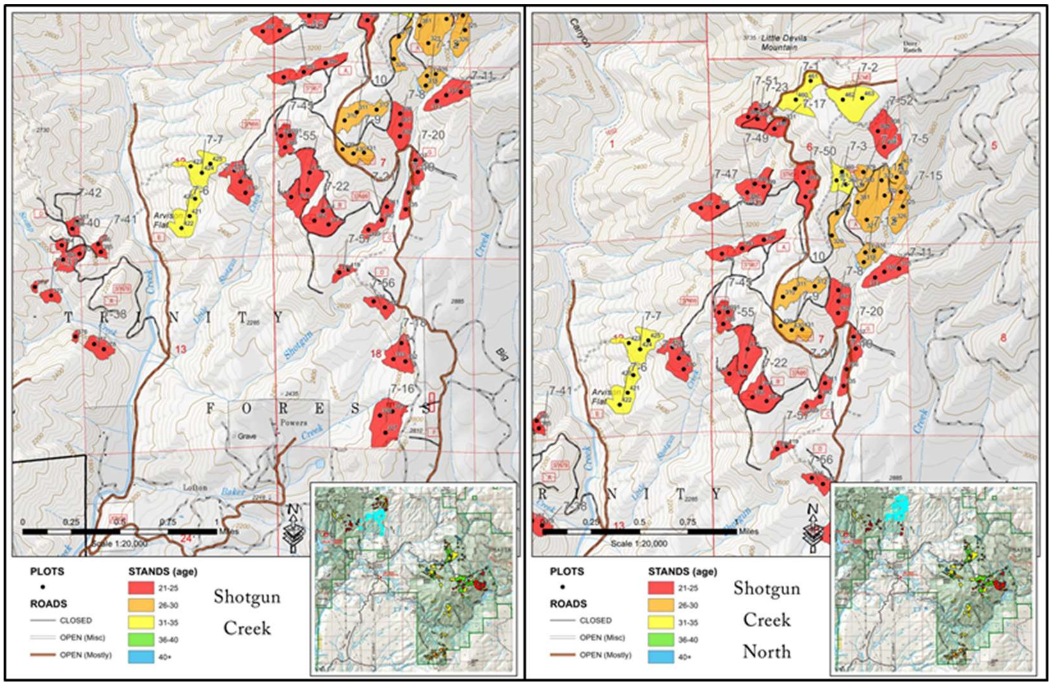

Figure 9. Map of region Shotgun Creek and Shotgun Creek North.

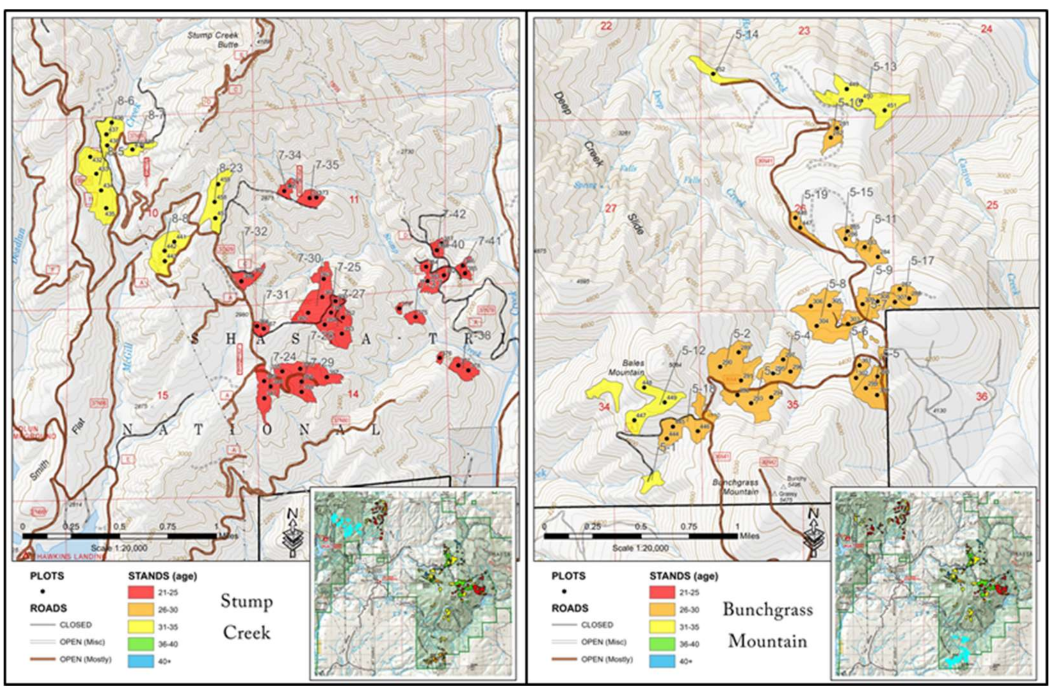

Figure 10. Map of region Stump Creek and Bunchgrass Mountain.