APPENDIX A

NASA DEVELOP TECHNICAL REPORT

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Santa Monica Mountains Ecological Forecasting II

Utilizing NASA Earth Observations to Determine Drought Dieback and Insect-related Damage in the Santa Monica Mountains, California

DEVELOP Technical Report
Final Draft – November 17, 2017

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1. Abstract
The Santa Monica Mountains (SMM) lie between the city of Los Angeles and the San Fernando Valley, California, enduring as a steadfast haven for native vegetation, wildlife, and recreational activities. Both public and private conservation agencies have secured protection for much of the mountain range, however the severe California drought from 2011-2017 had a major impact on vegetation, including 11,000 acres of oak woodlands. The fall Santa Monica Mountains Ecological Forecasting II project explored how and why vegetation has changed from 2013-2017, a continuation study from the spring term that further investigated the effect of climate, harmful beetles, and varying topography on dieback. The heavy rains of the 2016-2017 winter allowed our team to investigate initial response to post-drought conditions. The team used ER-2 Airborne Visible Infrared Imaging Spectrometer (AVIRIS) imagery, climate data, digital elevation models, and *in situ* beetle and oak data to analyze the extent of vegetation loss over the course of the drought, including which areas will be most vulnerable to drought in the future. The results from these analyses will help the Resource Conservation District of the Santa Monica Mountains determine how to focus efforts towards regaining oak woodland vigor.

Keywords
Remote sensing, AVIRIS, oak woodland, drought, Santa Monica Mountains, SRTM

2. Introduction

2.1 Background Information
Along a south-facing stretch of the California coast lie the Santa Monica Mountains, home to a beautiful and unique Mediterranean ecosystem featuring the indigenous coast live oak, *Quercus agrifolia*. Accessible and inviting, the mountains allow residents in Los Angeles and the other surrounding urban areas to experience and benefit from the ecosystem services of this habitat, which enhance both physical and mental wellbeing. The area is ecologically complex, hosts hundreds of vertebrate species, and contains many of the important California plant assemblages that contribute to the state's designation as a global Biodiversity Hotspot (Tiszler & Rundel, 2007, Myers et al., 1999).Oak woodlands in particular have been recognized as providing considerable benefits to their home environment, including carbon sequestration, slope stability, flood control, temperature moderation, and aesthetic value. In 1982, Los Angeles County was among the first in the state to take action towards protecting the oaks, with the Oak Tree Ordinance that declared oak trees as "significant and valuable historical, aesthetic, and ecological resources" (Dagit et al., 2014). In 2001, recognition of the importance of these trees and their increasing vulnerability to human removal resulted in the Oak Woodlands Conservation Act, which identified oak woodlands as a significant resource throughout the state.

Figure 1. Oak canopy at Trippet Ranch in Topanga State Park in the SMM (September 2017). If the oaks were healthy, the sky would not be visible through their canopy. Image credit: Ariana Nickmeyer.

These hardy trees are adapted for surviving years of decreased rainfall and periodic drought stress, but the recent drought from 2011-2017 was unusual in its severity and duration, and took a heavy toll on the oak woodlands. Years of low rainfall and extended drought are not uncommon in this area, but the increased severity of these fluctuations due to an increasingly variable climate have taken a toll on the vegetation (Tiszler & Rundel, 2007). In addition to inflicting physical stress on the trees, the drought may have left the trees more susceptible to damage from harmful beetles, such as the invasive Polyphagous Shot Hole Borer (*Euwallacea sp.*) and the native Western oak bark beetle (*Pseudopityopthorus pubipennis*) (Eskalen et al., 2013, Staggs, 2014). Drought dieback in the Santa Monica Mountains National Recreation Area (SMMNRA) has thus been widespread and unrelenting, heightening concern about the future of the oak woodlands and calling different perspectives into action to decide the best approach for preserving them.

This project builds upon the work of the spring 2017 team, which used AVIRIS data to map plant mortality in an effort to understand dieback patterns. The project's study region encompasses the Santa Monica Mountains and the Simi Hills, which lie in the northern part of the study boundary and contain oak woodlands (Figure 2). The time period of the study is from 2013-2017, which covers only a part of the drought due to data availability. This term will allow the team to continue the analysis with the addition of data from 2017, which saw heavy winter rains and ended the drought. Over this time interval, climatic variables such as temperature and precipitation were obtained for every month of the year, while aerial imagery of the vegetation itself was obtained for only May or June of each year.

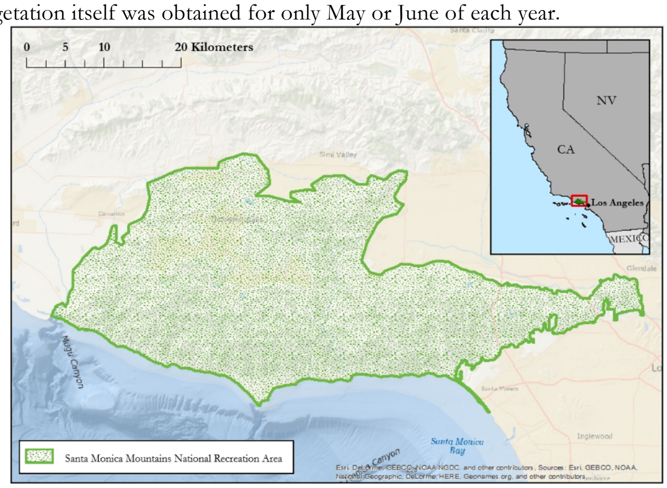

Figure 2. Project study area

Project Partners & Objectives

This project's partners are the Resource Conservation District of the Santa Monica Mountains (RCDSMM); the National Parks Service, Santa Monica Mountains National Recreation Area; California Department of Parks and Recreation, Los Angeles District; California Department of Forestry and Fire Protection (CAL FIRE); County of Los Angeles Fire Department, Prevention Services Bureau, Forestry Division; and the University of California, UC Cooperative Extension.

Our primary partner, the RCDSMM, is dedicated to environmental stewardship and conservation. Through research, habitat restoration and conservation planning, the RCDSMM works to preserve native habitats and prevent the spread of invasive species. Currently, the RCDSMM is collecting data about the impacts that drought and pest infestation are having on oak woodlands using survey plots and citizen science programs.

While these methods allow for an in-depth understanding of oak conditions from the ground, the survey plots cover a relatively small area of the Santa Monica Mountains. The development of a large scale overview of oak woodland conditions will aid land managers in identifying high-risk areas of infestation, tree mortality, or increased wildfire risk. This will ultimately assist land managers in prioritizing areas of concern to focus scarce resources for monitoring oak health, and allow for better outreach and targeted education.

The objectives of this project were to determine how much green vegetation has been lost in the SMMNRA over the span of the drought, to analyze the role of physical constraints and harmful beetles on dieback, and to determine areas that are especially likely to suffer from future drought. This final objective is intrinsically linked to the results of the first two, and places the project within the NASA national application area of Ecological Forecasting as the future state of the oak woodlands is investigated.

3. Methodology

3.1 Data Acquisition

In order to study land cover, the team downloaded AVIRIS L2-surface reflectance data products from the AVIRIS data portal. The team downloaded all flightlines that covered the study area in May of 2013, a time that was chosen to maintain consistency with work done in the first term of this project. Surface reflectance data was necessary in order to perform species mapping using spectral reflectance. To relate species to plant mortality, AVIRIS-derived Relative Fraction of Alive cover (RFAL) data were obtained from the spring 2017 Santa Monica Mountains Ecological Forecasting I team. The team also downloaded National Agriculture Imagery Program (NAIP) orthoimagery in order to visually confirm land cover types

The team decided on a set of climate variables to download based on data options, advice and interest from project partners, and inspiration from a similar study of drought-induced die-off in pine trees (Clifford et al, 2013). Ultimately, the team downloaded daily values of precipitation, minimum temperature, maximum temperature, and minimum vapor pressure deficit (VPD) from Parameter elevation Regression on Independent Slopes Model (PRISM) climate group's data portal. These data were acquired for 2012-2017 to accommodate the study period and the early start of the water year.

To account for topography, the team downloaded a digital elevation model (DEM) from Shuttle Radar Topography Mission (SRTM) from USGS EarthExplorer.

The team acquired high resolution LiDAR data of the SMM from the Los Angeles Region Imagery Consortium (LAIAC), Internal Services Department. These data consist of 1,211 LAS datasets in their native format acquired on January 2016. Each LAS file contains binned cells of 1 m X 1 m resolution point cloud. The dataset excludes a western portion of the SMM in Ventura County, yet includes all of the SMMNRA. The products created from LiDAR in order to derive a suitable Fire Danger Map include a Digital Elevation Model (DEM), Digital Surface Model (DSM), Canopy Height Model (CHM) and canopy density. Our aim was to investigate the use of LiDAR in this project, and to determine if fire danger maps could be derived.

Finally, the team received several datasets from project partners that helped with species mapping and testing thresholds of plant mortality. The RCDSMM provided the team with oak health plot data and harmful beetle trap data. The National Park Service (NPS) shared a detailed vegetation map, fire history polygons, and the delineation of the study area and distinct ecological zones within the area.

3.2 Data Processing

Slope and aspect maps were derived from the DEM using the straightforward slope and aspect tools in ArcMap. In order to understand broader aspect trends that were difficult to see at 30m resolution on a landscape scale, a Triangular Irregular Network (TIN) was created. The TIN shows surface morphology, and captures features like ridgelines and streams. The team used the TIN, which is in vector data format, to create separate files for each aspect.

PRISM preprocessing
To generate annual rasters for the climate variables, the team completed several stages of preprocessing on PRISM data. For all variables, each raster was clipped to the study area extent and projected to UTM zone 11N - WGS 84 to match the projection of AVIRIS data. To generate annual precipitation rasters, the daily precipitation rasters were organized by water year, which runs from October 1st of one year to September 30th of the following year (U.S. Geological Survey, 2016). To calculate annual cumulative precipitation, the rasters were added together for each water year to find the cumulative precipitation value for each pixel. To calculate the number of days of precipitation, a threshold for the precipitation amount that would count as a precipitation day was set at 0.1 inch or greater, based on NOAA data (National Oceanic and Atmospheric Administration, 2017). Each daily precipitation raster was reclassified so that every pixel with precipitation ≥ 0.1 inch became 1 and all else became 0. The reclassified daily precipitation rasters were added together, resulting in one raster per water year containing the number of precipitation days per pixel. To generate annual temperature rasters, the daily minimum and daily maximum temperature data were organized by year. To calculate annual minimum temperature, the daily minimum temperature rasters were added together and averaged. To calculate days of extreme heat, defined as 95°F or above (Lin, 2016), the daily maximum temperature rasters were reclassified in a similar way to the precipitation days. Pixels ≥ 95°F became 1 and all else became 0. These rasters were added together, which created a map of extreme heats days by pixel. Finally to generate annual VPD, the daily minimum VPD rasters were organized by year, added together, and averaged.

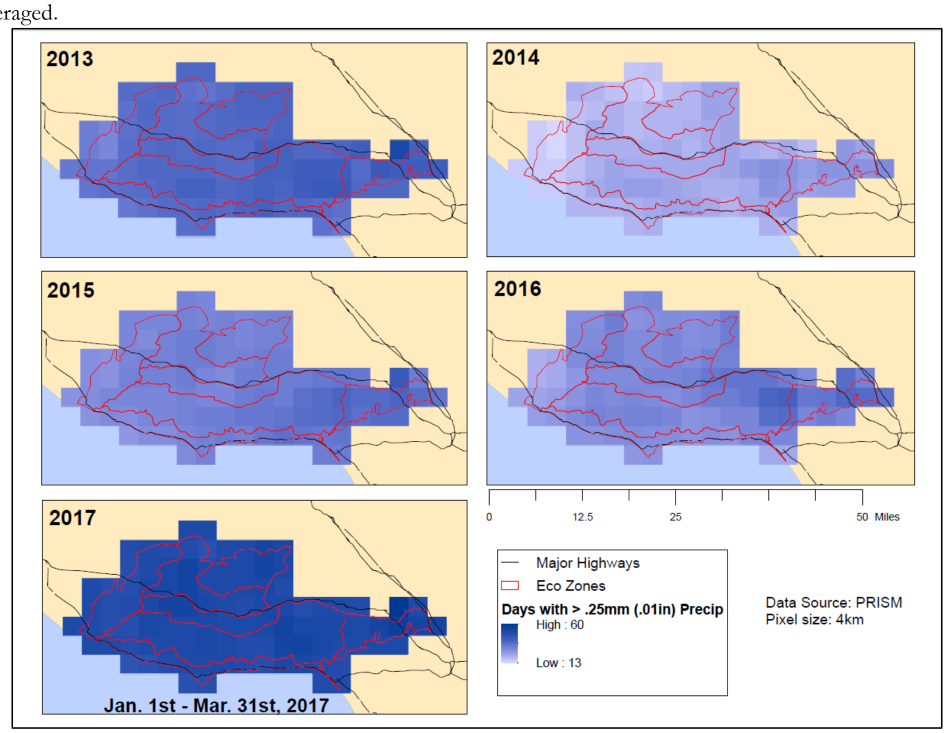

Figure 3. Sum of the number of precipitation days occurring in each PRISM pixel over the course of one water year (Oct 1st – Sep 30th).

Species Mapping
The team used the AVIRIS data and Viper Tools, an ENVI package created by the Viper Lab at University of California, Santa Barbara (Roberts et al., 2017), to create a species map of the study area. Viper tools streamlines the process of Multiple Endmember Spectral Mixing Analysis (MESMA), a method of spectral unmixing that uses endmembers, or pure representations of a spectral class, to classify an image. MESMA has been used successfully to map vegetation species with high accuracy (Roberts et al., 1998). The first step was creating a spectral library, which would serve as training data for the classification of the AVIRIS image.

To create a spectral library, the team consulted with project partners to determine what vegetation classes to target. The team ultimately chose to target the following species: annual grass, *Ceanothus megacarpus*, *Ceanothus spinosus*, chaparral--common species (*Adenostoma fasciculatum, Cercocarpus betuloides, Quercus berberidifolia*), coastal sage scrub--drought deciduous (*Artemisia spp., Eriogonum fasciculatum, Salvia spp.*), coastal sage scrub--summer active (*Eriogonum cinereum*), *Malosma laurina*, Coast live oak woodland (*Quercus agrifolia*), and Riparian (*Alnus rhombifolia, Juglans californica, Platanus racemosa, Salix spp.).* The team added classes for substrate and water to prevent other classes for being erroneously classified in these areas. The team used the highly detailed vegetation map provided by the project partners and the very high spatial resolution (1m) NAIP orthoimagery to define a minimum of 10 polygons per class that contained pure representations of each class. Then we overlaid the AVIRIS imagery and created points for each AVIRIS pixel that fell completely within a polygon. Using Viper Tools, these points were imported into ENVI and the spectrum at each point was extracted from the AVIRIS imagery and compiled in a spectral library. The full spectral library consisted of 2,698 spectra.

To increase computational efficiency and choose the best endmembers for each class, the team used endmember average root mean square error (EAR). EAR uses MESMA to calculate average error of a spectra being modeled by other members of its class. The lowest EAR spectra are the best representatives of the class (Dennison & Roberts, 2003). After calculating EAR for each spectra, the 20 lowest EAR in each class were chosen for the spectral library. From within this library, certain spectra were manually deleted using previous familiarity with what spectral outliers for the class may look like. After manual deletion, stratified random sampling was used to assign half of the spectra from each class to the final library for training data, and the other half as validation data. The validation data consisted of the original points from which the spectra were derived.

Using the final spectral library, the team used MESMA to classify the four flightlines that covered the study area. MESMA models the image based on the given library and an additional "shade" endmember, which represents 0% reflectance, and outputs a fractional value of cover of a given class. There are several adjustable preferences and constraints, including the number of desired endmembers for the model, and fractional, RMSE, and residual constraints. The team ran MESMA with 2-endmember models only, which means each pixel was modeled with one of our defined classes and shade, to maintain computational efficiency. Fractional constraints were limited from 0 to 1, and RMSE and residuals maxima were raised to 0.15 to ensure a large portion of the image would be classified. In future work, lower RMSE and residuals constraints should be tested.

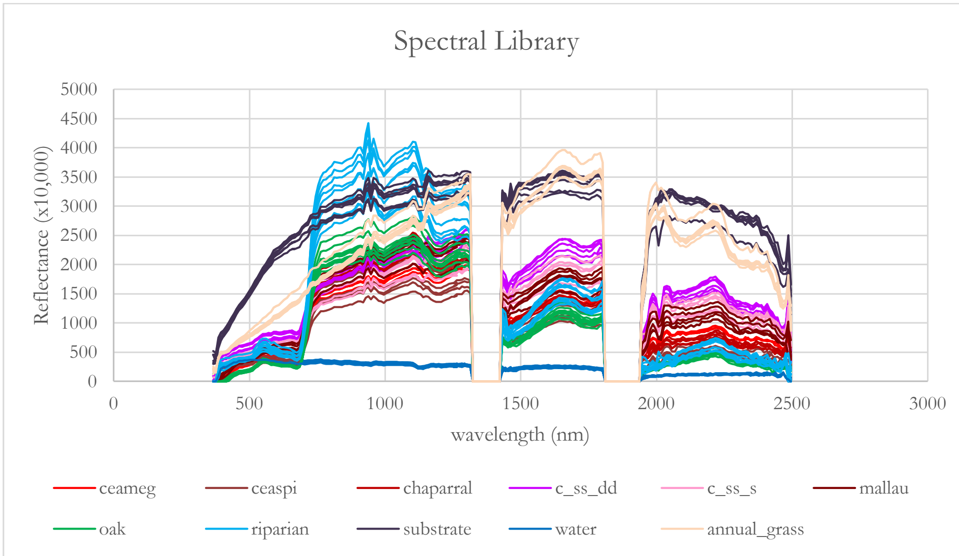

Figure 4. This graph shows the final spectral library used to classify the AVIRIS images by species, where ceameg is *Ceanothus megacarpus*, ceaspi is *Ceanothus spinosus*, c_ss_dd is coastal sage scrub—drought

Dieback Threshold

To determine the RFAL value under which vegetation would be considered dead, the team compared its partner's field data with its own RFAL data. RFAL is a metric that was calculated in the spring 2017 Santa Monica Mountains Ecological Forecasting I project that determines the relative amount of alive vegetation in each AVIRIS pixel. Our partners provided center coordinates for 2016 oak tree field plots and the field plot size (25m by 25m). This information was used to create a shapefile of all the field plot locations using the Buffer and Minimum Bounding Geometry tools in ArcMap. Upon visual inspection of the 2016 RFAL imagery overlaid with the 2016 field plots and 2016 NAIP imagery, it was determined that the RFAL imagery was not properly registered (Figure A_). Due to the misalignment, 2016 AVIRIS imagery, which was used to calculate RFAL, was co-registered to NAIP imagery using the Image Registration workflow in ENVI. The Image Registration workflow geometrically aligns two images by using tie points, so that pixels in each image correspond to the same objects (Jin, n.d.). NAIP imagery was used as the reference image and was resampled in ArcMap to 10m so that the spatial resolution of NAIP was similar to AVIRIS, which has 15.6m spatial resolution. This resampling was done because ENVI's automatic tie point generation performs better when both images have similar spatial resolution (Jin, n.d.). The results of image registration were previewed to ensure that objects in both images aligned, and were then exported with an output pixel size equal to AVIRIS imagery. Using the methods from the Santa Monica Mountains Ecological Forecasting I project, MESMA was run on the co-registered 2016 AVIRIS imagery to classify the images into substrate, nonphotosynthetic vegetation, and green vegetation and to calculate RFAL(1).

$$\text{RFAL} = \frac{\text{green vegetation}}{\text{green vegetation} + \text{nonphotosynthetic vegetation}} \quad (1)$$

3.3 Data Analysis

Species Map Accuracy

To assess the accuracy of the species map, each validation point was viewed to see if it coincided with the correct classification. The team created a confusion matrix to view overall, producer's, and user's accuracies, as well as Cohen's kappa coefficient. Overall accuracy is computed by dividing the total number of agreements by the total number of reference points. While overall accuracy describes the average accuracy of the classification, it leaves out the details of the individual classes and does not acknowledge that error is not distributed evenly amongst them. Producer's and user's accuracies provide information on the performance of the classification according to each land cover type. A high producer's accuracy, which is computed by dividing the number of class agreements by the total number of reference points in that class, shows that the reference points are consistently classified as the correct cover type. A high user's accuracy, which is computed by dividing the number of class agreements by the total number of classified pixels for that land cover type, means that the classification corresponds well to the actual cover on the ground. The final statistic, Cohen's kappa coefficient, quantifies how much better the classification is than if it were left to random chance. Kappa is computed as follows:

$$K = \frac{\text{observed accuracy - chance agreement}}{\text{1 - chance agreement}} \quad (2)$$

By incorporating the probabilities of random agreements, kappa adds insight to the accuracy assessment that is not provided by the other accuracy indicators. Kappa can be expressed as the percent by which the classification performed better than if left to chance.

Dieback Threshold

The team was provided with oak tree field plot locations containing the condition of each plot in 2016 by the RCD. The condition of each field plot represents the percentage of dead leaves, as determined from a visual estimate of canopy cover. A field plot condition of 1 represents 0% brown or missing leaves and a field plot condition of 4 represents 75% brown or missing leaves. In order to understand the condition metric, we created a field fraction alive metric that was plotted against the field condition (3). The Extract by Mask tool in ArcMap was then used to extract the 2016 RFAL pixel values whose center fell within the perimeter of a field plot. The RFAL pixel values were then averaged to find the mean RFAL value for each field plot. The RFAL values were plotted against field condition, and a trendline with the highest R^2 value was fitted to the plot. The equation of the trendline was used to calculate the RFAL value that corresponded with a field plot condition of 3.2 or 55% dead, which the RCD identifies as declining tree health.

$$\text{field fraction alive} = \left(\frac{\text{\# alive trees}}{\text{\# trees}}\right)(\text{adjusted canopy \%}) + (\text{\% live understory})(\text{adjusted live understory}) \quad (3)$$

Climate Variable Regressions

The RFAL value that corresponded with a field plot condition of 3.2 was used as the dieback threshold. The Con tool in ArcMap was used to subset RFAL rasters into an alive vegetation raster (RFAL values > dieback threshold) and a dead vegetation raster (RFAL values <= dieback threshold). The Extract by Mask tool in ArcMap was used to extract dead and alive pixels for each vegetation type and the Reclassify tool was used to reclassify the dead and alive pixels to a value of 1. This process was repeated for each vegetation type in each year. Once each vegetation class was split into dead and alive rasters for each year and reclassified, an R script was run to extract the data necessary to run regressions. The R script counted the number of dead and alive 15.6m pixels of a vegetation type that fell within a 4km PRISM pixel. The count of dead and alive pixels was used to calculate the percent vegetation type alive for a single PRISM pixel (4).

$$\text{\% vegetation type alive} = \frac{\text{\# alive pixels}}{\text{\# dead pixels + \# alive pixels}} \quad (4)$$

The PRISM pixel value, which corresponds to a climate variable value (e.g. minimum temperature), was extracted and written to a table for every pixel within the PRISM climate variable raster. The percent vegetation type alive within a 4 km PRISM pixel was also written to a table. This was repeated for every vegetation type and PRISM climate variable raster for each year. The percent vegetation type alive was plotted against a climate variable and fitted with a trendline that had the highest R^2 value (Figure _).

Topographic Effects

The team prepared elevation, slope, and aspect rasters in order to assess topographic effect on vegetation dieback. However, due to time constraints the team was only able to assess the role of aspect on dieback for oak woodland, *Ceanothus megacarpus*, and chaparral-common. Oak woodland and *C. megacarpus* were chosen due to expressed interest from the project partners. Chaparral-common was also chosen because it had significantly higher classification accuracies than *C. megacarpus* and represents similar species. To find how aspect affected these species, the team used the dead and alive species rasters created for the climate variable regressions, along with the separate aspect files created from the TIN. Using the aspect files, the team extracted the number of dead pixels per aspect class per species class, then the number of alive pixels. The team was able to assess how aspect affected the fraction of dead vegetation per species class with the following for the years 2013-2016:

$$\text{fraction dead pixels} = \frac{\text{\# dead pixels}}{\text{\# dead pixels} + \text{\# alive pixels}} \quad (5)$$

LiDAR

The team derived a DEM and a DSM using the LAS dataset to Raster tool which processes all the data points in a raster surface. The interpolation requires that ground points are classified for a DEM and return points for DSM. Through Raster Calculator, the team calculated a canopy height model (CHM) by subtracting the bare earth surface DEM with first return surface DSM (6). Due to the file size of each LAS dataset, the team chose a single dataset within Trippet Ranch (Figure 5).

$$\text{CHM} = \text{DSM} - \text{DEM} \quad (6)$$

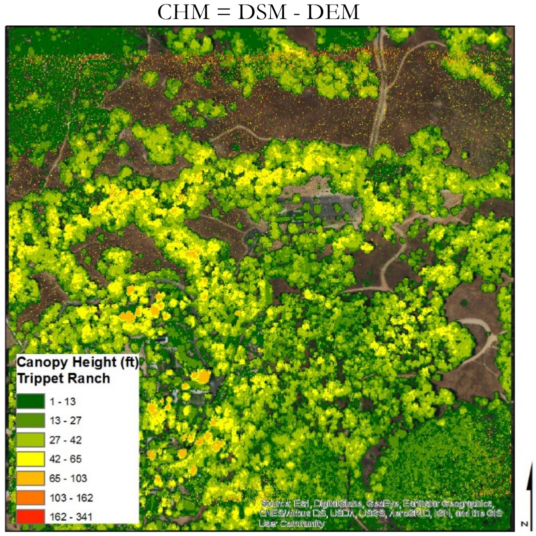

Figure 5. Canopy Height Model (CHM) depicting Forest height in Trippet Ranch.

Canopy density was computed using the LAS Point Statistics as Raster geoprocessing tool. Estimating forest canopy density was based on dividing the LAS datasets of the SMM into many smaller, equally-sized units through rasterization. The raster cell was then compared to the aboveground points with the total number of points. This method provides a point-count using the cell size (1m) to convert the study area into small equal-sized units during rasterization. Together, the number of aboveground points can be compared with the total number of points in each raster cell to generate vegetation density.

In order to derive relative fraction dead vegetation cover for the entire study area, the team subtracted RFAL from one. Fire danger was then computer by multiplying Canopy Density by relative fraction dead (1 – RFAL) (7).

$$\text{Fire Danger} = \text{Canopy Density} * (1 - \text{RFAL}) \qquad (7)$$

4. Results & Discussion

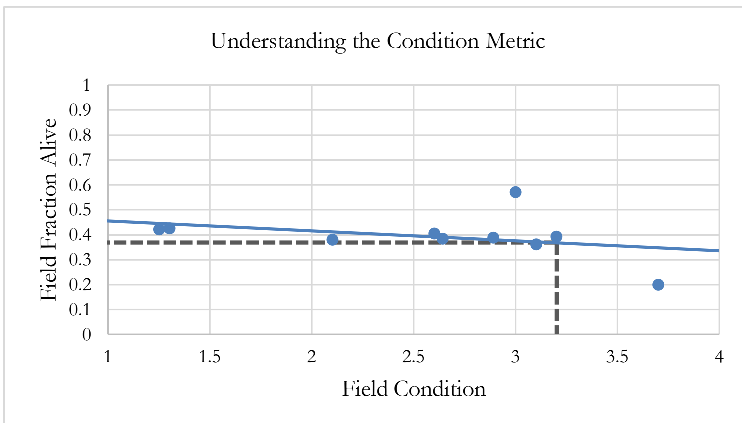

Figure 6. This shows the negative relationship between the field fraction alive and the field condition. As the field fraction alive declines, the field plot condition worsen. The R^2 is 0.1286 and the linear trend line equation is y = -0.04x + 0.4963.

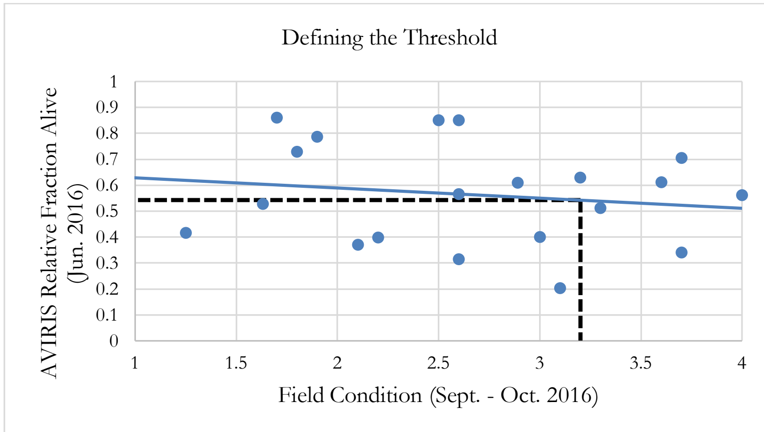

Figure 7. This shows the positive relationship between RFAL and field plot percentage alive. The R^2 is 0.0251 and the linear trend line equation is y = 0.0016x + 0.4711. Our partner's told us that 45% field plot percentage alive is where oaks show signs of declining health and this corresponds with a RFAL value of 0.5431.

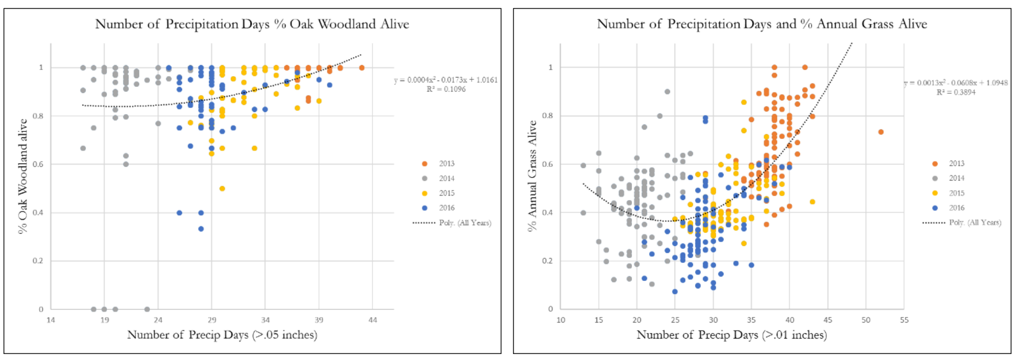

Figure 8. Percent oak woodland and annual grassland alive plotted against the PRISM variable of number of precipitation days per water year.

R^2 Values	Min VPD	Min Temp	Days >95F	Cumulative Precipitation	# Precipitation Days
Annual Grass	0.0189	0.0007	0.005	0.004	0.3894
Ceanothus megacarpus	0.007	0.0343	0.0121	0.1193	0.2093
Ceanothus spinosus	0.007	0.0417	0.0345	0.0153	0.096
Chaparral	0.0153	0.0116	0.0127	0.0693	0.1993
Coastal Sage Scrub Drought Deciduous	0.0135	0.038	0.0141	0.1182	0.348
Coastal Sage Scrub Summer Active	0.004	0.05	0.0139	0.1361	0.1686
Malosma laurina	0.0264	0.0375	0.0206	0.1462	0.2336
Oak woodland	0.0006	0.0214	0.0455	0.0007	0.1096
Riparian	0.0085	0.005	0.0355	0.0262	0.2236

Table 1. The nine vegetation classes and give PRISM climate variables plotted with their R^2 values.

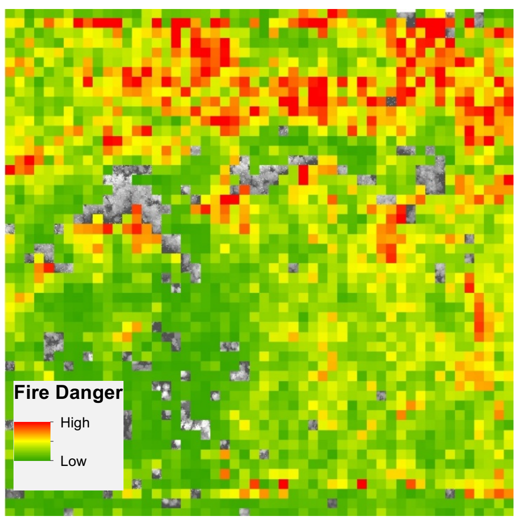

Figure 9. Fire Danger probability map at Trippet Ranch derived from multiplying canopy density with Relative Fraction Dead (1-RFAL). Pixels tend to line up with areas of lower vegetation grasses

4.1 Analysis of Results

Species Map

The species map had generally high accuracy, with an overall accuracy of 81.01%, and average producer's and user's accuracies of 78.3% and 82.42%, respectively. The team considered everything above 75% as high accuracy, and everything below as low accuracies. The high producer's accuracies were seen for annual grass (90%), *Ceanothus spinosus* (100%), chaparral-common (100%), oak woodland (100%), riparian (88.89%), substrate (85.71%), and water (80%). High user's accuracies were observed for annual grass (90%), *C.*

megacarpus (100%), *C. spinosus* (100%), chaparral-common (85.71%), coastal sage scrub-drought deciduous (80%), oak woodland (90.91%), riparian (100%), and water (100%). Classes that had high accuracies in both include annual grass, *C. spinosus*, chaparral-common, oak woodland, riparian, and water. Low producer's accuracies were seen for *C. megacarpus* (40%), coastal sage scrub-drought deciduous (66.67%), coastal sage scrub-summer active (60%), and *Malosma laurina* (50%). Low user's accuracies were seen in coastal sage scrub-summer active (50%), *M. laurina* (50%), and substrate (60%). Classes that had low accuracies in both include coastal sage-summer active and *M. laurina.*

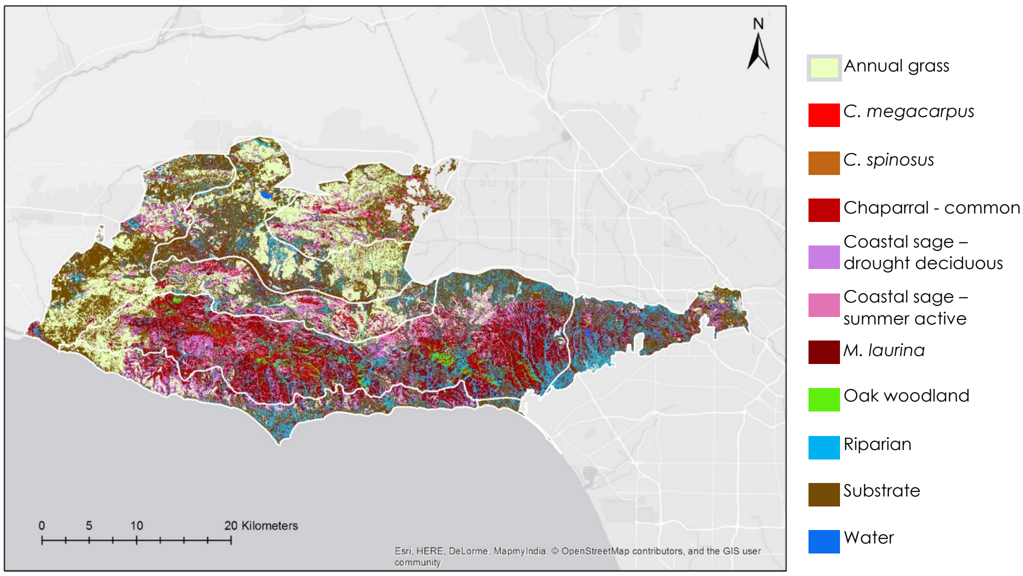

Figure 10. This image shows the species classification over the Santa Monica Mountains using Multiple Endmember Spectral Mixture Analysis (MESMA) on AVIRIS imagery.

Due to time constraints, the team was not able to run these classifications again after revising or eliminating the classes with the poorest performance (coastal sage scrub-summer active and *M. laurina*). Having noticed considerable confusion between chaparral classes and coastal sage scrub classes, the team experimentally merged *C. megacarpus*, *C. spinosus*, chaparral-common, and *M. laurina* into 'chaparral' and coastal sage scrub-drought deciduous and coastal sage scrub-summer into 'coastal sage scrub.' Merging these classes and reorganizing the confusion matrix improved overall accuracy to 88.61%, as well as average producer's and user's accuracies (88.19% and 88.96%, respectively). The kappa statistic also improved to 0.865. The only low accuracy result was user's accuracy for substrate (60%). The underlying cause for why several categories were classified incorrectly as substrate is unclear, although it may be caused by pixels having mixed fractional cover of substrate if too much bare ground is exposed.

Dieback Threshold

The RFAL threshold value was found to be 0.5431, with an R^2 value of 0.0251 (Figure 6). The low R^2 value can be attributed to the low sample size of plots (n=22) and to the difference in data collection times. The AVIRIS imagery was taken in June, while the field plot data was recorded from September to October. Our partners note that oak trees are dying within months, meaning that the field condition recorded could be much worse than the RFAL alive values obtained. In addition, when the team created the plot to better understand the condition metric, the field condition observed tended to be an overestimate of the field fraction alive (Figure 7). The team expected to see a field condition of 3.2 correspond with a 0.5 field fraction alive, but found that a field condition of 3.2 corresponded with a 0.36 field fraction alive. This may also serve as an explanation as to why the R^2 value for RFAL threshold was low.

Climate Variable Regressions
While most of the R^2 values for the nine vegetation classes plotted against the given PRISM climate variables were low, the number of precipitation days had the highest R^2 values among all climate variables (Table 1). This suggests that the health of the vegetation species has a stronger relationship with the number of precipitation days than min VPD, min temperature, and cumulative precipitation days. Even though vegetation species had a stronger relationship with the number of precipitation days, the type of response each species had varied greatly. Annual grassland had a sharp increase in % annual grassland alive when the number of precipitation days increased, but oaks had a much slower increase in % oak woodland alive (Figure 8). Even with increased precipitation days, oaks woodlands may still be dying because die-off patterns are a result of a combination of variables including increased temperature and increased atmospheric demands (Clifford, 2013). It is possible that there are confounding variables that the team did not account for which should have been included in the regression analysis.

Topographic Effects
Oak woodlands have the highest fraction of dead pixels in the southern, southwestern, and western aspects. The lowest fraction of dead pixels is in the northern and northeastern aspects (Figure 11). This suggests that the oaks are experiencing the greatest dieback on the south to west gradient. *C. megacarpus* has the highest fraction of dead pixels in the southeastern, western, and southwestern aspects. The lowest fraction is in the northern and northeastern. These are also the highest and lowest fractions for chaparral-common, although the highs and lows are more discernable in chaparral-common. Judging by the range amongst the different aspect dead fractions, the oak woodlands are more severely affected by aspect.

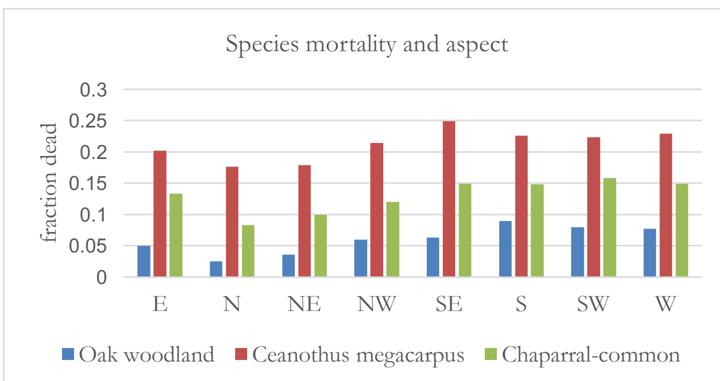

Figure 11. This graph shows the fraction of dead pixels across 2013-2016 for oak woodlands, *C. megacarpus*, and chaparral—common.

LiDAR – Fire Danger Zone
Multiplying Canopy Density with Relative Fraction Dead (1-RFAL) resulted in areas of higher fire danger that tend to correlate with shrubs and grasses when compared with Canopy Height < 1 ft and the values of RFAL. Areas that are depicted to be much lower in Fire Danger tend to be more present with higher canopy, yet, it is not clear whether the fire danger model portrays accuracy when comparing with the RFAL threshold value described above. The fire danger maps could, however, offer probable areas in which RCDSMM could use to aid in their work for fuel clearing in relation to camp sites or other areas of human activity.

4.2 Future Work

There are many possible avenues for continuing work on this project. One interesting approach would be to modify the time intervals in which to view climatic variables such as precipitation. Looking at cumulative and number of days of precipitation annually is a reasonable human metric, but oak trees and other vegetation types operate on their own timescales. Relationships or trends may be missed as a result of the lag time between a climatic occurrence and vegetation response because the study's temporal field of vision is not aligned. There is also room for a more in-depth analysis of harmful beetle impact on the oaks, as this project did not get to explore their impact on the trees very closely due to time constraints. The RCD has noticed that not only invasive but native beetles are beginning to attack and kill more trees, making it an important perspective to investigate. Exploring the applications of LiDAR and AVIRIS towards another concern, fire danger, is another possibility, as this project mainly focused on the tree side of things and not on their impact on fuel levels and fire danger to surrounding areas.

5. Conclusions

Through the combination of using NASA Earth Observations and field data, this team was able to better understand the repercussions of the most recent drought in California on multiple scales. The number of precipitation days had the strongest relationship with percent oak woodland alive, highlighting the importance of precipitation days throughout the year. Overall, the severe drought has weakened oak trees and made them more susceptible to the impacts of physical stress as well as attacks from harmful beetles, ultimately resulting in greater oak woodland dieback.

6. Acknowledgments

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- Rosi Dagit (RCD Santa Monica Mountains)

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7. Glossary

AVIRIS – Airborne Visible/Infrared Imaging Spectrometer
CAL FIRE - California Department of Forestry and Fire Protection
DEM – Digital elevation model
EAR - endmember average root mean square error
endmember - pure representation of a spectral class
LiDAR - Light Detection and Ranging
MESMA - Multiple Endmember Spectral Mixture Analysis
NAIP - National Agriculture Imagery Program
NPS - National Park Service
PRISM – Parameter-elevation Regressions on Independent Slopes Model
RCDSMM – Resource Conservation District of the Santa Monica Mountains
RFAL - Relative fraction of alive vegetation
SMMNRA – Santa Monica Mountains National Recreation Area
SRTM – Shuttle Radar Topography Mission

TIN - Triangular Irregular Network
VPD - Vapor pressure deficit

8. References

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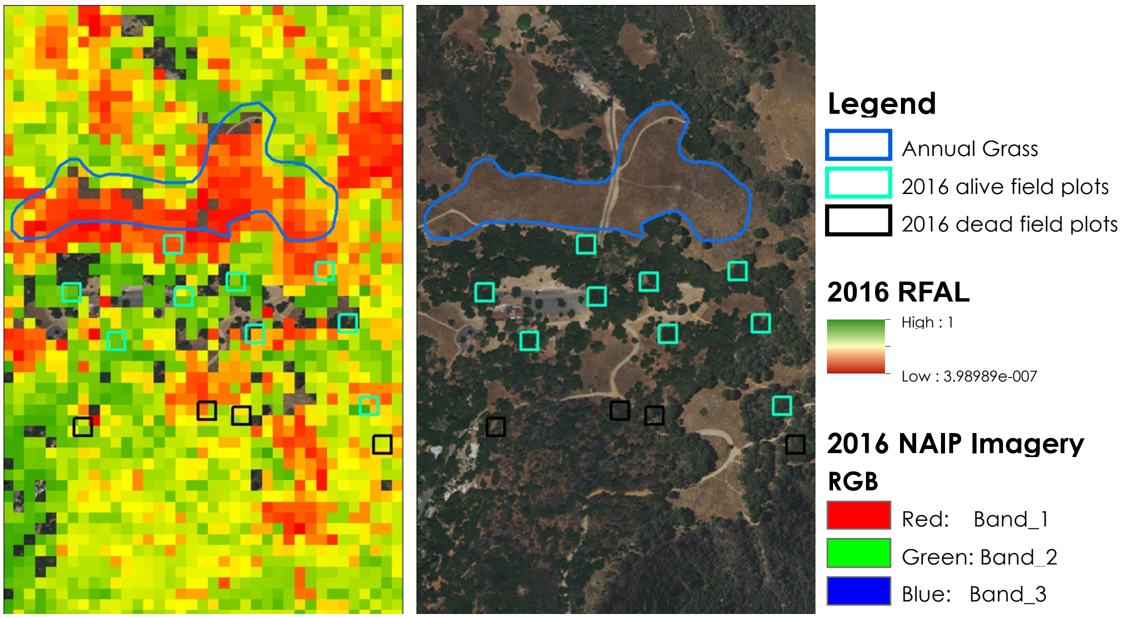
9. Appendices

Appendix A: RFAL registration issue

Figure A1: RFAL is not co-registered to NAIP imagery.



Appendix B: Aspect and species mortality by year

Figure B1: Oak woodland

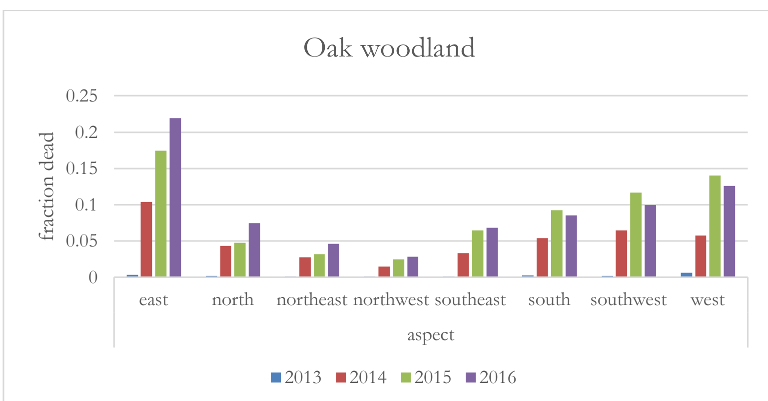


Figure B2: *Ceanothus megacarpus*

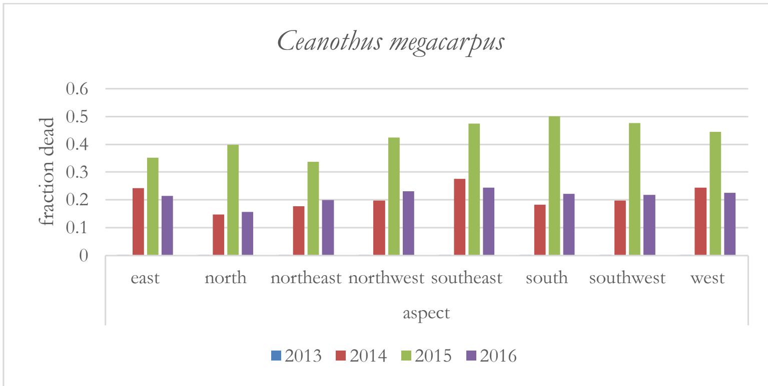
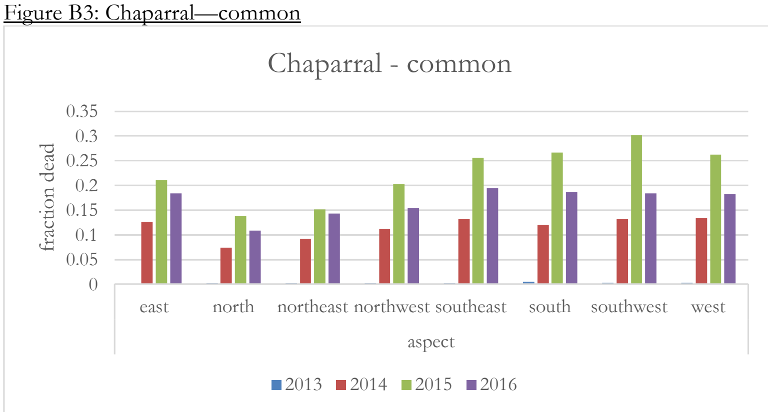


Figure B3: Chaparral—common



Appendix C: Species map confusion matrices

Table C1: Confusion matrix with all classes

		Reference source												
		Ann. grass	*C. mega-carpus*	*C. spinosus*	Chap. -com.	Coastal sage - dr. dec.	Coastal sage - sum. act.	*M. laurina*	Oak wood.	Ripar.	Substr.	Water	Total	**user's accuracy**
Classified map	Annual grass	9	0	0	0	1	0	0	0	0	0	0	10	90%
	C. mega-carpus	0	2	0	0	0	0	0	0	0	0	0	2	100%
	C. spinosus	0	0	5	0	0	0	0	0	0	0	0	5	100%
	Chap. - common	0	0	0	6	0	0	1	0	0	0	0	7	85.7%
	Coastal sage - dr. dec.	0	0	0	0	4	1	0	0	0	0	0	5	80%
	Coastal sage - sum. act.	0	0	0	0	1	3	2	0	0	0	0	6	50%

	Malosma laurina	0	3	0				3	0	0	0	0	6	50%
	Oak wood.	0	0	0	0	0	0	0	10	1	0	0	11	90.9%
	Riparian	0	0	0	0	0	0	0	0	8	0	0	8	100%
	Substrate	1	0	0	0	0	1	0	0	0	6	2	10	60%
	Water	0	0	0	0	0	0	0	0	0	0	8	8	100%
	Un-classified	0	0	0	0	0	0	0	0	0	1		1	
	Total	10	5	5	6	6	5	6	10	9	7	10	79	Average = 82.42%
	producer's accuracy	90%	40%	100%	100%	66.7%	60%	50%	100%	88.9 %	85.7%	80%	Avg = 78.30 %	Overall = 81.01%
	agreement	9	2	5	6	4	3	3	10	8	6	8	64	
	by chance	1.266	0.127	0.316	0.532	0.380	0.380	0.456	1.392	0.911	0.886	1.013	7.658	
	kappa												0.790	

Table C2: Confusion matrix with merged chaparral and coastal sage scrub

		Reference source								
		Annual grass	Chaparral	Coastal sage scrub	Oak woodland	Riparian	Substrate	Water	Total	**user's accuracy**
Classified map	Annual grass	9		1					10	90%
	Chaparral		20						20	100%
	Coastal sage scrub		2	9					11	###
	Oak woodland				10	1			11	###
	Riparian					8			8	100%
	Substrate	1		1			6	2	10	60%
	Water							8	8	100%
	Unclassified						1		1	
	Total	10	22	11	10	9	7	10	79	Avg = 88.96%
	producer's accuracy	90%	90.9%	81.8%	100%	88.9%	85.7%	80%	Avg = 88.19%	Overall = 88.61%
	agreement	9	20	9	10	8	6	8	70	
	by chance	1.266	5.570	1.532	1.392	0.911	0.886	1.013	###	

APPENDIX B

Tree Plot Data and Photographs

DECEMBER 2017

TREE PLOT AND TRAP LOCATIONS
RCDSMM 2017

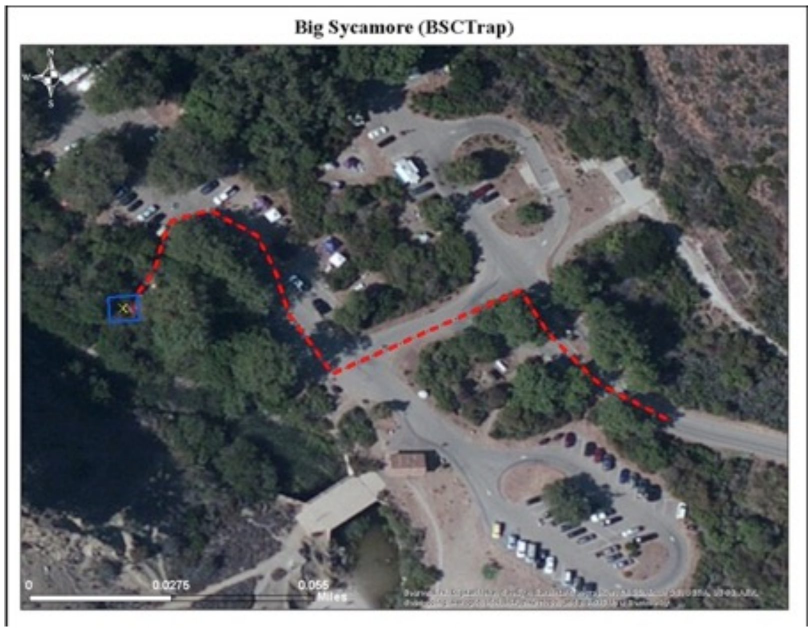
Study area map showing all trap and tree plot locations

Coastal Sites
driving from west to east on PCH

- Big Sycamore State Beach
- Leo Carillo State Park – upper and lower
- Ramirez Canyon
- Solstice Creek

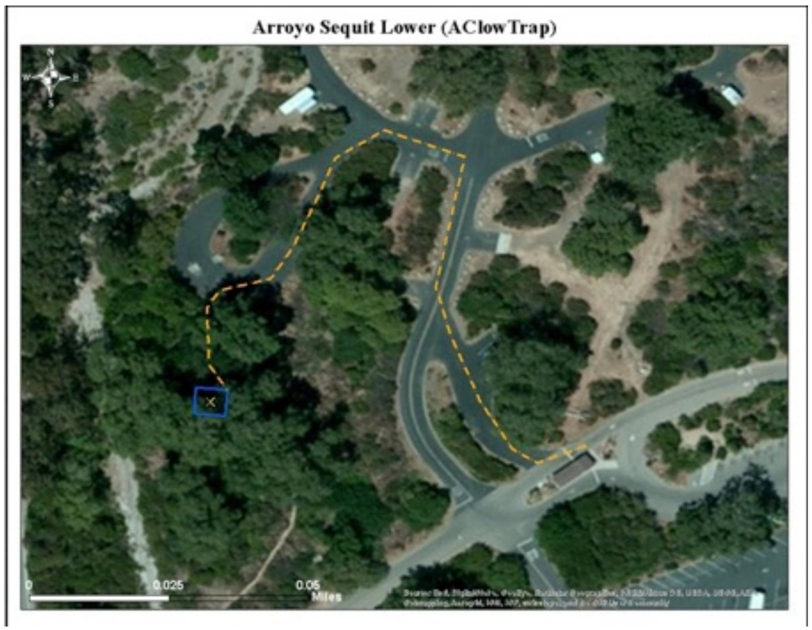
Big Sycamore Trap (BSCtrap): 34.0722, -119.01537

Enter the campground and make first left towards the beach. Campsite #57 is located just on the right. The trap will be to the east of the campsite.



Leo Carrillo State Park, Arroyo Sequit lower (AClowTrap): 34.04674, -118.93467

Enter the campground from PCH and ask for directions to the dump station from the kiosk folks. Tell them you are with the RCDSMM study and no parking fee! Park by the dump station and walk into grove towards the beach. Trap will be on the left outside the dripline of the big oak.



Leo Carrillo State Park, Arroyo Sequit upper (ACCTrap): 34.0645, -118.9327

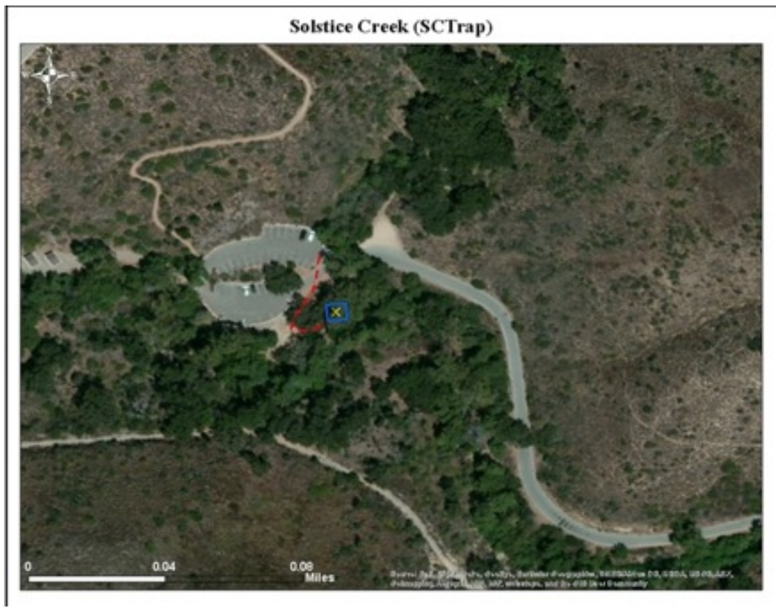
Take PCH to Mulholland Highway. Go north on Mulholland about 2 miles to the bridge. Park on the southbound road shoulder. Cross road, hop over k-rail barrier and follow path to creek. Trap is downstream on the east bank next to rock outcrop. No need to cross the creek. Watch out for poison oak!

Ramirez Creek (RCTrap): 34.0394, -118.79427

take driveway to end past old orchard where road ends. Hike North up trail. Follow signs to barn

Solstice Creek (SCTrap): 34.037588, -118.747105

Turn right off PCH on Corral Canyon Rd. Entrance to the park is about ¼ mile up on the left. Drive into the main parking area loop and park near the amphitheater. Trap will be to the left of the amphitheater as you face the creek, behind the sign.



Malibu Creek Sites

- Malibu Creek State Park main parking lot
- Malibu Creek State Park Dream House
- Malibu Creek State Park Tapia
- Malibu Forestry
- King Gillette Ranch

Malibu Creek State Park Trap (MCTrap): 34.09605, -118.71763

Enter Malibu Creek State Park main entrance off Las Virgenes Rd. Tell folks at kiosk you are with RCDSMM collecting bug samples. Follow drive to main parking lot closest to the main trailhead.
Trap will be on hillside on the left before you cross the creek, on the edge of a grove of oaks.

Malibu Creek Dream house (MCDreamhouse): 34.09489 -118.7122

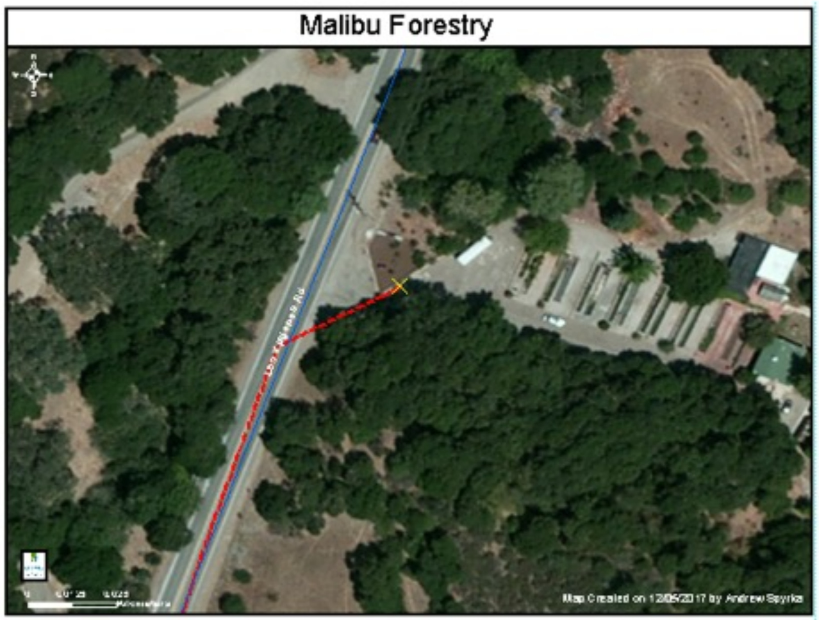
Enter Malibu Creek State Park main entrance off Las Virgenes Rd. Follow drive to main camping site in the back. Than follow the loop until you reach the only house in the are.
Trap will be on hillside next to the dream house, on the edge of a grove of oaks.

Malibu Creek State Park Tapia Park Trap (MCTapiatrap): 34.08474,-118.70526

Entrance to Tapia is on Las Virgenes Road just south of the Malibu Forestry Unit and north of Piuma Road. Southbound take a right turn into the driveway, pass the kiosk and park in the spaces on the right next to the creek. The trap will be along the creek edge across from a huge oak grove over the campground.

Malibu Forestry: 34.08518, -118.70417

Pull over on shoulder of Las Virgenes Road at the Forestry gates and look on the inner North side of the gates by the dumpsters to access



King Gillette Ranch: 34.1023 -118.70705

Enter the King Gillette visitor center parking lot off of Las Virgenes Rd. Trap is on south end of parking lot next to the trail entrance and "oversize vehicle" sign.

Calabasas Sites

- Mountains Restoration Trust – Headwaters Corner 3815 Old Topanga Cyn. Rd, Calabasas
- Washburn 22544 Calipatria Dr Calabasas
- 4515 Park Serena, Calabasas
- Las Virgenes Open Space Preserve

Masson House: 34.13518, -118.63177

Located on Mountain Restoration Trust Headwaters Corner
3815 Old Topanga Cyn. Rd, Calabasas

Sycamore Bridge: 34.13643, -118.63108

Located on Mountain Restoration Trust Headwaters Corner
3815 Old Topanga Cyn. Rd, Calabasas

Mother Oak: 34.13661, -118.63112

Located on Mountain Restoration Trust Headwaters Corner
3815 Old Topanga Cyn. Rd, Calabasas

Behind House: 34.13623, -118.63168

Located on Mountain Restoration Trust Headwaters Corner
3815 Old Topanga Cyn. Rd, Calabasas

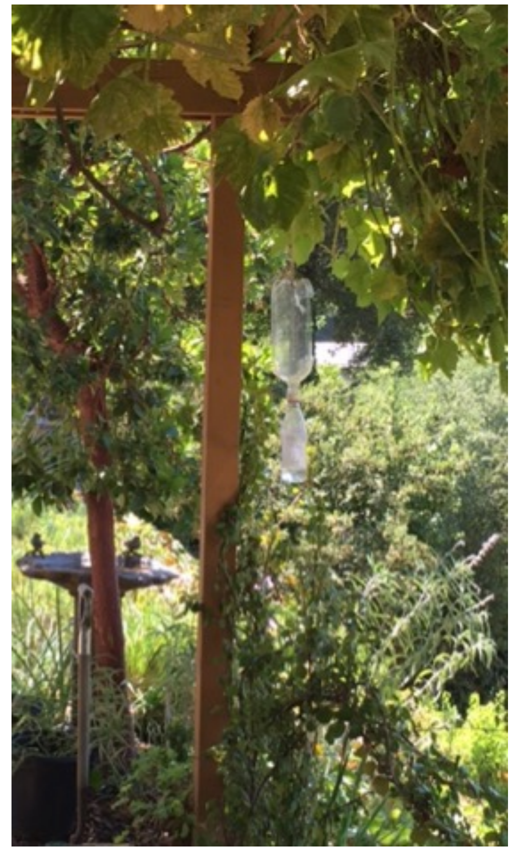
Wild Walnut Park: 34.13495, -118.63097

Located on Mountain Restoration Trust Headwaters Corner
3815 Old Topanga Cyn. Rd, Calabasas

4515 Park Serena: 34.151233, -118.6397222

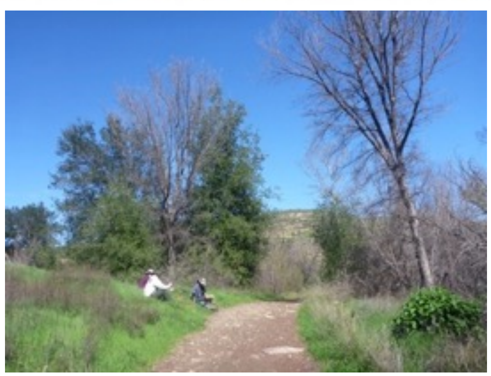
From highway 101 South, exit Mulholland drive than take Valmar Road to Park Ora Road, than right on Park Sienna until you see Park Serena. Follow the road to its end and trap will be on left behind 4515 house.

Washburn: 22544 Calipatria Dr Calabasas
34.13806, -118.6492



Las Virgenes Open Space Preserve (LVOSPtrap): 34.17199,-118.70319

Take Las Virgenes Road north untill it dead ends at the trailhead. Hike approximately ½ mile on the main trail, pass the old fence and go to the social trail on the left, just before you hit a grove of oaks. Turn left up the trail and trap will be in the meadow.

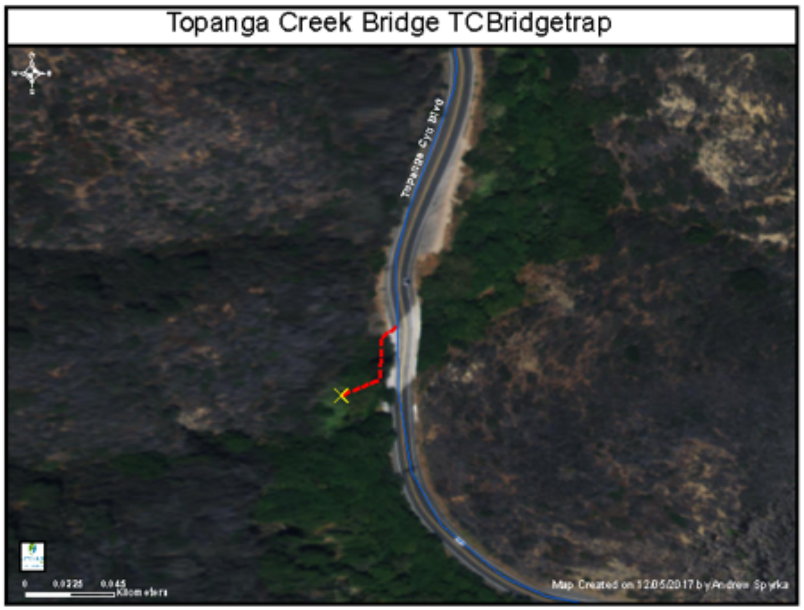


Topanga Creek Sites
south to north

- Topanga Blvd Bridge MM 2.02
- RCD office 540 S. Topanga Canyon Blvd.
- Marissa 20651 Medley Lane
- Old Topanga Backbone Trail
- Petersen Trap -21342 Entrada Rd, Topanga
- Trippett Ranch trap 8 off Waveview Rd.
- Ken Safari Trap - Hillside Dr. Topanga

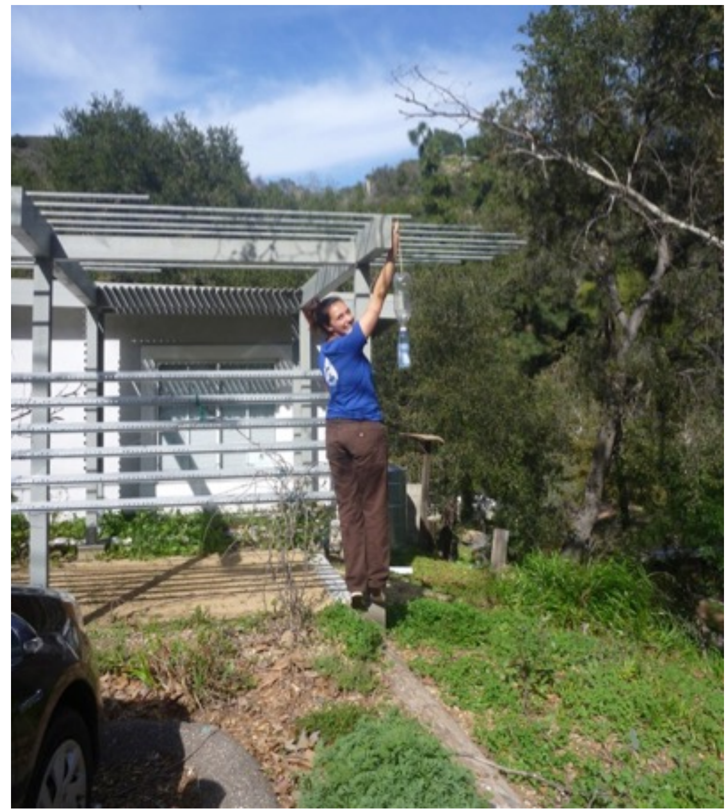
Topanga Creek Bridge (TCBridgetrap): 34.06384,-118.58739

Park Southbound on top bridge on shoulder. Hike down to creek, walk downstream to Big Sycamore



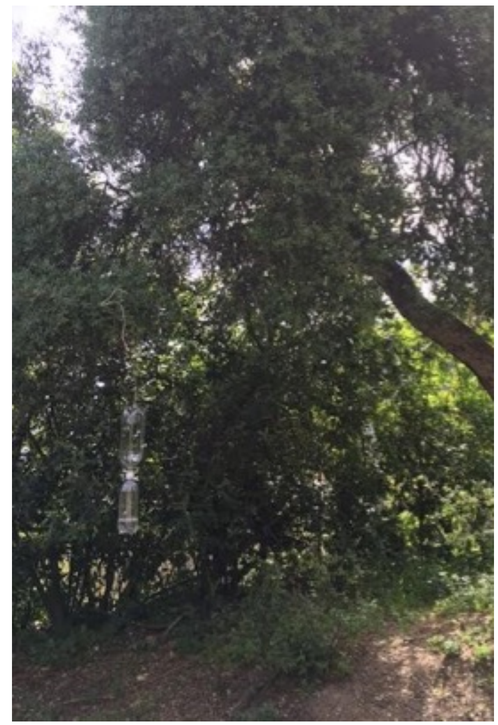
Topanga Creek RCD Office Trap (RCDTrap): 34.08183, -118.5978

Park on shoulder of street or in front of the office to access trap.



Marisa Oak Tree Trap (MOakTrap): 34.0739, -118.6020

From Hwy 27 use Fernwood Pacific Drive to access Medley Lane. Trap will be behind house, about a quarter of a mile down the lane.



Marisa Jacaranda Tree Trap (MJTrap): 34.0739, -118.6022

From Hwy 27 use Fernwood Pacific Drive to access Medley Lane. Trap will be behind house, about a quarter of a mile down the lane.

Old Topanga Creek Backbone Trail (OTBBTrap): 34.09298, -118.61019

Park on Old Topanga Canyon Road at backbone trail on shoulder, hike by creek to first clearing.
Trap is on left up slope before going under oak.

Peterson Trap: 34.09222, -118.597859

From Hwy 27 drive half mile down Entrada Rd. to access trap, behind house. On the right.

Topanga Creek Trippett Ranch (TCTR8): 34.09221, -118.58862

Park at the end of Wave Veiw Rd off Entrada Dr. Hike along trail approximately 50 meters and look for trap on the left behind an oak grove.

Ken Safari: 34.105005, -118.592652

From Hwy 27 take Hillside Drive to access trap location which will be after the first curve, on the left.

West San Fernando Valley Sites

- Rancho Sierra Vista – Lynn Rd. entrance
- Cheeseboro Road
- Paramount Ranch

Rancho Sierra Vista Satwiwa (RSVtrap): 34.154226, -118.969954

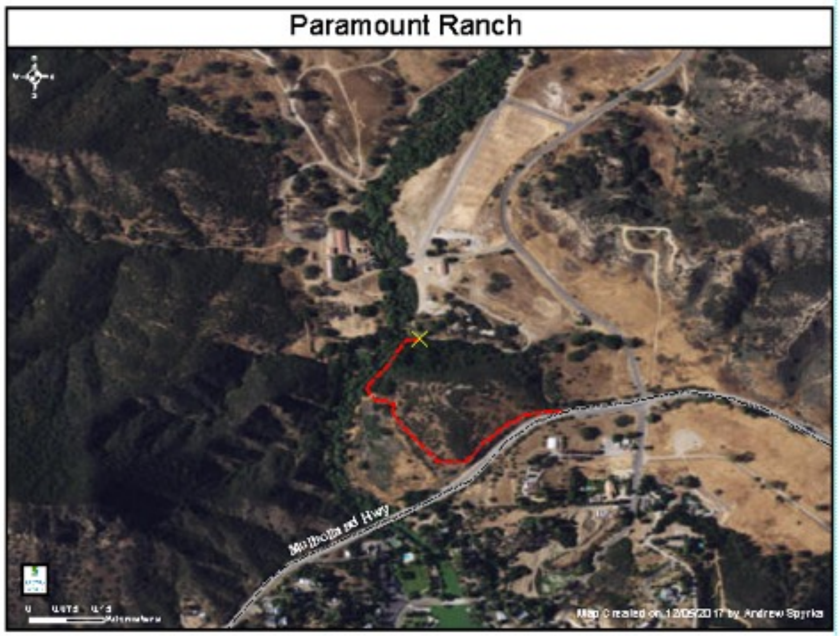
Take Lynn Road to the main park entrance south of Reino Rd. As you drive into the park the equestrian lot is on the right and the overflow parking is about ¼ mile further on left. Turn around in overflow lot and return towards entrance. Park on the road shoulder next to the sumac bush near the yerba mansa restoration area. Hike through the restoration area (careful not to step on baby plants!) into the grassy area and follow the old barbed wire fence to the oaks. Trap will be tied to the fence post near the oak.

CHEESEBORO (CHCtrap): 34.1542, -118.734366

Take Palo Comoado Road into Old Agoura, then turn right on Cheeseboro Road. Go about 1-2 miles to the right turn into the park and immediately park in front of the houses by that intersection. Trap will be across the street adjacent to the oak/willow woodland.

Paramount Ranch: 34.1142, -118.75517

Past horse trailer area, take a left when the trail forks and trap is immediately on the right at the Mesa trailhead marker.



Chatsworth Sites

Germain St. – Wendi sites

Santa Susanna State Historic Park

- Teena Takata
- Vincents
- Methodist Church
- John Luker

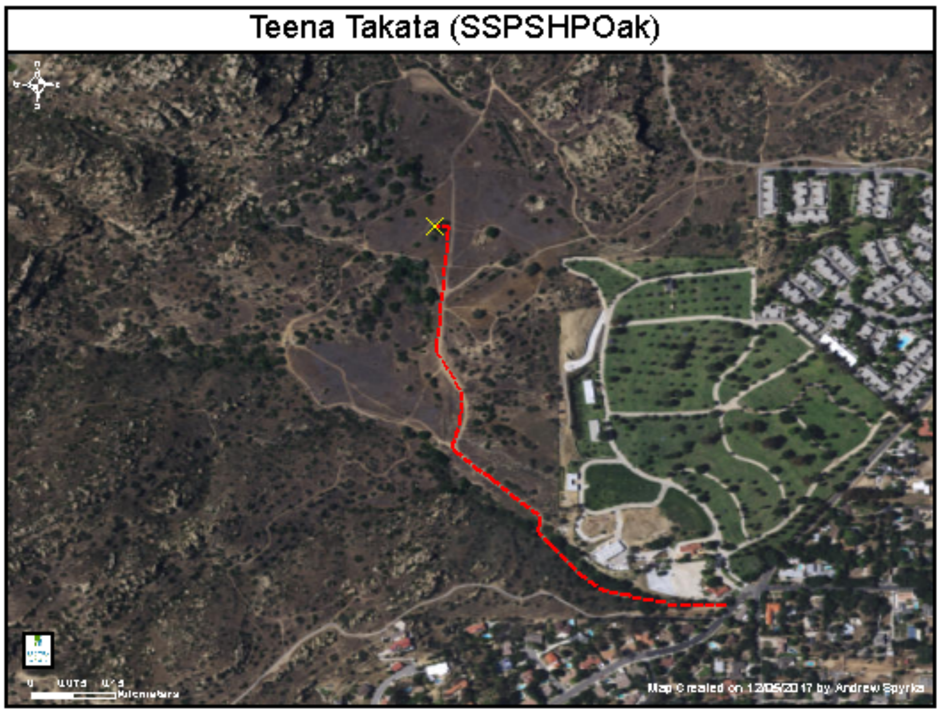
Santa Susanna Field Laboratory – Boeing sites

Chatsworth: 34.262525, -118.614167

From Hwy 27 use Chatsworth Street to access Germain Street, trap will be on left.

Teena Takata (SSPSHPOak): 34.255761 ,-118.624328

Park on Andora Avenue, and hike into Santa Susanna State Historic Park for about 20 minutes up the dirt trail, past the green open space until you hit the first grove of trees on the left in the middle of a open field.

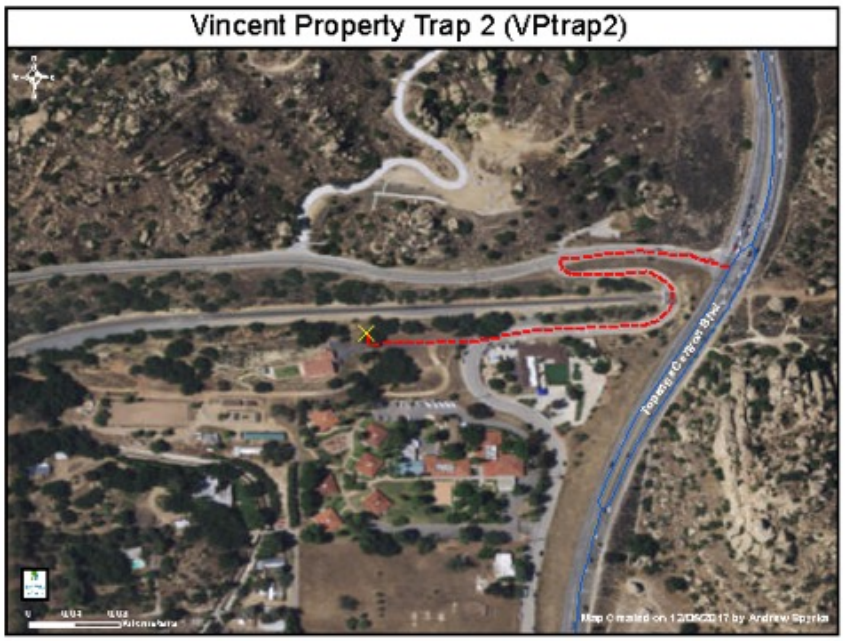


Vincent Property Trap 1: 34.271419, -118.608947

From Hwy 118 take exit Hwy 27, than right on Santa Susana Pass Rd. Turn immediately onto Old Santa Susana Pass Rd and follow until the end, than you will reach trap location behind the house.

Vincent Property Trap 2: 34.271783, -118.607739

From Hwy 118 take exit Hwy 27, than right on Santa Susana Pass Rd. Turn immediately onto Old Santa Susana Pass Rd and follow until you reach trap location on the right.



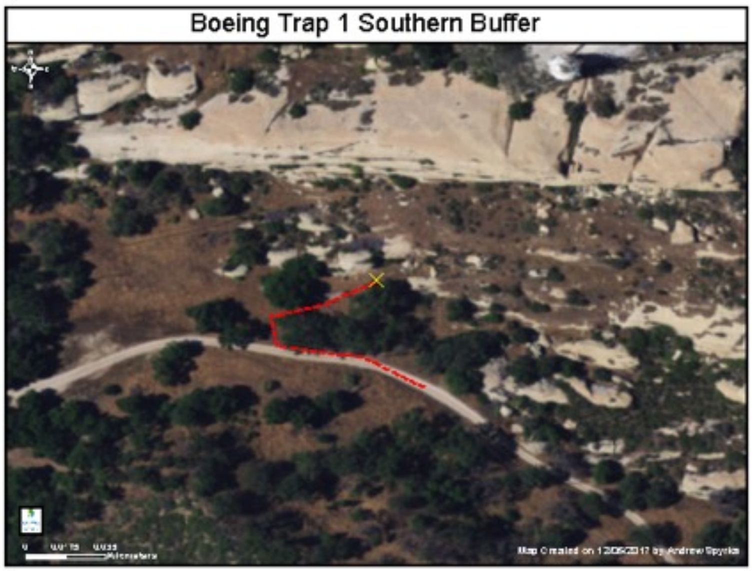
Methodist Church: 10824 Topanga Canyon boulevard – Chatsworth
34.26646, -118.605453

Luker Oak Trap (Luker Oak): 34.239883, -118.646057

From Hwy 27 use Box Canyon Road to access Hartman Way. Follow this road until the end, trap will be on the left behind house.

Boeing Trap 1 Southern Buffer: 34.22414, -118.70547

Once in the facilities, drive South through area 1, turn left at area 1 burn pit, take the outfall 1-2 southern buffer road, towards outfall 2.



Boeing Trap 2 Watering Hole: 34.22329, -118.70705

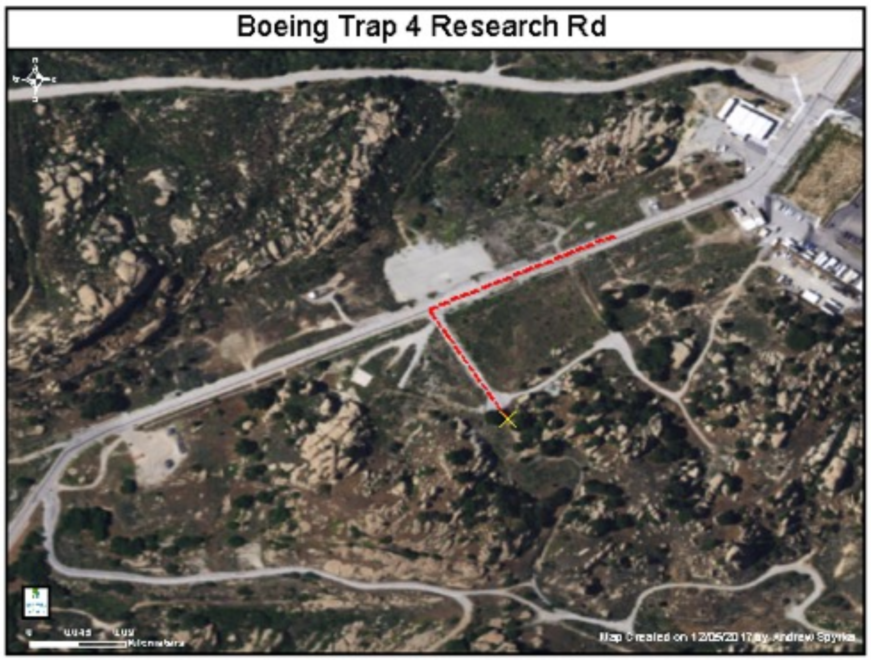
Once in the facilities use Roca Avenue to access trap location, trap will be on outside of road in the outfall 2 guzzler area.

Boeing Trap 3 Silvernail Pond: 34.23, -118.70612

Once in the facilities, use test area road to access CTI 5 road, trap location will be on the right.

Boeing Trap 4 Research Rd: 34.23326, -118.67765

Once in the facilities, take area 1 road to research road to access location.



Boeing Trap 5 R1 Pond: 34.22995, -118.68466

Once in the facilities use Area 1 road to access trap location on the closed shoulder.

Brentwood Sites

359 Bundy: 34.065113, -118.478678

Clark De Blasio: 34.067906, -118.505071

SCPA: 34.061989, -118.496767

359 Bundy: 34.065113, -118.478678
Clark De Blasio: 34.067906, -118.505071
SCPA: 34.061989, -118.496767
No Photos of Trap Available

APPENDIX C

Research Brief Summary of Riparian/Citizen Science Trap Results

DECEMBER 2017

RCDSMM RESOURCE BRIEF Fall 2017

Rosi Dagit, Senior Conservation Biologist
Russell Dauksis, Salvador Contreras, Andrew Spyrka, Field Biologists

Sensitive Riparian Area Tree Pest Detection Monitoring

IMPORTANCE

Invasive pests and diseases are one of the most important factors threatening both agricultural and natural resources in Ventura and Los Angeles Counties. The Invasive Shot Hole Borer/Fusarium Dieback (ISHB/FD) is a non-native ambrosia beetle/fungi complex that has invaded southern California and is currently threatening tens of thousands of native, residential, and agricultural trees. This invasive species complex is quickly reaching epidemic proportions, destroying entire riparian areas, and resulting in widespread environmental, economic, and aesthetic implications for the region. Additionally, the native western oak bark beetle (WOBB) has also been observed to kill oaks with a newly identified fungal associate, and gold spotted oak borers (GSOB) have been found in nearby Santa Clarita. This study examined the effects, distribution, and abundance of these pests in the Santa Monica Mountains National Recreation Area (SMMNRA) and their impact on sensitive riparian areas supporting endangered aquatic species. The results provide data critical for on-going park management in the face of these invasive pests.

METHODS

Thirty-three riparian tree traps and 13 additional citizen science volunteer traps were set at selected plots throughout the SMMNRA to monitor for presence of invasive beetles between March – September 2017. The 25 meter square plots were randomly selected using ArcGIS software to meet access, tree density, and proximity to sensitive aquatic resources criteria. Using the GPS center points, all trees within each plot were individually tagged, diameter and height measured, and condition noted. Homemade bottle traps consisting of two connected plastic bottles with soapy water acting as a collection basin were hung outside the driplines of trees within the plots (Figure 1). Querciverol lures (an aggregating hormone made by Synergy Semiochemicals Corp.) were placed in the traps and changed every six weeks. Samples were collected and analyzed weekly by RCDSMM biologists, NPS staff, CDPR staff and citizen science volunteers. All insects were examined under the microscope and any potential ISHB or WOBB sent to Dr. Richard Stouthamer's Lab at UCR for confirmation. All other specimens collected were stored in ethanol and archived for future examination.

Citizen volunteers and partners contributed over 2000 hours to this effort by setting, maintaining and monitoring traps.

Figure 1: Homemade Bottle Trap deployed at Trippett Ranch, Topanga State Park

RESEARCH OUTCOMES

A total of 41 plots were established with 353 individual trees tagged, dominated by coast live oaks and CA sycamores. In addition to the 33 sensitive riparian traps, citizen scientists set and monitored an additional 13 traps. Traps were located throughout the SMMNRA as shown in Table 1.

Table 1. Locations and numbers of Riparian Traps

Arroyo Sequit Creek– 2
Big Sycamore Creek – 1
Cheeseboro Creek- 1
Las Virgenes Creek (Upper Open Space Preserve) – 1
Los Angeles River (Calabasas) – 7
Los Angeles River (Santa Susanna Field Lab) - 5
Malibu Creek – 5
Paramount Ranch – 1
Rancho Sierra Vista Satwiwa - 1
Ramirez Creek – 1
Solstice Creek – 1
Topanga Creek - 7

During the 27 week long study, over 850 individual trap samples were collected. Potential target species were found in 225 samples sent to UC Riverside for confirmation. Only 52 of these (23%)came back with confirmed SHB, WOBB or both, with multiple hits at several locations. Many of the other potential problem species were other types of ambrosia beetles that were not identified beyond family.

No GSOB were found in the SMMNRA at this time.

The Sensitive Riparian Area Tree Pest Detection Monitoring study was funded in part by the Southern California Research Learning Center. *To obtain the complete report go to www.rcdsmm.org*

RESOURCE CONSERVATION DISTRICT OF THE SANTA MONICA MOUNTAINS

RCDSMM RESOURCE BRIEF

Fall 2017

What is the current extent of the infestation of ISHB and WOBB in the SMMNRA?

Invasive Shot Hole Borers

Calabasas: Throughout city
Mountains Restoration Trust
Calipatria Ave
Park Serena Ave
Chatsworth: all sites
Topanga:
Peterson Trap Entrada Rd
RCD office
Behind Topanga Market Center
Medley Lane

Western Oak Bark Beetle

SSFL Southern Buffer Rd, Chatsworth
Cheeseboro Park
Las Virgenes Open Space Preserve
Malibu Creek State Park
Nicholas Flats State Park
Trippett Ranch, Topanga State Park
Tapia State Park
Old Topanga Canyon Rd., Topanga
Greenleaf Rd, Topanga
Medley Lane, Topanga
Robinson Rd., Topanga
Entrada and Waveview Rds, Topanga

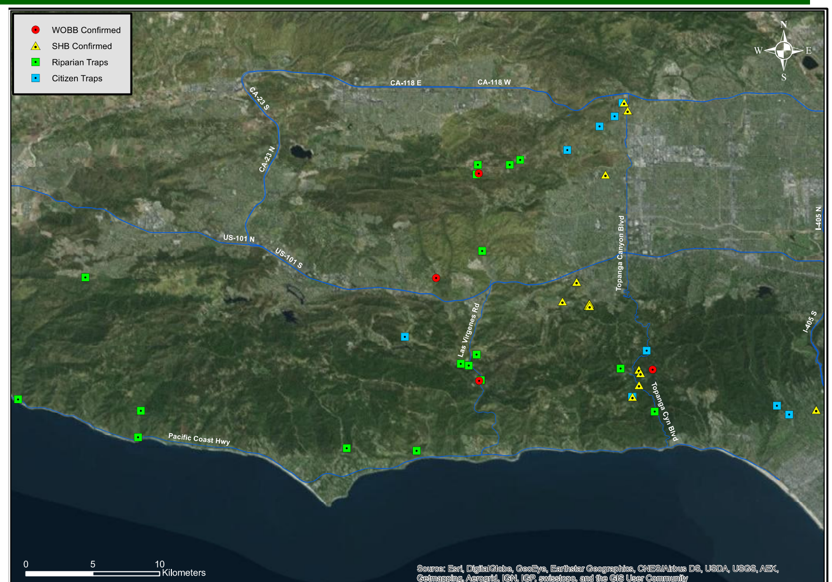
Based on the regional detection mapping are they expanding into sensitive riparian areas from urban or agricultural systems or vice versa?

It appears that the current infestations are patchy and associated with either potentially contaminated mulch or proximity to green waste facilities. Both wildland and landscape trees were infested but the ISHB have not yet been documented in sensitive riparian areas of the SMMNRA.

WOBB has become established in riparian areas and caused significant oak tree die-off.

Polyphagous shot hole borer

Western oak bark beetle



Riparian Tree Plots

How fast are these pests spreading?

We were unable to detect the rate of spread during this short study. However, this initial effort provides a baseline documenting the 2017 presence/absence data that can be used for comparison over time. It is anticipated that there are more infestations on private property but thus far, the loss of riparian trees in the creek channels appears to be more related to drought than infestation. Continued monitoring is needed to more accurately assess the extent and expansion of these pests.

Are they killing riparian trees and if so, how fast?

Both oaks and sycamores were in decline, but mortality rate is uncertain at this time. Tagged tree data between 2015-2017 at Trippett Ranch suggests that WOBB cause mortality within 1-2 years.

NEXT STEPS…..

We hope to continue our collaborations with LA County Agricultural Commission, NPS, CDPR and the NASA Develop Team to integrate the trap results with the broader analysis of impacts throughout the SMMNRA.

Acknowledgements

This project was possible thanks to funding from the Southern California Research Learning Center, Los Angeles County District 3 Supervisor Sheila Kuehl, and the Los Angeles County Fish and Game Commission. Dr. Richard Stouthamer and Veronica Fernandez provided important assistance with identification and Dr. Akif Eskalen helped with fungi.

We also thank the Topanga Canyon and Malibu Creek Docents, Julie Clark de Blasio, Wendi Gladstone, John Luker, Marissa Kuizenga, Garrett Nichols, Kerrie Petersen, Gabino Rezendis, John Simon, Teena Takita, Nina Trusso, West Valley United Methodist Church, the Vincents, Dennis Washburn, and Mountains Restoration Trust – Amy Yuelapwan for over 2000 volunteer hours.

APPENDIX D

Detection Detective Citizen Science Volunteer Information

DECEMBER 2017

RCDSMM Detection Detectives Trapping Protocol

Spring 2017

GOAL: To deploy home-made traps to detect Polyphagous/Kurishio shot hole borer spread in the Santa Monica Mountains and have citizen science volunteers assist with the research project.

BACKGROUND: The purpose of this research effort is to track the extent and speed of dispersal of introduced tree pests including a suite of ambrosia beetles including polyphagous/Kuroshio shot hole borer (PSHB/KSHB), western oak bark beetles (WOBB), and gold spotted oak borer (GSOB) in sensitive riparian areas throughout the Santa Monica Mountains. This effort addresses a variety of identified SMMNRA research needs regarding invasive species and will provide data critical for on-going park management in the face of these invasive pests.

The specific research questions are:
1) What is the current extent of the infestation of PSH, KSHB and WOBB in riparian areas near sensitive aquatic species? Based on the regional detection mapping are they expanding into sensitive riparian areas from urban or agricultural systems or vice versa?

2) How fast are these pests spreading?

3) Are they killing riparian trees and if so, how fast?

RESEARCH DESIGN AND METHODOLOGY

Task 1. Develop sampling protocol and identify priority sensitive riparian areas for surveying.

a. Randomly select 14 sites that are easily accessible for citizen science volunteers/interns and focus on creek reaches with sycamore, willow, oak, and alders located near known locations of federally listed California red-legged frogs sites and/or southern steelhead trout. A team of local scientists from NPS, State Parks and RCDSMM identified priority sites within watersheds throughout the Santa Monica Mountains.
b. A 25 square meter grid was overlaid on the selected reaches and numbered. A random number generator was used to select three plots within the grid.
c. Field visits were made to check out each of the potential plots and the best one for access was selected.
d. Within the selected 25 m plot, every native tree with DBS over 6 inches was tagged, measured and health/vigor condition assessed. Presence of any evidence of insect or disease damage was also noted. GPS coordinates for center and each corner of the plot were collected. A Photo point was also established.
e. Trap locations were established outside the canopy of the trees but within 5 meters of the canopy. Trap set ups included a rebar pounded into the ground, a stand made from ½" conduit standing approximately 1-2 meters above ground slipped over it. Home-made traps were then attached to the stands. GPS coordinates of the trap location was collected along with a photograph of each site.
f. In addition to the core sites selected by the Technical Advisory Comm. We have

additional traps deployed by citizen science volunteers at a variety of additional sites. A map of those sites will be generated and those locations added during the course of the study.

Figure 1. Location of Riparian trap deployment in Santa Monica Mountains

Task 2 Deploy and monitor detection traps from March – October 2017

A) Sampling window - We propose 32 weeks of trapping from March – October because the beetles fly any time the ambient temperature is over 20°C. They do not fly when it is colder, though they continue to develop in the host plant above 12°C.

B) Traps and lures – We are using homemade traps consisting of two connected plastic bottles and soapy water collection basins (Appendix A) set on stands, which cost approximately $8 each for materials. (Note: some or all of the cost for traps/stands/lures may be donated or provided by another grant proposal.) The lures are made of quercivorol, an aggregating hormone, and are placed in the top of the traps. Lures cost $6/lure and last for six weeks. Traps are placed on stakes outside the dripline at mid-trunk level of adjacent trees. A few drops of Dawn dish soap is added to a cup of water in the bottom of the trap.

C) Deployment/Sample collection schedule - The deployment and sample collection schedule will be 1 day/week. Routes will minimize mileage as much as possible and relies heavily on volunteer assistance. The use of soapy water requires checking traps weekly to preserve the insects for analysis and for early detection. The sample collection procedure is simple: unscrew the trap's bottom bottle with the catch basin, drain it through a V-shaped coffee filter, and store the labeled sample in a ziplock bag in the refrigerator until dropped off at the RCDSMM office during weekday office hours.

Task 3 Sample collection and Analysis

A) Sample Screening – The preliminary screening for ambrosia beetles in each sample will take place at RCDSMM headquarters. The RCDSMM Field Biologist will train the AmeriCorps Watershed Steward intern and NPS interns to do the preliminary sorting where any potential shot hole borers, western oak bark beetles or gold spotted oak borers are separated out of the sample. Each sample should take approximately 30 minutes to process. Samples from each trap/event will be kept separate during screening and the sorted with beetles per each trap/date stored in 95% ethanol in a labeled bottle. Any other organisms collected in the sample will also be collected in a separate bottle and labeled by trap/date. Any potential problem beetle samples will be sent to the Stouthamer lab for further identification. All samples will be archived at the RCDSMM office or at UC Riverside.

B) Confirmation of Identification – The Stouthamer Lab at UCR will confirm the identification of the ambrosia beetle samples at $1/sample, and additionally, a random sub-sample will be submitted for DNA processing at $5/sample.

RESULTS AND REPORTING

Funding for this effort ends in October 2017 and therefore the final report detailing all results of the trapping effort will be shared at that time.

Beetle Detection Bottle Trap Instructions

TO DEPLOY YOUR TRAP

1. Configure lure to hang on bottle using twist tie at the top of the upper bottle.
2. Put 5 drops of dawn liquid detergent and 1 cup of water into the small 16 oz bottle.
3. Hang trap with the opening facing the trees and the bottom of the trap between 3-6 feet off the ground from a gate, post or fence located outside the dripline of the nearby trees. Secure well so the wind does not blow it away.
4. Take a photo of the location showing the trap and nearby trees.
5. Using Google Earth or Maps, or a GPS unit, record the latitude and longitude in decimal degrees for the trap location.
6. Please provide: **Your name, address, email and phone number, trap photo and GPS coordinates to Rosi Dagit (rdagit@rcdsmm.org) to be included into the database.**

COLLECTING SAMPLES WEEKLY

Because we are using water in the trap, the bugs will turn to mush unless they are collected every 7-10 days!!!!!

1. Use a permanent marker or pencil (pen ink will run!) to label a coffee filter with the date, your name, email, phone number and address of the trap location.

(NOTE: If you have adopted one of the RCDSMM traps, use the Trap Code Name)

2. Unscrew the smaller lower bottle and pour the water through the labeled coffee filter.

3. Place the coffee filter inside a Ziploc baggie that ALSO is labeled with date, your name, email, phone and trap location information.

4. Store the sample in your refrigerator immeditately. It must remain cold or the bugs will disintegrate!

DROP OFF SAMPLES WITHIN 1-2 DAYS TO RCD

Place samples in the cooler labeled **BUGS GO HERE** located near the front of the RCD Office 540 S. Topanga Canyon Blvd, Topanga, CA 90290.

PLEASE BRING SAMPLES AS SOON AS POSSIBLE!!!

The longer the time between collection and analysis, the more bugs will turn to mush and not be identifiable!

Become a Detection Detective!

Help track the spread of Polyphagous/Kuroshio shot hole borers

Sign up to share your trap information and learn where to place your traps, how often to check them, how to collect samples, and where to take the samples you collect at www.rcdsmm.org/resources/oaktrees/trapping

TO BUILD YOUR TRAP

STEP 1.

Take 2L plastic soda bottle and measure 6cm from the bottom center along the side of the bottle. Mark it. From that mark, measure out and trace a 13 cm long by 17 cm wide panel on the outside of the bottle.

STEP 2.

Using the razor/box cutter, cut the panel out along the marked lines to create a large opening.

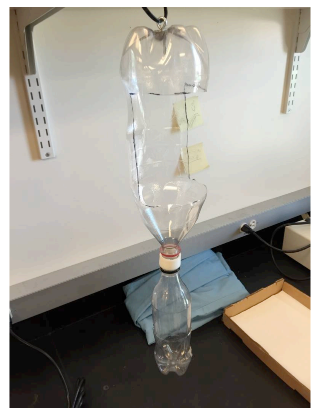
Materials needed:

Clear 2L bottle
**Pepsi products only*
Clear 16oz bottle
**Pepsi or Coke Product only*
Eye Bolts with Nut
5/32 x 1.5/8
Drill with 5/32 bit
3Dprinted
"Connector" OR
2" radiator clamp
Lure
Dawn dish soap
V-shaped coffee filter
Ziplock baggie
Sharpie

STEP 3.

Use a drill (bit 5/32") to create a hole at the bottom center of the bottle for the eye bolt and nut.

STEP 4. Insert eye bolt and secure nut to hole. Put 1 cup of water and 5 drops of Dawn dish soap into the 16 oz bottle. Twist on either a 3D printed connector (available upon request from the RCDSMM) or use a small 2 inch wide radiator screw clamp to connect the opening of the 2L bottle with the opening of the 16 oz bottle.



STEP 5. Attach the lure inside the 2L bottle by hanging from the nut end with a string. Ambrosia Beetle Lure Product # 3361 cost $12@, last 6 weeks and should be ordered from Synergy Semiochemicals: *http://www.semiochemical.com/html/ambrosia_beetles.html#lures*

STEP 6. DEPLOY the TRAP: Traps should be placed on a stake or hung just outside of the dripline of the tree, approximately half way up the height of the trunk. . Take photo of the trap showing the tree as well. Fill in the information on the DETECTION DETECTIVE website to sign up and send in the photo and GPS coordinates.

STEP 7: Once a week, pour out the water from the 16 oz bottle through a V shaped coffee filter. Place filter in Ziploc bag, write date, name and address on it. Keep in the refrigerator until you drop it off at the RCDSMM office 540. S. Topanga Canyon Blvd., Topanga CA 90290. Please call ahead (818.587.8627 x102) to make sure someone is in the office to collect your sample!

Add more water and 5 drops of Dawn to the small bottle and reset the trap!

APPENDIX E

OUTREACH EVENTS AND PUBLICATIONS

December 2017

PUBLICATIONS AND VIDEO LINKS

Videos:

JPL NASA DEVELOP projects
Santa Monica Mountains Ecological Forecasting I
https://www.youtube.com/watch?v=T4LdzkY-V7I

JPL NASA DEVELOP projects
Santa Monica Mountains Ecological Forecasting II
https://www.youtube.com/watch?v=aSv9

Publications:

Dagit, Rosi. 2 June 2017. NASA's down-to-earth view of drought impacts. Messenger Mountain News Vol 1(10):14 http://messengermountainnews.com/e-issues/

Dagit, Rosi. 17 November 2017. Taking Care of our Trees during drought. Messenger Mountain News Vol 1(22):11 http://messengermountainnews.com/e-issues/

Sahagun, Louis. 5 December 2017. Drought and bugs have killed tens of thousands of trees in the Santa Monica Mountains. LA Times. http://www.latimes.com/local/california/la-me-santa-monica-mountains-trees20171205-story.

RCDSMM TREE PEST ACTIVITIES LOG
FOR UCANR AND LA COUNTY

October 2016
Docent training for Malibu Creek to set plots and tag trees
Community meeting on PSHB issues

December 2016
Obtained grant from LA County
Coordinated stakeholder meeting for NASA project
Participated in San Diego meeting on PSHB

January 2017
Set up work plan and volunteer schedule for Tree Study
Got funding from SMMRLC for riparian trapping for PSHB
Shared data sheets with SD PSHB group
Coordinated and participated in web meeting for NASA Project
Presentation to Santa Susanna State Historic Park Docents

February 2017
Presentation to Santa Monica Mountains NRA Science Day
Set up study plots for trapping in Arroyo Sequit, Big Sycamore, Malibu, Solstice, Ramirez, Ranch Sierra Vista Satwiwa, Las Virgenes Open Space Preserve
Organized volunteer training day for trapping and spread the word

March 2017
Completed establishment of oak plots, set up database and maps, trained team members on collecting samples and analysis. Participated in NASA call and went to presentation at JPL at the end of the project. Continued email communication with TAC members and set up meeting for 13 April to finalize the deliverables from NASA. Participated in several conference calls for regional SHB efforts.

DETECTION DETECTIVE trap making meeting in Malibu Creek State Park.

April 2017
Coordinated the final presentation of the NASA work to all TAC members. Prepared an article for the Messenger. Coordinated on-going trap monitoring, maintenance, sample collection and analysis. Sent first batch of bad bugs to UCR for DNA analysis. Participated in several conference calls for regional SHB efforts.

May 2017
Coordinated revision and second proposal for the NASA work with all TAC members. Prepared an article for the Messenger. Coordinated on-going trap monitoring, maintenance, sample collection and analysis. Sent more bad bugs to UCR for DNA analysis. Participated in several conference calls for regional SHB efforts and

reviewed/commented on draft regional plan. Set up water meter with state parks to care for restoration plantings in lower Topanga.

Worked with Julie Clark de Basio on outreach to Brentwood area.

June 2017
Coordinated on-going trap monitoring, maintenance, sample collection and analysis. Sent more bad bugs to UCR for DNA analysis. Got confirmation of SHB id for Calabasas sites and WOBB id for Tapia, Topanga state park and other sites. One SHB site confirmed in Topanga but no trees currently experiencing die back. Checked out some of the greenwaste facilities and thanks to help from volunteers John Lukar and Wendi Gladstone got traps installed nearby.

Participated in several conference calls for regional SHB efforts and reviewed/commented on draft regional plan.

Set up water meter with state parks to care for restoration plantings in lower Topanga.

July 2017
Continued weekly trap monitoring. Sent more suspected bad beetles to UCR. Outreach to city of Calabasas and MRT to get more monitoring going near their infestation. Conducted tree care event for 30 people on Sat 8 July.

August 2017
Worked with NASA to set up next project. Coordinated bad beetle trapping and data input/management. Site visit to Entrado Rd to confirm SHB presence. Met with LA County District 3 staff regarding tree management problems.

September 2017
Calls and emails with NASA to get project up and running. Kick off meeting and site visit took place on 25 Sept. Attended by 15 TAC members and citizen scientists.

Presentation on the drought/beetle project to ISA meeting in Anaheim attended by 160 people.

Coordinated and supervised all tree condition oak plot data collection for over 340 trees. Completed all trap sampling and pulled traps out. Sent last batch of samples to UCR to confirm id.

October 2017
Participated in regional SHB management group and education and outreach committee conference calls.

Conducted training in the field with 35 MRT volunteers on Monday 2 October and then met with the City Manager at Calabasas to discuss coordinated efforts on city managed landscapes.

Coordinated tree care event on Saturday 7 October for 20 volunteers. Presentation to CNPS meeting on 10 October attended by 20 people on the drought and beetles. NASA update call on 11 Oct and worked with LA County Regional Planning GIS and NPS to obtain required GIS files.

Presentation to Sierra Club meeting on 17 Oct attended by 15 people and to 45 Topanga Canyon Docents on Sat 21 October on the drought and beetles.

Worked with staff on data management and analysis, updating the maps and figures.

Set up community meeting presentation for 5 December at the Topanga Library 630-8 pm. Send info to the Messenger Mountain News on firewood purchasing info. Prepared tree care article for the Messenger.

Started work on final reports for Southern CA Research Learning Center Research Brief and LA County.

November 2017
Prepared draft final report and power point presentation for community meeting with NASA team. Completed final data analysis, map revisions, and report appendixes.

Submitted the Research Brief to NPS and shared with UCANR community.

Attended the NASA team final presentation 17 November at JPL.

Submitted a press release on project results to all local news media.

December 2017
Completed the final report for the county and submitted to all TAC stakeholders, other funders including NPS and LA County Fish and Game Commission.

Over 30 people attended a community meeting to share results on 5 December at the Topanga Library. The meeting was video-taped and the final product will be available online by early January.

Met with LA Times reporter for a story released on 5 December 2017.

Prepared all the “good” bug samples for transfer to LA County Natural History Museum.

APPENDIX F

i-Tree Report

DECEMBER 2017

Benefits Summary By Species

Location: Topanga, Los Angeles, California, United States of America
Project: SMM, Series: Oaks, Year: 2017
Generated: 11/28/2017

	Trees	Carbon Storage		Gross Carbon Sequestration		Avoided Runoff		Pollution Removal		Structural Value
Species	**Number**	**Ton**	**$**	**Ton/Yr**	**$/yr**	**ft3/yr**	**$/yr**	**Ton/Yr**	**$/yr**	**$**
Mimosa	3	0.83	107.76	0.04	5.54	16.01	1.07	0.00	0.00	11,055.69
White alder	5	4.50	583.38	0.14	18.53	37.36	2.50	0.00	0.00	40,801.37
Laurel sumac	1	0.14	18.52	0.01	1.32	0.77	0.05	0.00	0.00	2,621.52
Mioporo	1	0.40	51.71	0.02	2.39	7.68	0.51	0.00	0.00	4,685.66
California sycamore	14	25.86	3,354.86	0.36	46.23	292.11	19.53	0.00	0.00	214,328.57
Coastal live oak	266	604.57	78,429.79	8.79	1,139.96	2,914.48	194.82	0.00	0.00	5,459,032.32
California white oak	4	1.18	153.23	0.06	7.65	15.64	1.05	0.00	0.00	16,643.68
Neomexican elderberry	1	0.52	66.94	0.02	2.79	1.72	0.11	0.00	0.00	6,022.48
Arroya willow	20	19.34	2,508.40	0.47	60.96	137.89	9.22	0.00	0.00	117,667.47
Total	**315**	**657.34**	**85,274.60**	**9.91**	**1,285.36**	**3,423.65**	**228.86**	**0.00**	**0.00**	**5,872,858.77**

Carbon storage and gross carbon sequestration value is calculated based on the price of $129.73 per ton
Avoided runoff value is calculated by the price $0.067/ft³. The user-designated weather station reported 7.5 inches of total annual precipitation.
Pollution removal value is calculated based on the prices of $0.000 per ton (CO), $0.000 per ton (O3), $0.000 per ton (NO2), $0.000 per ton (SO2), $0.000 per ton (PM2.5)
Structural value is the compensatory value calculated based on the local cost of having to replace a tree with a similar tree.

i-Tree
Ecosystem Analysis

SMM

Urban Forest Effects and Values
November 2017

Summary

Understanding an urban forest's structure, function and value can promote management decisions that will improve human health and environmental quality. An assessment of the vegetation structure, function, and value of the SMM urban forest was conducted during 2017. Data from 314 trees located throughout SMM were analyzed using the i-Tree Eco model developed by the U.S. Forest Service, Northern Research Station.

- Number of trees: 314
- Tree cover: 10.38 acres
- Most common species of trees: Coastal live oak, Arroya willow, California sycamore
- Percentage of trees less than 6" (15.2 cm) diameter: 3.5%
- Pollution removal: 0 tons/year ($0/year)
- Carbon storage: 657.3 tons ($85.3 thousand)
- Carbon sequestration: 9.908 tons/year ($1.29 thousand/year)
- Oxygen production: 26.42 tons/year
- Avoided runoff: 3424 cubic feet/year ($229/year)
- Building energy savings: n/a – data not collected
- Avoided carbon emissions: n/a – data not collected
- Structural values: $5.87 million

Ton: short ton (U.S.) (2,000 lbs)
Monetary values $ are reported in US Dollars throughout the report except where noted
Ecosystem service estimates are reported for trees.

For an overview of i-Tree Eco methodology, see Appendix I. Data collection quality is determined by the local data collectors, over which i-Tree has no control.

Table of Contents

I. Tree Characteristics of the Urban Forest

The urban forest of SMM has 314 trees with a tree cover of 10.38 acres. The three most common species are Coastal live oak (84.7 percent), Arroya willow (6.4 percent), and California sycamore (4.5 percent).

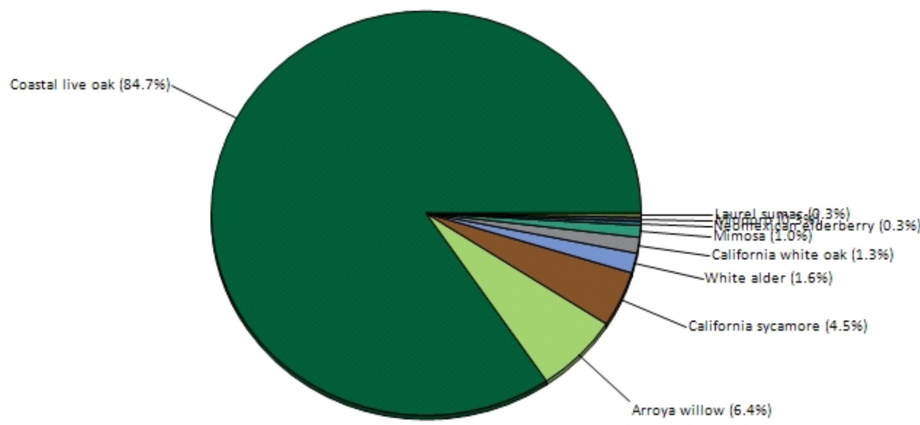


Figure 1. Tree species composition in SMM

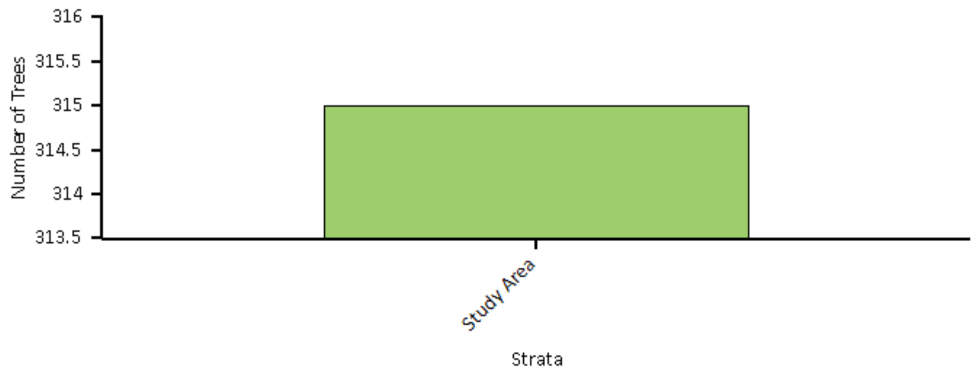


Figure 2. Number of trees in SMM by strata

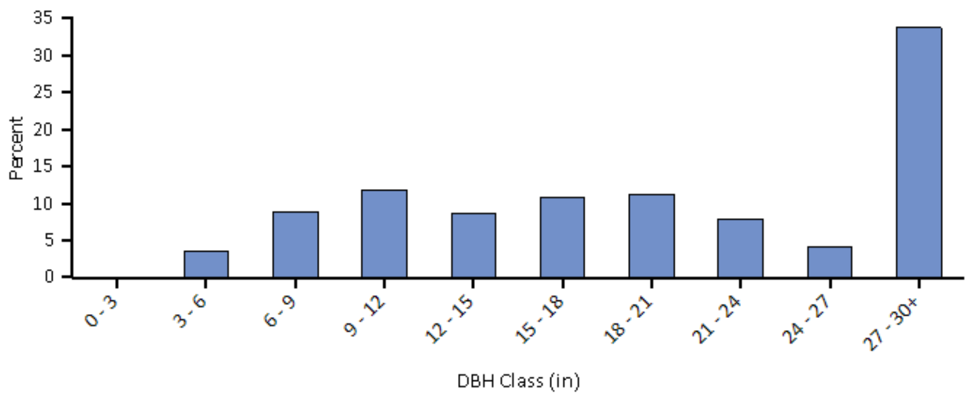


Figure 3. Percent of tree population by diameter class (DBH=stem diameter at 4.5 feet)

Urban forests are composed of a mix of native and exotic tree species. Thus, urban forests often have a tree diversity that is higher than surrounding native landscapes. Increased tree diversity can minimize the overall impact or destruction by a species-specific insect or disease, but it can also pose a risk to native plants if some of the exotic species are invasive plants that can potentially out-compete and displace native species. In SMM, about 98 percent of the trees are species native to North America, while 98 percent are native to California. Species exotic to North America make up 2 percent of the population. Most exotic tree species have an origin from Asia (1 percent of the species).

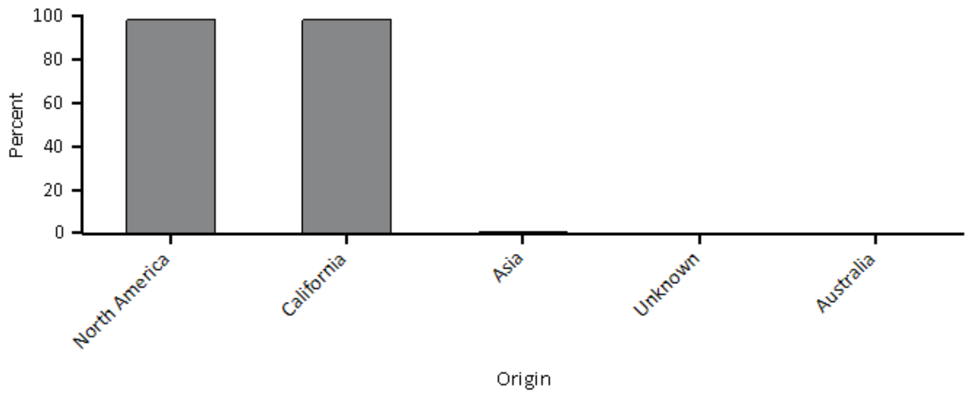


Figure 4. Percent of live tree population by area of native origin, SMM

Invasive plant species are often characterized by their vigor, ability to adapt, reproductive capacity, and general lack of natural enemies. These abilities enable them to displace native plants and make them a threat to natural areas (National Invasive Species Information Center 2011). Zero of the 9 tree species in SMM are identified as invasive on the state invasive species list (California Invasive Species Advisory Committee 2010).

II. Urban Forest Cover and Leaf Area

Many tree benefits equate directly to the amount of healthy leaf surface area of the plant. Trees cover about 10.38 acres of SMM and provide 36.48 acres of leaf area.

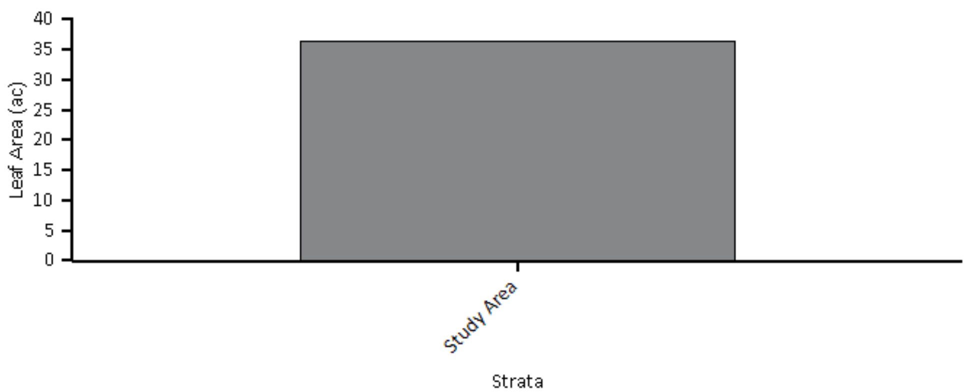


Figure 5. Leaf area by strata, SMM

In SMM, the most dominant species in terms of leaf area are Coastal live oak, California sycamore, and Arroya willow. The 10 species with the greatest importance values are listed in Table 1. Importance values (IV) are calculated as the sum of percent population and percent leaf area. High importance values do not mean that these trees should necessarily be encouraged in the future; rather these species currently dominate the urban forest structure.

Table 1. Most important species in SMM

Species Name	*Percent Population*	*Percent Leaf Area*	*IV*
Coastal live oak	84.4	85.1	169.6
California sycamore	4.4	8.5	13.0
Arroya willow	6.3	4.0	10.4
White alder	1.6	1.1	2.7
California white oak	1.3	0.5	1.7
Mimosa	1.0	0.5	1.4
Mioporo	0.3	0.2	0.5
Neomexican elderberry	0.3	0.1	0.4
Laurel sumac	0.3	0.0	0.3

Common ground cover classes (including cover types beneath trees and shrubs) in SMM are not available since they are configured not to be collected.

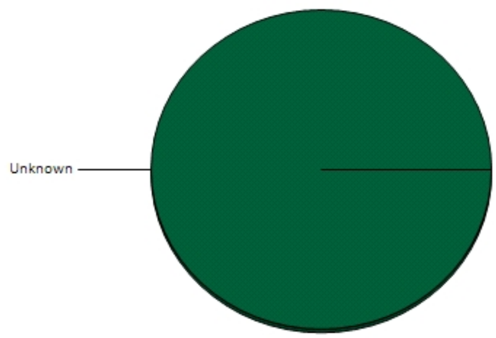


Figure 6. Percent of land by ground cover classes, SMM

III. Air Pollution Removal by Urban Trees

Poor air quality is a common problem in many urban areas. It can lead to decreased human health, damage to landscape materials and ecosystem processes, and reduced visibility. The urban forest can help improve air quality by reducing air temperature, directly removing pollutants from the air, and reducing energy consumption in buildings, which consequently reduces air pollutant emissions from the power sources. Trees also emit volatile organic compounds that can contribute to ozone formation. However, integrative studies have revealed that an increase in tree cover leads to reduced ozone formation (Nowak and Dwyer 2000).

Pollution removal[1] by trees in SMM was estimated using field data and recent available pollution and weather data available. Pollution removal was greatest for PM2.5 (Figure 7). It is estimated that trees remove 0 tons of air pollution (ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), particulate matter less than 2.5 microns (PM2.5)[2], and sulfur dioxide (SO2)) per year with an associated value of $0 (see Appendix I for more details).

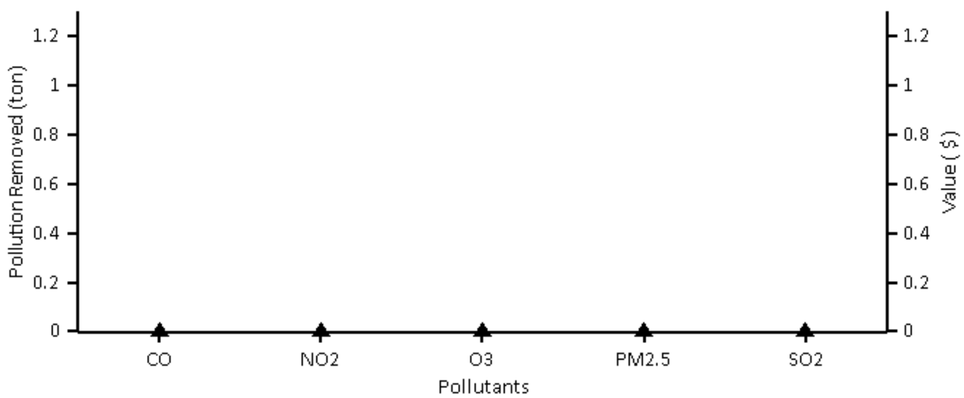


Figure 7. Annual pollution removal (points) and value (bars) by urban trees, SMM

[1] Particulate matter less than 10 microns is a significant air pollutant. Given that i-Tree Eco analyzes particulate matter less than 2.5 microns (PM2.5) which is a subset of PM10, PM10 has not been included in this analysis. PM2.5 is generally more relevant in discussions concerning air pollution effects on human health.

[2] Trees remove PM2.5 when particulate matter is deposited on leaf surfaces. This deposited PM2.5 can be resuspended to the atmosphere or removed during rain events and dissolved or transferred to the soil. This combination of events can lead to positive or negative pollution removal and value depending on various atmospheric factors (see Appendix I for more details).

In 2017, trees in SMM emitted an estimated 1.134 tons of volatile organic compounds (VOCs) (1.118 tons of isoprene and 0.01672 tons of monoterpenes). Emissions vary among species based on species characteristics (e.g. some genera such as oaks are high isoprene emitters) and amount of leaf biomass. Ninety-eight percent of the urban forest's VOC emissions were from Coastal live oak and Arroya willow. These VOCs are precursor chemicals to ozone formation.[3]

General recommendations for improving air quality with trees are given in Appendix VIII.

[3] Some economic studies have estimated VOC emission costs. These costs are not included here as there is a tendency to add positive dollar estimates of ozone removal effects with negative dollar values of VOC emission effects to determine whether tree effects are positive or negative in relation to ozone. This combining of dollar values to determine tree effects should not be done, rather estimates of VOC effects on ozone formation (e.g., via photochemical models) should be conducted and directly contrasted with ozone removal by trees (i.e., ozone effects should be directly compared, not dollar estimates). In addition, air temperature reductions by trees have been shown to significantly reduce ozone concentrations (Cardelino and Chameides 1990; Nowak et al 2000), but are not considered in this analysis. Photochemical modeling that integrates tree effects on air temperature, pollution removal, VOC emissions, and emissions from power plants can be used to determine the overall effect of trees on ozone concentrations.

IV. Carbon Storage and Sequestration

Climate change is an issue of global concern. Urban trees can help mitigate climate change by sequestering atmospheric carbon (from carbon dioxide) in tissue and by altering energy use in buildings, and consequently altering carbon dioxide emissions from fossil-fuel based power sources (Abdollahi et al 2000).

Trees reduce the amount of carbon in the atmosphere by sequestering carbon in new growth every year. The amount of carbon annually sequestered is increased with the size and health of the trees. The gross sequestration of SMM trees is about 9.908 tons of carbon per year with an associated value of $1.29 thousand. See Appendix I for more details on methods.

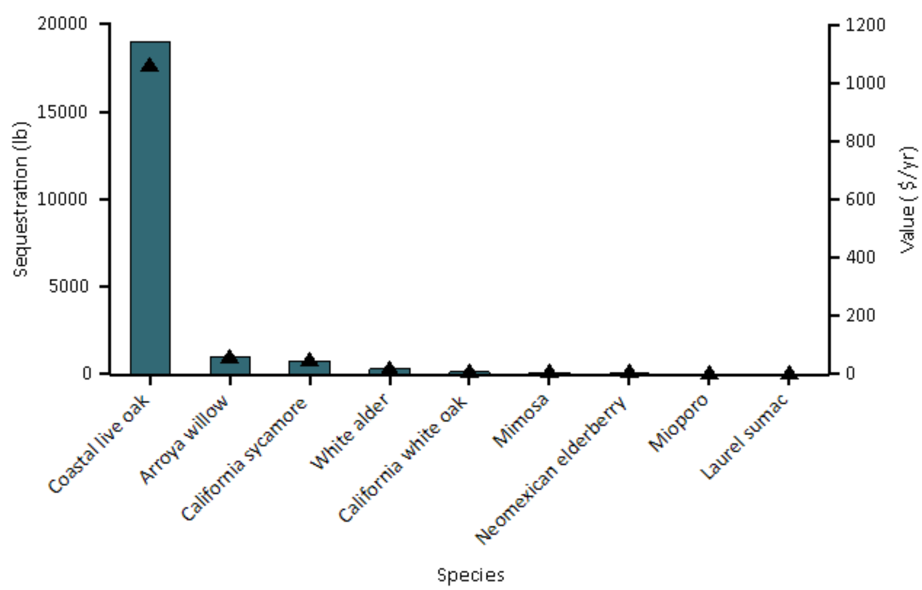


Figure 8. Estimated annual gross carbon sequestration (points) and value (bars) for urban tree species with the greatest sequestration, SMM

Carbon storage is another way trees can influence global climate change. As a tree grows, it stores more carbon by holding it in its accumulated tissue. As a tree dies and decays, it releases much of the stored carbon back into the atmosphere. Thus, carbon storage is an indication of the amount of carbon that can be released if trees are allowed to die and decompose. Maintaining healthy trees will keep the carbon stored in trees, but tree maintenance can contribute to carbon emissions (Nowak et al 2002c). When a tree dies, using the wood in long-term wood products, to heat buildings, or to produce energy will help reduce carbon emissions from wood decomposition or from fossil-fuel or wood-based power plants.

Trees in SMM are estimated to store 657.3 tons of carbon ($85.3 thousand). Of the species sampled, Coastal live oak stores and sequesters the most carbon (approximately 92% of the total carbon stored and 88.7% of all sequestered carbon.)

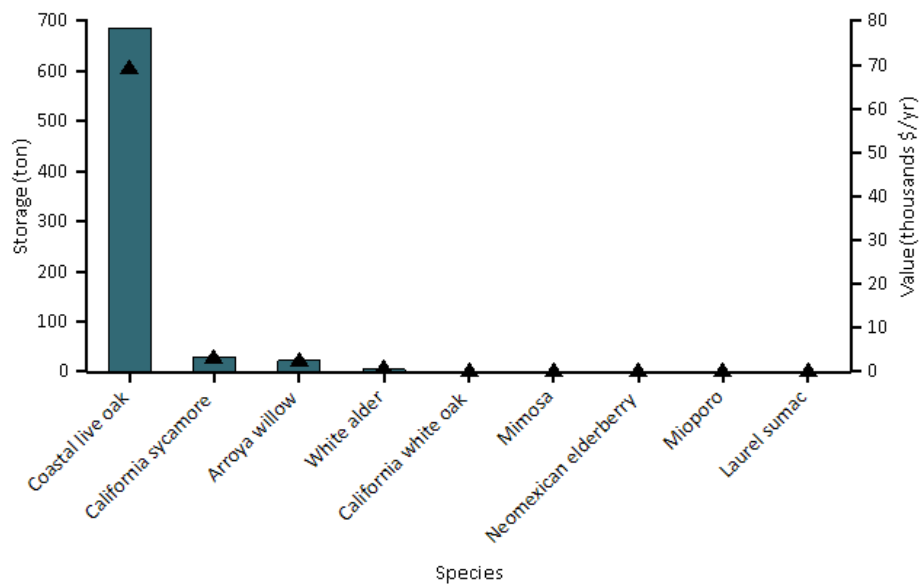


Figure 9. Estimated carbon storage (points) and values (bars) for urban tree species with the greatest storage, SMM

V. Oxygen Production

Oxygen production is one of the most commonly cited benefits of urban trees. The annual oxygen production of a tree is directly related to the amount of carbon sequestered by the tree, which is tied to the accumulation of tree biomass.

Trees in SMM are estimated to produce 26.42 tons of oxygen per year.[4] However, this tree benefit is relatively insignificant because of the large and relatively stable amount of oxygen in the atmosphere and extensive production by aquatic systems. Our atmosphere has an enormous reserve of oxygen. If all fossil fuel reserves, all trees, and all organic matter in soils were burned, atmospheric oxygen would only drop a few percent (Broecker 1970).

Table 2. The top 20 oxygen production species.

Species	*Oxygen (ton)*	*Gross Carbon Sequestration (pound/yr)*	*Number of Trees*	*Leaf Area (acre)*
Coastal live oak	23.43	17,574.64	266	31.05
Arroya willow	1.25	939.86	20	1.47
California sycamore	0.95	712.67	14	3.11
White alder	0.38	285.72	5	0.40
California white oak	0.16	117.94	4	0.17
Mimosa	0.11	85.34	3	0.17
Neomexican elderberry	0.06	43.07	1	0.02
Mioporo	0.05	36.83	1	0.08
Laurel sumac	0.03	20.32	1	0.01

VI. Avoided Runoff

Surface runoff can be a cause for concern in many urban areas as it can contribute pollution to streams, wetlands, rivers, lakes, and oceans. During precipitation events, some portion of the precipitation is intercepted by vegetation (trees and shrubs) while the other portion reaches the ground. The portion of the precipitation that reaches the ground and does not infiltrate into the soil becomes surface runoff (Hirabayashi 2012). In urban areas, the large extent of impervious surfaces increases the amount of surface runoff.

Urban trees and shrubs, however, are beneficial in reducing surface runoff. Trees and shrubs intercept precipitation, while their root systems promote infiltration and storage in the soil. The trees and shrubs of SMM help to reduce runoff by an estimated 3.42 thousand cubic feet a year with an associated value of $230 (see Appendix I for more details). Avoided runoff is estimated based on local weather from the user-designated weather station. In SMM, the total annual precipitation in 2015 was 7.5 inches.

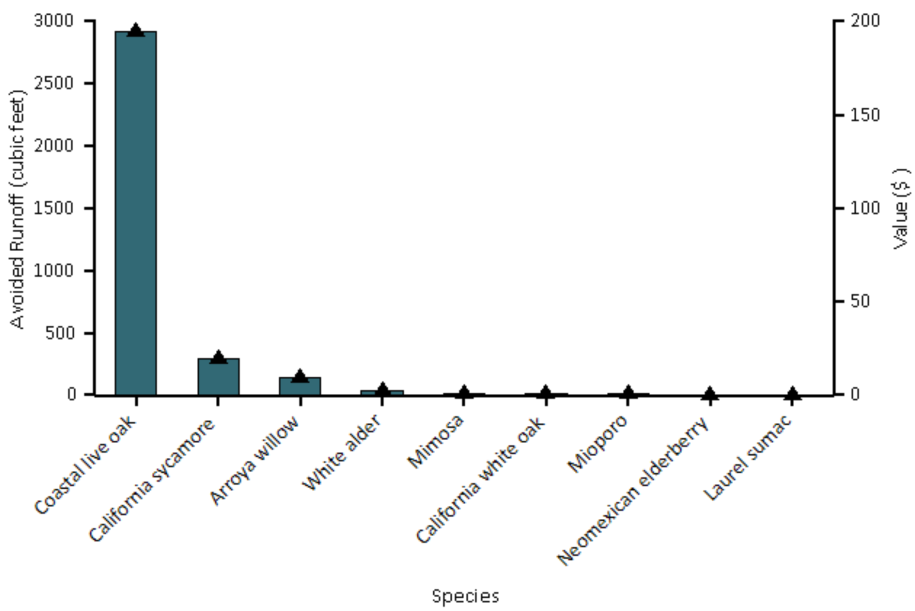


Figure 10. Avoided runoff (points) and value (bars) for species with greatest overall impact on runoff, SMM

VII. Trees and Building Energy Use

Trees affect energy consumption by shading buildings, providing evaporative cooling, and blocking winter winds. Trees tend to reduce building energy consumption in the summer months and can either increase or decrease building energy use in the winter months, depending on the location of trees around the building. Estimates of tree effects on energy use are based on field measurements of tree distance and direction to space conditioned residential buildings (McPherson and Simpson 1999).

Because energy-related data were not collected, energy savings and carbon avoided cannot be calculated.

Table 3. Annual energy savings due to trees near residential buildings,SMM

	Heating	*Cooling*	*Total*
MBTU[a]	0	n/a	0
MWH[b]	0	0	0
Carbon avoided (pounds)	0	0	0

[a]MBTU = one million British Thermal Units

[b]MWH = megawatt-hour

Table 4. Annual savings[a] ($) in residential energy expenditure during heating and cooling seasons, SMM

	Heating	*Cooling*	*Total*
MBTU[b]	0	n/a	0
MWH[c]	0	0	0
Carbon avoided	0	0	0

[b]Based on the prices of $154.53 per MWH and $11.38 per MBTU (see Appendix I for more details)

[c]MBTU = one million British Thermal Units

[c]MWH = megawatt-hour

[5] Trees modify climate, produce shade, and reduce wind speeds. Increased energy use or costs are likely due to these tree-building interactions creating a cooling effect during the winter season. For example, a tree (particularly evergreen species) located on the southern side of a residential building may produce a shading effect that causes increases in heating requirements.

VIII. Structural and Functional Values

Urban forests have a structural value based on the trees themselves (e.g., the cost of having to replace a tree with a similar tree); they also have functional values (either positive or negative) based on the functions the trees perform.

The structural value of an urban forest tends to increase with a rise in the number and size of healthy trees (Nowak et al 2002a). Annual functional values also tend to increase with increased number and size of healthy trees. Through proper management, urban forest values can be increased; however, the values and benefits also can decrease as the amount of healthy tree cover declines.

Urban trees in SMM have the following structural values:

- Structural value: $5.87 million
- Carbon storage: $85.3 thousand

Urban trees in SMM have the following annual functional values:

- Carbon sequestration: $1.29 thousand
- Avoided runoff: $229
- Pollution removal: $0
- Energy costs and carbon emission values: $0.00

(Note: negative value indicates increased energy cost and carbon emission value)

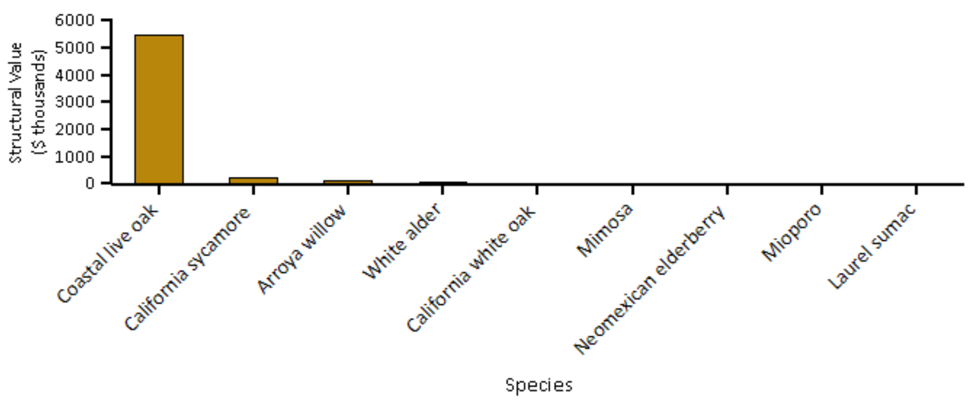


Figure 11. Tree species with the greatest structural value, SMM

IX. Potential Pest Impacts

Various insects and diseases can infest urban forests, potentially killing trees and reducing the health, structural value and sustainability of the urban forest. As pests tend to have differing tree hosts, the potential damage or risk of each pest will differ among cities. Thirty-six pests were analyzed for their potential impact and compared with pest range maps (Forest Health Technology Enterprise Team 2014) for the conterminous United States to determine their proximity to Los Angeles County. Seven of the thirty-six pests analyzed are located within the county. For a complete analysis of all pests, see Appendix VII.

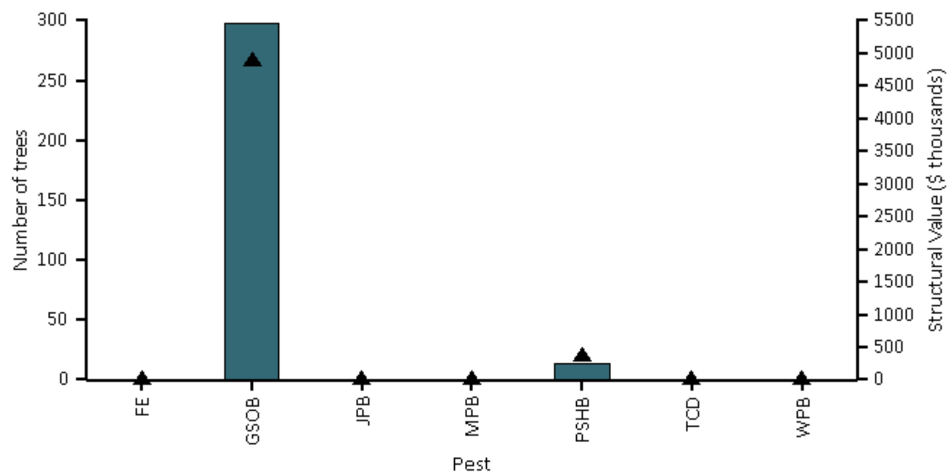


Figure 12. Number of trees at risk (points) and associated compensatory value (bars) for most threatening pests located in the county, SMM

One common pest of white fir, grand fir, and red fir trees is the fir engraver (FE) (Ferrell 1986). FE poses a threat to 0.0 percent of the SMM urban forest, which represents a potential loss of $0 in structural value.

Infestations of the goldspotted oak borer (GSOB) (Society of American Foresters 2011) have been a growing problem in southern California. Potential loss of trees from GSOB is 84.7 percent ($5.46 million in structural value).

The Jeffrey pine beetle (JPB) (Smith et al 2009) is native to North America and is distributed across California, Nevada, and Oregon where its only host, Jeffrey pine, also occurs. This pest threatens 0.0 percent of the population, which represents a potential loss of $0 in structural value.

Mountain pine beetle (MPB) (Gibson et al 2009) is a bark beetle that primarily attacks pine species in the western United States. MPB has the potential to affect 0.0 percent of the population ($0 in structural value).

Polyphagous shot hole borer (PSHB) (University of California 2014) is a boring beetle that was first detected in California. SMM could possibly lose 6.1 percent of its trees to this pest ($255 thousand in structural value).

Thousand canker disease (TCD) (Cranshaw and Tisserat 2009; Seybold et al 2010) is an insect-disease complex that kills several species of walnuts, including black walnut. Potential loss of trees from TCD is 0.0 percent ($0 in structural value).

The western pine beetle (WPB) (DeMars and Roettgering 1982) is a bark beetle and aggressive attacker of ponderosa and Coulter pines. This pest threatens 0.0 percent of the population, which represents a potential loss of $0 in structural value.

Appendix I. i-Tree Eco Model and Field Measurements

i-Tree Eco is designed to use standardized field data and local hourly air pollution and meteorological data to quantify urban forest structure and its numerous effects (Nowak and Crane 2000), including:

- Urban forest structure (e.g., species composition, tree health, leaf area, etc.).
- Amount of pollution removed hourly by the urban forest, and its associated percent air quality improvement throughout a year.
- Total carbon stored and net carbon annually sequestered by the urban forest.
- Effects of trees on building energy use and consequent effects on carbon dioxide emissions from power sources.
- Structural value of the forest, as well as the value for air pollution removal and carbon storage and sequestration.
- Potential impact of infestations by pests, such as Asian longhorned beetle, emerald ash borer, gypsy moth, and Dutch elm disease.

Typically, all field data are collected during the leaf-on season to properly assess tree canopies. Typical data collection (actual data collection may vary depending upon the user) includes land use, ground and tree cover, individual tree attributes of species, stem diameter, height, crown width, crown canopy missing and dieback, and distance and direction to residential buildings (Nowak et al 2005; Nowak et al 2008).

During data collection, trees are identified to the most specific taxonomic classification possible. Trees that are not classified to the species level may be classified by genus (e.g., ash) or species groups (e.g., hardwood). In this report, tree species, genera, or species groups are collectively referred to as tree species.

<u>Tree Characteristics:</u>

Leaf area of trees was assessed using measurements of crown dimensions and percentage of crown canopy missing. In the event that these data variables were not collected, they are estimated by the model.

An analysis of invasive species is not available for studies outside of the United States. For the U.S., invasive species are identified using an invasive species list (California Invasive Species Advisory Committee 2010)for the state in which the urban forest is located. These lists are not exhaustive and they cover invasive species of varying degrees of invasiveness and distribution. In instances where a state did not have an invasive species list, a list was created based on the lists of the adjacent states. Tree species that are identified as invasive by the state invasive species list are cross-referenced with native range data. This helps eliminate species that are on the state invasive species list, but are native to the study area.

<u>Air Pollution Removal:</u>

Pollution removal is calculated for ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide and particulate matter less than 2.5 microns. Particulate matter less than 10 microns (PM10) is another significant air pollutant. Given that i-Tree Eco analyzes particulate matter less than 2.5 microns (PM2.5) which is a subset of PM10, PM10 has not been included in this analysis. PM2.5 is generally more relevant in discussions concerning air pollution effects on human health.

Air pollution removal estimates are derived from calculated hourly tree-canopy resistances for ozone, and sulfur and nitrogen dioxides based on a hybrid of big-leaf and multi-layer canopy deposition models (Baldocchi 1988; Baldocchi et al 1987). As the removal of carbon monoxide and particulate matter by vegetation is not directly related to transpiration, removal rates (deposition velocities) for these pollutants were based on average measured values from the literature (Bidwell and Fraser 1972; Lovett 1994) that were adjusted depending on leaf phenology and leaf area.

Particulate removal incorporated a 50 percent resuspension rate of particles back to the atmosphere (Zinke 1967). Recent updates (2011) to air quality modeling are based on improved leaf area index simulations, weather and pollution processing and interpolation, and updated pollutant monetary values (Hirabayashi et al 2011; Hirabayashi et al 2012; Hirabayashi 2011).

Trees remove PM2.5 when particulate matter is deposited on leaf surfaces (Nowak et al 2013). This deposited PM2.5 can be resuspended to the atmosphere or removed during rain events and dissolved or transferred to the soil. This combination of events can lead to positive or negative pollution removal and value depending on various atmospheric factors. Generally, PM2.5 removal is positive with positive benefits. However, there are some cases when net removal is negative or resuspended particles lead to increased pollution concentrations and negative values. During some months (e.g., with no rain), trees resuspend more particles than they remove. Resuspension can also lead to increased overall PM2.5 concentrations if the boundary layer conditions are lower during net resuspension periods than during net removal periods. Since the pollution removal value is based on the change in pollution concentration, it is possible to have situations when trees remove PM2.5 but increase concentrations and thus have negative values during periods of positive overall removal. These events are not common, but can happen.

For reports in the United States, default air pollution removal value is calculated based on local incidence of adverse health effects and national median externality costs. The number of adverse health effects and associated economic value is calculated for ozone, sulfur dioxide, nitrogen dioxide, and particulate matter less than 2.5 microns using data from the U.S. Environmental Protection Agency's Environmental Benefits Mapping and Analysis Program (BenMAP) (Nowak et al 2014). The model uses a damage-function approach that is based on the local change in pollution concentration and population. National median externality costs were used to calculate the value of carbon monoxide removal (Murray et al 1994).

For international reports, user-defined local pollution values are used. For international reports that do not have local values, estimates are based on either European median externality values (van Essen et al 2011) or BenMAP regression equations (Nowak et al 2014) that incorporate user-defined population estimates. Values are then converted to local currency with user-defined exchange rates.

For this analysis, pollution removal value is calculated based on the prices of $0 per ton (carbon monoxide), $0 per ton (ozone), $0 per ton (nitrogen dioxide), $0 per ton (sulfur dioxide), $0 per ton (particulate matter less than 2.5 microns).

Carbon Storage and Sequestration:

Carbon storage is the amount of carbon bound up in the above-ground and below-ground parts of woody vegetation. To calculate current carbon storage, biomass for each tree was calculated using equations from the literature and measured tree data. Open-grown, maintained trees tend to have less biomass than predicted by forest-derived biomass equations (Nowak 1994). To adjust for this difference, biomass results for open-grown urban trees were multiplied by 0.8. No adjustment was made for trees found in natural stand conditions. Tree dry-weight biomass was converted to stored carbon by multiplying by 0.5.

Carbon sequestration is the removal of carbon dioxide from the air by plants. To estimate the gross amount of carbon sequestered annually, average diameter growth from the appropriate genera and diameter class and tree condition was added to the existing tree diameter (year x) to estimate tree diameter and carbon storage in year x+1.

Carbon storage and carbon sequestration values are based on estimated or customized local carbon values. For international reports that do not have local values, estimates are based on the carbon value for the United States (U.S. Environmental Protection Agency 2015, Interagency Working Group on Social Cost of Carbon 2015) and converted to local currency with user-defined exchange rates.

For this analysis, carbon storage and carbon sequestration values are calculated based on $129.7 per ton.

Oxygen Production:

The amount of oxygen produced is estimated from carbon sequestration based on atomic weights: net O2 release (kg/yr) = net C sequestration (kg/yr) × 32/12. To estimate the net carbon sequestration rate, the amount of carbon sequestered as a result of tree growth is reduced by the amount lost resulting from tree mortality. Thus, net carbon sequestration and net annual oxygen production of the urban forest account for decomposition (Nowak et al 2007). For complete inventory projects, oxygen production is estimated from gross carbon sequestration and does not account for decomposition.

Avoided Runoff:

Annual avoided surface runoff is calculated based on rainfall interception by vegetation, specifically the difference between annual runoff with and without vegetation. Although tree leaves, branches, and bark may intercept precipitation and thus mitigate surface runoff, only the precipitation intercepted by leaves is accounted for in this analysis.

The value of avoided runoff is based on estimated or user-defined local values. For international reports that do not have local values, the national average value for the United States is utilized and converted to local currency with user-defined exchange rates. The U.S. value of avoided runoff is based on the U.S. Forest Service's Community Tree Guide Series (McPherson et al 1999; 2000; 2001; 2002; 2003; 2004; 2006a; 2006b; 2006c; 2007; 2010; Peper et al 2009; 2010; Vargas et al 2007a; 2007b; 2008).

For this analysis, avoided runoff value is calculated based on the price of $0.067 per ft^3.

Building Energy Use:

If appropriate field data were collected, seasonal effects of trees on residential building energy use were calculated based on procedures described in the literature (McPherson and Simpson 1999) using distance and direction of trees from residential structures, tree height and tree condition data. To calculate the monetary value of energy savings, local or custom prices per MWH or MBTU are utilized.

For this analysis, energy saving value is calculated based on the prices of $154.53 per MWH and $11.38 per MBTU.

Structural Values:

Structural value is the value of a tree based on the physical resource itself (e.g., the cost of having to replace a tree with a similar tree). Structural values were based on valuation procedures of the Council of Tree and Landscape Appraisers, which uses tree species, diameter, condition, and location information (Nowak et al 2002a; 2002b). Structural value may not be included for international projects if there is insufficient local data to complete the valuation procedures.

Potential Pest Impacts:

The complete potential pest risk analysis is not available for studies outside of the United States. The number of trees at risk to the pests analyzed is reported, though the list of pests is based on known insects and disease in the United States.

For the U.S., potential pest risk is based on pest range maps and the known pest host species that are likely to experience mortality. Pest range maps for 2012 from the Forest Health Technology Enterprise Team (FHTET) (Forest Health Technology Enterprise Team 2014) were used to determine the proximity of each pest to the county in which the urban forest is located. For the county, it was established whether the insect/disease occurs within the county, is within 250 miles of the county edge, is between 250 and 750 miles away, or is greater than 750 miles away. FHTET did not have pest range maps for Dutch elm disease and chestnut blight. The range of these pests was based on known occurrence and the host range, respectively (Eastern Forest Environmental Threat Assessment Center; Worrall 2007).

<u>Relative Tree Effects:</u>

The relative value of tree benefits reported in Appendix II is calculated to show what carbon storage and sequestration, and air pollutant removal equate to in amounts of municipal carbon emissions, passenger automobile emissions, and house emissions.

Municipal carbon emissions are based on 2010 U.S. per capita carbon emissions (Carbon Dioxide Information Analysis Center 2010). Per capita emissions were multiplied by city population to estimate total city carbon emissions.

Light duty vehicle emission rates (g/mi) for CO, NOx, VOCs, PM10, SO2 for 2010 (Bureau of Transportation Statistics 2010; Heirigs et al 2004), PM2.5 for 2011-2015 (California Air Resources Board 2013), and CO2 for 2011 (U.S. Environmental Protection Agency 2010) were multiplied by average miles driven per vehicle in 2011 (Federal Highway Administration 2013) to determine average emissions per vehicle.

Household emissions are based on average electricity kWh usage, natural gas Btu usage, fuel oil Btu usage, kerosene Btu usage, LPG Btu usage, and wood Btu usage per household in 2009 (Energy Information Administration 2013; Energy Information Administration 2014)

- CO2, SO2, and NOx power plant emission per KWh are from Leonardo Academy 2011. CO emission per kWh assumes 1/3 of one percent of C emissions is CO based on Energy Information Administration 1994. PM10 emission per kWh from Layton 2004.
- CO2, NOx, SO2, and CO emission per Btu for natural gas, propane and butane (average used to represent LPG), Fuel #4 and #6 (average used to represent fuel oil and kerosene) from Leonardo Academy 2011.
- CO2 emissions per Btu of wood from Energy Information Administration 2014.
- CO, NOx and SOx emission per Btu based on total emissions and wood burning (tons) from (British Columbia Ministry 2005; Georgia Forestry Commission 2009).

Appendix II. Relative Tree Effects

The urban forest in SMM provides benefits that include carbon storage and sequestration, and air pollutant removal. To estimate the relative value of these benefits, tree benefits were compared to estimates of average municipal carbon emissions, average passenger automobile emissions, and average household emissions. See Appendix I for methodology.

Carbon storage is equivalent to:

- Amount of carbon emitted in SMM in 5 days
- Annual carbon (C) emissions from 465 automobiles
- Annual C emissions from 191 single-family houses

Carbon monoxide removal is equivalent to:

- Annual carbon monoxide emissions from 0 automobiles
- Annual carbon monoxide emissions from 0 single-family houses

Nitrogen dioxide removal is equivalent to:

- Annual nitrogen dioxide emissions from 0 automobiles
- Annual nitrogen dioxide emissions from 0 single-family houses

Sulfur dioxide removal is equivalent to:

- Annual sulfur dioxide emissions from 0 automobiles
- Annual sulfur dioxide emissions from 0 single-family houses

Annual carbon sequestration is equivalent to:

- Amount of carbon emitted in SMM in 0.1 days
- Annual C emissions from 0 automobiles
- Annual C emissions from 0 single-family houses

Appendix III. Comparison of Urban Forests

A common question asked is, "How does this city compare to other cities?" Although comparison among cities should be made with caution as there are many attributes of a city that affect urban forest structure and functions, summary data are provided from other cities analyzed using the i-Tree Eco model.

I. City totals for trees

City	% Tree Cover	Number of trees	Carbon Storage (tons)	Carbon Sequestration (tons/yr)	Pollution removal (tons/yr)
Calgary, Canada	7.2	11,889,000	445,333	21,385	326
Atlanta, GA	36.8	9,415,000	1,344,818	46,407	1,662
Toronto, Canada	20.5	7,542,000	992,079	40,345	1,213
New York, NY	21.0	5,212,000	1,351,432	42,329	1,677
Baltimore, MD	21.0	2,627,000	596,350	16,094	430
Philadelphia, PA	15.7	2,113,000	530,211	16,094	577
Washington, DC	28.6	1,928,000	522,495	16,094	418
Boston, MA	22.3	1,183,000	318,568	10,472	284
Woodbridge, NJ	29.5	986,000	159,835	5,512	211
Minneapolis, MN	26.5	979,000	250,224	8,929	305
Syracuse, NY	23.1	876,000	173,063	5,401	109
Morgantown, WV	35.9	661,000	93,696	2,976	66
Moorestown, NJ	28.0	583,000	116,845	3,748	118
Jersey City, NJ	11.5	136,000	20,944	882	41
Freehold, NJ	34.4	48,000	19,842	551	21

II. Per acre values of tree effects

City	No. of trees/acre	Carbon Storage (tons/acre)	Carbon Sequestration (tons/yr/acre)	Pollution removal (tons/yr/acre)
Calgary, Canada	66.7	2.50	0.06	1.8
Atlanta, GA	111.6	15.90	0.28	19.7
Toronto, Canada	48.3	6.40	0.13	7.8
New York, NY	26.4	6.80	0.11	8.5
Baltimore, MD	50.8	10.43	0.14	7.5
Philadelphia, PA	25.0	6.30	0.09	6.8
Washington, DC	49.0	13.30	0.21	10.6
Boston, MA	33.5	9.00	0.15	8.0
Woodbridge, NJ	66.5	10.80	0.19	14.2
Minneapolis, MN	26.2	6.70	0.12	8.2
Syracuse, NY	54.5	10.80	0.17	6.8
Morgantown, WV	119.7	17.00	0.27	11.9
Moorestown, NJ	62.0	12.50	0.20	12.6
Jersey City, NJ	14.3	2.20	0.05	4.3
Freehold, NJ	38.5	16.00	0.22	16.8

Appendix IV. General Recommendations for Air Quality Improvement

Urban vegetation can directly and indirectly affect local and regional air quality by altering the urban atmosphere environment. Four main ways that urban trees affect air quality are (Nowak 1995):

- Temperature reduction and other microclimate effects
- Removal of air pollutants
- Emission of volatile organic compounds (VOC) and tree maintenance emissions
- Energy effects on buildings

The cumulative and interactive effects of trees on climate, pollution removal, and VOC and power plant emissions determine the impact of trees on air pollution. Cumulative studies involving urban tree impacts on ozone have revealed that increased urban canopy cover, particularly with low VOC emitting species, leads to reduced ozone concentrations in cities (Nowak 2000). Local urban management decisions also can help improve air quality.

Urban forest management strategies to help improve air quality include (Nowak 2000):

Strategy	***Result***
Increase the number of healthy trees	Increase pollution removal
Sustain existing tree cover	Maintain pollution removal levels
Maximize use of low VOC-emitting trees	Reduces ozone and carbon monoxide formation
Sustain large, healthy trees	Large trees have greatest per-tree effects
Use long-lived trees	Reduce long-term pollutant emissions from planting and removal
Use low maintenance trees	Reduce pollutants emissions from maintenance activities
Reduce fossil fuel use in maintaining vegetation	Reduce pollutant emissions
Plant trees in energy conserving locations	Reduce pollutant emissions from power plants
Plant trees to shade parked cars	Reduce vehicular VOC emissions
Supply ample water to vegetation	Enhance pollution removal and temperature reduction
Plant trees in polluted or heavily populated areas	Maximizes tree air quality benefits
Avoid pollutant-sensitive species	Improve tree health
Utilize evergreen trees for particulate matter	Year-round removal of particles

Appendix V. Invasive Species of the Urban Forest

The following inventoried tree species were listed as invasive on the California invasive species list (California Invasive Species Advisory Committee 2010):

Species Name[a]	*Number of trees*	*% Tree Number*	*Leaf Area (ac)*	*% Leaf Area*
Total	**0**	**0.00**	**0.00**	**0.00**

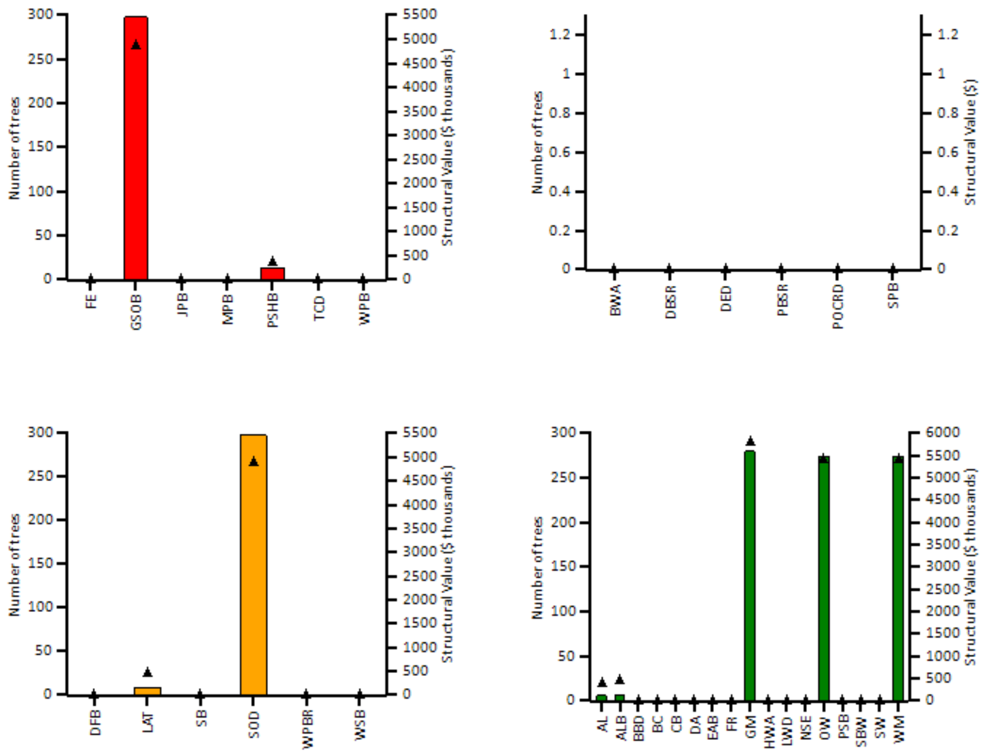
[a]Species are determined to be invasive if they are listed on the state's invasive species list

Appendix VI. Potential Risk of Pests

Thirty-six insects and diseases were analyzed to quantify their potential impact on the urban forest. As each insect/ disease is likely to attack different host tree species, the implications for SMM will vary. The number of trees at risk reflects only the known host species that are likely to experience mortality.

Code	Scientific Name	Common Name	Trees at Risk (#)	Value ($ thousands)
AL	Phyllocnistis populiella	Aspen Leafminer	20	117.67
ALB	Anoplophora glabripennis	Asian Longhorned Beetle	23	128.72
BBD	Neonectria faginata	Beech Bark Disease	0	0.00
BC	Sirococcus clavigignenti juglandacearum	Butternut Canker	0	0.00
BWA	Adelges piceae	Balsam Woolly Adelgid	0	0.00
CB	Cryphonectria parasitica	Chestnut Blight	0	0.00
DA	Discula destructiva	Dogwood Anthracnose	0	0.00
DBSR	Leptographium wageneri var. pseudotsugae	Douglas-fir Black Stain Root Disease	0	0.00
DED	Ophiostoma novo-ulmi	Dutch Elm Disease	0	0.00
DFB	Dendroctonus pseudotsugae	Douglas-Fir Beetle	0	0.00
EAB	Agrilus planipennis	Emerald Ash Borer	0	0.00
FE	Scolytus ventralis	Fir Engraver	0	0.00
FR	Cronartium quercuum f. sp. Fusiforme	Fusiform Rust	0	0.00
GM	Lymantria dispar	Gypsy Moth	290	5,593.34
GSOB	Agrilus auroguttatus	Goldspotted Oak Borer	266	5,459.03
HWA	Adelges tsugae	Hemlock Woolly Adelgid	0	0.00
JPB	Dendroctonus jeffreyi	Jeffrey Pine Beetle	0	0.00
LAT	Choristoneura conflictana	Large Aspen Tortrix	25	158.47
LWD	Raffaelea lauricola	Laurel Wilt	0	0.00
MPB	Dendroctonus ponderosae	Mountain Pine Beetle	0	0.00
NSE	Ips perturbatus	Northern Spruce Engraver	0	0.00
OW	Ceratocystis fagacearum	Oak Wilt	270	5,475.68
PBSR	Leptographium wageneri var. ponderosum	Pine Black Stain Root Disease	0	0.00
POCRD	Phytophthora lateralis	Port-Orford-Cedar Root Disease	0	0.00
PSB	Tomicus piniperda	Pine Shoot Beetle	0	0.00
PSHB	Euwallacea nov. sp.	Polyphagous Shot Hole Borer	19	255.13
SB	Dendroctonus rufipennis	Spruce Beetle	0	0.00
SBW	Choristoneura fumiferana	Spruce Budworm	0	0.00
SOD	Phytophthora ramorum	Sudden Oak Death	266	5,459.03
SPB	Dendroctonus frontalis	Southern Pine Beetle	0	0.00
SW	Sirex noctilio	Sirex Wood Wasp	0	0.00
TCD	Geosmithia morbida	Thousand Canker Disease	0	0.00
WM	Operophtera brumata	Winter Moth	270	5,475.68
WPB	Dendroctonus brevicomis	Western Pine Beetle	0	0.00
WPBR	Cronartium ribicola	White Pine Blister Rust	0	0.00
WSB	Choristoneura occidentalis	Western Spruce Budworm	0	0.00

In the following graph, the pests are color coded according to the county's proximity to the pest occurrence in the United States. Red indicates that the pest is within the county; orange indicates that the pest is within 250 miles of the county; yellow indicates that the pest is within 750 miles of the county; and green indicates that the pest is outside of these ranges.



Note: points --- Number of trees, bars --- Structural value

Based on the host tree species for each pest and the current range of the pest (Forest Health Technology Enterprise Team 2014), it is possible to determine what the risk is that each tree species in the urban forest could be attacked by an insect or disease.

Spp. Risk	Risk Weight	Species Name	AL	ALB	BBD	BC	BWA	CB	DA	DBSR	DED	DFB	EAB	FE	FR	GM	GSOB	HWA	JPB	LAT	LWD	MPB	NSE	OW	PBSR	POCRD	PSB	PSHB	SB	SBW	SOD	SPB	SW	TCD	WM	WPB	WPBR	WSB
	10	Coastal live oak																																					
	7	White alder																																					
	6	Arroya willow																																					
	4	California sycamore																																					
	3	California white oak																																					
	1	Mimosa																																					

Note:
Species that are not listed in the matrix are not known to be hosts to any of the pests analyzed.

Species Risk:
- Red indicates that tree species is at risk to at least one pest within county
- Orange indicates that tree species has no risk to pests in county, but has a risk to at least one pest within 250 miles from the county
- Yellow indicates that tree species has no risk to pests within 250 miles of county, but has a risk to at least one pest that is 250 to 750 miles from the county
- Green indicates that tree species has no risk to pests within 750 miles of county, but has a risk to at least one pest that is greater than 750 miles from the county

Risk Weight:
Numerical scoring system based on sum of points assigned to pest risks for species. Each pest that could attack tree species is scored as 4 points if red, 3 points if orange, 2 points if yellow and 1 point if green.

Pest Color Codes:
- Red indicates pest is within Lenawee county
- Orange indicates pest is within 250 miles of Lenawee county
- Yellow indicates pest is within 750 miles of Lenawee county
- Green indicates pest is outside of these ranges

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Individual Tree Data

Location: Topanga, Los Angeles, California, United States of America
Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft^2)	Tree Condition	Leaf Area (ft^2)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft^2)	Street Tree	Native to State
1	White alder	10.3	51.0	437.4	Fair	2,090.6	37.6	4.8	0.6	NO	YES
2	White alder	25.7	86.4	1,034.9	Fair	4,023.9	72.3	3.9	3.6	NO	YES
3	White alder	18.4	71.3	809.3	Fair	3,549.7	63.8	4.4	1.8	NO	YES
4	Coastal live oak	9.0	46.1	369.8	Fair	1,532.5	44.5	4.1	0.4	NO	YES
5	Coastal live oak	12.0	55.1	551.5	Fair	2,403.2	69.7	4.4	0.8	NO	YES
6	Coastal live oak	26.4	81.4	1,654.7	Fair	5,514.1	160.0	3.3	3.8	NO	YES
7	Coastal live oak	4.2	29.1	141.0	Fair	436.3	12.7	3.1	0.1	NO	YES
8	Coastal live oak	6.9	39.0	257.3	Fair	959.2	27.8	3.7	0.3	NO	YES
9	Coastal live oak	16.5	66.3	865.7	Fair	2,971.4	86.2	3.4	1.5	NO	YES
10	Coastal live oak	9.5	47.7	397.6	Fair	1,673.0	48.5	4.2	0.5	NO	YES
11	Coastal live oak	9.5	47.7	397.6	Fair	1,673.0	48.5	4.2	0.5	NO	YES
12	Coastal live oak	12.5	56.5	585.4	Fair	2,539.1	73.7	4.3	0.9	NO	YES
13	Coastal live oak	12.5	56.5	585.4	Fair	2,539.1	73.7	4.3	0.9	NO	YES
14	Coastal live oak	14.5	61.7	721.1	Fair	3,000.3	87.1	4.2	1.1	NO	YES
15	Coastal live oak	18.5	70.5	1,017.9	Fair	3,442.9	99.9	3.4	1.9	NO	YES
16	Coastal live oak	48.5	84.1	3,196.9	Fair	10,333.7	299.9	3.2	12.8	NO	YES
17	Coastal live oak	70.0	84.1	3,599.7	Fair	11,095.7	322.0	3.1	26.7	NO	YES
18	Coastal live oak	28.5	82.9	1,832.3	Fair	6,105.8	177.2	3.3	4.4	NO	YES
19	Coastal live oak	10.0	49.2	426.4	Fair	1,817.1	52.7	4.3	0.5	NO	YES
20	Coastal live oak	22.4	76.9	1,333.2	Fair	4,509.3	130.8	3.4	2.7	NO	YES
21	California sycamore	8.1	38.9	380.1	Fair	2,523.7	23.7	6.6	0.4	NO	YES
22	California sycamore	8.8	40.7	422.7	Fair	2,888.2	27.2	6.8	0.4	NO	YES
23	Coastal live oak	30.6	83.8	2,003.0	Fair	6,674.7	193.7	3.3	5.1	NO	YES
24	Coastal live oak	35.6	84.1	2,393.1	Fair	7,855.2	227.9	3.3	6.9	NO	YES
25	Coastal live oak	23.0	77.7	1,378.9	Fair	4,663.8	135.3	3.4	2.9	NO	YES
26	Coastal live oak	31.5	84.0	2,075.0	Fair	6,914.7	200.6	3.3	5.4	NO	YES
27	Coastal live oak	17.0	67.4	907.9	Fair	3,116.3	90.4	3.4	1.6	NO	YES
28	California white oak	15.0	62.9	759.6	Fair	2,607.4	54.0	3.4	1.2	NO	YES
29	Coastal live oak	21.0	74.8	1,219.2	Fair	4,123.9	119.7	3.4	2.4	NO	YES
30	Coastal live oak	6.5	37.6	240.5	Fair	875.0	25.4	3.6	0.2	NO	YES
31	Coastal live oak	6.5	37.6	240.5	Fair	875.0	25.4	3.6	0.2	NO	YES
32	Coastal live oak	10.5	50.7	456.2	Fair	1,963.5	57.0	4.3	0.6	NO	YES
33	Coastal live oak	30.0	83.6	1,947.8	Fair	6,490.9	188.4	3.3	4.9	NO	YES
34	Coastal live oak	7.0	39.4	263.0	Fair	988.4	28.7	3.8	0.3	NO	YES

Individual Tree Data

Location: Topanga, Los Angeles, California, United States of America
Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft^2)	Tree Condition	Leaf Area (ft^2)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft^2)	Street Tree	Native to State
35	Arroya willow	55.5	80.0	1,764.6	Fair	7,434.4	96.5	4.2	16.8	NO	YES
36	Coastal live oak	7.8	42.1	304.8	Fair	1,195.6	34.7	3.9	0.3	NO	YES
37	Coastal live oak	6.6	38.0	243.3	Fair	890.2	25.8	3.7	0.2	NO	YES
38	Coastal live oak	18.3	70.1	1,006.6	Fair	3,404.7	98.8	3.4	1.8	NO	YES
39	California sycamore	30.0	78.1	2,206.2	Fair	13,573.0	127.7	6.2	4.9	NO	YES
40	White alder	18.9	72.4	829.6	Fair	3,603.3	64.7	4.3	1.9	NO	YES
41	Arroya willow	24.4	61.3	945.7	Fair	3,937.0	51.1	4.2	3.2	NO	YES
42	Arroya willow	32.5	70.9	1,326.7	Fair	5,589.5	72.5	4.2	5.8	NO	YES
43	White alder	27.6	90.0	1,063.6	Fair	4,069.3	73.1	3.8	4.2	NO	YES
44	Arroya willow	22.7	59.0	870.9	Fair	3,625.7	47.0	4.2	2.8	NO	YES
45	Coastal live oak	32.6	84.1	2,156.5	Fair	7,078.5	205.4	3.3	5.8	NO	YES
46	Coastal live oak	16.5	66.3	865.7	Fair	2,971.4	86.2	3.4	1.5	NO	YES
47	Coastal live oak	10.5	50.7	456.2	Fair	1,963.5	57.0	4.3	0.6	NO	YES
48	Coastal live oak	55.9	84.1	3,483.7	Fair	10,738.1	311.6	3.1	17.0	NO	YES
49	Coastal live oak	34.3	84.1	2,290.2	Fair	7,517.4	218.1	3.3	6.4	NO	YES
50	Coastal live oak	18.5	70.5	1,017.9	Fair	3,442.9	99.9	3.4	1.9	NO	YES
51	Coastal live oak	83.3	84.1	3,599.7	Fair	11,095.7	322.0	3.1	37.9	NO	YES
52	Coastal live oak	66.3	84.1	3,599.7	Fair	11,095.7	322.0	3.1	24.0	NO	YES
53	Coastal live oak	61.0	84.1	3,589.1	Fair	11,063.0	321.0	3.1	20.3	NO	YES
54	Coastal live oak	7.0	39.4	263.0	Fair	988.4	28.7	3.8	0.3	NO	YES
55	Coastal live oak	37.0	84.1	2,489.5	Fair	8,171.4	237.1	3.3	7.5	NO	YES
56	Coastal live oak	86.0	84.1	3,599.7	Fair	11,095.7	322.0	3.1	40.4	NO	YES
57	Coastal live oak	33.0	84.1	2,189.6	Fair	7,187.0	208.5	3.3	5.9	NO	YES
58	Coastal live oak	65.5	84.1	3,610.4	Fair	11,128.5	322.9	3.1	23.4	NO	YES
59	Coastal live oak	16.0	65.2	829.6	Fair	2,847.4	82.6	3.4	1.4	NO	YES
60	Coastal live oak	30.5	83.8	1,995.0	Fair	6,648.3	192.9	3.3	5.1	NO	YES
61	Coastal live oak	24.5	79.6	1,499.9	Fair	5,073.2	147.2	3.4	3.3	NO	YES
62	Coastal live oak	40.5	84.1	2,734.0	Fair	8,837.3	256.4	3.2	8.9	NO	YES
63	Coastal live oak	66.5	84.1	3,599.7	Fair	11,095.7	322.0	3.1	24.1	NO	YES
64	Coastal live oak	57.5	84.1	3,525.7	Fair	10,867.5	315.3	3.1	18.0	NO	YES
65	Coastal live oak	13.5	59.2	651.4	Fair	2,791.4	81.0	4.3	1.0	NO	YES
66	Coastal live oak	24.0	79.0	1,459.0	Fair	4,934.8	143.2	3.4	3.1	NO	YES
67	Coastal live oak	14.5	61.7	721.1	Fair	3,000.3	87.1	4.2	1.1	NO	YES
68	Coastal live oak	10.0	49.2	426.4	Fair	1,817.1	52.7	4.3	0.5	NO	YES

Individual Tree Data

Location: Topanga, Los Angeles, California, United States of America
Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft²)	Tree Condition	Leaf Area (ft²)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft²)	Street Tree	Native to State
69	Coastal live oak	11.0	52.2	487.0	Fair	2,111.0	61.3	4.3	0.7	NO	YES
70	Coastal live oak	22.5	77.1	1,339.6	Fair	4,531.2	131.5	3.4	2.8	NO	YES
71	Coastal live oak	30.7	83.8	2,010.9	Fair	6,701.1	194.5	3.3	5.1	NO	YES
72	Coastal live oak	15.2	63.4	774.4	Fair	2,658.0	77.1	3.4	1.3	NO	YES
73	Coastal live oak	22.4	76.9	1,333.2	Fair	4,509.3	130.8	3.4	2.7	NO	YES
74	Coastal live oak	14.0	60.4	688.1	Fair	2,903.7	84.3	4.2	1.1	NO	YES
75	Coastal live oak	19.7	72.7	1,116.3	Fair	3,775.7	109.6	3.4	2.1	NO	YES
76	Coastal live oak	10.2	49.8	437.4	Fair	1,873.1	54.4	4.3	0.6	NO	YES
77	Coastal live oak	5.3	33.3	186.3	Fair	624.5	18.1	3.4	0.2	NO	YES
78	Coastal live oak	49.2	84.1	3,237.1	Fair	9,978.1	289.5	3.1	13.2	NO	YES
79	Coastal live oak	61.6	84.1	3,589.1	Fair	11,063.0	321.0	3.1	20.7	NO	YES
80	Coastal live oak	12.5	56.5	585.4	Fair	2,539.1	73.7	4.3	0.9	NO	YES
81	Coastal live oak	19.6	72.5	1,104.5	Fair	3,735.7	108.4	3.4	2.1	NO	YES
82	Coastal live oak	30.8	83.9	2,018.9	Fair	6,727.6	195.2	3.3	5.2	NO	YES
83	Coastal live oak	19.4	72.1	1,092.7	Fair	3,696.0	107.2	3.4	2.1	NO	YES
84	Coastal live oak	16.9	67.2	897.3	Fair	3,079.8	89.4	3.4	1.6	NO	YES
85	Coastal live oak	29.7	83.5	1,924.4	Fair	6,412.9	186.1	3.3	4.8	NO	YES
86	Coastal live oak	23.3	78.1	1,405.3	Fair	4,753.3	137.9	3.4	3.0	NO	YES
87	Coastal live oak	13.4	58.9	646.9	Fair	2,771.2	80.4	4.3	1.0	NO	YES
88	Coastal live oak	4.5	30.2	151.7	Fair	478.9	13.9	3.2	0.1	NO	YES
89	California sycamore	8.0	38.7	373.3	Fair	2,467.4	23.2	6.6	0.3	NO	YES
90	California sycamore	8.8	40.7	422.7	Fair	2,888.2	27.2	6.8	0.4	NO	YES
91	California sycamore	9.7	42.9	483.1	Fair	3,383.7	31.8	7.0	0.5	NO	YES
92	Coastal live oak	20.9	74.7	1,206.9	Fair	4,082.1	118.5	3.4	2.4	NO	YES
93	Coastal live oak	20.5	74.0	1,176.3	Fair	3,978.7	115.5	3.4	2.3	NO	YES
94	Coastal live oak	23.2	78.0	1,398.7	Fair	4,730.9	137.3	3.4	2.9	NO	YES
95	Coastal live oak	36.1	84.1	2,428.0	Fair	7,969.5	231.3	3.3	7.1	NO	YES
96	Coastal live oak	8.7	45.1	353.0	Fair	1,443.6	41.9	4.1	0.4	NO	YES
97	Coastal live oak	12.9	57.6	611.4	Fair	2,645.0	76.8	4.3	0.9	NO	YES
98	Coastal live oak	15.4	63.8	784.3	Fair	2,691.9	78.1	3.4	1.3	NO	YES
99	Coastal live oak	32.4	84.1	2,140.1	Fair	7,024.6	203.8	3.3	5.7	NO	YES
100	Coastal live oak	17.2	67.8	918.6	Fair	3,153.1	91.5	3.4	1.6	NO	YES
101	Coastal live oak	20.1	73.4	1,146.1	Fair	3,876.5	112.5	3.4	2.2	NO	YES
102	Coastal live oak	20.0	73.2	1,140.1	Fair	3,856.2	111.9	3.4	2.2	NO	YES

Individual Tree Data

Location: Topanga, Los Angeles, California, United States of America
Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft²)	Tree Condition	Leaf Area (ft²)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft²)	Street Tree	Native to State
103	Coastal live oak	19.5	72.3	1,098.6	Fair	3,715.9	107.8	3.4	2.1	NO	YES
104	Coastal live oak	15.3	63.6	779.3	Fair	2,674.9	77.6	3.4	1.3	NO	YES
105	Coastal live oak	9.5	47.7	397.6	Fair	1,673.0	48.5	4.2	0.5	NO	YES
106	Coastal live oak	16.6	66.6	876.2	Fair	3,007.3	87.3	3.4	1.5	NO	YES
107	Coastal live oak	29.4	83.4	1,901.2	Fair	6,335.5	183.8	3.3	4.7	NO	YES
108	Coastal live oak	35.7	84.1	2,393.1	Fair	7,855.2	227.9	3.3	7.0	NO	YES
109	Coastal live oak	18.9	71.2	1,052.1	Fair	3,558.6	103.3	3.4	1.9	NO	YES
110	Coastal live oak	28.9	83.1	1,862.7	Fair	6,207.3	180.1	3.3	4.6	NO	YES
111	Coastal live oak	19.6	72.5	1,104.5	Fair	3,735.7	108.4	3.4	2.1	NO	YES
112	Coastal live oak	46.5	84.1	3,097.5	Fair	10,012.3	290.5	3.2	11.8	NO	YES
113	Arroya willow	17.5	51.7	637.9	Fair	3,259.3	42.3	5.1	1.7	NO	YES
114	Mimosa	17.7	62.0	789.2	Fair	3,646.0	32.5	4.6	1.7	NO	NO
115	Coastal live oak	10.5	50.7	456.2	Fair	1,963.5	57.0	4.3	0.6	NO	YES
116	Coastal live oak	46.0	84.1	3,068.0	Fair	9,916.9	287.8	3.2	11.5	NO	YES
117	California white oak	18.0	69.5	984.2	Fair	3,329.1	68.9	3.4	1.8	NO	YES
118	Coastal live oak	16.5	66.3	865.7	Fair	2,971.4	86.2	3.4	1.5	NO	YES
119	California white oak	5.0	32.1	172.0	Fair	563.8	11.7	3.3	0.1	NO	YES
120	Arroya willow	22.0	58.1	839.8	Fair	3,496.2	45.4	4.2	2.6	NO	YES
121	California sycamore	36.2	86.4	2,715.5	Fair	16,706.3	157.2	6.2	7.1	NO	YES
122	California sycamore	77.2	103.8	3,578.5	Fair	22,015.7	207.1	6.2	32.5	NO	YES
123	Arroya willow	9.8	38.5	323.7	Fair	1,457.1	18.9	4.5	0.5	NO	YES
124	Coastal live oak	72.6	84.1	3,599.7	Fair	11,095.7	322.0	3.1	28.8	NO	YES
125	California sycamore	54.7	103.8	3,578.5	Fair	22,015.7	207.1	6.2	16.3	NO	YES
126	Coastal live oak	29.9	83.6	1,940.0	Fair	6,464.9	187.6	3.3	4.9	NO	YES
127	Coastal live oak	132.3	84.1	3,599.7	Fair	11,095.7	322.0	3.1	95.5	NO	YES
128	Coastal live oak	130.3	84.1	3,599.7	Fair	11,095.7	322.0	3.1	92.6	NO	YES
129	Coastal live oak	149.2	84.1	3,599.7	Fair	11,095.7	322.0	3.1	121.5	NO	YES
130	Coastal live oak	62.2	84.1	3,599.7	Fair	11,095.7	322.0	3.1	21.1	NO	YES
131	Coastal live oak	53.9	84.1	3,421.2	Fair	10,545.5	306.0	3.1	15.9	NO	YES
132	Coastal live oak	78.3	84.1	3,599.7	Fair	11,095.7	322.0	3.1	33.4	NO	YES
133	Coastal live oak	128.3	84.1	3,599.7	Fair	11,095.7	322.0	3.1	89.8	NO	YES
134	Coastal live oak	114.6	84.1	3,599.7	Fair	11,095.7	322.0	3.1	71.7	NO	YES
135	Coastal live oak	48.0	84.1	3,176.9	Fair	10,269.0	298.0	3.2	12.6	NO	YES
136	Coastal live oak	41.0	84.1	2,771.2	Fair	8,957.5	259.9	3.2	9.2	NO	YES

Individual Tree Data

Location: Topanga, Los Angeles, California, United States of America
Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

i-Tree Eco

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft^2)	Tree Condition	Leaf Area (ft^2)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft^2)	Street Tree	Native to State
137	Coastal live oak	8.2	43.5	326.9	Fair	1,307.1	37.9	4.0	0.4	NO	YES
138	Coastal live oak	41.7	84.1	2,818.0	Fair	9,109.0	264.3	3.2	9.5	NO	YES
139	Coastal live oak	12.0	55.1	551.5	Fair	2,403.2	69.7	4.4	0.8	NO	YES
140	Coastal live oak	31.8	84.1	2,099.3	Fair	6,995.7	203.0	3.3	5.5	NO	YES
141	Coastal live oak	45.6	84.1	3,048.4	Fair	9,853.5	285.9	3.2	11.3	NO	YES
142	Coastal live oak	4.9	31.8	169.7	Fair	552.7	16.0	3.3	0.1	NO	YES
143	Coastal live oak	7.9	42.5	307.9	Fair	1,218.1	35.3	4.0	0.3	NO	YES
144	Coastal live oak	30.2	83.7	1,971.4	Fair	6,569.4	190.6	3.3	5.0	NO	YES
145	Coastal live oak	17.2	67.8	918.6	Fair	3,153.1	91.5	3.4	1.6	NO	YES
146	Coastal live oak	19.5	72.3	1,098.6	Fair	3,715.9	107.8	3.4	2.1	NO	YES
147	Coastal live oak	15.5	64.1	794.2	Fair	2,726.1	79.1	3.4	1.3	NO	YES
148	Coastal live oak	11.0	52.2	487.0	Fair	2,111.0	61.3	4.3	0.7	NO	YES
149	Coastal live oak	17.0	67.4	907.9	Fair	3,116.3	90.4	3.4	1.6	NO	YES
150	Coastal live oak	4.7	31.0	160.6	Fair	513.9	14.9	3.2	0.1	NO	YES
151	Coastal live oak	21.4	75.5	1,250.4	Fair	4,229.2	122.7	3.4	2.5	NO	YES
152	Coastal live oak	49.1	84.1	3,227.1	Fair	10,431.1	302.7	3.2	13.2	NO	YES
153	Coastal live oak	26.6	81.6	1,676.4	Fair	5,586.4	162.1	3.3	3.9	NO	YES
154	Coastal live oak	21.2	75.2	1,231.6	Fair	4,165.9	120.9	3.4	2.5	NO	YES
155	Coastal live oak	33.3	84.1	2,214.5	Fair	7,268.9	210.9	3.3	6.0	NO	YES
156	Coastal live oak	26.4	81.4	1,654.7	Fair	5,514.1	160.0	3.3	3.8	NO	YES
157	Coastal live oak	5.1	32.5	176.7	Fair	582.1	16.9	3.3	0.1	NO	YES
158	Coastal live oak	31.1	83.9	2,042.8	Fair	6,807.5	197.5	3.3	5.3	NO	YES
159	Coastal live oak	28.3	82.8	1,817.1	Fair	6,055.3	175.7	3.3	4.4	NO	YES
160	Coastal live oak	9.8	48.6	415.5	Fair	1,761.4	51.1	4.2	0.5	NO	YES
161	Coastal live oak	32.0	84.1	2,107.4	Fair	7,022.7	203.8	3.3	5.6	NO	YES
162	Coastal live oak	5.9	35.5	211.2	Fair	739.9	21.5	3.5	0.2	NO	YES
163	Coastal live oak	39.0	84.1	2,633.0	Fair	8,510.8	247.0	3.2	8.3	NO	YES
164	Coastal live oak	56.0	84.1	3,483.7	Fair	10,738.1	311.6	3.1	17.1	NO	YES
165	Coastal live oak	13.0	57.8	620.2	Fair	2,670.1	77.5	4.3	0.9	NO	YES
166	Coastal live oak	11.5	53.7	518.7	Fair	2,263.7	65.7	4.4	0.7	NO	YES
167	Coastal live oak	41.0	84.1	2,771.2	Fair	8,957.5	259.9	3.2	9.2	NO	YES
168	Coastal live oak	13.0	57.8	620.2	Fair	2,670.1	77.5	4.3	0.9	NO	YES
169	Coastal live oak	11.0	52.2	487.0	Fair	2,111.0	61.3	4.3	0.7	NO	YES
170	Coastal live oak	75.8	84.1	3,599.7	Fair	11,095.7	322.0	3.1	31.3	NO	YES

Individual Tree Data

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Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft^2)	Tree Condition	Leaf Area (ft^2)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft^2)	Street Tree	Native to State
171	Coastal live oak	16.5	66.3	865.7	Fair	2,971.4	86.2	3.4	1.5	NO	YES
172	Coastal live oak	12.2	55.7	564.1	Fair	2,458.2	71.3	4.4	0.8	NO	YES
173	Coastal live oak	31.5	84.0	2,075.0	Fair	6,914.7	200.6	3.3	5.4	NO	YES
174	Coastal live oak	51.2	84.1	3,318.3	Fair	10,228.4	296.8	3.1	14.3	NO	YES
175	Coastal live oak	21.7	75.9	1,275.6	Fair	4,314.4	125.2	3.4	2.6	NO	YES
176	Coastal live oak	16.1	65.5	839.8	Fair	2,882.6	83.6	3.4	1.4	NO	YES
177	Coastal live oak	24.0	79.0	1,459.0	Fair	4,934.8	143.2	3.4	3.1	NO	YES
178	Coastal live oak	18.3	70.1	1,006.6	Fair	3,404.7	98.8	3.4	1.8	NO	YES
179	Coastal live oak	11.8	54.5	539.1	Fair	2,347.7	68.1	4.4	0.8	NO	YES
180	Coastal live oak	17.9	69.3	973.1	Fair	3,340.2	96.9	3.4	1.7	NO	YES
181	Coastal live oak	28.6	83.0	1,839.8	Fair	6,131.1	177.9	3.3	4.5	NO	YES
182	Coastal live oak	20.4	73.9	1,170.2	Fair	3,958.1	114.9	3.4	2.3	NO	YES
183	California sycamore	6.5	34.6	286.5	Fair	1,751.4	16.5	6.1	0.2	NO	YES
184	California sycamore	12.1	48.2	656.0	Fair	4,663.8	43.9	7.1	0.8	NO	YES
185	Coastal live oak	20.1	73.4	1,146.1	Fair	3,876.5	112.5	3.4	2.2	NO	YES
186	Coastal live oak	15.1	63.1	764.5	Fair	2,624.2	76.1	3.4	1.2	NO	YES
187	Coastal live oak	25.8	80.9	1,611.7	Fair	5,451.4	158.2	3.4	3.6	NO	YES
188	Coastal live oak	19.7	72.7	1,116.3	Fair	3,775.7	109.6	3.4	2.1	NO	YES
189	Coastal live oak	18.9	71.2	1,052.1	Fair	3,558.6	103.3	3.4	1.9	NO	YES
190	Coastal live oak	18.5	70.5	1,017.9	Fair	3,442.9	99.9	3.4	1.9	NO	YES
191	Coastal live oak	8.1	43.1	320.5	Fair	1,273.0	36.9	4.0	0.4	NO	YES
192	Coastal live oak	5.7	34.7	203.6	Fair	700.1	20.3	3.4	0.2	NO	YES
193	Coastal live oak	22.0	76.4	1,301.0	Fair	4,400.5	127.7	3.4	2.6	NO	YES
194	Coastal live oak	8.0	42.8	314.2	Fair	1,243.4	36.1	4.0	0.3	NO	YES
195	Coastal live oak	6.1	36.2	221.7	Fair	784.3	22.8	3.5	0.2	NO	YES
196	Coastal live oak	9.9	48.9	422.7	Fair	1,795.1	52.1	4.2	0.5	NO	YES
197	Coastal live oak	53.1	84.1	3,400.5	Fair	10,481.7	304.2	3.1	15.4	NO	YES
198	Coastal live oak	20.0	73.2	1,140.1	Fair	3,856.2	111.9	3.4	2.2	NO	YES
199	Coastal live oak	24.7	79.8	1,520.5	Fair	5,143.0	149.2	3.4	3.3	NO	YES
200	Coastal live oak	47.1	84.1	3,127.2	Fair	10,108.2	293.3	3.2	12.1	NO	YES
201	Coastal live oak	8.1	43.1	320.5	Fair	1,273.0	36.9	4.0	0.4	NO	YES
202	Coastal live oak	13.8	59.9	674.3	Fair	2,857.0	82.9	4.2	1.0	NO	YES
203	Coastal live oak	35.9	84.1	2,410.5	Fair	7,912.3	229.6	3.3	7.0	NO	YES
204	Coastal live oak	21.6	75.8	1,262.9	Fair	4,271.7	124.0	3.4	2.5	NO	YES

Individual Tree Data

Location: Topanga, Los Angeles, California, United States of America
Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft²)	Tree Condition	Leaf Area (ft²)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft²)	Street Tree	Native to State
205	Coastal live oak	28.4	82.9	1,824.7	Fair	6,080.5	176.4	3.3	4.4	NO	YES
206	Coastal live oak	7.0	39.4	263.0	Fair	988.4	28.7	3.8	0.3	NO	YES
207	Coastal live oak	19.2	71.8	1,075.2	Fair	3,636.8	105.5	3.4	2.0	NO	YES
208	Coastal live oak	21.1	75.0	1,225.4	Fair	4,144.9	120.3	3.4	2.4	NO	YES
209	Coastal live oak	53.2	84.1	3,400.5	Fair	10,481.7	304.2	3.1	15.4	NO	YES
210	Coastal live oak	11.9	54.8	543.3	Fair	2,370.0	68.8	4.4	0.8	NO	YES
211	Coastal live oak	11.8	54.5	539.1	Fair	2,347.7	68.1	4.4	0.8	NO	YES
212	Coastal live oak	17.3	68.1	929.4	Fair	3,190.1	92.6	3.4	1.6	NO	YES
213	Coastal live oak	22.1	76.5	1,307.4	Fair	4,422.2	128.3	3.4	2.7	NO	YES
214	Coastal live oak	17.9	69.3	973.1	Fair	3,340.2	96.9	3.4	1.7	NO	YES
215	Coastal live oak	12.8	57.3	602.6	Fair	2,613.8	75.8	4.3	0.9	NO	YES
216	Coastal live oak	28.9	83.1	1,862.7	Fair	6,207.3	180.1	3.3	4.6	NO	YES
217	Coastal live oak	20.1	73.4	1,146.1	Fair	3,876.5	112.5	3.4	2.2	NO	YES
218	Coastal live oak	24.7	79.8	1,520.5	Fair	5,143.0	149.2	3.4	3.3	NO	YES
219	Coastal live oak	10.7	51.3	467.6	Fair	2,020.1	58.6	4.3	0.6	NO	YES
220	Coastal live oak	11.0	52.2	487.0	Fair	2,111.0	61.3	4.3	0.7	NO	YES
221	Coastal live oak	11.9	54.8	543.3	Fair	2,370.0	68.8	4.4	0.8	NO	YES
222	Coastal live oak	24.3	79.3	1,486.2	Fair	5,026.8	145.9	3.4	3.2	NO	YES
223	Coastal live oak	25.7	80.8	1,597.5	Fair	5,403.4	156.8	3.4	3.6	NO	YES
224	Coastal live oak	24.8	79.9	1,527.5	Fair	5,166.5	149.9	3.4	3.4	NO	YES
225	Coastal live oak	34.3	84.1	2,290.2	Fair	7,517.4	218.1	3.3	6.4	NO	YES
226	Coastal live oak	23.6	78.5	1,425.3	Fair	4,821.0	139.9	3.4	3.0	NO	YES
227	Coastal live oak	76.0	84.1	3,599.7	Fair	11,095.7	322.0	3.1	31.5	NO	YES
228	Mimosa	10.6	46.1	460.0	Fair	2,095.4	18.7	4.6	0.6	NO	NO
229	Mimosa	9.1	42.2	387.1	Fair	1,687.1	15.0	4.4	0.5	NO	NO
230	Coastal live oak	41.7	84.1	2,818.0	Fair	9,109.0	264.3	3.2	9.5	NO	YES
231	California white oak	6.0	35.8	216.4	Fair	759.2	15.7	3.5	0.2	NO	YES
232	California sycamore	35.6	85.6	2,669.5	Fair	16,423.4	154.5	6.2	6.9	NO	YES
233	Mioporo	15.2	59.5	735.4	Fair	3,565.1	54.7	4.8	1.3	NO	NO
234	Arroya willow	6.9	32.3	213.8	Fair	842.3	10.9	3.9	0.3	NO	YES
235	Arroya willow	18.1	52.6	665.1	Fair	3,377.5	43.8	5.1	1.8	NO	YES
236	Arroya willow	16.5	50.2	598.3	Fair	3,057.2	39.7	5.1	1.5	NO	YES
237	Arroya willow	11.2	41.2	376.7	Fair	1,778.0	23.1	4.7	0.7	NO	YES
238	Arroya willow	7.5	33.6	235.1	Fair	954.0	12.4	4.1	0.3	NO	YES

Individual Tree Data

Location: Topanga, Los Angeles, California, United States of America
Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft^2)	Tree Condition	Leaf Area (ft^2)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft^2)	Street Tree	Native to State
239	California sycamore	18.3	60.1	1,164.2	Fair	7,162.2	67.4	6.2	1.8	NO	YES
240	Coastal live oak	150.8	84.1	3,599.7	Fair	11,095.7	322.0	3.1	124.1	NO	YES
241	Coastal live oak	22.8	77.5	1,365.7	Fair	4,619.4	134.0	3.4	2.8	NO	YES
242	Coastal live oak	43.3	84.1	2,912.9	Fair	9,415.6	273.2	3.2	10.2	NO	YES
243	Coastal live oak	228.3	84.1	3,599.7	Fair	11,095.7	322.0	3.1	284.4	NO	YES
244	Coastal live oak	45.3	84.1	3,028.8	Fair	9,790.4	284.1	3.2	11.2	NO	YES
245	Coastal live oak	55.1	84.1	3,462.8	Fair	10,673.7	309.7	3.1	16.6	NO	YES
246	Coastal live oak	15.0	62.9	759.6	Fair	2,607.4	75.7	3.4	1.2	NO	YES
247	Coastal live oak	22.0	76.4	1,301.0	Fair	4,400.5	127.7	3.4	2.6	NO	YES
248	Coastal live oak	125.0	84.1	3,599.7	Fair	11,095.7	322.0	3.1	85.2	NO	YES
249	Coastal live oak	40.3	84.1	2,724.7	Fair	8,807.4	255.6	3.2	8.9	NO	YES
250	Coastal live oak	49.5	84.1	3,247.2	Fair	10,009.2	290.4	3.1	13.4	NO	YES
251	Coastal live oak	9.9	48.9	422.7	Fair	1,795.1	52.1	4.2	0.5	NO	YES
252	Coastal live oak	11.4	53.4	514.7	Fair	2,241.2	65.0	4.4	0.7	NO	YES
253	Coastal live oak	55.5	84.1	3,473.2	Fair	10,705.9	310.7	3.1	16.8	NO	YES
254	Coastal live oak	67.9	84.1	3,599.7	Fair	11,095.7	322.0	3.1	25.2	NO	YES
255	Coastal live oak	29.1	83.2	1,878.1	Fair	6,258.4	181.6	3.3	4.6	NO	YES
256	Coastal live oak	106.3	84.1	3,599.7	Fair	11,095.7	322.0	3.1	61.6	NO	YES
257	Coastal live oak	181.1	84.1	3,599.7	Fair	11,095.7	322.0	3.1	178.9	NO	YES
258	Coastal live oak	8.1	43.1	320.5	Fair	1,273.0	36.9	4.0	0.4	NO	YES
259	Coastal live oak	7.2	40.1	274.6	Fair	1,041.3	30.2	3.8	0.3	NO	YES
260	Coastal live oak	7.5	41.1	289.5	Fair	1,117.0	32.4	3.9	0.3	NO	YES
261	Coastal live oak	28.0	82.6	1,787.0	Fair	5,955.0	172.8	3.3	4.3	NO	YES
262	Coastal live oak	20.6	74.2	1,188.5	Fair	4,019.9	116.6	3.4	2.3	NO	YES
263	Coastal live oak	36.4	84.1	2,445.5	Fair	8,026.9	232.9	3.3	7.2	NO	YES
264	Coastal live oak	12.8	57.3	602.6	Fair	2,613.8	75.8	4.3	0.9	NO	YES
265	Coastal live oak	19.8	72.9	1,122.2	Fair	3,795.8	110.1	3.4	2.1	NO	YES
266	Coastal live oak	13.0	57.8	620.2	Fair	2,670.1	77.5	4.3	0.9	NO	YES
267	Coastal live oak	14.1	60.7	692.8	Fair	2,922.5	84.8	4.2	1.1	NO	YES
268	Coastal live oak	12.7	57.0	598.3	Fair	2,592.5	75.2	4.3	0.9	NO	YES
269	Coastal live oak	10.5	50.7	456.2	Fair	1,963.5	57.0	4.3	0.6	NO	YES
270	Coastal live oak	12.9	57.6	611.4	Fair	2,645.0	76.8	4.3	0.9	NO	YES
271	Coastal live oak	12.0	55.1	551.5	Fair	2,403.2	69.7	4.4	0.8	NO	YES
272	Coastal live oak	15.6	64.3	799.2	Fair	2,743.3	79.6	3.4	1.3	NO	YES

Individual Tree Data

Location: Topanga, Los Angeles, California, United States of America
Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft^2)	Tree Condition	Leaf Area (ft^2)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft^2)	Street Tree	Native to State
273	Coastal live oak	7.1	39.7	268.8	Fair	1,014.7	29.4	3.8	0.3	NO	YES
274	Coastal live oak	56.3	84.1	3,494.2	Fair	10,770.4	312.5	3.1	17.3	NO	YES
275	Coastal live oak	16.5	66.3	865.7	Fair	2,971.4	86.2	3.4	1.5	NO	YES
276	Coastal live oak	37.8	84.1	2,551.8	Fair	8,375.9	243.0	3.3	7.8	NO	YES
277	Coastal live oak	22.6	77.2	1,346.1	Fair	4,553.2	132.1	3.4	2.8	NO	YES
278	Coastal live oak	14.9	62.7	749.9	Fair	2,574.0	74.7	3.4	1.2	NO	YES
279	Coastal live oak	18.4	70.3	1,012.2	Fair	3,423.8	99.3	3.4	1.8	NO	YES
280	Coastal live oak	14.6	61.9	730.6	Fair	3,025.1	87.8	4.1	1.2	NO	YES
281	Coastal live oak	30.3	83.7	1,979.2	Fair	6,595.6	191.4	3.3	5.0	NO	YES
282	Coastal live oak	40.9	84.1	2,761.8	Fair	8,927.4	259.1	3.2	9.1	NO	YES
283	Coastal live oak	21.5	75.6	1,256.6	Fair	4,250.5	123.3	3.4	2.5	NO	YES
284	Arroya willow	18.0	52.5	660.5	Fair	3,365.9	43.7	5.1	1.8	NO	YES
285	California sycamore	37.0	87.4	2,780.5	Fair	17,106.4	160.9	6.2	7.5	NO	YES
286	Arroya willow	19.5	54.7	725.8	Fair	3,639.5	47.2	5.0	2.1	NO	YES
287	Arroya willow	16.1	49.6	581.1	Fair	2,970.2	38.5	5.1	1.4	NO	YES
288	Arroya willow	5.9	29.8	176.7	Fair	659.2	8.6	3.7	0.2	NO	YES
289	Arroya willow	16.1	49.6	581.1	Fair	2,970.2	38.5	5.1	1.4	NO	YES
290	Neomexican elderberry	17.7	16.6	235.1	Fair	796.9	12.2	3.4	1.7	NO	NO
291	Arroya willow	24.2	61.0	940.2	Fair	3,914.3	50.8	4.2	3.2	NO	YES
292	Arroya willow	15.9	49.3	572.6	Fair	2,922.9	37.9	5.1	1.4	NO	YES
293	Laurel sumac	10.2	30.6	167.4	Fair	358.6	5.5	2.1	0.6	NO	YES
294	Coastal live oak	76.4	84.1	3,599.7	Fair	11,095.7	322.0	3.1	31.8	NO	YES
295	Coastal live oak	15.4	63.8	784.3	Fair	2,691.9	78.1	3.4	1.3	NO	YES
296	Coastal live oak	31.1	83.9	2,042.8	Fair	6,807.5	197.5	3.3	5.3	NO	YES
297	Coastal live oak	12.8	57.3	602.6	Fair	2,613.8	75.8	4.3	0.9	NO	YES
298	Coastal live oak	11.5	53.7	518.7	Fair	2,263.7	65.7	4.4	0.7	NO	YES
299	Coastal live oak	22.2	76.7	1,313.8	Fair	4,443.9	129.0	3.4	2.7	NO	YES
300	Coastal live oak	57.9	84.1	3,536.2	Fair	10,899.9	316.3	3.1	18.3	NO	YES
301	Coastal live oak	12.6	56.8	589.6	Fair	2,566.5	74.5	4.4	0.9	NO	YES
302	Coastal live oak	38.2	84.1	2,578.7	Fair	8,464.3	245.6	3.3	8.0	NO	YES
303	Coastal live oak	10.0	49.2	426.4	Fair	1,817.1	52.7	4.3	0.5	NO	YES
304	Coastal live oak	22.0	76.4	1,301.0	Fair	4,400.5	127.7	3.4	2.6	NO	YES
305	Coastal live oak	11.0	52.2	487.0	Fair	2,111.0	61.3	4.3	0.7	NO	YES

Individual Tree Data

Location: Topanga, Los Angeles, California, United States of America
Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft^2)	Tree Condition	Leaf Area (ft^2)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft^2)	Street Tree	Native to State
306	Coastal live oak	20.1	73.4	1,146.1	Fair	3,876.5	112.5	3.4	2.2	NO	YES
307	Coastal live oak	23.3	78.1	1,405.3	Fair	4,753.3	137.9	3.4	3.0	NO	YES
308	Coastal live oak	18.4	70.3	1,012.2	Fair	3,423.8	99.3	3.4	1.8	NO	YES
309	Coastal live oak	12.6	56.8	589.6	Fair	2,566.5	74.5	4.4	0.9	NO	YES
310	Coastal live oak	45.3	84.1	3,028.8	Fair	9,790.4	284.1	3.2	11.2	NO	YES
311	Coastal live oak	20.0	73.2	1,140.1	Fair	3,856.2	111.9	3.4	2.2	NO	YES
312	Coastal live oak	28.2	82.7	1,802.0	Fair	6,005.1	174.3	3.3	4.3	NO	YES
313	Arroya willow	28.5	66.3	1,140.1	Fair	4,746.3	61.6	4.2	4.4	NO	YES
314	Coastal live oak	7.0	39.4	263.0	Fair	988.4	28.7	3.8	0.3	NO	YES
315	Coastal live oak	17.6	68.7	951.1	Fair	3,264.7	94.7	3.4	1.7	NO	YES
	Total			**451,965.4**		**1,588,936.3**	**41,955.9**		**2,645.7**		

Individual Tree Data

Location: Topanga, Los Angeles, California, United States of America
Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft^2)	Tree Condition	Leaf Area (ft^2)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft^2)	Street Tree	Native to State
1	White alder	10.3	51.0	437.4	Fair	2,090.6	37.6	4.8	0.6	NO	YES
2	White alder	25.7	86.4	1,034.9	Fair	4,023.9	72.3	3.9	3.6	NO	YES
3	White alder	18.4	71.3	809.3	Fair	3,549.7	63.8	4.4	1.8	NO	YES
4	Coastal live oak	9.0	46.1	369.8	Fair	1,532.5	44.5	4.1	0.4	NO	YES
5	Coastal live oak	12.0	55.1	551.5	Fair	2,403.2	69.7	4.4	0.8	NO	YES
6	Coastal live oak	26.4	81.4	1,654.7	Fair	5,514.1	160.0	3.3	3.8	NO	YES
7	Coastal live oak	4.2	29.1	141.0	Fair	436.3	12.7	3.1	0.1	NO	YES
8	Coastal live oak	6.9	39.0	257.3	Fair	959.2	27.8	3.7	0.3	NO	YES
9	Coastal live oak	16.5	66.3	865.7	Fair	2,971.4	86.2	3.4	1.5	NO	YES
10	Coastal live oak	9.5	47.7	397.6	Fair	1,673.0	48.5	4.2	0.5	NO	YES
11	Coastal live oak	9.5	47.7	397.6	Fair	1,673.0	48.5	4.2	0.5	NO	YES
12	Coastal live oak	12.5	56.5	585.4	Fair	2,539.1	73.7	4.3	0.9	NO	YES
13	Coastal live oak	12.5	56.5	585.4	Fair	2,539.1	73.7	4.3	0.9	NO	YES
14	Coastal live oak	14.5	61.7	721.1	Fair	3,000.3	87.1	4.2	1.1	NO	YES
15	Coastal live oak	18.5	70.5	1,017.9	Fair	3,442.9	99.9	3.4	1.9	NO	YES
16	Coastal live oak	48.5	84.1	3,196.9	Fair	10,333.7	299.9	3.2	12.8	NO	YES
17	Coastal live oak	70.0	84.1	3,599.7	Fair	11,095.7	322.0	3.1	26.7	NO	YES
18	Coastal live oak	28.5	82.9	1,832.3	Fair	6,105.8	177.2	3.3	4.4	NO	YES
19	Coastal live oak	10.0	49.2	426.4	Fair	1,817.1	52.7	4.3	0.5	NO	YES
20	Coastal live oak	22.4	76.9	1,333.2	Fair	4,509.3	130.8	3.4	2.7	NO	YES
21	California sycamore	8.1	38.9	380.1	Fair	2,523.7	23.7	6.6	0.4	NO	YES
22	California sycamore	8.8	40.7	422.7	Fair	2,888.2	27.2	6.8	0.4	NO	YES
23	Coastal live oak	30.6	83.8	2,003.0	Fair	6,674.7	193.7	3.3	5.1	NO	YES
24	Coastal live oak	35.6	84.1	2,393.1	Fair	7,855.2	227.9	3.3	6.9	NO	YES
25	Coastal live oak	23.0	77.7	1,378.9	Fair	4,663.8	135.3	3.4	2.9	NO	YES
26	Coastal live oak	31.5	84.0	2,075.0	Fair	6,914.7	200.6	3.3	5.4	NO	YES
27	Coastal live oak	17.0	67.4	907.9	Fair	3,116.3	90.4	3.4	1.6	NO	YES
28	California white oak	15.0	62.9	759.6	Fair	2,607.4	54.0	3.4	1.2	NO	YES
29	Coastal live oak	21.0	74.8	1,219.2	Fair	4,123.9	119.7	3.4	2.4	NO	YES
30	Coastal live oak	6.5	37.6	240.5	Fair	875.0	25.4	3.6	0.2	NO	YES
31	Coastal live oak	6.5	37.6	240.5	Fair	875.0	25.4	3.6	0.2	NO	YES
32	Coastal live oak	10.5	50.7	456.2	Fair	1,963.5	57.0	4.3	0.6	NO	YES
33	Coastal live oak	30.0	83.6	1,947.8	Fair	6,490.9	188.4	3.3	4.9	NO	YES
34	Coastal live oak	7.0	39.4	263.0	Fair	988.4	28.7	3.8	0.3	NO	YES

Individual Tree Data

Location: Topanga, Los Angeles, California, United States of America
Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft^2)	Tree Condition	Leaf Area (ft^2)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft^2)	Street Tree	Native to State
35	Arroya willow	55.5	80.0	1,764.6	Fair	7,434.4	96.5	4.2	16.8	NO	YES
36	Coastal live oak	7.8	42.1	304.8	Fair	1,195.6	34.7	3.9	0.3	NO	YES
37	Coastal live oak	6.6	38.0	243.3	Fair	890.2	25.8	3.7	0.2	NO	YES
38	Coastal live oak	18.3	70.1	1,006.6	Fair	3,404.7	98.8	3.4	1.8	NO	YES
39	California sycamore	30.0	78.1	2,206.2	Fair	13,573.0	127.7	6.2	4.9	NO	YES
40	White alder	18.9	72.4	829.6	Fair	3,603.3	64.7	4.3	1.9	NO	YES
41	Arroya willow	24.4	61.3	945.7	Fair	3,937.0	51.1	4.2	3.2	NO	YES
42	Arroya willow	32.5	70.9	1,326.7	Fair	5,589.5	72.5	4.2	5.8	NO	YES
43	White alder	27.6	90.0	1,063.6	Fair	4,069.3	73.1	3.8	4.2	NO	YES
44	Arroya willow	22.7	59.0	870.9	Fair	3,625.7	47.0	4.2	2.8	NO	YES
45	Coastal live oak	32.6	84.1	2,156.5	Fair	7,078.5	205.4	3.3	5.8	NO	YES
46	Coastal live oak	16.5	66.3	865.7	Fair	2,971.4	86.2	3.4	1.5	NO	YES
47	Coastal live oak	10.5	50.7	456.2	Fair	1,963.5	57.0	4.3	0.6	NO	YES
48	Coastal live oak	55.9	84.1	3,483.7	Fair	10,738.1	311.6	3.1	17.0	NO	YES
49	Coastal live oak	34.3	84.1	2,290.2	Fair	7,517.4	218.1	3.3	6.4	NO	YES
50	Coastal live oak	18.5	70.5	1,017.9	Fair	3,442.9	99.9	3.4	1.9	NO	YES
51	Coastal live oak	83.3	84.1	3,599.7	Fair	11,095.7	322.0	3.1	37.9	NO	YES
52	Coastal live oak	66.3	84.1	3,599.7	Fair	11,095.7	322.0	3.1	24.0	NO	YES
53	Coastal live oak	61.0	84.1	3,589.1	Fair	11,063.0	321.0	3.1	20.3	NO	YES
54	Coastal live oak	7.0	39.4	263.0	Fair	988.4	28.7	3.8	0.3	NO	YES
55	Coastal live oak	37.0	84.1	2,489.5	Fair	8,171.4	237.1	3.3	7.5	NO	YES
56	Coastal live oak	86.0	84.1	3,599.7	Fair	11,095.7	322.0	3.1	40.4	NO	YES
57	Coastal live oak	33.0	84.1	2,189.6	Fair	7,187.0	208.5	3.3	5.9	NO	YES
58	Coastal live oak	65.5	84.1	3,610.4	Fair	11,128.5	322.9	3.1	23.4	NO	YES
59	Coastal live oak	16.0	65.2	829.6	Fair	2,847.4	82.6	3.4	1.4	NO	YES
60	Coastal live oak	30.5	83.8	1,995.0	Fair	6,648.3	192.9	3.3	5.1	NO	YES
61	Coastal live oak	24.5	79.6	1,499.9	Fair	5,073.2	147.2	3.4	3.3	NO	YES
62	Coastal live oak	40.5	84.1	2,734.0	Fair	8,837.3	256.4	3.2	8.9	NO	YES
63	Coastal live oak	66.5	84.1	3,599.7	Fair	11,095.7	322.0	3.1	24.1	NO	YES
64	Coastal live oak	57.5	84.1	3,525.7	Fair	10,867.5	315.3	3.1	18.0	NO	YES
65	Coastal live oak	13.5	59.2	651.4	Fair	2,791.4	81.0	4.3	1.0	NO	YES
66	Coastal live oak	24.0	79.0	1,459.0	Fair	4,934.8	143.2	3.4	3.1	NO	YES
67	Coastal live oak	14.5	61.7	721.1	Fair	3,000.3	87.1	4.2	1.1	NO	YES
68	Coastal live oak	10.0	49.2	426.4	Fair	1,817.1	52.7	4.3	0.5	NO	YES

Individual Tree Data

Location: Topanga, Los Angeles, California, United States of America
Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft^2)	Tree Condition	Leaf Area (ft^2)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft^2)	Street Tree	Native to State
69	Coastal live oak	11.0	52.2	487.0	Fair	2,111.0	61.3	4.3	0.7	NO	YES
70	Coastal live oak	22.5	77.1	1,339.6	Fair	4,531.2	131.5	3.4	2.8	NO	YES
71	Coastal live oak	30.7	83.8	2,010.9	Fair	6,701.1	194.5	3.3	5.1	NO	YES
72	Coastal live oak	15.2	63.4	774.4	Fair	2,658.0	77.1	3.4	1.3	NO	YES
73	Coastal live oak	22.4	76.9	1,333.2	Fair	4,509.3	130.8	3.4	2.7	NO	YES
74	Coastal live oak	14.0	60.4	688.1	Fair	2,903.7	84.3	4.2	1.1	NO	YES
75	Coastal live oak	19.7	72.7	1,116.3	Fair	3,775.7	109.6	3.4	2.1	NO	YES
76	Coastal live oak	10.2	49.8	437.4	Fair	1,873.1	54.4	4.3	0.6	NO	YES
77	Coastal live oak	5.3	33.3	186.3	Fair	624.5	18.1	3.4	0.2	NO	YES
78	Coastal live oak	49.2	84.1	3,237.1	Fair	9,978.1	289.5	3.1	13.2	NO	YES
79	Coastal live oak	61.6	84.1	3,589.1	Fair	11,063.0	321.0	3.1	20.7	NO	YES
80	Coastal live oak	12.5	56.5	585.4	Fair	2,539.1	73.7	4.3	0.9	NO	YES
81	Coastal live oak	19.6	72.5	1,104.5	Fair	3,735.7	108.4	3.4	2.1	NO	YES
82	Coastal live oak	30.8	83.9	2,018.9	Fair	6,727.6	195.2	3.3	5.2	NO	YES
83	Coastal live oak	19.4	72.1	1,092.7	Fair	3,696.0	107.2	3.4	2.1	NO	YES
84	Coastal live oak	16.9	67.2	897.3	Fair	3,079.8	89.4	3.4	1.6	NO	YES
85	Coastal live oak	29.7	83.5	1,924.4	Fair	6,412.9	186.1	3.3	4.8	NO	YES
86	Coastal live oak	23.3	78.1	1,405.3	Fair	4,753.3	137.9	3.4	3.0	NO	YES
87	Coastal live oak	13.4	58.9	646.9	Fair	2,771.2	80.4	4.3	1.0	NO	YES
88	Coastal live oak	4.5	30.2	151.7	Fair	478.9	13.9	3.2	0.1	NO	YES
89	California sycamore	8.0	38.7	373.3	Fair	2,467.4	23.2	6.6	0.3	NO	YES
90	California sycamore	8.8	40.7	422.7	Fair	2,888.2	27.2	6.8	0.4	NO	YES
91	California sycamore	9.7	42.9	483.1	Fair	3,383.7	31.8	7.0	0.5	NO	YES
92	Coastal live oak	20.9	74.7	1,206.9	Fair	4,082.1	118.5	3.4	2.4	NO	YES
93	Coastal live oak	20.5	74.0	1,176.3	Fair	3,978.7	115.5	3.4	2.3	NO	YES
94	Coastal live oak	23.2	78.0	1,398.7	Fair	4,730.9	137.3	3.4	2.9	NO	YES
95	Coastal live oak	36.1	84.1	2,428.0	Fair	7,969.5	231.3	3.3	7.1	NO	YES
96	Coastal live oak	8.7	45.1	353.0	Fair	1,443.6	41.9	4.1	0.4	NO	YES
97	Coastal live oak	12.9	57.6	611.4	Fair	2,645.0	76.8	4.3	0.9	NO	YES
98	Coastal live oak	15.4	63.8	784.3	Fair	2,691.9	78.1	3.4	1.3	NO	YES
99	Coastal live oak	32.4	84.1	2,140.1	Fair	7,024.6	203.8	3.3	5.7	NO	YES
100	Coastal live oak	17.2	67.8	918.6	Fair	3,153.1	91.5	3.4	1.6	NO	YES
101	Coastal live oak	20.1	73.4	1,146.1	Fair	3,876.5	112.5	3.4	2.2	NO	YES
102	Coastal live oak	20.0	73.2	1,140.1	Fair	3,856.2	111.9	3.4	2.2	NO	YES

Individual Tree Data

Location: Topanga, Los Angeles, California, United States of America
Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft^2)	Tree Condition	Leaf Area (ft^2)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft^2)	Street Tree	Native to State
103	Coastal live oak	19.5	72.3	1,098.6	Fair	3,715.9	107.8	3.4	2.1	NO	YES
104	Coastal live oak	15.3	63.6	779.3	Fair	2,674.9	77.6	3.4	1.3	NO	YES
105	Coastal live oak	9.5	47.7	397.6	Fair	1,673.0	48.5	4.2	0.5	NO	YES
106	Coastal live oak	16.6	66.6	876.2	Fair	3,007.3	87.3	3.4	1.5	NO	YES
107	Coastal live oak	29.4	83.4	1,901.2	Fair	6,335.5	183.8	3.3	4.7	NO	YES
108	Coastal live oak	35.7	84.1	2,393.1	Fair	7,855.2	227.9	3.3	7.0	NO	YES
109	Coastal live oak	18.9	71.2	1,052.1	Fair	3,558.6	103.3	3.4	1.9	NO	YES
110	Coastal live oak	28.9	83.1	1,862.7	Fair	6,207.3	180.1	3.3	4.6	NO	YES
111	Coastal live oak	19.6	72.5	1,104.5	Fair	3,735.7	108.4	3.4	2.1	NO	YES
112	Coastal live oak	46.5	84.1	3,097.5	Fair	10,012.3	290.5	3.2	11.8	NO	YES
113	Arroya willow	17.5	51.7	637.9	Fair	3,259.3	42.3	5.1	1.7	NO	YES
114	Mimosa	17.7	62.0	789.2	Fair	3,646.0	32.5	4.6	1.7	NO	NO
115	Coastal live oak	10.5	50.7	456.2	Fair	1,963.5	57.0	4.3	0.6	NO	YES
116	Coastal live oak	46.0	84.1	3,068.0	Fair	9,916.9	287.8	3.2	11.5	NO	YES
117	California white oak	18.0	69.5	984.2	Fair	3,329.1	68.9	3.4	1.8	NO	YES
118	Coastal live oak	16.5	66.3	865.7	Fair	2,971.4	86.2	3.4	1.5	NO	YES
119	California white oak	5.0	32.1	172.0	Fair	563.8	11.7	3.3	0.1	NO	YES
120	Arroya willow	22.0	58.1	839.8	Fair	3,496.2	45.4	4.2	2.6	NO	YES
121	California sycamore	36.2	86.4	2,715.5	Fair	16,706.3	157.2	6.2	7.1	NO	YES
122	California sycamore	77.2	103.8	3,578.5	Fair	22,015.7	207.1	6.2	32.5	NO	YES
123	Arroya willow	9.8	38.5	323.7	Fair	1,457.1	18.9	4.5	0.5	NO	YES
124	Coastal live oak	72.6	84.1	3,599.7	Fair	11,095.7	322.0	3.1	28.8	NO	YES
125	California sycamore	54.7	103.8	3,578.5	Fair	22,015.7	207.1	6.2	16.3	NO	YES
126	Coastal live oak	29.9	83.6	1,940.0	Fair	6,464.9	187.6	3.3	4.9	NO	YES
127	Coastal live oak	132.3	84.1	3,599.7	Fair	11,095.7	322.0	3.1	95.5	NO	YES
128	Coastal live oak	130.3	84.1	3,599.7	Fair	11,095.7	322.0	3.1	92.6	NO	YES
129	Coastal live oak	149.2	84.1	3,599.7	Fair	11,095.7	322.0	3.1	121.5	NO	YES
130	Coastal live oak	62.2	84.1	3,599.7	Fair	11,095.7	322.0	3.1	21.1	NO	YES
131	Coastal live oak	53.9	84.1	3,421.2	Fair	10,545.5	306.0	3.1	15.9	NO	YES
132	Coastal live oak	78.3	84.1	3,599.7	Fair	11,095.7	322.0	3.1	33.4	NO	YES
133	Coastal live oak	128.3	84.1	3,599.7	Fair	11,095.7	322.0	3.1	89.8	NO	YES
134	Coastal live oak	114.6	84.1	3,599.7	Fair	11,095.7	322.0	3.1	71.7	NO	YES
135	Coastal live oak	48.0	84.1	3,176.9	Fair	10,269.0	298.0	3.2	12.6	NO	YES
136	Coastal live oak	41.0	84.1	2,771.2	Fair	8,957.5	259.9	3.2	9.2	NO	YES

Individual Tree Data

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Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft^2)	Tree Condition	Leaf Area (ft^2)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft^2)	Street Tree	Native to State
137	Coastal live oak	8.2	43.5	326.9	Fair	1,307.1	37.9	4.0	0.4	NO	YES
138	Coastal live oak	41.7	84.1	2,818.0	Fair	9,109.0	264.3	3.2	9.5	NO	YES
139	Coastal live oak	12.0	55.1	551.5	Fair	2,403.2	69.7	4.4	0.8	NO	YES
140	Coastal live oak	31.8	84.1	2,099.3	Fair	6,995.7	203.0	3.3	5.5	NO	YES
141	Coastal live oak	45.6	84.1	3,048.4	Fair	9,853.5	285.9	3.2	11.3	NO	YES
142	Coastal live oak	4.9	31.8	169.7	Fair	552.7	16.0	3.3	0.1	NO	YES
143	Coastal live oak	7.9	42.5	307.9	Fair	1,218.1	35.3	4.0	0.3	NO	YES
144	Coastal live oak	30.2	83.7	1,971.4	Fair	6,569.4	190.6	3.3	5.0	NO	YES
145	Coastal live oak	17.2	67.8	918.6	Fair	3,153.1	91.5	3.4	1.6	NO	YES
146	Coastal live oak	19.5	72.3	1,098.6	Fair	3,715.9	107.8	3.4	2.1	NO	YES
147	Coastal live oak	15.5	64.1	794.2	Fair	2,726.1	79.1	3.4	1.3	NO	YES
148	Coastal live oak	11.0	52.2	487.0	Fair	2,111.0	61.3	4.3	0.7	NO	YES
149	Coastal live oak	17.0	67.4	907.9	Fair	3,116.3	90.4	3.4	1.6	NO	YES
150	Coastal live oak	4.7	31.0	160.6	Fair	513.9	14.9	3.2	0.1	NO	YES
151	Coastal live oak	21.4	75.5	1,250.4	Fair	4,229.2	122.7	3.4	2.5	NO	YES
152	Coastal live oak	49.1	84.1	3,227.1	Fair	10,431.1	302.7	3.2	13.2	NO	YES
153	Coastal live oak	26.6	81.6	1,676.4	Fair	5,586.4	162.1	3.3	3.9	NO	YES
154	Coastal live oak	21.2	75.2	1,231.6	Fair	4,165.9	120.9	3.4	2.5	NO	YES
155	Coastal live oak	33.3	84.1	2,214.5	Fair	7,268.9	210.9	3.3	6.0	NO	YES
156	Coastal live oak	26.4	81.4	1,654.7	Fair	5,514.1	160.0	3.3	3.8	NO	YES
157	Coastal live oak	5.1	32.5	176.7	Fair	582.1	16.9	3.3	0.1	NO	YES
158	Coastal live oak	31.1	83.9	2,042.8	Fair	6,807.5	197.5	3.3	5.3	NO	YES
159	Coastal live oak	28.3	82.8	1,817.1	Fair	6,055.3	175.7	3.3	4.4	NO	YES
160	Coastal live oak	9.8	48.6	415.5	Fair	1,761.4	51.1	4.2	0.5	NO	YES
161	Coastal live oak	32.0	84.1	2,107.4	Fair	7,022.7	203.8	3.3	5.6	NO	YES
162	Coastal live oak	5.9	35.5	211.2	Fair	739.9	21.5	3.5	0.2	NO	YES
163	Coastal live oak	39.0	84.1	2,633.0	Fair	8,510.8	247.0	3.2	8.3	NO	YES
164	Coastal live oak	56.0	84.1	3,483.7	Fair	10,738.1	311.6	3.1	17.1	NO	YES
165	Coastal live oak	13.0	57.8	620.2	Fair	2,670.1	77.5	4.3	0.9	NO	YES
166	Coastal live oak	11.5	53.7	518.7	Fair	2,263.7	65.7	4.4	0.7	NO	YES
167	Coastal live oak	41.0	84.1	2,771.2	Fair	8,957.5	259.9	3.2	9.2	NO	YES
168	Coastal live oak	13.0	57.8	620.2	Fair	2,670.1	77.5	4.3	0.9	NO	YES
169	Coastal live oak	11.0	52.2	487.0	Fair	2,111.0	61.3	4.3	0.7	NO	YES
170	Coastal live oak	75.8	84.1	3,599.7	Fair	11,095.7	322.0	3.1	31.3	NO	YES

Individual Tree Data

Location: Topanga, Los Angeles, California, United States of America
Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft²)	Tree Condition	Leaf Area (ft²)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft²)	Street Tree	Native to State
171	Coastal live oak	16.5	66.3	865.7	Fair	2,971.4	86.2	3.4	1.5	NO	YES
172	Coastal live oak	12.2	55.7	564.1	Fair	2,458.2	71.3	4.4	0.8	NO	YES
173	Coastal live oak	31.5	84.0	2,075.0	Fair	6,914.7	200.6	3.3	5.4	NO	YES
174	Coastal live oak	51.2	84.1	3,318.3	Fair	10,228.4	296.8	3.1	14.3	NO	YES
175	Coastal live oak	21.7	75.9	1,275.6	Fair	4,314.4	125.2	3.4	2.6	NO	YES
176	Coastal live oak	16.1	65.5	839.8	Fair	2,882.6	83.6	3.4	1.4	NO	YES
177	Coastal live oak	24.0	79.0	1,459.0	Fair	4,934.8	143.2	3.4	3.1	NO	YES
178	Coastal live oak	18.3	70.1	1,006.6	Fair	3,404.7	98.8	3.4	1.8	NO	YES
179	Coastal live oak	11.8	54.5	539.1	Fair	2,347.7	68.1	4.4	0.8	NO	YES
180	Coastal live oak	17.9	69.3	973.1	Fair	3,340.2	96.9	3.4	1.7	NO	YES
181	Coastal live oak	28.6	83.0	1,839.8	Fair	6,131.1	177.9	3.3	4.5	NO	YES
182	Coastal live oak	20.4	73.9	1,170.2	Fair	3,958.1	114.9	3.4	2.3	NO	YES
183	California sycamore	6.5	34.6	286.5	Fair	1,751.4	16.5	6.1	0.2	NO	YES
184	California sycamore	12.1	48.2	656.0	Fair	4,663.8	43.9	7.1	0.8	NO	YES
185	Coastal live oak	20.1	73.4	1,146.1	Fair	3,876.5	112.5	3.4	2.2	NO	YES
186	Coastal live oak	15.1	63.1	764.5	Fair	2,624.2	76.1	3.4	1.2	NO	YES
187	Coastal live oak	25.8	80.9	1,611.7	Fair	5,451.4	158.2	3.4	3.6	NO	YES
188	Coastal live oak	19.7	72.7	1,116.3	Fair	3,775.7	109.6	3.4	2.1	NO	YES
189	Coastal live oak	18.9	71.2	1,052.1	Fair	3,558.6	103.3	3.4	1.9	NO	YES
190	Coastal live oak	18.5	70.5	1,017.9	Fair	3,442.9	99.9	3.4	1.9	NO	YES
191	Coastal live oak	8.1	43.1	320.5	Fair	1,273.0	36.9	4.0	0.4	NO	YES
192	Coastal live oak	5.7	34.7	203.6	Fair	700.1	20.3	3.4	0.2	NO	YES
193	Coastal live oak	22.0	76.4	1,301.0	Fair	4,400.5	127.7	3.4	2.6	NO	YES
194	Coastal live oak	8.0	42.8	314.2	Fair	1,243.4	36.1	4.0	0.3	NO	YES
195	Coastal live oak	6.1	36.2	221.7	Fair	784.3	22.8	3.5	0.2	NO	YES
196	Coastal live oak	9.9	48.9	422.7	Fair	1,795.1	52.1	4.2	0.5	NO	YES
197	Coastal live oak	53.1	84.1	3,400.5	Fair	10,481.7	304.2	3.1	15.4	NO	YES
198	Coastal live oak	20.0	73.2	1,140.1	Fair	3,856.2	111.9	3.4	2.2	NO	YES
199	Coastal live oak	24.7	79.8	1,520.5	Fair	5,143.0	149.2	3.4	3.3	NO	YES
200	Coastal live oak	47.1	84.1	3,127.2	Fair	10,108.2	293.3	3.2	12.1	NO	YES
201	Coastal live oak	8.1	43.1	320.5	Fair	1,273.0	36.9	4.0	0.4	NO	YES
202	Coastal live oak	13.8	59.9	674.3	Fair	2,857.0	82.9	4.2	1.0	NO	YES
203	Coastal live oak	35.9	84.1	2,410.5	Fair	7,912.3	229.6	3.3	7.0	NO	YES
204	Coastal live oak	21.6	75.8	1,262.9	Fair	4,271.7	124.0	3.4	2.5	NO	YES

Individual Tree Data

Location: Topanga, Los Angeles, California, United States of America
Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft^2)	Tree Condition	Leaf Area (ft^2)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft^2)	Street Tree	Native to State
205	Coastal live oak	28.4	82.9	1,824.7	Fair	6,080.5	176.4	3.3	4.4	NO	YES
206	Coastal live oak	7.0	39.4	263.0	Fair	988.4	28.7	3.8	0.3	NO	YES
207	Coastal live oak	19.2	71.8	1,075.2	Fair	3,636.8	105.5	3.4	2.0	NO	YES
208	Coastal live oak	21.1	75.0	1,225.4	Fair	4,144.9	120.3	3.4	2.4	NO	YES
209	Coastal live oak	53.2	84.1	3,400.5	Fair	10,481.7	304.2	3.1	15.4	NO	YES
210	Coastal live oak	11.9	54.8	543.3	Fair	2,370.0	68.8	4.4	0.8	NO	YES
211	Coastal live oak	11.8	54.5	539.1	Fair	2,347.7	68.1	4.4	0.8	NO	YES
212	Coastal live oak	17.3	68.1	929.4	Fair	3,190.1	92.6	3.4	1.6	NO	YES
213	Coastal live oak	22.1	76.5	1,307.4	Fair	4,422.2	128.3	3.4	2.7	NO	YES
214	Coastal live oak	17.9	69.3	973.1	Fair	3,340.2	96.9	3.4	1.7	NO	YES
215	Coastal live oak	12.8	57.3	602.6	Fair	2,613.8	75.8	4.3	0.9	NO	YES
216	Coastal live oak	28.9	83.1	1,862.7	Fair	6,207.3	180.1	3.3	4.6	NO	YES
217	Coastal live oak	20.1	73.4	1,146.1	Fair	3,876.5	112.5	3.4	2.2	NO	YES
218	Coastal live oak	24.7	79.8	1,520.5	Fair	5,143.0	149.2	3.4	3.3	NO	YES
219	Coastal live oak	10.7	51.3	467.6	Fair	2,020.1	58.6	4.3	0.6	NO	YES
220	Coastal live oak	11.0	52.2	487.0	Fair	2,111.0	61.3	4.3	0.7	NO	YES
221	Coastal live oak	11.9	54.8	543.3	Fair	2,370.0	68.8	4.4	0.8	NO	YES
222	Coastal live oak	24.3	79.3	1,486.2	Fair	5,026.8	145.9	3.4	3.2	NO	YES
223	Coastal live oak	25.7	80.8	1,597.5	Fair	5,403.4	156.8	3.4	3.6	NO	YES
224	Coastal live oak	24.8	79.9	1,527.5	Fair	5,166.5	149.9	3.4	3.4	NO	YES
225	Coastal live oak	34.3	84.1	2,290.2	Fair	7,517.4	218.1	3.3	6.4	NO	YES
226	Coastal live oak	23.6	78.5	1,425.3	Fair	4,821.0	139.9	3.4	3.0	NO	YES
227	Coastal live oak	76.0	84.1	3,599.7	Fair	11,095.7	322.0	3.1	31.5	NO	YES
228	Mimosa	10.6	46.1	460.0	Fair	2,095.4	18.7	4.6	0.6	NO	NO
229	Mimosa	9.1	42.2	387.1	Fair	1,687.1	15.0	4.4	0.5	NO	NO
230	Coastal live oak	41.7	84.1	2,818.0	Fair	9,109.0	264.3	3.2	9.5	NO	YES
231	California white oak	6.0	35.8	216.4	Fair	759.2	15.7	3.5	0.2	NO	YES
232	California sycamore	35.6	85.6	2,669.5	Fair	16,423.4	154.5	6.2	6.9	NO	YES
233	Mioporo	15.2	59.5	735.4	Fair	3,565.1	54.7	4.8	1.3	NO	NO
234	Arroya willow	6.9	32.3	213.8	Fair	842.3	10.9	3.9	0.3	NO	YES
235	Arroya willow	18.1	52.6	665.1	Fair	3,377.5	43.8	5.1	1.8	NO	YES
236	Arroya willow	16.5	50.2	598.3	Fair	3,057.2	39.7	5.1	1.5	NO	YES
237	Arroya willow	11.2	41.2	376.7	Fair	1,778.0	23.1	4.7	0.7	NO	YES
238	Arroya willow	7.5	33.6	235.1	Fair	954.0	12.4	4.1	0.3	NO	YES

Individual Tree Data

Location: Topanga, Los Angeles, California, United States of America
Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft^2)	Tree Condition	Leaf Area (ft^2)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft^2)	Street Tree	Native to State
239	California sycamore	18.3	60.1	1,164.2	Fair	7,162.2	67.4	6.2	1.8	NO	YES
240	Coastal live oak	150.8	84.1	3,599.7	Fair	11,095.7	322.0	3.1	124.1	NO	YES
241	Coastal live oak	22.8	77.5	1,365.7	Fair	4,619.4	134.0	3.4	2.8	NO	YES
242	Coastal live oak	43.3	84.1	2,912.9	Fair	9,415.6	273.2	3.2	10.2	NO	YES
243	Coastal live oak	228.3	84.1	3,599.7	Fair	11,095.7	322.0	3.1	284.4	NO	YES
244	Coastal live oak	45.3	84.1	3,028.8	Fair	9,790.4	284.1	3.2	11.2	NO	YES
245	Coastal live oak	55.1	84.1	3,462.8	Fair	10,673.7	309.7	3.1	16.6	NO	YES
246	Coastal live oak	15.0	62.9	759.6	Fair	2,607.4	75.7	3.4	1.2	NO	YES
247	Coastal live oak	22.0	76.4	1,301.0	Fair	4,400.5	127.7	3.4	2.6	NO	YES
248	Coastal live oak	125.0	84.1	3,599.7	Fair	11,095.7	322.0	3.1	85.2	NO	YES
249	Coastal live oak	40.3	84.1	2,724.7	Fair	8,807.4	255.6	3.2	8.9	NO	YES
250	Coastal live oak	49.5	84.1	3,247.2	Fair	10,009.2	290.4	3.1	13.4	NO	YES
251	Coastal live oak	9.9	48.9	422.7	Fair	1,795.1	52.1	4.2	0.5	NO	YES
252	Coastal live oak	11.4	53.4	514.7	Fair	2,241.2	65.0	4.4	0.7	NO	YES
253	Coastal live oak	55.5	84.1	3,473.2	Fair	10,705.9	310.7	3.1	16.8	NO	YES
254	Coastal live oak	67.9	84.1	3,599.7	Fair	11,095.7	322.0	3.1	25.2	NO	YES
255	Coastal live oak	29.1	83.2	1,878.1	Fair	6,258.4	181.6	3.3	4.6	NO	YES
256	Coastal live oak	106.3	84.1	3,599.7	Fair	11,095.7	322.0	3.1	61.6	NO	YES
257	Coastal live oak	181.1	84.1	3,599.7	Fair	11,095.7	322.0	3.1	178.9	NO	YES
258	Coastal live oak	8.1	43.1	320.5	Fair	1,273.0	36.9	4.0	0.4	NO	YES
259	Coastal live oak	7.2	40.1	274.6	Fair	1,041.3	30.2	3.8	0.3	NO	YES
260	Coastal live oak	7.5	41.1	289.5	Fair	1,117.0	32.4	3.9	0.3	NO	YES
261	Coastal live oak	28.0	82.6	1,787.0	Fair	5,955.0	172.8	3.3	4.3	NO	YES
262	Coastal live oak	20.6	74.2	1,188.5	Fair	4,019.9	116.6	3.4	2.3	NO	YES
263	Coastal live oak	36.4	84.1	2,445.5	Fair	8,026.9	232.9	3.3	7.2	NO	YES
264	Coastal live oak	12.8	57.3	602.6	Fair	2,613.8	75.8	4.3	0.9	NO	YES
265	Coastal live oak	19.8	72.9	1,122.2	Fair	3,795.8	110.1	3.4	2.1	NO	YES
266	Coastal live oak	13.0	57.8	620.2	Fair	2,670.1	77.5	4.3	0.9	NO	YES
267	Coastal live oak	14.1	60.7	692.8	Fair	2,922.5	84.8	4.2	1.1	NO	YES
268	Coastal live oak	12.7	57.0	598.3	Fair	2,592.5	75.2	4.3	0.9	NO	YES
269	Coastal live oak	10.5	50.7	456.2	Fair	1,963.5	57.0	4.3	0.6	NO	YES
270	Coastal live oak	12.9	57.6	611.4	Fair	2,645.0	76.8	4.3	0.9	NO	YES
271	Coastal live oak	12.0	55.1	551.5	Fair	2,403.2	69.7	4.4	0.8	NO	YES
272	Coastal live oak	15.6	64.3	799.2	Fair	2,743.3	79.6	3.4	1.3	NO	YES

Individual Tree Data

Location: Topanga, Los Angeles, California, United States of America
Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft^2)	Tree Condition	Leaf Area (ft^2)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft^2)	Street Tree	Native to State
273	Coastal live oak	7.1	39.7	268.8	Fair	1,014.7	29.4	3.8	0.3	NO	YES
274	Coastal live oak	56.3	84.1	3,494.2	Fair	10,770.4	312.5	3.1	17.3	NO	YES
275	Coastal live oak	16.5	66.3	865.7	Fair	2,971.4	86.2	3.4	1.5	NO	YES
276	Coastal live oak	37.8	84.1	2,551.8	Fair	8,375.9	243.0	3.3	7.8	NO	YES
277	Coastal live oak	22.6	77.2	1,346.1	Fair	4,553.2	132.1	3.4	2.8	NO	YES
278	Coastal live oak	14.9	62.7	749.9	Fair	2,574.0	74.7	3.4	1.2	NO	YES
279	Coastal live oak	18.4	70.3	1,012.2	Fair	3,423.8	99.3	3.4	1.8	NO	YES
280	Coastal live oak	14.6	61.9	730.6	Fair	3,025.1	87.8	4.1	1.2	NO	YES
281	Coastal live oak	30.3	83.7	1,979.2	Fair	6,595.6	191.4	3.3	5.0	NO	YES
282	Coastal live oak	40.9	84.1	2,761.8	Fair	8,927.4	259.1	3.2	9.1	NO	YES
283	Coastal live oak	21.5	75.6	1,256.6	Fair	4,250.5	123.3	3.4	2.5	NO	YES
284	Arroya willow	18.0	52.5	660.5	Fair	3,365.9	43.7	5.1	1.8	NO	YES
285	California sycamore	37.0	87.4	2,780.5	Fair	17,106.4	160.9	6.2	7.5	NO	YES
286	Arroya willow	19.5	54.7	725.8	Fair	3,639.5	47.2	5.0	2.1	NO	YES
287	Arroya willow	16.1	49.6	581.1	Fair	2,970.2	38.5	5.1	1.4	NO	YES
288	Arroya willow	5.9	29.8	176.7	Fair	659.2	8.6	3.7	0.2	NO	YES
289	Arroya willow	16.1	49.6	581.1	Fair	2,970.2	38.5	5.1	1.4	NO	YES
290	Neomexican elderberry	17.7	16.6	235.1	Fair	796.9	12.2	3.4	1.7	NO	NO
291	Arroya willow	24.2	61.0	940.2	Fair	3,914.3	50.8	4.2	3.2	NO	YES
292	Arroya willow	15.9	49.3	572.6	Fair	2,922.9	37.9	5.1	1.4	NO	YES
293	Laurel sumac	10.2	30.6	167.4	Fair	358.6	5.5	2.1	0.6	NO	YES
294	Coastal live oak	76.4	84.1	3,599.7	Fair	11,095.7	322.0	3.1	31.8	NO	YES
295	Coastal live oak	15.4	63.8	784.3	Fair	2,691.9	78.1	3.4	1.3	NO	YES
296	Coastal live oak	31.1	83.9	2,042.8	Fair	6,807.5	197.5	3.3	5.3	NO	YES
297	Coastal live oak	12.8	57.3	602.6	Fair	2,613.8	75.8	4.3	0.9	NO	YES
298	Coastal live oak	11.5	53.7	518.7	Fair	2,263.7	65.7	4.4	0.7	NO	YES
299	Coastal live oak	22.2	76.7	1,313.8	Fair	4,443.9	129.0	3.4	2.7	NO	YES
300	Coastal live oak	57.9	84.1	3,536.2	Fair	10,899.9	316.3	3.1	18.3	NO	YES
301	Coastal live oak	12.6	56.8	589.6	Fair	2,566.5	74.5	4.4	0.9	NO	YES
302	Coastal live oak	38.2	84.1	2,578.7	Fair	8,464.3	245.6	3.3	8.0	NO	YES
303	Coastal live oak	10.0	49.2	426.4	Fair	1,817.1	52.7	4.3	0.5	NO	YES
304	Coastal live oak	22.0	76.4	1,301.0	Fair	4,400.5	127.7	3.4	2.6	NO	YES
305	Coastal live oak	11.0	52.2	487.0	Fair	2,111.0	61.3	4.3	0.7	NO	YES

Individual Tree Data

Location: Topanga, Los Angeles, California, United States of America
Project: SMM, Series: Oaks, Year: 2017
Generated: 12/5/2017

Tree ID	Species Name	DBH (in)	Height (ft)	Canopy Cover (ft^2)	Tree Condition	Leaf Area (ft^2)	Leaf Biomass (lb)	Leaf Area Index	Basal Area (ft^2)	Street Tree	Native to State
306	Coastal live oak	20.1	73.4	1,146.1	Fair	3,876.5	112.5	3.4	2.2	NO	YES
307	Coastal live oak	23.3	78.1	1,405.3	Fair	4,753.3	137.9	3.4	3.0	NO	YES
308	Coastal live oak	18.4	70.3	1,012.2	Fair	3,423.8	99.3	3.4	1.8	NO	YES
309	Coastal live oak	12.6	56.8	589.6	Fair	2,566.5	74.5	4.4	0.9	NO	YES
310	Coastal live oak	45.3	84.1	3,028.8	Fair	9,790.4	284.1	3.2	11.2	NO	YES
311	Coastal live oak	20.0	73.2	1,140.1	Fair	3,856.2	111.9	3.4	2.2	NO	YES
312	Coastal live oak	28.2	82.7	1,802.0	Fair	6,005.1	174.3	3.3	4.3	NO	YES
313	Arroya willow	28.5	66.3	1,140.1	Fair	4,746.3	61.6	4.2	4.4	NO	YES
314	Coastal live oak	7.0	39.4	263.0	Fair	988.4	28.7	3.8	0.3	NO	YES
315	Coastal live oak	17.6	68.7	951.1	Fair	3,264.7	94.7	3.4	1.7	NO	YES
	Total			**451,965.4**		**1,588,936.3**	**41,955.9**		**2,645.7**		