ABSTRACT

This project sought a method to map Sudden Oak Death distribution in the Santa Cruz Mountains of California, a coastal mountain range and one of the locations where this disease was first observed. The project researched a method to identify forest affected by SOD using 30 m multi-spectral Landsat satellite imagery to classify tree mortality at the canopy-level throughout the study area, and applied that method to a time series of data to show pattern of spread. A successful methodology would be of interest to scientists trying to identify areas which escaped disease contagion, environmentalists attempting to quantify damage, and land managers evaluating the health of their forests. The more we can learn about the disease, the more chance we have to prevent further spread and damage to existing wild lands. The primary data source for this research was springtime Landsat Climate Data Record surface reflectance data. Non-forest areas were masked out using data produced by the National Land Cover Database and supplemental land cover classification from the Landsat 2011 Climate Data Record image. Areas with other known causes of tree death, as identified by Fire and Resource Assessment Program fire perimeter polygons, and US Department of Agriculture Forest Health Monitoring Program Aerial Detection Survey polygons, were also masked out. Within the remaining forested study area, manually-created points were classified based on the land cover contained by the corresponding Landsat 2011 pixel. These were used to extract value ranges from the Landsat bands and calculated vegetation indices. The range and index which best differentiated healthy from dead trees, SWIR/NIR, was applied to each Landsat scene in the time series to map tree mortality. Results Validation Points, classified using Google Earth high- resolution aerial imagery, were created to evaluate the accuracy of the mapping methodology for the 2011 data.

Results indicated three areas which had largely escaped Sudden Oak Death infestation and one area with high tree mortality that was not previously identified as Sudden Oak Death. However, the methodology identified widespread tree death throughout the study area, including in 1994, when little tree death should have been found. This indicated that healthy tree canopy was able to produce a spectral signature matching that of pixels containing some dead trees. In addition, the number of pixels classified as containing tree death varied widely from year to year, suggesting that seasonal variation plays a much larger role in the spectral signature than anticipated. Finally, an analysis of the Results Validation Points showed a high rate of false positives, with only 24 percent mapping accuracy for tree death. This demonstrated conclusively that the methodology and mapping results were unreliable.

The project demonstrates that Landsat data did not work for this study due to spectral confusion and seasonal variation. Results might have been improved if a custom index was devised to remove some of the false positives, if the definition of serious tree death was limited to pixels containing a greater percentage of dead tree canopy, and/or if seasonal differences in rainfall and temperature had been considered when choosing Landsat scenes to represent each year.