2009 UCDavis UPDATE
The Big Sur Ecological Monitoring Plot Network

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Big Sur is one of the regions most heavily impacted by the emergent forest pathogen *Phytophthora ramorum*, causal agent of sudden oak death. In 2006 and 2007, we established 280 long-term ecological monitoring plots throughout the region. The plots were randomly distributed across the landscape on public and private lands and stratified by forest type (redwood-tanoak or mixed-evergreen), watershed, fire history and infection level. Within each 500-m^2 plot, all stems greater than 1-cm dbh were identified, measured, mapped and scrutinized for *Phytophthora* symptoms or evidence of other pests. We also quantified the number and identity of regenerating seedlings and saplings, the percent coverage of each species, the volume of coarse woody debris (downed logs >20cm in diameter), and plot-wide canopy height and openness, as well as topographical descriptors such as elevation, slope and aspect. In sum, we collected detailed information on over 13,000 trees throughout the Big Sur region.

Eighty of 163 mixed-evergreen plots and 73 of 117 redwood-tanoak tested positive for *P.ramorum*. Dead host biomass in the form of downed logs and standing dead stems was significantly higher in infected plots compared to background mortality levels in uninfected plots. SOD mortality has caused shifts in species abundance; infected stands are increasingly dominated by species that are not killed by the disease. The composition of the seedlings and saplings regenerating in these plots closely tracks the composition of the over story species, and similarly displays significant changes in understory composition between infected and uninfected areas (Frangioso et. al. 2009).

In 2008, the Basin and Chalk fires burned significant portions of Big Sur, including areas where sudden oak death was present and absent. We have several projects using our network of monitoring plots to understand how the effects of the pathogen and fire interact to affect the forest. Immediately following the Basin fire, we set out to conduct a rapid response survey to assess fire damage. We used the Composite Burn Index, a rating from zero to three of the damage to several forest strata (substrate, herbs, shrubs, intermediate trees, and dominant trees). We also quantified soil damage in eight random locations in the plot by measuring depth of ash, consumed litter and duff and destroyed soil. The height of bole charring and canopy scorching or torching was measured on the tree nearest the soil sample point. We found a correlation between burn severity and the stage of SOD infection. There was higher burn severity in plots where there was recent SOD mortality (standing dead trees with fine fuels like leaves and twigs still attached). Where there were large amounts of coarse woody debris (logs >20cm in diameter) the soil burn severity rating was higher (Metz et. al. 2009).

In 2009 we revisited 115 plots out of the 280 plots established in the Big Sur area; 85 were in the 2008 burn area and 30 in the unburned area. We re-surveyed and re-measured all plot attributes. Symptomatic bay, tanoak and oak trees were extensively sampled as part of the UC Davis state wide monitoring plot network. We were able to recover the pathogen at 10 different locations in the burned area; all but one had previously been infected. Positives in the burn area came from the soil, bay laurel leaves and tanoak basal sprouts and surviving canopy. The one new positive location in Mill Creek along Nacimiento Road is well within the known boundary of the pathogen. We did not recover the pathogen from 40 previously positive, burned plots, and 6 previously positive, unburned plots. We are conducting further analyses to confirm these results, but negative recoveries may be due to the drought California is experiencing.

Watershed monitoring, consisting of stream baiting and water filtration techniques, was performed in 12 Big Sur watersheds (seven burned, five unburned) in the spring of 2009. These techniques assess *P. ramorum* presence on the landscape scale at different time scales; baiting provides information on cumulative pathogen presence over several weeks, while filtration allows for quantification of pathogen spores at a distinct time. All of the watersheds except one (Big Creek, unburned) were known to contain *P. ramorum* before the wildfires. We were able to recover *P. ramorum* via stream baiting in five out of the seven burned watersheds, and in four out of the five unburned watersheds. The pathogen remained undetected in Big Creek, though it was recovered from adjacent Devil's Creek (Beh et al. 2009).

Terrestrial sampling for pathogen survival in the burned area was conducted in the summer of 2009. Twenty-three plots that had tested positive for *P. ramorum* prior to the 2008 fires were used in this study; four of these plots remained unburned and 19 were burned in varying severity. Previously known *P. ramorum*-positive bay laurel trees and the soil from beneath these trees were tested for the presence of the pathogen in both mixed-evergreen and redwood-tanoak type forest plots. The pathogen was recovered from bay leaves in all four unburned plots, but recovery declined as mean overstory burn indices increased. Pathogen recovery from the soil was overall very low (from only 26% of the subset plots), but did not appear affected by burn severity. More extensive survival analyses will be performed on the comprehensive plot network data in the near future.

Bark and ambrosia beetle surveys commenced in the late summer of 2009. Sticky cards were used to assess beetle landing rates on tanoak trees in all four combinations of burned vs. unburned and *P.ramorum*-positive vs. –negative. Ambrosia beetles were trapped in much greater levels in the *P. ramorum*- positive/burned plots than in the other three treatments (Beh et al., 2009a). This increased attraction of beetles to infected tanoaks may potentially lead to neighboring, uninfected trees being attacked and compromised, but further research will be necessary to verify this scenario.

In collaboration with UC Berkeley, we initiated a re-establishment survey to study the genetic population structure of *P.ramorum* in the burned area. We would like to understand what makes particular strains of *P.ramorum* more virulent than others and whether particular strains become ubiquitous over time within the burned area. Also in 2009, we recovered the pathogen from canyon live oak (*Quercus chrysolepsis*) in the unburned area. This was the first year we detected the pathogen on canyon live oak in our study area. SOD specialists around the state are now becoming more concerned for the fate of canyon live oaks as we are seeing big trees die from SOD in San Mateo County.

These plots provide invaluable information on environment, vegetation, forest structure, disease level, and site history in areas with and without the disease. Understanding the current spatial distribution of *P. ramorum* on the landscape, how this distribution is changing, and the underlying influences on establishment and spread of *P. ramorum* are critical to making management decisions throughout the state of California. We are beginning to work on a SOD strategy with the Forest Service for the Los Padres National Forest to determine what sort of management techniques can be used to slow or stop the spread of SOD and give parts of the forest a better chance of survival or revival.

Beh M., Frangioso K., Aram K., and Rizzo D. 2009. The Impacts of Wildfire on *Phytophthora ramorum* Survival in the Big Sur Region. Fourth Sudden Oak Death Science Symposium. 15-18 June 2009. Santa Cruz, CA, USA. (Abstract)

Beh M., Seybold S., and Rizzo D. 2009a. Ambrosia Beetles Show an Increased Attraction to Burned, Sudden Oak Death-Infected Tanoak Trees in the Big Sur Region. 58th Annual Meeting of the California Forest Pest Council. 17-18 November 2009. Woodland, CA, USA. (Poster)

Frangioso K, Wickland A, Metz M, and Rizzo D. The Big Sur ecological monitoring plot network: Distribution and impacts of Sudden oak Death in the Santa Lucia Mountains. Fourth Sudden Oak Death Science Symposium. 15-18 June 2009. Santa Cruz, CA, USA. (Abstract).

Metz M, Frangioso K, Rizzo D, Meentemeyer R, 2009. Interacting disturbances: did Sudden Oak Death mortality in Big Sur worsen the impacts of the 2008 Basin Complex wildfire? Fourth Sudden Oak Death Science Symposium. 15-18 June 2009. Santa Cruz, CA, USA. (Abstract).