62nd Annual Meeting of the California Forest Pest Council - 2013

California Forests – Stressed Out

Meeting Abstracts

November 20 – 21, 2013

Wildland Fire Training and Conference Center, McClellan, CA

About the California Forest Pest Council (CFPC)

The California Forest Pest Council (CFPC) fosters education concerning forest pests and forest health, and advises the California Board of Forestry and Fire Protection on forest health protection issues. It comprises a diverse group of forestry professionals and others interested in the prevention of damage to forests from insects, pathogens, animals, weeds, and pollution. Meetings are held throughout the State to discuss and evaluate current forest pest conditions. The annual meeting is the most important, providing the membership a chance to review what has happened in the last year, to formulate and vote on resolutions, and to address topics of special concern. Membership in the CFPC is granted to anyone attending. The CFPC is a 501(c)3 non-profit corporation (Tax-ID 94-3248518).

2013 Conference Organizers

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Meeting Sponsors

The USDA Forest Service, Pacific Southwest Region, State and Private Forestry, Forest Health Protection

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Program of Events Summary

Wednesday, November 20, 2013

11:30	am	Registration
12:30	pm	Welcome
12:35	pm	2013 Forest Conditions and Aerial Survey Report
12:50	pm	Insect Committee Meeting (All are welcome)
2:50	pm	Break
3:00	pm	Disease Committee Meeting (All are welcome)
4:15	pm	Break
4:30	pm	Pesticide Laws and Regulations
5:30	pm	Poster Session and Social
6:30	pm	Adjourn

Thursday, November 21, 2013

7:30	am	Registration
8:30	am	Welcome
8:40	am	New and Noteworthy
10:00	am	BREAK
10:20	am	Ongoing California Forest Health Issues
11:00	am	Drought and Climate Change
11:35	am	LUNCH (included)
12:30	pm	CFPC Business Meeting (including task force updates)
1:00	pm	Drought and Climate Change (cont)
1:45	pm	Fire Salvage: Race Against Time
2:55	pm	BREAK
3: 10	pm	Fire Salvage: Race Against Time (cont)
4:00	pm	Threats to Wildlife
4:30	pm	Adjourn

Oral Presentation Abstracts

(In Agenda Order)

Phenology and Life History Characteristics of Mountain Pine Beetle and Jeffrey Pine Beetle

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Substantial genetic variation in development time is known to exist among mountain pine beetle (*Dendroctonus ponderosae* Hopkins) populations across the western US. The effect of this variation on geographic patterns in voltinism (generation time) and thermal requirements to produce specific voltinism pathways have not been investigated. Relative to mountain pine beetle, even less is known about voltinism patterns of the closely related Jeffrey pine beetle (*D. jeffreyi* Hopkins). For both species, it remains unclear if populations in warm habitats are capable of producing two generations in a single year. We monitored mountain pine beetle voltinism, adult body size, sex ratio, and air temperatures at sites across latitudinal and elevational gradients in the western US, including six sites in California. Similar metrics were collected for two Jeffrey pine beetle populations within California.

We monitored mountain pine beetle at sites from 34.2° to 48.1° latitude across an elevational range from 1341 to 2926 m. With the exception of two sites at the coolest and warmest locations, the number of days required to complete a generation was surprisingly similar. Thermal units required to achieve a generation, however, were significantly less for individuals at the coolest sites. For example, to complete a generation, beetles at a warm site on the San Bernardino National Forest required four times the thermal heat than did beetles at a cool, high elevation site near Lake Tahoe. Although a partial second generation occurred at the warmest site, we did not observe two generations in a single year for mountain pine beetle. Evolved adaptations explain this pattern, including developmental rates and thresholds that serve to synchronize cohorts and minimize cold sensitive life stages in winter. These same adaptations reduce the capacity of mountain pine beetle at the warmest sites to take full advantage of increased thermal units, limiting the capacity for bivoltinism within the current realized distribution. We saw similar voltinism patterns in Jeffrey pine beetle, although information is lacking to link our results to life stage-specific patterns in development time. Our results are discussed as they relate to historical and potential future patterns in bark beetle-caused tree mortality in California.

What We Know About Native Bee Populations in California's Forests

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Little is known about bees and their ecological relationships with plants in forested California wildlands. The few available survey studies indicate that the forests are rich with abundant bee species and their understory flowering host plants. This paper will examine a few of the survey studies and especially the emerging patterns. It will also examine relationships between bees in forested and agricultural/urban interfaces. Suggestions for future studies will be offered.

Maple Leaf Scorch on Bigleaf Maple – 1964 to 2013

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Maple leaf scorch (MLS) may have first been reported in the 1964 Forest Pest Conditions in California: "*Big leaf maple appeared to have a blight that inhibited full leaf development and caused a browning of the leaf margins.…"* Since 1964, scorching of bigleaf maple (*Acer macrophyllum*) has appeared in Forest Pest Conditions in California numerous times either as an abiotic disease or one possibly caused by insects or a bacteria vectored by insects. The cause of MLS has yet to be proven.

In 2008 and 2009, over 70 percent of the California MLS bigleaf maple samples processed by Rutgers University (Ann B Gould/ Donald Kobayashi) tested positive using real-time PCR with primers and probes specific for *Xylella fastidiosa*. In 2012, 18 (16.7%) of 108 bigleaf maple samples from approximately 100 locations in Northern California tested positive using PCR with *Xylella*-specific primers. Eleven of the positives where identified with sequencing to be *X. fastidiosa*; and four of the 11 were identified as *X. fastidiosa subsp. Multiplex*. In 2012, none of 128 additional leaf samples from the same trees tested PCR positive for *X. fastidiosa* at UC Davis (Bruce Kirkpatrick), UC Riverside (Leonard Nunney), or Texas A&M (David Appel). No viable *X. fastidiosa* isolate has yet been recovered from California bigleaf maples. Therefore, Koch's Postulates have yet to be completed to prove that *X. fastidiosa* is the cause of MLS in big leaf maples.

In 2013, a subset of the 2012 MLS bigleaf maple sample trees were again tested for *X. fastidiosa* using PCR screening at Rutgers University, UC Riverside, and Texas A&M labs. Samples were collected several weeks apart from each sample tree throughout the summer in an attempt to learn if *X. fastidiosa* in big leaf maple can be more readily detected and/or isolated from different age leaves. In addition to the standard practice of screening petiole tissue for *X. fastidiosa*, labs were asked to also screen leaf tissue from some of the samples to learn more about where the bacteria resides in the leaf. Wood was also drilled from bigleaf maple trees for DNA screening. Test results for all 2013 leaf and wood samples will soon be available.

Brown Marmorated Stink Bug in Sacramento

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Brown marmorated stink bug, *Halyomorpha halys*, is a polyphagous insect that is native to Asia and was first reported in the US in Pennsylvania in 1998. Unlike native stink bugs, in the fall, brown marmorated stink bugs aggregate in large numbers and move inside buildings to overwinter. They can easily be transported long distances when items are moved from such infested buildings. Since 2002, the stink bugs have been detected in California associated with shipments of furniture and other household items from infested states in the eastern US. The stink bugs were found to have established a breeding population in the Pasadena area of Los Angeles Co. in 2006. Between 2006 and 2013, isolated stink bugs were found in the environment in several additional locations. No additional breeding populations were known to be in the State until a large, widespread infestation was discovered in midtown Sacramento in September 2013. Since then, the bugs have been confirmed in several other areas.

Swiss Needle Cast on the Pacific Coast

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Swiss needle cast (SNC), caused by the Ascomycete *Phaeocryptopus gaeumannii*, has emerged over the past two decades as a major concern for coastal Douglas-fir tree growers in Oregon and Washington. Interest has also emerged concerning Northern California due to sporadic reports of yellow (chlorotic) bands of Douglas-fir in the mountains north and east of Arcata, CA. Aerial surveys have formed the basis for understanding the general distribution of possible disease impacts, but on-the-ground plots are important to link visible symptoms to growth impacts. A network of growth impact plots in NW Oregon have documented growth loss, but not mortality. Chlorosis, needle casting, and growth loss are the main symptoms.

Aerial surveys conducted in spring by the cooperative aerial survey programs in Oregon (USDA Forest Service, Forest Health Protection (FHP) and Oregon Dept. of Forestry) have been completed each year since 1996. In Washington, an aerial survey was conducted in 2012 which was considered reasonably accurate by USDA FS, FHP and Washington Department of Natural Resources. Coastal Northern California was flown in 2013 by USFS FHP in cooperation with the SNC Cooperative.

Over 600,000 acres were surveyed in northern coastal California in 2013 and essentially no SNC was documented from the air, although a few hundred acres of chlorotic trees were noted as suspicious. We suspect that in Northern California, leaf wetness during spore dispersal (May, June, July) must not be adequate to allow massive build-up of the fungus as is occurring in Oregon.

In Oregon, the disease is continuing to intensify from Bandon north, and in 2013 reached another all-time high of 524,518 acres of visible symptoms from the air. The past 4 years have each been records for total acres. In Washington, the 2012 aerial survey estimated 228,500 acres with visible symptoms. We believe the disease is reducing growth across a 4 million acre swath of near coastal Douglas-fir forests. Epidemiology models include two primary functions, leaf wetness during spore dispersal period and temperature, either in winter or spring, depending on the model.

The SNC Cooperative website is http://sncc.forestry.oregonstate.edu/.

Goldspotted Oak Borer: The Latest Advances (Spread, Management, Monitoring, Policy, and Outreach)

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The rate of tree mortality caused by the goldspotted oak borer (GSOB) (*Agrilus auroguttatus*) during the summer of 2013 appears to have increased noticeably over the level of the previous 2 years in San Diego Co. This may be attributable to a second consecutive season of below normal rainfall following the very wet season of 2010-11. The 2013 aerial imagery, when it becomes available, will enable us to make a better evaluation of mortality levels.

Up until the discovery of GSOB in Riverside Co. in late October 2012, no appreciable spread of the beetle had occurred since 2010. However, over the course of 2013, three new locations have been identified in San Diego Co.; all three are relatively close to the previous margin of known infestation. The infestation in the Riverside Co. mountain community of Idyllwild has reached a total of 22 GSOB-infested trees, all within a 3-square-mile area; no trees have been found on national forest land yet. The GSOB infestation has not been found in any other Southern California county to date.

Riverside Co.'s new and isolated infestation has provided an opportunity to test the value of having a GSOB Preparedness Plan in place to implement an aggressive response to a new outbreak. A small army of volunteer citizen scientists are working with the university and CAL FIRE to survey most of the California black oaks on private land in Idyllwild. Infested trees are being cut down promptly and the infested wood is being ground to a 3 in. minus or smaller specification. Property owners have been provided with educational materials, including the latest UC integrated pest management (IPM) information which discusses the potential use of pesticides to protect high-value trees. The San Jacinto Ranger District is monitoring the surrounding national forest land with purple prism traps and inspecting stressed trees.

Development and implementation of IPM options for GSOB are continuing. Tom Coleman, USDA FS Forest Health Protection, continued pesticide trials on standing oak trees and also started an additional trial with a bark-applied systemic (Dinotefuran). Bureau of Indian Affairs (BIA) Forester Adrian Ackley assisted two San Diego tribes in applying carbaryl prophylactic treatments on high-value oaks. Tom Scott and Kevin Turner, UC Cooperative Extension, conducted a successful test of a topically applied pesticide (carbaryl) to determine its ability to prevent the emergence of adult GSOB from infested bolts. The Riverside County Agricultural Commissioner partnered with Gregg Bratcher, CAL FIRE; Tom Coleman; Tom Scott; and Kevin Turner to relay GSOB-related information to licensed pesticide applicators who may offer landowners pesticide treatments to protect high-value oaks. A horizontal wood grinder in Idyllwild was tested for effectiveness in killing GSOB larvae and produced excellent results.

The GSOB Early Warning System, which includes trained agency and university personnel along with citizen scientist volunteers, has responded to investigate new reports of possible GSOB infestation around Southern California. A web-based reporting system was introduced last winter to assist with GSOB inspection data collection and allowed the use of mobile devices to collect data in the field. It is currently being re-designed as a mobile device-based app with a significantly simplified interface to enable laypersons to easily report suspect trees by providing pictures of the tree, location coordinates, and contact information for the reporting party.

Firewood from the infested area of San Diego Co. continues to be moved and sold in and outside the county despite education efforts directed towards landowners, the firewood industry, and firewood consumers. California Penal Code 384.5 (a.) has been suggested as a potential template for developing a firewood regulation that would track firewood from its place of origin to the consumer. Oak wood from Idyllwild in Riverside Co. must now be considered as a potential vector of GSOB. CAL FIRE intends to ask the Board of Forestry to amend the current GSOB Zone of Infestation to include the Idyllwild area in Riverside Co.

Demand for GSOB presentations, workshops, and field training continues at a high level, especially since the discovery of GSOB in Riverside Co. An inter-tribal GSOB working group for Southern California tribes was initiated with a kickoff meeting at San Pasqual in May. Nearly 300 GSOB identification kits have been produced at UC Riverside and are being distributed to participating partner agencies and volunteer groups. The kits contain a GSOB adult sample, bark with D-shaped exit holes, plastic ID cards, a CD of publications, and other educational materials. We continue to support and expand the www.gsob.org website, produce educational materials, and have begun holding quarterly GSOB "Stakeholders" conference calls open to anyone interested in the GSOB effort.

One Step Forward, Two Steps Back: An Update on Sudden Oak Death in California

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Sudden Oak Death Tree Mortality and Infestation Status

Sudden oak death (SOD), caused by the invasive pathogen *Phytophthora ramorum*, continues to be the primary cause of tree mortality in coastal California from Monterey Co. north to Humboldt Co., according to the USDA Forest Service Pacific Southwest Region, Forest Health Protection 2013 aerial survey. Tanoak mortality is severe in the Santa Cruz Mountains as well as along the coast in Sonoma, Marin, and Monterey Cos., with the worst impacted areas in Jenner and Guerneville (Sonoma Co.) as well as Big Sur and Mill Creek (Monterey Co.). No tanoak mortality was observed in Del Norte Co. The total number of acres with mortality and number of trees killed due to SOD in California is slightly lower than last year's levels, with over 294,000 dead trees on 47,500 acres. California's 2012 SOD mortality levels were the highest since 2007, and elevated mortality levels continued into 2013.

The SOD pathogen has been confirmed near the Six Rivers National Forest (SRNF) and the Trinity Co. line, with infected tanoak and California bay laurel as close as 1.1 miles from the SRNF boundary and 1.7 miles from the Trinity Co. line. The pathogen is spreading from the Redway area, further north in the Larabee Creek corridor, and is now approximately 7.5 miles south of the town of Bridgeville (Humboldt Co.).

Phytophthora ramorum also continues to spread southward along the Big Sur coast, with tanoak mortality intensifying in Landels-Hill Big Creek Reserve as well as in the Mill, Plaskett, and Willow Creek watersheds. To date, the San Carporforo watershed, which represents the southern boundary of Monterey County, has not been culture positive for the pathogen even though four consecutive *P. ramorum*-positive PCR water positives were recovered from the watershed in 2012 (March – June 2012).

Other significant new finds include an infestation at Jackson Demonstration State Forest (Mendocino Co.) and Golden Gate Park (San Francisco Co.) in a nursery next to the AIDS Memorial Grove. The Golden Gate Park discovery was part of the 2013 SOD Blitz survey, with over 400 volunteer surveyors, led by Matteo Garbelotto, UC Berkeley. For more SOD Blitz results see the UC Berkeley Forest Pathology and Mycology website at http://nature.berkeley.edu/garbelotto/english/index.php.

Management

In Humboldt Co., 2013 has been a year of transition for SOD management, with the Redwood Valley eradication effort shifting from direct control (rapid removal of infected tanoak and California bay laurel) to a still evolving strategy of conservation management, where stand species composition is redirected toward conifers, with a goal of tanoak retention at low levels and slowed pathogen spread.

Since 2011, an isolated outbreak (initially detected on privately owned properties in 2010) in Redwood Valley has been under direct control, with 350 acres and a buffer zone treated with herbicide or by removal of infected trees. The multi-agency collaborative effort, led by Yana Valachovic, University of California Cooperative Extension (UCCE), Humboldt and Del Norte Cos., has relied on early detection and rapid response. Despite treatment, wet springs led to pathogen spread in 2010, 2011, and 2012;

consequently, eradication would now require treatment of more than 2,000 additional acres. The infestation spread to steep, rocky, densely vegetated terrain around Lacks Creek which instigated the Bureau of Land Management (BLM) Arcata Field Office to propose an “indirect approach” roadside buffer, intended to meet multiple forest health objectives, including development of SOD-resistant and -resilient stands, conversion of tanoak-dominated stands to conifers, a fuel break, and slowed pathogen spread toward Hoopa and Yurok lands as well as Redwood National and State Park. However, the infested trees were not removed due to accessibility issues. This strategic response continues to evolve as new infestations continue to be detected.

In Big Sur (Monterey Co.), where millions of trees have been killed by *P. ramorum* since the mid-1990s, management focus is on decreasing fuel loads. The Los Padres National Forest and the Nature Conservancy’s Fire Learning Network initiated Fire Scape Monterey in spring 2011, which brings community members and 27 public and private organizations together to work on local fire issues. Fuel reduction projects have been conducted at the Santa Lucia Preserve in Carmel Valley with hundreds of standing dead tanoaks felled and chipped on site. Additionally, the California Department of Forestry and Fire Protection is supporting multiple fuel reduction projects in the region, and the Palo Colorado community and Mid-Coast Fire Brigade have pooled resources to implement a self-funded project to collectively remove fuels along 4 miles of shared roadway.

In San Mateo Co., the San Francisco Public Utilities Commission (SFPUC) has been applying Agri-Fos® annually since 2008 as a large-scale field application for protection of a high-value tanoak stand above Crystal Springs Reservoir. The pathogen was first detected in the stand in 2011. The trunk spray application of potassium phosphite did not appear to impede SOD development in the stand, where about 15 percent of the trees died in the treated area (a level slightly higher than the untreated control plot). The SFPUC has discontinued trunk spray applications, but is continuing trials with removal of California bay laurel to protect coast live oak in another part of the watershed.

Research Highlights

Coast redwoods are nearly four times more likely to die during forest fires in SOD-infested forests than in non-infested forests, according to a recent study conducted by Metz and others (2013). Tanoak killed by SOD result in more fuel for wildfires as well as decreased moisture levels in affected forests as shade diminishes in the absence of trees. These dynamics make SOD-infested forests dryer and allow flames to travel into the canopy, allowing fire to scorch nearby redwood crowns.

Hayden and others (2013) identified tanoak traits and seedling families with increased survivorship in planted trees, and a framework to further identify seed parents for restoration. Expanding on this, Richard Cobb and David Rizzo, UC Davis, are working with the Hoopa, Yurok, SRNF, BLM-Arcata Field Office, and others to determine the level of resistance of culturally significant tanoaks in Humboldt Co. to *P. ramorum*.

Little is known about the basic ecology of tanoak, the tree species most susceptible to *P. ramorum* in California. Wright and Dodd (2013) conducted a pollination study in cooperation with the Midpeninsula Regional Open Space District and demonstrated that tanoak is primarily an insect-pollinated species, though some level of wind pollination is likely. Prior to the study, it was assumed that tanoak was wind pollinated.

Cobb and others (2013) published a new conservation strategy for tanoak that incorporates both pathogen-centric management and host-centric preventative treatments to reduce rates of *P. ramorum* spread and local prevalence as well as increase protection of individual trees. The strategy is based on recent findings identifying heritable disease resistance traits, ameliorative treatments that reduce pathogen populations, and silvicultural treatments that shift stand composition, holding promise for increasing the resiliency of tanoak populations.

Literature Cited

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Wright, J.W. and Dodd, R.S. 2013. Could Tanoak Mortality Affect Insect Biodiversity? Evidence for Insect Pollination in Tanoaks. Madroño, 60(2): 87-94.

From Drought to Death: The Ecohydrology and Physiology of Sudden Aspen Decline

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Recent drought-induced, widespread forest die-offs have large ramifications for plant community structure, ecosystem function, and the ecosystem services provided by forests. Climate-induced forest mortality therefore represents a major uncertainty in projections of climate change impacts on terrestrial ecosystems. Yet our ability to model and predict such die-offs is constrained by our poor understanding of how drought characteristics such as seasonality interact with tree ecohydrology to cause lasting physiological damage, often leading to tree death multiple years after the inciting drought.

We explored the ecophysiological basis of a recent widespread die-off of trembling aspen trees known as sudden aspen decline, which was initiated by a severe drought during the early 2000s, but which continued up to a decade post-drought. Sudden aspen decline (SAD) has been documented throughout the US Rocky Mountains and into Canada and is estimated to have effected approximately 20 percent of Colorado aspens. We investigated the ecophysiology of SAD using a combination of observations from native healthy trees during drought, native trees while they were dying, experimental drought manipulations, and statewide climate analysis.

We found that aspen trees rely on very shallow soil moisture even when these moisture resources become scarce, making them highly susceptible to severe growing season drought. Because of this, the extremely hot drought of 2001-2003 subjected Rocky Mountain aspens to the most severe water stress of the last century through unprecedented evaporative demand and low shallow soil moisture. When stressed by such a drought, we found that aspens experience damage to their hydraulic system that persists and, in dying trees, increases over multiple years. This accumulated hydraulic damage, driven largely by cavitation fatigue (an increased vulnerability to cavitation), can lead to tree mortality many years after the inciting drought and has left surviving aspen forests more vulnerable to future drought.

Post-Fire Aspen Seedling Establishment During an Intense Drought in the Southwest

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Severe decline of quaking aspen (*Populus tremuloides* Michx) occurred in the southwestern US during record drought and high temperatures. Large wildfires accompanied drought, including through aspen forested areas. In addition to reproducing through asexual root suckering, establishment of aspen seedlings has been observed throughout Arizona, even occurring in low elevation sites and during severe drought. In one area, aspen seedlings appeared in ponderosa pine plantations that were fenced to exclude browse impacts by livestock and wild game ungulates. Only two aspen seedlings were observed outside exclosures 10 years post fire. Genetic analysis of aspen regeneration confirmed that 70 individuals in fenced ponderosa pine plantations were unique. Seedlings established over a 6-year-period, with 91 percent established in the first 3 years. Clonal development was both diverse and robust: 61 percent of seedlings produced 1¬ 39 suckers and the total number of suckers (n=246) now far exceeds the 70 seedlings. Aspen seedlings established during severe drought years had a greater association with large woody debris than those established later. The establishment of aspen seedlings during severe drought, along with the relative abundance of aspen seedlings in fenced exclosures suggests that aspen seedling establishment in at least some locations may be more limited by herbivory than directly by warming climate.

Managing Water in Forest Landscapes: An Eco-Hydrologic Modeling Perspective

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Widespread threats to forests resulting from drought stress are prompting a re-evaluation of priorities for water management on forest lands. In contrast to the widely held view that forest management should emphasize providing water for downstream uses, we argue that maintaining forest health in the context of a changing climate may require focusing on the forests themselves and on strategies to reduce their vulnerability to increasing water stress. Management strategies, however, would need to be tailored to specific landscapes, but could include thinning, planting, and selecting for drought-tolerant species, irrigating, and making more water available to plants for transpiration. Models are key tools used to examine the complex spatial-temporal patterns that give rise to both drought and forest vulnerability to it. Given the importance of water limitation and drought stress as a control on how forests will respond to a changing climate, models that explicitly link forest productivity with hydrology are essential tools and demonstrate some of the key controls on vulnerability. I use RHESSys, a coupled model of spatially distributed hydrology and ecosystem biogeochemical cycling, to examine the geography of forest drought stress vulnerability and linkages among forest water use, productivity, carbon cycling, drought-related mortality, soil moisture, and streamflow. One of the strengths of this tool is the use of multiple data sources for parameterization and evaluation. Application of the model provides an integrated systems-oriented perspective on forest drought stress and mortality and allows us to disentangle to relative importance of multiple controls and the implications for downstream flows. Ultimately this system-oriented, place-based perspective is needed if we are to apply what are often limited resources to managing forests for water and water for forests.

Related Publications

Grant, G.; Tague, C.; and Allen, C. 2013. Watering the Forest for the Trees: An Emerging Priority for Managing Water in Forest Landscapes. Frontiers in Ecology. 11: 314–321. DOI: 10.1890/120209.

Tague, C. and Peng, H. 2013. The Sensitivity of Forest Water use to the Timing of Precipitation and Snowmelt Recharge in the California Sierra: Implications for a Warming Climate. J. Geophys. Res. Biogeosciences. 118(2): 875–887. 118. DOI: 10.1002/jgrg.20073.

Tague, C.; McDowell, N.; and Allen, C. *In press*. An Integrated Model of Environmental Drivers of Growth, Carbohydrate Balance, and Mortality of *Pinus ponderosa* Forests in the Southern Rocky Mountains. PLOS-One.

Examples of Downscaling Climate Change Information to the Watershed Level

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Ongoing changes in climate are having measureable impacts on our water supply, landscapes, and western forests. Hydrologic response to climate change is an important factor in landscape stress, water availability, and impacts to species. We use a regional water balance model with climatic inputs downscaled to a fine spatial scale to illustrate impacts to the environment on the basis of historical change in climate and projected future changes. Examples will be shown illustrating historical changes in climate and hydrology, projected changes in water supply, and landscape deficits related to forest die-off, wildfire recurrence, and severity.

Deterioration and Decay in Fire- and Insect-Killed Trees

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Many factors influence the deterioration rates of fire- and beetle-killed conifers and thus influence the volume and quality of wood available. Factors can include the species and size of trees involved, time since disturbance, fire intensity, and site characteristics, all of which guide available management options. There are species-specific changes in wood quality that influence the potential suitability of the wood for commercial use. Generally, small trees (less than 10 in. diameter breast height) will be difficult to remove in economically feasible operations. This will make activities to reduce hazardous fuels in the wildland-urban interface expensive when they involve small-diameter stands that have either been damaged or have the potential for damage by disturbance agents. Increased time since disturbance alters some of the outcomes. For example, blue stain in pines significantly reduces their value recovery generally within 1 year post fire. It is still possible to recover some wood products 2 to 4 years after tree death, but with losses in both value and volume. Waiting more than 4 years following disturbance to harvest a stand limits product options. It may be desirable to use some of the wood from the dead trees, but harvesting and transportation costs in conjunction with available wood product markets need to be considered. In addition, market changes influence product options. The deteriorating quality of wood over time may make it uneconomical to harvest, transport, and process. With a visual assessment process, potential volume and value losses associated with disturbance can be estimated for post-disturbance management planning.

Snag Longevity and Surface Fuel Accumulation Following Post-Fire Logging in a Ponderosa Pine Dominated Forest

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Fire salvage has gained increasing scrutiny in recent years. Nonetheless, there is little published information on salvage effects over time from designed experiments. Following the Cone Fire (September 2002) in northeastern California, a fire salvage study was established using sound experimental design to evaluate the effects of varying levels of fire salvage. The Cone Fire burned 2000 acres at Blacks Mountain Experimental Forest. Much of the area burned with high severity in a forest dominated by ponderosa pine (*Pinus ponderosa*) with a mix of white fir (*Abies concolor*) and incense-cedar (*Calocedrus decurrens*). Treatments ranged from no salvage (3 replicates) to complete removal of all fire-killed trees (3 replications) and varying levels (by basal area retained) in between. Treatments were randomly assigned to 15, 5-acre plots. Salvage harvesting took place in the fall of 2003. A grid of permanent plots was established in each treatment unit. Initial measurements were taken in spring of 2004 and every 2 years thereafter.

We observed breast height diameter and total height or height to the point of breakage for each fire-killed tree in 2004, 2006, 2008, 2010, and 2012. We also observed planted seedling development on a grid, 1/100 acre plots, noting damage from falling snags.

By 2010, 8 years after the Cone Fire, 80 percent of retained biomass was down. By year 6, areas not salvaged exceeded historic levels of surface fuels for this forest type. Despite the high levels of 1,000 hour surface fuels accumulated (40-60 Mg ha^{-1} in unsalvaged areas), percent of ground area covered by surface fuels was fairly low, never exceeding 10 percent. The percent ground area covered was highly correlated with basal area retained (R^2=.91 by year 8). These low values for ground area covered are reflected in low levels of damage to planted trees. We observed no salvage harvest effect on planted tree growth.

On the individual snag basis, we observed:

- Fir longevity exceeded pine snag longevity (lower decay rates in true fir).
- Cedar snags remained intact for the duration of the study.
- Cavity excavation was highest among fir trees and virtually non-existent in incense-cedar.
- Among pines 30-45 cm diameter only 39 percent were still standing with a 2 m threshold by year 8.
- Among fir trees 30-45 cm diameter, 75 percent were still standing (2 m) in 2008 and 93 percent of the trees >45 cm were still “intact.”

An Approach to a Forest Service Fire Salvage Project: An Examination of the Chip-Munk Fire Salvage Project

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The Chips Fire started at the end of July 2012 and burned until the end of August. The final acreage estimates of the fire are approximately 75,431 acres. The fire burned at a wide range of severities, including areas that had 100 percent basal area mortality to areas that experienced low severity ground fire.

Although there are many approaches to post-fire assessment and treatment, due to the potential for rapid deterioration of forest product value, it is important to have an approach that emphasizes efficiency of treatment determination and analysis. A fast turnaround time from project design to treatment implementation is a vital key to success. The fire salvage process includes the post-fire silvicultural assessment, the determination of treatment opportunities, and the physical implementation of the project. Challenges and insight gained will be highlighted as well.

The post-fire treatment process began soon after the fire was contained. The area was assessed for potential treatment opportunities using a combination of remote sensing analysis and field visits. Potential treatment opportunities identified included reforestation, fire salvage, hazard mitigation, and natural recovery. Treatment opportunities were then stratified by risk, potential success, and feasibility and presented to appropriate line officers and decision makers.

Fire salvage and reforestation units, project mitigations, and salvage guidelines were designed using an interdisciplinary process that combined public and resource specialist input. National Environmental Policy Analysis (NEPA) and documentation was facilitated through an environmental analysis (EA) with an eventual signing of a Decision Notice (DN) and No Finding of Significant Impact. Other activities that were deemed as low risk or needed immediate action used the categorical exclusion process which expedited the NEPA process. In addition, an emergency situation determination was filed and approved by the Forest Service Washington Office to allow salvage operations to take place during the EA appeal period.

Operations occurred within a very short time frame of the DN being signed with completion of salvage operations expected by the beginning of next summer, if not this fall. Reforestation will take place the season or two after completion of salvage sales, depending upon site conditions.

Bats – Fire and White Nose Syndrome

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Bats are important components of ecosystems and many species depend on forested habitats in the western US. Wildlife response to fire is important for managing natural resources. There are few studies that have researched the impacts of wildland fire on bat populations in the west. We present data that show that bat activity was equivalent or higher in areas that were burned by a large fire in the southern Sierra Nevada in 2002, suggesting that bats may be resilient to landscape-scale fire events and that burned areas may be beneficial for foraging for some bat species. In addition, I will speak about White-Nose Syndrome (WNS), which is an emerging infectious disease of hibernating bats that emerged in 2006 in upstate New York and has spread rapidly, decimating hibernating bat populations in eastern North America. The threat that WNS poses to bats in western states is currently unknown, but efforts to conduct surveillance and monitoring of bats in the west are being conducted by state biologists and researchers.