
Blodgett Forest
Research Station
RESEARCH
WORKSHOP
2004

University of California, Berkeley
College of Natural Resources
Center for Forestry

The **Center for Forestry** provides leadership in the development of basic scientific understanding of ecosystem process, human interactions and value systems, and management and silvicultural practices that ensure the sustainability of forest land. The **Center** pulls together interdisciplinary teams of campus faculty, Cooperative Extension specialists and advisors, and staff from various agencies and organizations to develop research projects, outreach and public education activities, and policy analysis on issues affecting California's forest lands.

The **Center for Forestry** manages five research forest properties: Baker Forest/U.C. Forestry Summer Camp, Blodgett Forest, Howard Forest, Russell Reservation, and Whitaker Forest. These offer field locations and facilities (lodging, meeting rooms) for research and workshops on forestry issues.

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BAKER FOREST/UC SUMMER CAMP

Designed as a summer instructional camp for UC Berkeley forestry students, situated in Plumas County. Camp facilities for up to 100 persons are on 40 acres of USDA Forest Service property by special use permit. Adjoining 80 acre Baker Forest is heavily used as an outdoor laboratory.

BLODGETT FOREST

In El Dorado County, the most developed of the field sites, Blodgett's primary use is for research and practical demonstrations of forestry practices. The forest is divided in management compartments, based on land use and study. Facilities include residences, rough labs, conference and shop space.

HOWARD FOREST

Howard Forest is 90 acres alongside Highway 101 in Mendocino County. A major California Department of Forestry and Fire Protection facility is located here, the only structures on site. Prototype forest and agroforest management plans for non-industrial forestland owners have been developed here.

RUSSELL RESERVATION

Donated to UC in 1961, this land was originally part of a Spanish land grant in what is now Contra Costa County. Russell research includes extensive forest genetic and tree improvement research. An observatory is located on site, as is a seismology study. Some residences and meeting facilities are available.

WHITAKER FOREST

Whitaker Forest is 320 acres of giant sequoia and mixed conifer forest at Tulare County's upper reaches between Kings Canyon and Sequoia National Park. Current research on this impressive site includes all-terrestrial vertebrate inventories and permanent vegetation and stream resource inventories.

IN MEMORIAM

DONALD L. DAHLSTEN

1933-2003

A respected expert in biological control and forest entomology, and a leader in biological control research, Donald Lee Dahlsten passed away September 10, 2003, after a long illness. Dahlsten's research focused on development of ecologically sensitive methods of controlling insects attacking trees.

Dahlsten received his bachelor's in entomology from UC Davis, then transferred to UC Berkeley for his graduate studies. After a brief teaching period at Los Angeles State College, Don returned to the Berkeley campus, where he established himself as an contributing and influential member of the UC faculty.

Don's research led him to ground breaking contributions, most notably his work on psyllid pests that attack eucalyptus trees. He introduced a wasp species that effectively saved blue gum eucalyptus trees in nurseries throughout California. He was also well known for his research activities on tree-killing bark beetles and factors that attracted their natural enemies. Dahlsten maintained one of the largest databases of insectivorous birds in California and was considered an expert on the biology of the chestnut-backed chickadee.

Don used Blodgett Forest as his research site through nearly all of his 40 year career. His Blodgett research of the last few years, focused on *Ips paraconfusus* responses to host trees and associated fungal factors, nest site selection for mountain and chestnut-backed chickadees and pheromone attraction of bark beetle predators. He was one of the primary investigators of the Fire and Fire Surrogate Study currently underway, looking at fire and treatment effects on ground beetles and spiders.

Don's contributions earned him the UC Berkeley Distinguished Service Award and the College of Natural Resources Citation. He had also received the UC Berkeley College of Natural Resources Outstanding Teaching Award.

ABSTRACTS
2004 Blodgett Forest Research Workshop

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RESEARCH PROJECTS LISTS

BLODGETT FOREST RESEARCH STATION

RUSSELL FOREST RESEARCH STATION

WHITAKER FOREST RESEARCH STATION

The Fire and Fire Surrogate Study: Effects of Fire and Mechanical Treatments on Avian Nest survival.

ANDREW J. AMACHER, R.H. BARRETT, AND S.L. STEPHENS

The Fire and Fire Surrogate study (FFS)is a national program, funded by the Joint Fire Sciences Program, to quantify the ecological and economic consequences of prescribed fire and mechanical fuel-reduction treatments. Thirteen forest ecosystems have been selected across the United States that were once frequented by fire.

We are conducting research on wildlife at Blodgett Forest Research Station, near Georgetown, California. Twelve Sierran mixed-conifer stands (15-25 hectares each) with similar stand structure, composition and management histories were selected randomly from a set of available stands.

Each selected stand was randomly assigned to 4 treatment groups: control (no manipulation), prescribed fire only, mechanical only (both thinning and mastication combined), and mechanical/fire combined.

All stands were intensively searched for nests during the avian breeding season. Over 770 active nests were located between 2001-2003. For open-cup nesting species the most common were: the Dark-eyed Junco (n = 110), American Robin (n = 104), and Cassin's Vireo (n =79). A total of 74 Woodpecker nests were monitored. The Mayfield daily survival rate was used to compare nest success between treatments.

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Effects of fire and fire surrogate treatments on leaf litter arthropods: initial post-treatment results

KYLE APIGIAN AND DONALD L. DAHLSTEN

Leaf litter arthropods are important components of all forest ecosystems, serving as predators, detritivores, herbivores, as well as food for higher trophic levels. Some groups, such as ground beetles (Carabidae), spiders (Araneae), and ants (Formicidae) have been studied extensively and have been shown to have variable responses to disturbances such as fire and timber harvesting. The abundance and diversity of these taxa make them valuable as indicators of forest health. The effects of fire and harvesting on these groups was investigated as part of the interdisciplinary Fire/Fire Surrogate Study from 2001 to 2003. Three-hundred pitfall traps were placed in 12 forest compartments that experienced one of four treatments: prescribed burning, mechanical treatments (timber harvesting and mastication), mechanical followed by burning treatments, or control. Five traps were placed within each of 5 randomly selected plots in each of the 12 compartments. Insects were collected in propylene glycol over the course of five days each month, from June through September. A complete species list formed based on three years of trapping shows very high diversity of ground active beetles (>250 species in 46 families) and ants (23 species) at Blodgett. We will present the initial results of the effects of the FFS treatments on these groups, as well as discuss the ongoing and future analysis of these data.

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The Blodgett Fire and Fire Surrogate Study- Wildlife, Camera Trap Results

REGINALD H. BARRETT AND ANDREW J. AMACHER

This work is a portion of the wildlife study associated with the Blodgett portion of the national Fire and Fire Surrogates Study funded by the US Forest Service. The study design involves three replicates of three treatments and a control. Treatments include prescribed burning, mechanical thinning and the two combined. Camera traps were operated annually for ten days at each of six stations within each replicate (plot, compartment). Peanut butter and raw chicken baits were provided. Results by species detected were analyzed using four metrics: total detections, latency to detection, mean frequency of occurrence on stations, and frequency of occurrence on plots. Results are presented as "response indices" to facilitate comparisons among species. No results were statistically significant. We discuss the responses predicted by the California Wildlife Habitat Relationships System and compare them with our response indices for seven species of mammals.

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Effects of prescribed fire on channel morphology and instream large woody debris at Blodgett Forest Research Station

L.A. Beche, S.L. Stephens, and V.H. Resh

Prescribed fire can be an efficient forest management tool for fuel reduction and ecosystem restoration; however, concerns about the effects of fire on sensitive habitats, such as streams and riparian areas, have often limited their use in management. In late October 2002, an upland and riparian plot (approx. 50 acres) was prescribed burned in the central Sierra Nevada, CA at Blodgett Forest Research Station. One year post-fire, we re-surveyed riparian vegetation, instream large woody debris (LWD) and channel morphology (in addition to documenting changes in water quality, hydrology, aquatic macroinvertebrates, algal biomass). This study is employing a beyond-BACI experimental design, with one burned 1st order watershed (Dark Canyon Creek) and four unburned 1st order catchments. The fire itself was patchy, particularly in the riparian areas, which resulted in a mosaic of fire severity. In the primary study reach (200 m), there was no change in LWD biomass, nor was there any significant difference in downstream movement of LWD ($p>0.05$), as compared to control reaches. Outside of the intensively studied reach, LWD was recruited as a result of burned snags falling into or over the stream channel. This generally occurred in the most severely burnt areas. There was a slight increase and redistribution of fine sediment in the study reach; however, fine sediment made up 90% of the substrate prior to the fire. These results, one-year post-fire, indicate that although the fire resulted in dramatic changes to ground cover in many areas, the effect on LWD and channel morphology was minimal. In some cases (as with channel morphology), the documented effects cannot be attributed to the fire.

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A Pro-Active Approach to Road Abandonment: Stream Restoration After Culvert Removal

CHET BEHLING

In an effort to protect watersheds, several road abandonment and stream restoration projects have been designed and implemented at Blodgett Forest Research Station. The Mutton Creek headwaters stream restoration project represents a pro-active approach to road abandonment. A road abandonment undertaking nearly always includes removal of culverts and the restoration of any associated watercourses. Often, when forest roads are abandoned they are simply left to the mercy of physical processes. This inaction often results in detrimental outcomes. Since abandoned roads and culverts are not usually maintained, often sediment movement occurs along road surfaces, inlets develop blockage from debris or bed rock, and soils may become saturated. The latter is often the determining factor in culvert failure. Improperly abandoned roads with failed drainage structures often become barriers to migration of aquatic life.

Streams develop a specific width and gradient in response to debris, sediment and water produced in the surrounding watershed. When stream width is restricted by culverts, a series of adjustments are made by the stream itself. If culverts are not regularly maintained, the risk of culvert failure significantly increases. By restoring the natural stream channel after culvert removal, in both orientation and slope, the abandonment projects will effectively disconnect the old road system from the natural stream network.

Road abandonment includes sub-soiling road surfaces, planting an erosion control native mix, logging slash placement on erosion prone areas to divert water and potential soil movement and artificially planting native conifer seedlings in abandoned aeas. Several stream restoration techniques will be discussed, including culvert and fill removal, log placement in stream banks, the use of rip-rap and bio-degradable Aspen Mat. As a result of these

combined techniques, a stable, functioning stream channel with significantly lower erosion potential will be created.

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The Process of Abandoning A Road

ABOVE:
An undersized culvert on a spur road, scheduled to be pulled and abandoned.
RIGHT:
The spur road, no longer in use, will be abandoned and barricaded to vehicular traffic.

A: Debris removal after a backhoe has pulled the abandoned culvert.

B: Gary Roller and Jessica Range laying Aspen-Mat. The mat will be secured to the stream bank with biodegradable stakes to prevent soil movement.

C: Chet Behling doing some handwork in preparation for gravel layering.

D: Weed-free straw is spread on newly planted areas to prevent erosion.

ABOVE: Personnel from CDF/Tahoe and Center staff Gary Roller look at the completed abandonment project.

The influence of spatial crown variation on scaled estimates of carbon and water flux in three Sierran conifers.

Ralph Boniello, IV, and Joe R. McBride

It is well accepted that physiological and morphological variability exists within the crowns of trees. For example, sun leaves and shade leaves often differ in leaf area, leaf mass, and photosynthetic capacity. In addition, nitrogen gradients have been measured in tree crowns that correlate well with light gradients. These strategies presumably exist to maximize the efficiency of leaves with respect to carbon gain, and water and nutrient use.

Although such strategies are generally accepted, physiological variability has rarely been measured systematically within tree crowns. In addition, it is not well understood how various crown compartments contribute to the overall carbon and water fluxes of an individual tree. Quantification of the physiological variability within tree crowns will allow for more accurate scaling of leaf level responses to whole tree or canopy performance.

During the growing season of 2003, various measures of leaf level physiology were made on an individual of each of a ponderosa pine, Douglas-fir, and white fir. Morphological measurements of needles from these trees allowed us to compartmentalize their crowns according to statistically significant differences among categories of height, needle age, and azimuth. Nitrogen analysis of these needles will allow us to identify more detailed gradients within the crowns.

Preliminary results of physiological measurements will be presented. Leaf cuvettes were used to measure leaf photosynthetic responses to light and CO_2 concentration, for future input into the MAESTRA model. MAESTRA is an open source array model that scales leaf level photosynthetic parameters to the whole-tree level. Diurnal stomatal conductance measurements were taken approximately once a month. The curves developed from these measurements provide an independent measure of needle transpiration and leaf temperature, and allow for verification of model output. In addition, leaf water potential measurements may be used to examine whether differential water stress

occurs within the crown, as well as its influence on crown physiology.

Ralph Boniello using an Li-1600 steady-state porometer to measure stomatal conductance. An Li-6400 gas exchange system, in the background, is measuring CO_2 and water exchange. *Photo by Joe McBride*

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Blodgett FFS Site Productivity And Cost Analysis For Mechanical Treatment and Burning

ERIK S. DREWS AND BRUCE R. HARTSOUGH

The Blodgett research forest has one of the test sites for the nationwide Fire/Fire Surrogate (FFS) study. As part of this interdisciplinary study the cost and productivity was evaluated for performing three different treatments (replicated three times): mechanical thinning, mechanical thinning combined with a controlled burn, and controlled burn. These three treatments were intended to leave the stands in the same 80/80 condition, where a fire under the 80th percentile conditions would leave 80 percent of the stand living.

For the productivity analysis of the mechanical treatments information was collected on the number of person-hours worked, the number of machine-hours for each machine, and the amount of material removed measured in tons.

Using the productivity information a production rate was calculated for each operation step: felling, skidding, loading, and masticating. The production rate was expressed in terms of tons per hour, stems-of-average-size per hour, acres per hour. A cost per hour was calculated for worker/operator and for each machine. A cost for each operation was calculated by multiplying hours and cost-per-hour for each person and machine. The cost results were expressed in cost per ton, cost per stem-of-average-size, and cost per acre. A similar analysis was performed for the burns by tracking person-hours and equipment-hours. Preliminary results for the mechanical treatments were presented at last year's symposium.

BELOW: Masticator used for mechanical thinning in the burn treatment compartments.
Photo by Chris Hipkin

The controlled burn productivity results were expressed as person-hours per acre, and equipment-hours per acre for each machine. After determining a cost-per-hour for each worker and piece of equipment a total-cost per hour and a total-cost per acre was calculated.

No information was available on material removed by the burns so no results were calculated on a per-ton-removed, or per-stem-of-average-size removed basis. The results from the Blodgett FFS site were compared with results from several other FFS sites.

ABOVE:
The Licensed Timer Operator (LTO) moves logs in a landing, utilizing a rubber tired skidder.
Photo by Sheryl Rambeau

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First measurements of reactive nitrogen oxide fluxes over a ponderosa pine plantation

DELPHINE K. FARMER, PAUL J. WOOLDRIDGE, AND RONALD C. COHEN

The reactive nitrogen oxides (NO_y = NO + NO_2 + peroxy nitrates + alkyl nitrates + HNO_3 + …) play a key role in ozone production and atmospheric chemistry. Deposition of these species, in particular nitric acid (HNO_3), is a major loss process from the atmospheric NO_y reservoir, but also potentially provides a key nitrogen source to forest ecosystems. Despite the importance of understanding these nitrogen fluxes, few measurements have been made due to the technical difficulty in creating instrumentation that meets the criteria for eddy covariance fluxes. The thermal-dissociation laser induced fluorescence (TD-LIF) technique (Day et al. 2002) provides an accurate method for measurements of fluxes of HNO_3, peroxy nitrates (ΣPNs), alkyl nitrates (ΣANs), and NO_2. We describe the first measurements of these fluxes taken in 2003 above a ponderosa pine plantation at the University of California Blodgett Forest Research Station tower site.

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Controls of Canopy Activities on Roots and Soil Carbon Dynamics in a Young Ponderosa Pine Forest: Preliminary Root Observations

ALEXANDER GERSHENSON AND WEIXIN CHENG

Globally, belowground carbon (C) fluxes in forest ecosystems constitute a major link between atmospheric C and the soil C pools. However, a gap in our understanding of belowground carbon fluxes in forest ecosystems in general, and specifically the role that roots play in belowground C dynamics, is one of the primary factors limiting our ability to assess the contribution of forests as global C processors. This project is part of a larger effort which aims to investigate the role of aboveground controls on root turnover and soil carbon sequestration in a mid-elevation, young ponderosa pine plantation with a shrub understory (*Arctostaphylos* sp. and *Ceanothus* sp.)

This poster represents the first look at the belowground activity in an experimental plot at the Blodgett Forest Ameriflux site in the Sierra Nevada Mountains of California, USA. We conducted the first season of belowground observation using the minirhizotron observation method, which will continue for the next year and a half. Preliminary data, using root counts, show that the main peak in root production occurs between May15 and July 15, with the bulk of growth happening in June. This timing coincides with the increase of daily minimum temperatures, which remained below 5°C until mid-May. Root death was observed primarily in the first month after emergence, if at all. The net number of roots was the highest during the period between June and July, after which we observed a slow but continuous decline. Overwintering of fine roots appears to be minimal, although a second year of observation will be necessary for confirmation. Further implications and connections with research that includes canopy flux measurements and soil respiration will be discussed.

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Developing A Hybrid Growth Model For Multiaged Sierra Nevada Mixed-Conifer Forests

ROLF F. GERSONDE AND KEVIN L. O'HARA

A growth model was developed for multiaged mixed-conifer forests in the Sierra Nevada of California. The model incorporates process-oriented components that predict tree growth as a function of leaf area and absorbed light, as well as empirical information on site quality. Leaf area prediction equations were developed from sapwood area – leaf area relationships for *Pinus ponderosa* Laws., *Abies concolor* Gordon and Glend., *Calocedrus decurrens* (Torrey) Florin, *Pseudotsuga menzieii var. menziesii* (Mirb.) Franco, *Pinus lambertiana* L., and *Quercus kelloggii* Newb. Inclusion of site index improved model predictions across the range of sites sampled in the Sierra Nevada. Leaf area was used to calibrate a spatially explicit light model to conditions in the Sierra Nevada. The light model was able to predict the variable light environment within complex canopy structures. Moreover, it showed little loss in accuracy when model parameters were simplified for use of the model with inventory data. The model calculates light at any point within the canopy and can estimate mean incident and absorbed light of larger tree crowns. Boundary line analysis showed that the maximum amount of leaf area a tree maintained depended upon the mean light received over the growing season and differed among species. Tree growth efficiency, defined as stem volume increment per unit of leaf area, was correlated with tree size and light environment. Growth efficiency increased with tree height across the range of light intensity levels. Prediction equations were developed for volume increment as a function of projected leaf area and leaf area weighted by absorbed light. These relationships demonstrate the varying importance of shading and self-shading on tree growth in vertically structured stands. Additional models for height, basal area, and crown radial increment were developed to project

volume increment and stand structural development over periods of up to 20 years. The whole model was validated with independent permanent sample plot data from two multiaged mixed-conifer stands. It can be used to assess the effects of stand structure upon stand and component yield and structural development. The model is intended to be a tool for managers to design multiaged mixed-species stands of variable structure.

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Forest Thinning Dramatically Enhances Ozone Flux Due To Reactions With Elevated Emissions Of Biogenic Hydrocarbons

ALLEN H. GOLDSTEIN, MEGAN MCKAY, MEREDITH R. KURPIUS, GUNNAR W. SCHADE, ANITA LEE, AND RUPERT HOLZINGER

Forests are routinely managed for timber production and fire suppression by thinning and harvesting. The impact of these activities on biosphere-atmosphere exchange of reactive trace gases is profound, but has rarely been studied in the field. Here we present simultaneous observations of ozone and terpene fluxes before, during, and after pre-commercial thinning of a ponderosa pine plantation at Blodgett Forest (1300 m elevation on the western slope of the Sierra Nevada Mountains, CA).

We previously reported that monoterpene emissions increased by an order of magnitude during and following forest thinning (Schade and Goldstein, GRL 2003). We also previously reported that half the daytime ozone flux to this ecosystem under normal summertime conditions (no disturbance) was due to gas-phase chemical loss, and we suggested that this ozone loss was occurring by reactions with biogenically emitted terpenes whose lifetime was short enough that they reacted before escaping the forest canopy (Kurpius and Goldstein, GRL 2003).

Here we report that ozone loss was also dramatically enhanced during and following thinning, and we link these observations to confirm that the chemical ozone loss in the canopy was

indeed due to reaction with biogenically emitted compounds whose emission was enhanced by disturbance.

Based on the magnitudes of ozone flux due to chemical loss and the measured terpene fluxes, we infer that the emissions of previously undetected short-lived terpenes are approximately 15-20 times those of a-pinene during thinning, and 30-50 times those of a-pinene during summer and fall. Since a-pinene accounts for approximately 25% of the total monoterpenes we routinely measure with our automated in-situ GC instrumentation, we conclude that emissions of highly reactive terpenoid compounds could have been drastically under measured in previous field campaigns and that emissions of unidentified reactive terpenes could be 5-10 times larger than emissions of total terpenes documented in previous studies.

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Effects Of Tree Crowns On Duff Consumption At Two Prescribed Fires In A Sierra Nevada Mixed-Conifer Forest

MARCO HILLE AND SCOTT STEPHENS

This study describes patterns of duff properties in a mixed-conifer forest in the north-central Sierra Nevada, California. Variation in duff depth and moisture is linked to stand structures, especially to the distance from the stem base and the crown perimeter.

Stand structures are also linked to spatial patterns of duff depth after prescribed fire. On one site, which burned under dry conditions, almost all duff was consumed, with some remaining in overstory gaps. On a second site, which burned under moist conditions a few days after the first autumn storm, strong spatial patterns were observed. With increasing distance from the base of the nearest overstory-tree, the probability of finding remaining duff increased significantly. There is strong evidence, that spatial variation of throughfall resulted in wetter duff in gaps, while duff beneath crown cover was drier, and therefore, totally consumed. Our study indicated the the complete consumption of accumulated organic material around stem bases, which is of great concern for tree mortality. Our results can be used to make more differentiated predictions of duff consumption, and therefore, energy release by fire.

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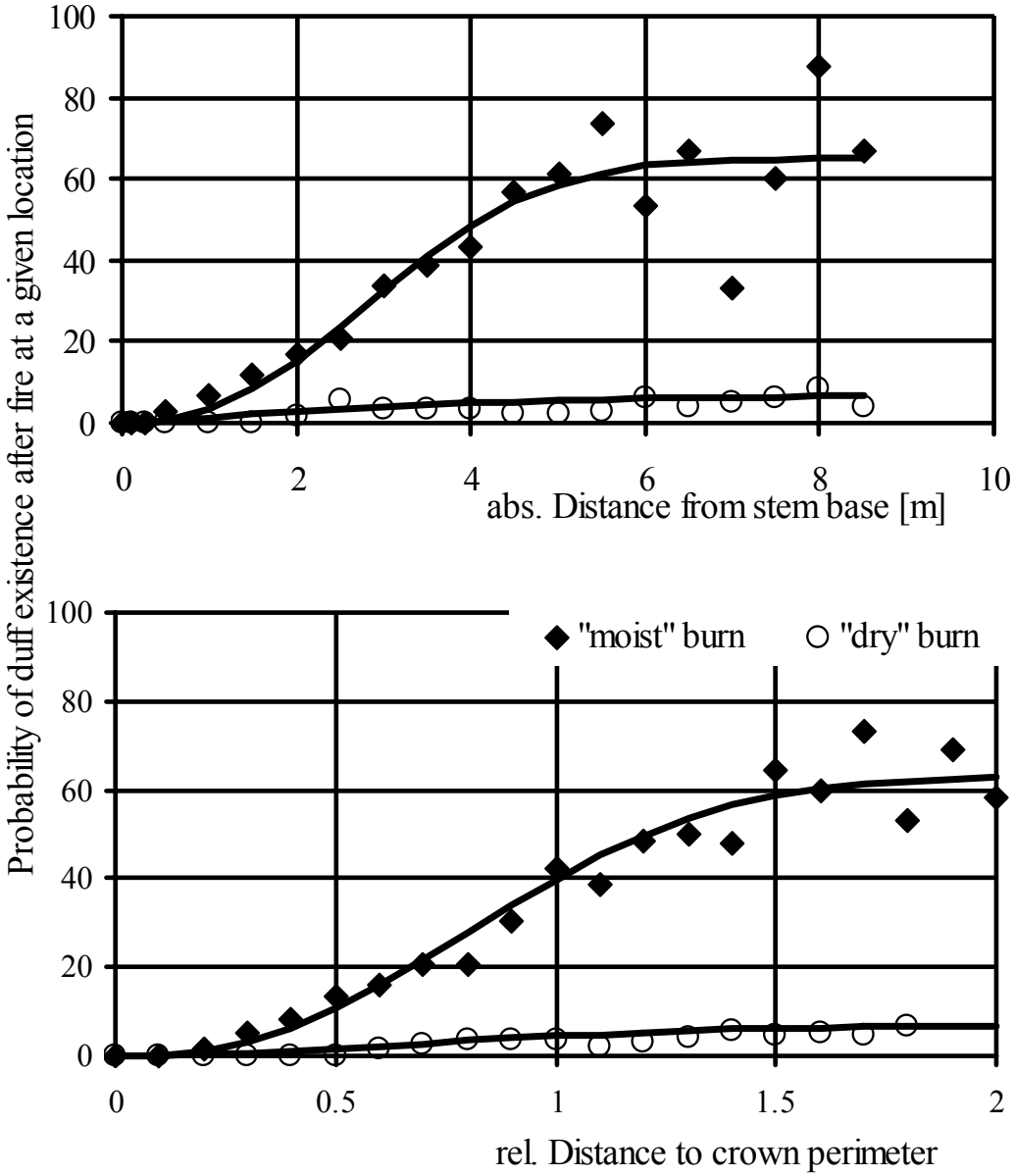

Figure 1. Spatial variation of duff remaining in the moist (diamonds) and the dry (empty circles) burn, related to the absolute (upper figure) and relative (lower figure) distance from tree. The probability of duff remaining (y-axis) is calculated from the percentage of datapoints where remaining duff was found. The relative distance from the stem base is expressed as ratio to the crown perimeter. A relative distance of "1" marks the edge of the crown.

Restoring Forest Composition And Structure With Prescribed Fire

MARCO HILLE, SCOTT STEPHENS AND LARS SCHMIDT

In this study we show, how prescribed fires of two different intensities were used to restore a typical overstocked mixed-conifer stand in the Western Sierra Nevada.

Mortality was strongly influenced by fire intensity, but occured mainly in the lower DBH-classes. Due to this, the J-shaped DBH distribution changed into a normal distribution.

The change in stand composition and spatial structure is described and the post-fire stand conditions are compared with three hypothetical stands, which allows us to evaluate the effectiveness of these two fires in restoring pristine stand structures.

Spatial tree distribution was analysed with the structural group of four, a method which considers the relative difference between a reference

tree and it's four nearest neighbors and with the Winkelmass-value, a method which looks at the angle between the four nearest trees from each sampling point.

Pre-fire stand structures were similar to stand 3 in figure 1, in the post-fire stand, trees were found in a more clumped distribution, similar to stand 2 in figure 1.

A high degree of clumping for extreme char heights was observed, too. This points at a high spatial variation of fire intensity within the two burns.

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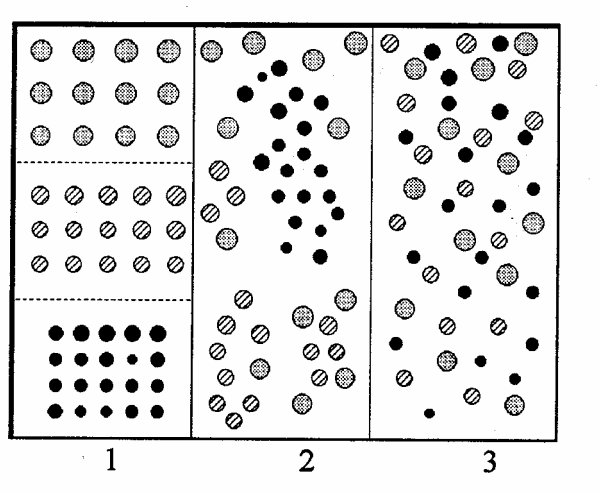

Figure 1. Three hypothetical stands in which the same 47 trees are existent. The stands are identical in their DBH and height distribution, but different in the spatial arrangement of tree positions. Stands 2 comes closest to our idea of pristine stand structures.

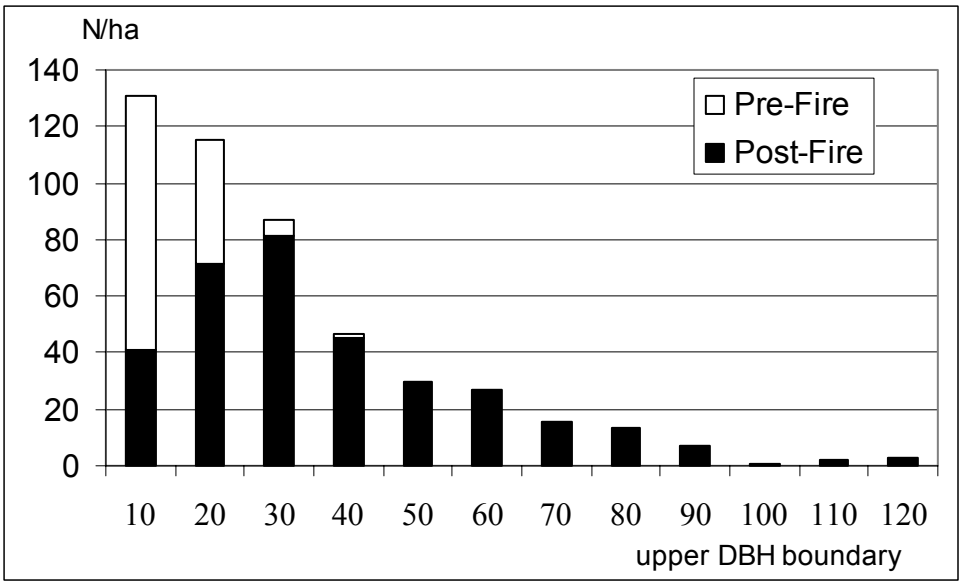

Figure 2. Pre-fire and post-fire DBH-distribution (trees with DBH above 2.5 cm) of the stand, which burned under low fire intensity (part A).

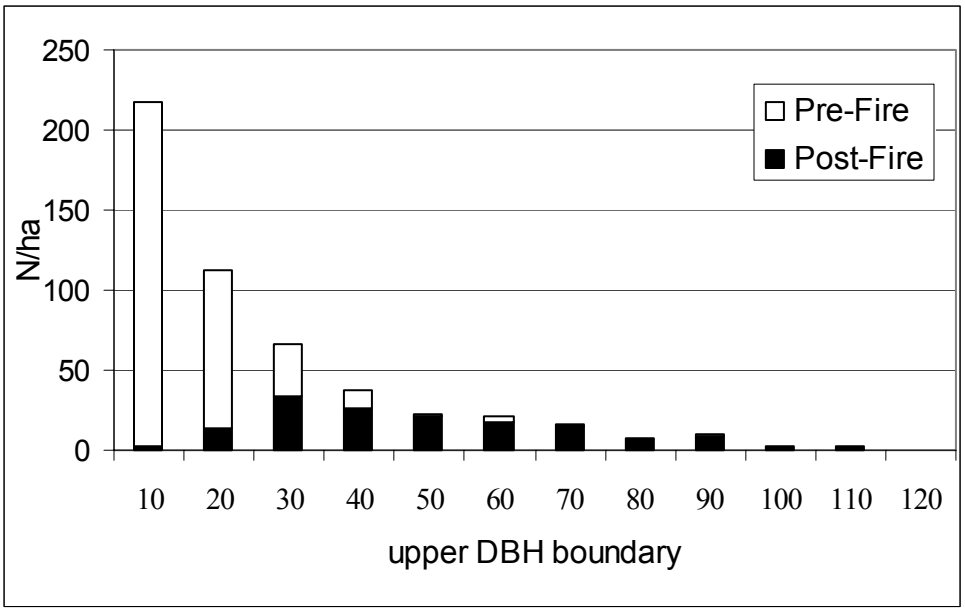

Figure 3. Pre-fire and post-fire DBH-distribution (trees with DBH above 2.5 cm) of the stand, which burned under high fire intensity (part B).

Certification Plans for Center Properties

Christopher Hipkin

The Center for Forestry is working on third-party Certification for 3 properties: Blodgett Forest Research Station (BFRS), Whitaker Forest Research Station (WFRS), and Baker Forest. Certification is used by forest owners to demonstrate social responsibility and sustainability of forest management. Our plan is to use two major forest management certification programs Forest Stewardship Council (FSC) and Sustainable Forestry Initiative (SFI) to evaluate Center for Forestry forest management practices. This will permit a comparison between the two certification approaches and provide opportunities for UC faculty, students and staff to study and evaluate the certification audit process, as well as become more aware of Center property management practices.

We plan a dynamic exchange between the audit teams and Center staff that could lead to improvements in Center forest management practices and policies, as well as improvements to the forest certification standards. The planned UC Center for Forestry dual certification audit is similar to one completed by Duke and North Carolina State Universities in the eastern US under a different and less rigorous government regulatory environment. Comparison between these two University's dual certification audits in different forest types, under different local cultural and regulatory environments, should lead to important insights on the relevance, utility and applicability of forest certification audits in North America.

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Large vertical gradients indicate emission and photochemically production for a wide variety of organic trace gases in a Ponderosa Pine plantation in the Sierra Nevada Mountains of California

RUPERT HOLZINGER, ANITA LEE, AND ALLEN H. GOLDSTEIN

We measured vertical gradients for a wide suite of volatile organic compounds (VOCs) through the forest canopy at the Blodgett Forest Research Station (38°53'N, 120 37'W, 1315m elevation) during summer 2003 using a PTR-MS. The sampling height was switched between 1.1, 3.1, 4.9, 8.75, and 12.5 m above the ground at 6 minute intervals, and mass to charge ratios ranging from 20 to 205 were recorded. The ability of the PTR-MS to achieve high time resolution, low detection limits (few ppt for averaged data), and whole air measurements without preconcentration allowed us to measure gradients for compounds that cannot be measured easily with other techniques. Significant gradients were observed for many compounds. Monoterpene and sesquiterpene emissions from the plants caused mixing ratios that were typically 2-3 times higher below the canopy than above, and our data did not show evidence for soil deposition of these compounds. Methanol mixing ratios were highest at the lowest level (1.1m) indicating that - in addition to emission from trees - methanol is also released from the shrub and possibly the soil. Mixing ratios of several compounds were highest at levels within the upper canopy and above. This pattern is indicative of compounds that are photochemically produced in the canopy whose photochemical lifetime is so short that they are removed before being mixed down to the ground (few minutes) and/or they are efficiently deposited to the soil. Many of these compounds were so far identified only by their mass to charge ratio and their identity or has not been conclusively determined. Concentrations of compounds emitted as a function of light and temperature by Ponderosa Pine tended to be highest at the 3.1m level; thereby showing that the emission rates were highest around this elevation; among those compounds is MBO.

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Ozone Oxidation of Monoterpenes, Sesquiterpenes, and Oxygenated Terpenes: Product Yields and Relevance to Field Observations and Atmospheric Chemistry

ANITA LEE AND ALLEN GOLDSTEIN

MELITA KEYWOOD, VARUNTIDA VARUTBANGKUL, ROYA BAHREINI, SONG GAO, RICHARD FLAGAN, AND JOHN SEINFELD*

Measurements conducted in a ponderosa pine plantation in the Sierra Nevada, CA have shown that the reaction of ozone with gas-phase compounds dominates summertime ozone deposition, with an exponential dependence on temperature similar to monoterpene emissions. Monoterpene fluxes measured above the forest canopy represent the monoterpenes that have effectively "escaped" the canopy, whereas measurements of ozone deposition due to chemistry provide an estimate of the compounds "missing" from the ecosystem scale flux due to within-canopy reactions with ozone. To better characterize the ozone oxidation of a range of terpenes, including those that escape the forest canopy and those oxidized within the canopy, we conducted laboratory measurements at the Caltech Indoor Chamber Facility to characterize the gas and particle phase yields from terpene + ozone reactions. These measurements were made to provide a guide to the oxidation products we expect to observe within a forest canopy, and to expand the knowledge of the impacts of these terpenes (both "missing" and "escaped") on atmospheric chemistry. The terpenes studied included six monoterpenes, two sesquiterpenes, and two oxygenated terpenes, many of which have been observed at our field site. A Proton Transfer Reaction Mass Spectrometer was used to measure the gas-phase yields of many low molecular weight oxidation products, including formaldehyde, acetaldehyde, formic acid, acetic acid, and acetone, as well as yields of larger oxidation products, including nopinone, pinonaldehyde, and many currently unidentified compounds which were observed according to their mass to charge ratios. Secondary organic aerosol yields, and

yields of small and large oxidation products varied widely between the different terpene species tested. In general, terpenes with high aerosol yields had low yields of small carbonyls, including the sesquiterpenes and □-terpinene, while terpenes with low aerosol yields had high yields of small carbonyls, including linalool, methyl chavicol, myrcene, and terpinolene.

A view from the Goldstein tower.

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Analyses By County, Special Trees And Borders
14-Year Data. Russell Reservation Kuser Redwood Trial

W. J. LIBBY

The 1989 University of California Russell Reservation plantation of the Kuser International Redwood Trial is among the oldest and most complete of such redwood trials. The Russell site is drier and has a somewhat more continental climate than that of redwood's native range. Data were taken in early 2003, after 14 growing seasons at Russell.

The analyses in this report focus on the performance of 176 random clones from throughout redwood's native range, organized and averaged by county of origin. Also analyzed are the average performance of 5 "standard" clones, 5 "plus-tree" clones, 10 clones from pedigreed offspring of plus-trees, and random seedling controls, all from Humboldt County. Finally, contrasts of the performance of border and interior trees are presented.

As has been observed at other warm-to-hot sites, redwoods from the southern (warmer) part of the native range, on average, have initially survived better and grown larger than those from the central and northern parts of the range. Not reported previously, redwoods from the central coastal part of the range exhibit the more-desirable branch-architecture traits (smaller knot size, narrower crowns, and more-uniform branch size and distribution). Redwoods from the northern part of the range have, on average, better lower-bole form, and their branches grow at closer to 90^{o} angles relative to the bole. Redwoods from the southern part of the range are, on average, generally the poorest in those branch and bole-form traits.

Forking, interestingly, occurred most frequently in trees from the edge of the native range (Curry, Napa, Santa Clara and Monterey Counties), and frequency of ramicorn branches (large up-angle branches that are usually

suppressed forks) follow a similar pattern. Epicormic branches were most common on the boles of trees from the southern part of the range, and southern trees also tended to have the most cones.

Clones included from Simpson Timber Company's plus-tree selection program, and from families bred from them, on average, scored well on the 3 indexes meant to synthesize overall value for wood-producing plantations. Some of the clones from the Simpson clonal-forestry program performed very well, and will be characterized in a later report.

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Fine Particle Formation And Processing In A Sierra Nevada Forest

MELISSA M. LUNDEN, DOUGLAS R. BLACK AND NANCY J. BROWN ; ANITA LEE, GUNNAR W. SCHADE AND ALLEN H. GOLDSTEIN

Forested ecosystems emit significant amounts of volatile organic compounds (VOCs), which impact atmospheric photochemistry through ozone and aerosol production. To study biosphere-atmosphere exchange of ozone and VOCs and their effects on aerosol formation and processing, we have conducted a study at the Blodgett Forest Research Station in the Sierra Nevada Mountains of California. The research site includes automated instrumentation for the in-situ measurement of concentration and biosphere-atmosphere flux of VOCs, ozone, aerosol integrated and size resolved instrumentation, and meteorological variables. Preliminary results have shown that particle concentrations are correlated with both biogenic (alpha-pinene and isoprene) and anthropogenic (toluene) VOC concentrations. In addition, the formation of small, nuclei model particles (<20nm) has been observed just after noon on many days. This presentation will focus on recent results from the Blodgett site focusing on the diurnal aerosol patterns at the site, the relative importance of anthropogenic and biogenic sources on aerosol concentrations, and correlations between VOC measurements, meteorology, and particle formation events. Experimental yield data will be used with measured fine mode aerosol data to investigate whether oxidation of various organic precursors can account for aerosol growth.

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Effect of Climate Variability and Management Practices on Carbon, Water and Energy Fluxes of a Young Ponderosa Pine Plantation at the Blodgett Forest Ameriflux Site.

LAURENT MISSON, MEGAN MCKAY, AND ALLEN H. GOLDSTEIN

Our research at Blodgett Forest in the Sierra Nevada mountains of California seeks to better understand how fluxes of CO_2, H_2O, and energy in a mid-elevation, young pine plantation change interannually in response to climate variability, and how they are impacted by management practices such as shrub removal and thinning.

Ecosystem scale fluxes have been measured by the eddy covariance method since 1997, along with meteorological parameters. During winter, the young Ponderosa pine plantation at Blodgett acted mainly as a sink of carbon. Strong variations in winter carbon sequestration occurred due to changes in leaf area index and frequency of freezing temperatures. Interannual variations in springtime carbon flux occurred mainly due to differences in the timing of seasonally increasing temperatures.

Drought is a regular feature of the California climate, making water availability the major controller of gas exchange in summer and fall. In late summer 2001, drought stress reduced ecosystem carbon uptake by 1/5, while the Bowen ratio increased by 1/3.

Thinning is a widespread procedure in plantation management carried out to reduce stand density, improve forest health, and optimize tree growth. In spring 2000, 2/3 of the trees were removed by mastication, the process of mechanically chewing up unwanted trees, which is becoming a widespread method for pre-commercial thinning in the U.S. During and after thinning, the plantation remained a sink of carbon. Thinning at the Blodgett site reduced the leaf area index from ~3 to ~1.5 m^2 m^{-2}, and created branch and stem debris of 400-500 g m^{-2}. During summer 2000, mastication decreased ecosystem carbon uptake by 1/3. Ecosystem water use efficiency decreased by 1/5 and the Bowen ratio increased by 1/3. This indicates the

increasing heat lost as sensible versus latent heat as the water flux decreased due to the reduction in leaf area index. After thinning, leaf area index rapidly increased to ~2.5 m^2 m^{-2} by the end of 2000, and to ~3.5 m^2 m^{-2} in 2001. As a result, the uptake of carbon by the ecosystem increased by 1/3 in early summer 2001 in comparison to the pre-thinning value.

By summer 2001 the Bowen ratio returned to its pre-thinning value, and the ecosystem water use efficiency increased by 1/3. Higher ecosystem water use efficiency was maintained in summer 2002 and 2003, indicating that the thinning led to better optimization of ecosystem water use for at least the following three years, increasing the ratio of carbon gained to water lost over the growing season.

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Soil responses to the Fire and Fire Surrogate Study

EMILY E.Y. MOGHADDAS AND SCOTT L. STEPHENS

The Fire and Fire Surrogate Study utilizes forest thinning and prescribed burning in attempt to create forest stand structures that reduce the risk of catastrophic wildfire. Replicated treatments consisting of mechanical tree harvest (commercial harvest plus mastication of sub-merchantable material), mechanical harvest followed by prescribed fire, prescribed fire alone, and no-treatment controls, were completed in fall 2002. Pre-treatment data of soil physical, chemical, biological characteristics were measured in 2001. Post-treatment samples were collected in 2003, and lab analyses will continue into 2004.

Harvesting operations may accelerate N mineralization due to microclimate changes. Skidding likely increased exposure of mineral soil and soil bulk density. Prescribed fire, both alone and in combination with thinning, reduced depth of materials on the forest floor. This may result in enhanced N mineralization rates in the surface soil, while intense heat pulses may have caused short-term alterations to microbial communities. Soil pH and base saturation are both expected to rise, while soil texture and compaction may remain unchanged by burning. Biological and chemical effects may be more pronounced in the thinned and burned stands than in the fire-only treatment units. Soil physical effects in the thinned and burned units are expected to be similar to those in the harvest-only treatment. The presence of skid trails in all treatment units (due to past harvest activities) increased the heterogeneity of the soil environment, and may influence treatment effects.

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Distribution of Reactive Nitrogen at Two Sites in the Sierra Nevada

J.G. MURPHY, D. K. FARMER, D. A. DAY, P.J. WOOLDRIDGE, AND R. C. COHEN

Nitrogen oxides can exert regional influence over areas downwind by governing photochemical ozone production and by depositing to ecosystems. The Mountain Counties in California's Sierra Nevada routinely exceed national ozone standards, and atmospheric nitrogen deposition has been identified as a cause of the declining water clarity of Lake Tahoe. Thermal dissociation laser-induced fluorescence (TD-LIF) was used to make continuous, high time resolution observations of NO_2, total peroxy nitrates (ΣPNs), total alkyl nitrates (ΣANs), and HNO_3 at two sites in the Sierra Nevada foothills. The abundance and partitioning of the reactive nitrogen species at the two sites are compared. During the summer, the Blodgett Forest site (1315 m asl) is subjected to a regular daily pattern of mountain-valley flow, whereas the site at Big Hill (1850 m asl) is exposed to a wider range of transport patterns. Comparison of the amplitude and phase of the diurnal profiles of reactive nitrogen species at the two sites allow us to begin to examine the complex interplay between transport and chemistry that governs the distribution of nitrogen species in the boundary layer. Relationships between NO_y species and environmental parameters, such as wind direction, temperature, water, and radiation and chemical constituents such as O_3 and particulate matter are also explored.

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Baker Forest
Proposed Management Plan

GARY ROLLER

Baker Forest is a previously unmanaged, 80-acre parcel in Meadow Valley. This heavily cut over land was acquired by the University of California in 1948 to protect the water supply to the adjacent Berkeley Forestry Summer Camp. The forest is named for Berkeley Professor Frederick S. Baker. The Center for Forestry is in the process of creating a management plan for this area to facilitate student use through Summer Camp and future research. Some current projects on Baker forest include; a legal property line survey, establishment of a permanent vegetation and fuel inventory system, and construction of Zivnuska Hall. This hall, named for former Dean, John A. Zivnuska, is a multipurpose facility designed as a meeting room and a computer center for students of Summer Camp. Opportunity exists at Baker Forest for limited research. Current research projects at Baker Forest include replications of giant sequoia,

white fir, and incense cedar provenance genetics studies. The management plan will outline guidelines to create forest conditions and structures to facilitate multiple teaching and research goals. Current and future use of the forest is by undergraduate students in Berkeley's forestry program attending Summer Camp, UC researchers, and a wide variety of other educational groups.

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ABOVE:
Forestry students examine freshly cut timber as part of their summer 2003 Summer Camp curriculum.

LEFT:
Baker Forest.

Photos by Gary Roller
Center for Forestry

Ecology of the Spotted Owl in the North-Central Sierra Nevada

MARK SEAMANS, MICHELLE CROZIER, AND R. J. GUTIÉRREZ

We use a capture/recapture study design to study population ecology of the California spotted owl. Our 925 km^2 study area lies between Georgetown, CA, and the western shore of Lake Tahoe. Since 1986, we have conducted over 12,000 surveys and captured and uniquely marked approximately 270 territorial and 260 juvenile California spotted owls. From this data we are able to estimate annual rates of survival, fecundity, and population change. Estimates of vital rates for territorial owls have varied by age-class: annual survival = 0.53 [SE = 0.10] for 1 and 2-year-olds, and 0.84 [SE = 0.02] for owls $\geq$3 years-old; annual number of young fledged = 0.66 [SE = 0.16] for 1 and 2-year-olds, and 0.80 [SE= 0.15] for owls $\geq$3 years-old. Fecundity has varied extensively over time (coefficient of temporal process variation [CV] = 70%) relative to survival (CV = 8%). Both empirical and statistically estimated rates of population change indicate abundance of territorial owls increased in the early 1990's, peaking around 1995, and has declined since.

Past and ongoing ancillary research on food habits, competitors, predators, physiology, habitat requirements, genetics, disease, and disturbance provide insight into why this population varies over space and time, and is used by individuals and agencies for better management of California spotted owls. For example, we have been following two sites at Blodgett Forest Research Station since 1997 that typically have a pair of spotted owls each. Although these owls are part of our larger demographic study and supply population level information, data we collect regarding annual locations and individual characteristics is used by the Blodgett staff to help with property management decisions. Current research topics include examining how habitat change at the landscape level affects demographic rates, how spotted and great horned owls compete for resources, and gauging when and how West Nile Virus will affect spotted owl populations.

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The Effects of Fire and Fire Surrogate Treatments on Insects and Pathogens in Sierran Mixed Conifer Forests

DANIEL T. STARK [1], ANDREW J. STORER [2], DAVID L. WOOD [3], AND SCOTT L. STEPHENS [1]

The Fire-Fire Surrogate Study (FFS) is a national, multi-disciplinary study funded by the Joint Fire Science Program (USDI-USDA). The objective of the study is to quantify the short- and long-term effects of fire and fire surrogate treatments on a range of variables in multiple disciplines. At Blodgett Forest Research Station located in El Dorado County, CA, entomological and pathological data were collected in Summer 2001 (pre-treatment), Summer 2002 (post-thinning, pre-burn), and Summer 2003 (post-treatment) for the following insect and disease conditions: red turpentine beetle, *Dendroctonus valens*, western pine beetle, *D. brevicomis*, mountain pine beetle, *D. ponderosae*, fir engraver, *Scolytus ventralis*, pine engraver beetles, *Ips* spp., defoliators, scale insects, root diseases (annosus root and butt rot, *Heterobasidion annosum* and blackstain, *Leptographium wageneri*), mistletoes (true and dwarf), rusts (white pine blister rust, *Cronartium ribicola*, western gall rust, *Peridermium harknessii*, and Incense-cedar rust, *Gymnosporangium libocedri*), and other diseases (true fir needle cast, *Lirula abietis-concoloris*, and Elytroderma disease, *Elytroderma deformans*). Categorical data were obtained from twenty 0.04-hectare plots in all treatment areas, and 360-degree scans were taken from the center of each plot to identify symptomatic trees outside of the plot area. Scans were limited to a distance of 30 meters in all treatments in the post-treatment collection to allow for increased visibility in the mechanical treatments. In Summer 2002, all stumps in the 0.04-hectare plots in the mechanically treated areas were visually inspected for signs and symptoms of root disease and infestation by insects. In Summer 2003, preliminary analysis of categorical data in the fire treated compartments, particularly the fire and mechanical treatments, reveal increased numbers of attacks by the red turpentine beetle on both ponderosa and sugar pines, and increased incidence of western and mountain pine beetle on ponderosa and sugar pines, respectively,. Additionally,

elevated activity of ambrosia beetles is apparent on scorched white firs in these fire treatments, based on the abundance of visible frass. From the scan data, preliminary analysis further suggests increased mortality levels of trees in the 11.4 to 25.4 cm (4.5 to 10 in) diameter class in the fire treated compartments. These trees may have been burned outright by the fire. Bark beetle presence on these trees will be confirmed in Summer 2004 (based on gallery identification) once the trees have died. Additionally, these trees have been mapped to follow trends in future tree mortality. Post-treatment data will continue to be collected annually through Summer 2005. Longer term annual monitoring of these treatment areas is anticipated as part of the national FFS study.

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Bark beetle landing rates as indicators of future tree mortality

DANIEL T. STARK[1], ANDREW J. STORER[2], DAVID L. WOOD[3], SCOTT L. STEPHENS[1]

The landing rates of bark beetles are being monitored using sticky traps on trees in the fire and fire-surrogate study treatment compartments and these rates will be correlated with future bark beetle activity on individual trees and in stands. Three ponderosa pines (*Pinus ponderosa*) and three white firs (*Abies concolor)* were selected from each of three plots chosen randomly within each compartment assigned to the four treatments for a total of 36 ponderosa pines and 36 white firs. Trees with no symptoms or signs of bark beetle infestation or root disease closest to the plot centers were chosen. Conditions for each tree were rated and recorded. One 61cm x 31cm sticky trap was hung at a random cardinal direction at a height of 1.3-m on each of the selected trees. Bark beetles are collected from these traps monthly during the flight period from Spring to late Fall each year until Summer 2004.

Studies in 2002: In May traps were hung in the control, fire only, and mechanical plus fire treatment compartments. For this trapping period, the prescribed fires had not been implemented. Thus, the catch in 3 cut and 6 uncut compartments were compared. Bark beetles and other beetles were removed from traps in August and September and were identified in the field to family or to genus. Collected specimens were brought to the lab for identification. Bark beetles collected included *Dendroctonus* spp, *Scolytus* spp, *Ips* spp, *Pityophthorus* spp, *Pseudohylesinus* spp, *Hylastes* spp., *Hylurgops* spp, and *Gnathotrichus* spp. Other beetles collected included beetles in the families Platypodidae and Cleridae, and weevils in the genus *Cossonus* (Curculionidae). All other beetles were left on the trap and will be sorted in the lab to at least family level.

Studies in 2003: In early June, traps were placed in all four treatment compartments. Mastication in the mechanical only compartments was completed in early Spring 2003, and all fire treatments were completed in Fall 2002. Bark beetles and other beetles

were removed from traps monthly from July through October/early November. Specimens were identified on site when possible and were brought back to the lab for positive identification. Traps were removed in December 2003 and all beetles will be removed and identified to at least family level. Bark beetles collected included *Dendroctonus* spp, *Scolytus* spp, *Ips* spp, *Pityophthorus* spp, *Hylastes* spp, and *Gnathotrichus* spp. Other beetles collected included beetles in the families Buprestidae, Platypodidae and Cleridae, and weevils in the genus *Cossonus*.

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Fire Hazard and Silvicultural Systems: 25 Years of Experience from the Sierra Nevada

DR. SCOTT STEPHENS AND JASON MOGHADDAS

Silviculture systems influence fire hazard by changing the arrangement and quantities of live and dead biomass. Each system regulates forest growth and development but their long-term influence on fire hazard is largely unknown. Using archived data from the Blodgett Forest Research Station (BFRS) Interactive Web Database, this paper determines if significant differences ($p < 0.05$) exist in fuel characteristics (1, 10, 100, 1000 hour, duff, and litter loads), surface fuel depth, crown cover, and height to live crown base between several treatment types at BFRS. We used Fuels Management Analyst™ to compare fire performance in these treatment types in terms of a) rate of spread, b) flame length, c) fire line intensity, d) crowning index , and e) torching index. Treatment types include a) single-tree selection, b) commercial thinning from below, c) over story removal, d) regeneration units less than 5 years old, e) regeneration units xx-xx years old with no treatments after planting, f) regeneration units that have been pre-commercially thinned using a rotary masticator, g) regeneration units that have been pre-commercially thinned using chainsaw crews, h) reserve units with an old growth component, i) young growth reserve units greater than 60 years old. All areas have experienced a policy of fire suppression over the last century. Activity fuels were lopped and scattered with the exception of regeneration units which were tractor piled and burned. With the exception of fuel depth, surface fuel characteristics were generally not significantly different between reserve and non-plantation treatment units. Fuel depth in old growth reserve units was deeper than that in over story removal units. Preliminary analysis indicate that activity fuel treatments must be an integral component of silvicultural systems to produce forests with low surface fuel hazard. We will report our findings on fire performance at the Blodgett Symposium.

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Vegetation Change and Fire Performance in Fire and Fire Surrogate Treatment Units

DR. SCOTT STEPHENS AND JASON MOGHADDAS

Fire and Fire Surrogate Treatments were implemented in 12 compartments at Blodgett Forest Research Station (BFRS). Treatments were each replicated 3 times in at a minimum 10-hectare (25 acre) unit size. Treatments include a) control- no treatment, b) mechanical only- commercial thinning followed by mastication, c) mechanical plus fire- commercial thinning and mastication followed by a prescribed burn, d) fire only- prescribed burning with no additional pre-treatment of fuels. Over story and under story vegetation, and fuels were assessed using 0.04 hectare ($1/10^{th}$ acre) permanent plots and line intercept transects, respectively. We will determine if significant differences ($p < 0.05$) exist in fuel characteristics (1, 10, 100, 1000 hour, duff, and litter loads), surface fuel depth, crown cover, and height to live crown base between treatment types. We use Fuels Management Analyst™ to compare fire performance in these treatment types in terms of a) rate of spread, b) flame length, c) fire line intensity, d) crowning index , and e) torching index. We are in the process of this analysis and will report preliminary findings at the Blodgett Forest Research Symposium.

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Development of Entomology and Pathology Hypotheses of Long Term Impacts of Fire and Fire-Surrogate Treatments on Sierra Mixed Conifer Forests.

ANDREW J. STORER[1], DANIEL T. STARK[2], DAVID L. WOOD[3] AND SCOTT L. STEPHENS[2]

Treatments at the Blodgett Forest site of the national Fire-Fire Surrogate Study (FFS) were completed in Spring 2003. During the summers of 2003 and 2004, short term (1-2 year) responses will be assessed that test hypotheses relating to short term elevated activity levels of bark beetles (Coleoptera: Scolytidae), and short and medium term (3-5 year) elevated activity of wood infesting insects such as beetles in the families Buprestidae, Cerambycidae and Anobiidae. While forest diseases will be impacted in the short term by the treatments, we do not anticipate detection of changes in the frequency of observed symptoms in the short term. In the long term (5-10+ years) however, elevated infection rates by, for example, root pathogens may be detected.

In the longer term, we anticipate that many species of bark beetles will return to endemic levels after a period of increased activity that may include mortality of some residual trees. We also anticipate that any elevated root disease activity will become detectable as symptoms start to develop. In turn this may lead to another increase in bark beetle activity due to the availability of disease weakened trees. The extent to which these and other effects occur in fire only, mechanical only and fire plus mechanical treatment areas compared with the untreated control areas is important for consideration of appropriate treatments to reduce wildfire impacts on Sierran mixed conifer forests.

In addition, longer term interdisciplinary hypotheses are being developed that relate to interactions between fire scorch on trees and susceptibility to bark beetle attack, tree response to thinning and susceptibility to bark beetle attack, response of *Ribes* (the alternate host for white pine blister rust) to changes in the forest floor environment, and interactions among cavity nesting birds and trees killed by bark beetles.

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Pulse effects of soil respiration after rain events in California

JIANWU TANG, DENNIS BALDOCCHI, ALLEN GOLDSTEIN, LIUKANG XU, AND LAURENT MISSON

We observed pulse effects of soil respiration following the first rain and second rain after the dry season in California savanna and forest ecosystems in 2002 and 2003. Soil respiration was measured by three different methods: soil CO2 profile measurements using solid-state CO2 sensors buried in several depths of soils, under-story eddy covariance measurements, and chamber measurements. In addition, we conducted laboratory soil incubation experiments and in situ watering experiments to simulate rain events to observe the pulse effects of soil respiration. The results indicated that soil microbes immediately responded to the rain events within an hour. The pulse CO2 efflux was about 10-20 times larger than the efflux before the rain. Spatially, soil respiration under trees has smaller pulse than that in the open area. Surface soils responded to rain events faster than deeper soils. The magnitude of the pulse correlated positively to the amount of rain. We found that the pulse effect is mainly driven by microbial activities, and can be simulated by an exponential decay function. The pulse effects also influence the seasonal pattern of soil respiration. It is suggested that soil respiration models may need to consider these pulse effects of soil respiration, since the amount and timing of rainfall significantly affect the annual carbon budget.

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Quantifying the Importance of Belowground Plant Allocation for Sequestration of Carbon In Temperate Forest Soils

MARGARET S. TORN, TODD DAWSON, JULIA GAUDINSKI, JEFFREY BIRD AND STEFANIA MAMBELLI

The recent DOE road map for Carbon Sequestration Science highlights the potential for enhancing C sequestration in soils by increasing plant allocation of C to belowground biomass. To design and/or evaluate effective strategies that maximize C sequestration, we must greatly improve our ability to measure the rates of C allocation belowground, the subsequent residence times of belowground C inputs and the associated dynamics of soil organic matter (SOM). The purpose of this project is to fill some of these critical gaps in our knowledge about C sequestration resulting from belowground plant C allocation in temperate forests. We propose to fill essential gaps by: (1) Quantifying the stocks and lifetime of fine roots (2) Comparing the C sequestration efficiency of leaf and fine root inputs, including both decomposition and humification rates, and the stability of the resulting SOM products. (3) Investigating the influence of resource availability on plant C allocation belowground including root exudation.

Our approach takes advantage of several innovative methods (i.e., radiocarbon analysis of roots and SOM, a dual stable isotope approach ($^{13}C/^{15}N$) to track the fate of belowground C and N into CO_2, the microbial community and SOM fractions, and ^{13}C pulse-label experiment to follow C allocation to roots/exudates).

Preliminary results include the following: (1) C allocation to fine roots versus leaves enhances sequestration in the short term because fine roots live longer and decompose more slowly than leaves (regardless of soil depth). (2) Longer-term implications are unclear because decomposition and C humification rates are often unrelated and plant allocation patterns influence the plant's ability to acquire and use belowground and aboveground

resources, which may in turn feedback to shape productivity and long-term C sequestration. (3) Fine roots are (at least) two populations short-lived (< 1 yr) and longer lived (2-18 yr). Sampling via size-class may not be the best strategy, as fine roots with same size class can have very different lifetimes, form, and potential function. Thus, estimates of BNPP need to be re-evaluated.

Ultimately this work should allow us to develop a template for more rapid assessment of the best ecosystems and species to target for future carbon sequestration efforts.

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Effects Of Fire And Fire Surrogate Treatments On Fisher Habitat

RICHARD L. TRUEX[1] AND WILLIAM J. ZIELINSKI[2]

The fisher (*Martes pennanti*) historically occurred throughout mid-elevation forests of the Sierra Nevada but currently appears to be limited in distribution to the southern Sierra from Yosemite National Park south to the Greenhorn Mountains. The population's isolation, size and association with mature forest conditions have raised concern for its long-term viability. Prominent among the factors influencing fisher population viability in the southern Sierra Nevada is the risk of catastrophic fire. Land management activities implemented to reintroduce fire as an ecological process may ultimately benefit the fisher population by reducing the likelihood of large fires, though there are short-term risks associated with these activities (e.g., loss of large snags and logs). During 2001 we initiated research at the Blodgett Forest Research Station (BFRS) and Sequoia-Kings Canyon (SEKI) in conjunction with the Fire and Fire Surrogate (FSS) Treatment Study to examine the short-term effects of several management activities on fisher habitat quality. At each FFS site, 10 plots within each treatment unit will be sampled before and 1 year after treatment. Changes in fisher habitat suitability will be assessed using a Resource Selection Function developed for fisher in California. Field data collection was completed at both FFS sites during 2003, and data analysis is ongoing. Efforts will be made to resample all plots 5 years after treatment implementation to better understand the delayed effects of treatments on fisher habitat suitability.

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Stand Structural Response To Decline Of Sugar Pine In California's Mixed-Conifer Forests.

KRISTEN M. WARING AND KEVIN L. O'HARA

Research in the Sierra Nevada mixed-conifer forests investigating the response of individual trees to the decline of sugar pine is lacking, as are detailed views of stand dynamics based upon stand reconstruction studies. Sugar pine decline began approximately 80 years ago, as a result of an introduced tree disease, white pine blister rust. This project is investigating which tree species' show quantitative responses to sugar pine decline, and how quickly the response occurs. Temporary circular plots were located throughout the Sierra Nevada Mountains including Blodgett Forest, ranging in size from 1/10 ha to 1/25 ha. On each plot, several trees were chosen for more intensive sampling, including destructive sampling where possible. Data collection included diameter, total height, crown radii, tree vigor measurements, sapwood area, age, and growth. On destructively sampled trees, cross sections were removed at various points along the tree bole for detailed ring measurement analysis. On other sample trees, cores were taken at the base, breast height (1.37m), and three meters. Expected results include detailed descriptions of stand dynamics, individual tree responses (quantified via growth and vigor analysis), and guidelines for management of affected mixed-conifer stands.

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WebApps at the Center for Forestry: Year 2

http://ecology.cnr.berkeley.edu/

JENNIFER YORK, JOHN BATTLES, CARRIE SALAZAR, AND FRIEDER SCHURR

This presentation will follow up on last year's introduction to the online version of the Center for Forestry's environmental databases. "WebApps" or the Blodgett Forest Digital Database provides online access to detailed raw data and summaries of forest attributes. This past year we added new databases: Whitaker Forest Digital Database, Hydrology at Blodgett, and a contributed database by the Goldstein group. We also updated the weather data, vegetation data, and maps.

A large part of the year was focused on data recovery efforts. Measurements have been taken on Blodgett forest since the 1960's. Weather data dates back to the 60's and vegetation data dates back to the early 70's. Since establishing our online database, we recognized that not all past data had been digitized and put into a manageable format. Data recovery efforts focused mainly on finding old files, digitizing them, and formatting them to coincide with the current datasets. Most effort was put into reconciling old inventories that did not match the current protocol.

This year we want to focus on adding new information to the online databases. Here are some ideas:

- Data from other Center for Forestry locations (Russell Reservation and Baker Forest)
- Blodgett stand history for all compartments
- List of publications from all Center properties
- Stand visualization of different management types
- More Researchers datasets

The online database is very simple to use. Go to http://ecology.cnr.berkeley.edu for the main webapps page and click on either the Blodgett or Whitaker database. The Blodgett main page is shown below. There are five main categories of data. Within each category link is a window that allows you to select data to export, also selecting time frame and format type. Check out the webapps and send

us suggestions on how we can make the digital databases more useful.

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Blodgett Forest Research Station

weather and vegetation databases

Historical Weather Databases

1990-2002 Comprehensive Weather Data NEW (2002 data)
1990-2001 Monthly Temperature Averages
1962-2001 Average Daily Highs and Lows
1994-2002 Monthly Relative Humidity Daily Highs and Lows
1961-2001 Daily Precipitation

Vegetation Database

Access Vegetation Database (Registration required)
Vegetation Data Thesaurus

Hydrology Databases NEW

1995-2000 Bacon Stream 15min Water Stages, Temps & Precip
1995-2000 Bacon Water Stages Temps & Precipitation Daily Avg, Max and Mins
1995-2000 Dark Canyon Stream Precipitation and Water Levels
Stream Monitoring Photos

Maps and Reports

Compartment Inventory Summary Reports and Maps NEW (2003 updates)

Contributed Databases

Goldstein Group Ameriflux Databases

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Establishment and recruitment of giant sequoia in experimental gaps

ROBERT A. YORK, ROBERT C. HEALD, JOHN J. BATTLES, AND FRIEDER G. SCHURR

In the effort to restore giant sequoia groves towards some semblance of pre-fire suppression conditions, managers are faced with uncertainty in appropriate reference conditions, doubt in the efficacy of treatments, and social constraints such as prohibitive costs. Whether a structural-, process-, or combination-oriented approach is used to restore groves, a consistent measure of success will be the establishment and survival of a cohort of giant sequoia trees. Prerequisites for a successful cohort of giant sequoia seedlings will likely include some form of modification to the seed bed for establishment as well as an increase in resource availability for growth and survival. At Center for Forestry's Whitaker's Forest Research Station (within the Redwood Mountain grove), we are currently studying the effect of seedbed and resource levels on the establishment and growth of artificially planted giant sequoia seeds and seedlings. The study is designed to experimentally control the growing conditions of regenerating seedlings to answer methodological questions about artificial means of regeneration, as well as autecological questions about seedling growth response to resource gradients within canopy openings of different sizes. Specifically, patches of second-growth forests intermixed with ancient giant sequoia trees were cleared with openings ranging in size from 0.05 to 0.4 ha. To study the effect of seedbed on regeneration, debris from logging was piled into windrows running along north-south transects, and then burned to form a continuous ash bed. In the Spring of 2004, both seeds and seedlings will be planted along the north south transects in the ash bed as well as on bare mineral soil. Nested within opening size effects, qualitative differences in seed bed type and quantitative differences in resource gradients of light and water created by the openings are expected to influence seedling survival and growth.

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LEFT: Post Logging debris piled in north-south windrows in one of the research gaps at Whitaker Forest.

(photo by Rob York)

RIGHT: Burning the logging debris to prepare a seed bed for research planting.

Photo by Rob York

WORKING AT CENTER PROPERTIES 2003

CENTER FOR FORESTRY RESEARCH STATION: RESEARCH PROJECT STATUS

2/3/2004

PROJECT NO.	STATUS	PRINCIPAL INVESTIGATORS	BEGIN DATE	COMPLETE	PROJECT TITLE	COMPART-MENT
BF03-06S	Active	Scott Stephens Marco Hille Lars Schmidt	06-03	08-03	Tree mortality after fire: the influence of duff consumption, bole damage and crown scorch	
BF03-05W	Proposed	David L. Wood Pierluigi Bonello Thomas R. Gordon	03-03	12-03	Mechanisms of host selection by pine bark beetles	611, 612
BF03-04B	Proposed	John Battles	03-03	09-10	Managing the consequences of exotic forest pests: Learning from white pine blister rust (*Cronartium ribicola*) impace on sugar pine (*Pinus lambertiana*)	220, 292, 101
BF03-03B	Proposed	John Battles	03-03	09-04	Tree demography in the Sierran mixed conifer forest: Determinants of success under a novel disturbance regime	220, 292, 461, 101
BF03-02R	Proposed	David Rizzo Allison Wickland	01-03	09-05	Distribution and Dynamics of *Phytophthora ramorum* at Blodgett Research Forest	
BF03-01O	Proposed	Kevin O'Hara Kristen Baker	01-03		Forest Stand Structure, Development & Response to Invasion by Exotic Pathogens	
BF02-11O	ACTIVE	Kevin O'Hara Rolf Gersonde	09-02	10-02	Stocking guidelines for uneven-aged Sierra Nevada mixed-conifer forests	330, 480
BF02-10R	Complete	Nancy Rappaport Amanda Roe Felix Sperling	07-02	08-02	Taxonomy and Identifiction of coneworms (*Dioryctria: Lepidoptera: Pyralidae*) in the Western United States	(Collec-tion only)
BF02-09S	Proposed	Scott Stephens	07-03	11-08	Mechanisms and probability of fire scar formation in Sierra Nevada mixed conifer tree species	611, 480
BF02-08M	ACTIVE	Joe McBride Ralph Boniello	07-01-02	12-03	Carbon and Water Response of Sierran Conifers to Seasonal Drought	60D
BF02-07F	ACTIVE	William Frost Robert Heald	06-02	10-02	Controlled grazing for suppression of shrub species	440
BF02-06S	ACTIVE	Andrew Storer Dave Wood	05-02	10-05	Activity of bark and wood infesting and other insects detected by passive trapping in the fire fire-surrogate treatment areas	FFSS
BF02-05W	Complete	Wendy Wilson Gary Anderson Ron Pletcher	04-02	07-02	A Study of the Microbial Diversity of Air in a Longitudinal Transect of California	
BF02-04B	ACTIVE	John Battles	03-02	09-04	Tree domography in the Sierran mixed conifer forest: Determinants of success under a novel disturbance regime	220, 292, 461
BF02-03S	Complete	Wendy Silk Kyaw Tha Paw U Angela Cheer	03-02	10-02	Coupling among environmental variables and spatial and temporal structure in plant canopies.	

CENTER FOR FORESTRY RESEARCH STATION: RESEARCH PROJECT STATUS

2/3/2004

PROJECT NO.	STATUS	PRINCIPAL INVESTIGATORS	BEGIN DATE	COMPLETE	PROJECT TITLE	COMPART-MENT
BF02-02S	ACTIVE	Scott Stephens Jason Moghaddas	02-02	10-03	Fire Hazard and Silvicultural Systems: 25 Years of Experience from the Sierra Nevada	BFRS data
BF01-26O	ACTIVE	Kevin O'Hara Bjorn Hannel Rolf Gersonde	03-01	09-02	Diameter growth response of shelterwood trees	
BF01-25O	ACTIVE	Kevin O'Hara Robert Heald Rolf Gersonde Mark Spencer Tudor Stancioiu Nadia Hamey Jennifer Heald Rob York Kristen Baker	03-01	09-03	Single-tree Selection for Shade Intolerant Species	C. 130
BF01-24H	ACTIVE (refer 82-3)	Robert C. Heald	01-02	12-04	Nelder Biomass Spacing Study	151
BF01-23D	ACTIVE (refer 87-1)	Don Dahlsten Nadir Erbilgin	01-87	01-04	Response of *Ips paraconfusus* parasitoids to host tree and associated fungal factors	
BF01-22D	ACTIVE (refer 84-4)	Don Dahlsten Nadir Erbilgin	06-84	01-04	Attraction of predators, parasites of economic important bark beetles Calif. To Pheromones	
BF01-21S	ACTIVE	Scott Stephens Jason Moghaddas	06-01	12-04	An Assessment of treatment effects on Ground and Surface Fuels	FFS
BF01-20S	ACTIVE	Scott Stephens Emily Greinke	06-01	12-04	An Assessment of treatment effects on Forest Soils, Litter, and Duff	FFS
BF01-19D	ACTIVE (refer 84-03)	Don Dahlsten Kyle Apigian David Rowney Deanna Simon	07-84	01-04	Nest site selection for mountain (MC) & chestnut backed chickadees (CBC)	80, 110, 292, 440, 570, 600
BF01-18G	ACTIVE	Ye Qi Allen Goldstein Weixin Cheng	01-02	12-03	Controls of Canopy Activities on Roots and Soil Carbon Dynamics in a Young Ponderosa Pine Forest	SPI site
BF01-17B	ACTIVE	Frank Beall Robert Heald William J. Libby	11-01	06-03	Giant Sequoia as a planted and plantation species	BFRS Whitaker Mt. Home
BF01-16S	ACTIVE	Scott Stephens John Battles Jason Moghaddas	06-00	12-04	An Assessment of treatment effects on Overstory and Understory Vegetation	FFS

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2/3/2004

PROJECT NO.	STATUS	PRINCIPAL INVESTIGATORS	BEGIN DATE	COMPLETE	PROJECT TITLE	COMPARTMENT
BF01-15S	Complete	Scott Stephens Brandon Collins Jason Moghaddas	06-00	06-02	Development of a Fire History for Blodgett Forest	FFS
BF01-14B	ACTIVE	Reg Barrett Andy Amacher	06-00	09-04	Fire and Fire Surrogate Study, Impact on Wildlife	FFS
BF01-13B	ACTIVE	Tom Bruns Antonio Izzo	07-01	07-03	Effect of fire and thinning on ectomycorrhizal diversity	FFS
BF01-12D	ACTIVE	Todd Dawson Margaret Torn Jeffery Bird Julia Gaudinski	06-01	09-05	Quantifying the importance of belowground plant allocation for sequestration of carbon in soils	450 120 630
BF01-11W	ACTIVE	Dave Wood Andrew Storer Daniel Stark	08-01	10-02	Insects and Diseases in the Fall Burn Units 520 and 292	292, 520
BF01-10H	Complete	Bruce Hartsough Stuart Chalmers	07-01	10-01	Economics of FFS Operations	FFS
BF01-09B	ACTIVE	Nancy J. Brown Melissa Lunden Douglas Black	08-00	10-02	Biogenic Secondary Organic Aerosol Formation Above a Western Pine Forest	SPI
BF01-08W	ACTIVE	Dave Wood Andrew Storer Dan Stark	05-01	09-05	Fire-Fire Surrogate Study: Insects and Diseases	FFS
BF01-07D	ACTIVE	Don Dahlsten Kyle Apigian Nadir Erbilgin David Rowney	05-01	08-04	Effects of prescribed fire and fire surrogate treatments on ground beetles and spiders in Blodgett Forest	FFS
BF01-06S	ACTIVE	John R. Shelly Luis M. Ibanez	07-01	08-03	Economical evaluation of the Fire surrogate treatments at Blodgett Forest	FFS
BF01-05Y	With-drawn	Louis Yang	06-01	07-01	Habitat Selection, mutualism, predation and metapopulation dynamics; a multilevel investigation of the phylloplane arthropod communities	
BF01-04W	Abandoned	Paul Wennberg Karena McKinney Ron Cohen	05-01	10-01	Measurements of Nitric Acid in the Atmospheric Boundary Layer by Chemical Ionization Mass Spectrometry (CIMS)	SPI site
BF01-03T	ACTIVE	Richard Truex William J. Zielinski	05-01	11-03	Fisher Habitat at FFS Treatment Units	FFS
BF01-02R	ACTIVE	Vince Resh Scott Stephens	03-01	10-04	Prescribed burning impacts on riparian and stream environments	BFRS

CENTER FOR FORESTRY RESEARCH STATION: RESEARCH PROJECT STATUS

2/3/2004

PROJECT NO.	STATUS	PRINCIPAL INVESTIGATORS	BEGIN DATE	COMPLETE	PROJECT TITLE	COMPART-MENT
BF01-01R	ACTIVE	Leah [Rogers] Beche Elizabeth Reinhardt Joe Scott	03-01	07-01	Quantifying Canopy Fuels in Conifer Forests	FFS
BF00-09	ACTIVE	Robert C. Heald Wm. David Rambeau	09-00	10-03	Sequoia Pruning Timing Study	431
BF00-08	Complete	Annie Barron Rosemary Carey	08-00	10-00	PNV Vegetatin Surveys for Tan Oak	BFRS
BF00-07	Complete	Tara Barrett Kevin O'Hara Frieder Schurr	07/00	07/01	The validity of computer-generated images for representing forest structure	220, 230, 250, 50
BF00-06	Complete	Allen Goldstein Robert S. Evans	06/00	08/00	Ameriflux Intercomparison	SPI site
BF00-05	Complete	Wayne Getz Don Miller	06-00	07-00	Dimorphic apterae on *Tamalia coweni*	600, 650
BF00-04	ACTIVE	John Battles Robert C. Heald	04-00	2010	Species Adjacency Study	C.152, C91
BF00-03	Complete	Kevin O'Hara Rolf Gersonde	04-00	06-01	Sapwood-leaf area prediction equations for mixed conifer stands	
BF00-02	Complete	M. Judith Charles Reggie Spaulding Vince Seaman Tom Cahill	03-00	06-01	Isoprene photooxication products: a comparison of laboratory data to field measurements	SPI Site
BF00-01	ACTIVE	Scott L. Stephens Robert C. Heald Reg Barrett Don Dahlsten Kevin O'Hara Dave Wood Matteo Garbelotto Emily Greinke Bruce Hartsough Andrew Storer Frank Beall	04-00	11-10	A Study of the Consequences of Fire & Fire Surrogate Treatment	

CENTER FOR FORESTRY RESEARCH STATION: RESEARCH PROJECT STATUS
2/3/2004

BFRS PROJECT NO.	STATUS	PRINCIPAL INVESTIGATORS	BEGIN DATE	COMPLETE DATE	PROJECT TITLE	COMPART-MENT
BF99-09	ACTIVE	Kevin O'Hara	03-00	09-09	Pruning to Reduce Infection of White Pine Blister Rust in Sugar Pine	
BF99-08	Complete	Weixin Cheng Roger F. Walker Dale W. Johnson Rick Susfalk	08-99	06-01	Rhizosphere Respiration & Root Demography in Forest Ecosystems	250
BF99-07	Complete	Vincent Resh Emily Betts Rosalie del Rosario	06-99	10-99	Comparison of the effects of cow manure and other food sources on the growth rates of aquatic insects	
BF99-06	ACTIVE	William R. Horwath Robert Powers	05-99	2004	The influence of understudy vegetation on cargon sequestration in managed forests	512
BF99-05	Complete	Kevin O'Hara Rolf Gersonde	05-99	08-99	Stand structure and development of mixed species single cohort stand	
BF99-04	ACTIVE	Ronald C. Cohen Paul Wooldridge Michael Dillon Douglas Day Erin Conlisk Rebecca Rosen Timothy Bertram	01-99	09-04	*In situ* Measurements of Nitrogen Oxides)Concentrations & Fluxes) Over a Sierra Nevada Ponderosa Pine Plantation	SPI Site
BF99-03	Complete	Ricki Kartes Jenifer Padgett Dionne Gruuer	05-99	09-99	Ozone Monitoring	SPI Site
BF99-02	Complete	Louise Fortmann Barbara Allen-Diaz Peter Walker	06-99	09-99	The Effect of Changes in Landholding Patterns and Land Use on Vegetation in Hardwood Rangelands	Off-site
BF99-01	Complete	Ken Hobson Patric Walsh	06-99	09-99	Development of attractants for longhorn and bark beetle trapping	
98-14	Complete	Ron Cohen Joel Thornton Paul Wooldridge	07-98	07-01	Ozone Production over a Ponderosa Pine Plantation	SPI site
98-13	Complete	John Battles	06-98	06-02	Early Detection of Neighboring Plants: Survival & growth of Trees	220
98-12	Complete	Allen Goldstein Brad Baker	07-98	07-99	Fluxes of Volatile Organic Carbon to the Atmosphere from a Ponderosa Pine Plantation	SPI site

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2/3/2004

BFRS PROJECT NO.	STATUS	PRINCIPAL INVESTIGATORS	BEGIN DATE	COMPLETE DATE	PROJECT TITLE	COMPART-MENT
98-11	ACTIVE	Robert C. Heald	1999	2010	Incense-cedar Growing Stock Level Study	651
98-10	ACTIVE	Ye Qi Jianwu Tang	06-98	**06-01**	Energy, Water, and Carbon balance in a managed Ecosystem	SPI site
98-09	Complete	Vince Resh Rosalie del Rosario	05-98	09-99	Cow Pats as Exogenous Organic Matter: Influences on Aquatic Invertebrate Communities	BFRS streams
98-08	ACTIVE	Bill McKillop Bruce Krumland Chris Hipkin	05-98	**06-01**	California Timber Supply – Statewide Growth Model Validation	BFRS Database
98-07	Complete	Ed Stone Bruce Krumland Janet Cavallero	04-98	2000	Growing Space Model	BFRS Database
98-06	Complete	Wayne M. Getz Don Miller	06-98	09-98	Alternative Life History Strategies on the Manzanita Leaf-Gall Aphid, *tamalia cowani*	600, 650
98-05	ACTIVE (refer 87-09)	David L. Wood Andrew J. Storer	04-98	09-02	Long Term Survival & Pines of Known Resin Pressure in 1961-5	611
98-04	Complete	Allen Goldstein Dennis Gray	06-98	10-00	Environmental Controls over Emission of Methylbutenol from Ponderosa Pine	SPI/ 180/260
98-03	ACTIVE	Robert C. Heald	03-98	2008	Shelterwood Regeneration of Planted R_R Sugar Pine	440
98-02	Abandoned	Greg Gilbert Cajun James	04-98	06-99	Edge Effects: Microclimatic Pattern and Biological Responses in Fragmented Forests	
98-01	Complete	John McColl Emily Greinke	04-98	10-99	Site Characterization of Selected Ecological Factors in SMC forests	10, 220, 240, 623
97-12	ACTIVE	D. L.Wood Thomas R. Gordon Andrew J. Storer Pierluigi Bonello	09-97	12-03	Bark Beetle Feeding Stimulants in California Host Pines and Non-Host Conifers	611, 612
97-11	Complete	John McColl Barbara Cade-Menum	08-97	08-00	A comparison of P and C forms in forests of two climatic regimes	10/20, 210/220, 510
97-10	Complete	John Battles Anna Levin	06-97	09-99	Effects of Group Selection cutting on Mycorrhizal Abundance and Diversity	20-40
97-9	Complete	Lynn Huntsinger	06-97	07-97	Resampling of Compartment 301;	301

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2/3/2004

BFRS PROJECT NO.	STATUS	PRINCIPAL INVESTIGATORS	BEGIN DATE	COMPLETE DATE	PROJECT TITLE	COMPART-MENT
		Barbara Allen-Diaz Kate Rassbach			Shrub and Tree Growth in Grazed versus ungrazed areas	
97-8	Complete	Richard Dodd Nasser Kashani	07-97	9-30-97	Oak Hybridization among California black oaks	180
97-7	ACTIVE	William Libby	05-97	**06-01**	Giant Sequoia - Ceanothus interaction	322, 372, 564
97-6	Complete	Ignacio Chapela Matteo Garbelotto	06-97	11-97	Field Inoculation of heterobasiolion annosum in White Fir	340, 530
97-5	Complete	Allen Goldstein Jeanne Panek	05-97	11-02	Impacts of ozone and nitrogen deposition on forest physiological function in the Sierra Nevada Mountains, CA	464, 481
97-4	ACTIVE	David L. Wood Tom Gordon Pierluigi Bonello Andrew J. Storer Dan Stark	05-97	09-03	Mechanisms by which root disease-induced changes in Ponderosa Pine physiology affect bark beetle behavior	611
97-3	Complete	T.N. Narasimhan Lucas W. Paz Carroll Williams	05-97	9-98	Impact of Clearcutting on Soil-Water Characteristics; Role of compaction & organic matter removal on permeability & moisture capacity	512
97-2	Complete	Stanley Scherr David Kaplow	04-97	04-97	Collection & Propagation of Taxus brevifolia & Tarreya california	Bacon Creek to Loop Road
96-9	Complete	Tara Barrett Robert C. Heald Frieder G. Schurr	7-96	1997	Snag dynamics in the mixed conifer forest - management implications	Bfrs database; 160, 380, 570
96-8	ACTIVE	John Battles Robert C. Heald	8-96	9-06	Group Selection Opening Size Effect on Residual Tree Growth	20, 40
96-7	Complete	Tara Barrett Frieder Schurr	7-96	1997	Forest vegetation classification for management planning; integrating air photo delineation with permanent inventory plots	bfrs database
96-6	Aband.	Lenny Vincent Ev Schlinger	5-96	5-96	Acrocerid parasites of the California turret Spider - *Atypeides riversi*	250
96-5	Complete	Nathan M. Schiff	5-96	5-97	Phylogenetic Reconstruction of the Symphyta using DNA Sequence Characters	291, 292
96-4	Complete	John Battles Robert C. Heald	06-97	09-97	Relationships between Forest Management Practices and Plant	20, 80, 130, 210, 220, 290, 471,

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		Barbara Allen-Diaz Reg Barrett Ayn Shlisky			Diversity	320
96-3	Abandoned	Paul D. Anderson James Houpis James Pushnik	10-96		Influence of soil moisture & competition on response of forest vegetation to Ozone exposure	
96-2	Denied	Rick Karban Anurag Agrawal	4-01-96	8-01-96	Costs & Benefits of Induced Resistance in Wild Radish	
96-1	ACTIVE	Robert C. Heald Rob York	1-15-96	2007	Group Selection Opening Size Effect on Tree Growth	20, 40
95-8	ACTIVE	Robert C. Heald Frieder G. Schurr Ryan Gregoire Jennifer Heald	7-01-95	2055	Mixed Conifer Plantation Pruning Study	10, 50, 200, 321, 380
95-7	Complete	David Smethurst	12-01-95		Land Vegetation Changes as Result of Land Ownership	bfrs
95-6	Complete	Peng Gong Ruiliang Pu	06-96	10-98	Hyperspectral Data Analysis for Forest Species Recognition	330, 431
95-5	Complete	John Battles Anna Levin	06-97	06-05	Mixed Conifer Forest Ecological Assessment	20/40, 220, 292
95-4	COMPLETE	Vince Resh Rosalie Leach	06-94	09-99	Survey of Aquatic Invertebrates in BFRS Streams	BFRS streams
95-3	Aband.	Ken Cullings Tom Parker Bill Stoll	10-15-95	3-15-99	Mycorrhizal community structure & specificity of symbiotic relationships	
95-2	Complete	Fred Euphrat	-95		Water Shed Assessment	bfrs
95-1	Complete	Greg Biging	95		Cumulative Impact Assessment	bfrs:database
94-4	Complete	William E. Frost Robert C. Heald Fred Euphrat	01-95	06-01	Water Quality & Livestock Grazing on Forestland	bfrs (sediment traps)
94-3	Aband	Randy Dahlgren Robert Northup	11-94	01-95	Edaphic Regulation of Pine Phenolic Content	660
94-2	Complete	Thomas D. Bruns Lee Taylor	09-94	11-95	Epiparasitism in Achlorophylous Orchids	bfrs-samples only
94-1	Complete	John Helms Robert C. Heald Craig Olson	05-95	12-99	Group Selection Regeneration Study	bfrs database

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93-4	Abandon	Joe McBride	10-93	12-94	Distribution of Pacific Yew	
93-3	Complete	Wayne Getz Don Miller	07-93	10-97	Sociality on the Manzanita Leaf-gall Aphid, Tamalia coweni	600, 650
93-2	Complete	Charles Turner	07-93	12-94	Biocontrol of Bull Thistle (Cirsinne vulgare)	501, off Mainline
93-1	ACTIVE	Reg Barrett	05-93	12-08	Survey Methods for Terrestrial Vertebrate in California	bfrs
92-5	ACTIVE	Robert Powers John McColl	05-92	12-03	Long Term Soil Productivity Study	220, 512
92-4	Aband.	R. D. Westfall			Genetic & Demographic Consequences of Catastrophic Epidemics in Sugar Pine	
BFRS PROJECT NO.	STATUS	PRINCIPAL INVESTIGATORS	BEGIN DATE	COMPLETE DATE	PROJECT TITLE	COMPART-MENT
92-3	Complete	Jennifer Harden Tom Black	09-92	09-94	Soil Carbon Recovery from Disturbance	220, 292
92-2	Complete	D. Lee Taylor Dr. Tom Bruns	07-92	?	The Erdophytic Fungus of Coral Root Orchid	bfrs samples only
92-1	Complete	Mary L. Reid	04-92	09-92	Colonization Patterns & Processes in Ips paraconfusus	
91-5	Complete	Don Dahlston Tom Eager	04-91	09-92	Relationship Between Ips bark beetles & R. Their natural enemies	
91-4	ACTIVE	Rocky Gutierrez Mark Seamans	04-91	09-04	Spotted Owl Inventory	292, Sec. 32
91-3	Complete	Marty Wilt Richard Dodd	10-91	12-93	Seasonal & Inter. Variation of Tax. Diter. in Taxus brevifolia	250, upper end of Bacon Crk
91-2	(see 96-10)	Mark Harmon Steve Hart	06-01-91	06-01-96	Long-Term Intersite Experiments of Leaf & Root Decomposition	
91-1	Aband.	Larry Davis	06-01-90	05-30-00	Stand Structure Development in Managed Group Selection Cuts	
90-2	Complete	Scott Tyler W. W. Miller	07-01-90	08-01-90	Macropore Infiltration & Its Impact on Nutrient Cycling	
90-1	Complete	Alan Gertler John Watson	07-90		Receptor Modeling of Acidic Air Pollutants to Forested Reg., Sierra	

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					Nevada	
89-2	ACTIVE	Robert Heald	04-01-89	12-09	Giant Sequoia Growing Stock Levels	431
89-1	Complete	Marcel Rejmanek	09-01-89	12-30-93	Effects of Interspecific Completion on Sequoia Dendron	360
88-5	ACTIVE	R. C. Heald F. G. Schurr	1992	2002	Mixed Conifer Regeneration	330, 480
88-4	Complete	Marcel Rejmanek	12-01-88	12-30-92	Effect of Bull Thistle (CIVU) on Ponderosa Pine	
88-3	Aband.	James Houpis	10-31-88	06-01-89	Carbohydrate translocation branch autonomy in Pinus ponderosa saplings.	
88-2	Aband.	L. Davis Pam Muick	11-01-89	12-01-93	Managing black oak in uneven-aged mixed conifer stands	
88-1	Complete	Edward C. Stone	04-01-88	12-01-93	White Fir Root Regeneration Capacity	
87-11	Abandoned	David A. Dyer	03-01-88	11-01-93	Whitethorn Ceanothus Evaluation Study	180, group A
87-10	Complete	John Miles	11-01-87	12-30-94	Prototype Yarder Residue Collection	bfrs
87-9	Complete	Dave Wood	04-15-87	12-01-94	Bark Beetles as Indicators of Stress in Ponderosa Pine	
87-8	Complete	M. Firestone	03-01-87	12-30-93	Process Controls & Nitrogen Trans. in Terr. Ecosyst.	
87-7	Complete	Barbara Allen	from 77-2	12-30-94	Forage Production & Utilization on Forest Range	420, 464, 500, 501, SPI
87-6	Aband.	Joe R. McBride	06-01-87	09-01-87	Fire History Dating	
87-5	Abandoned	Larry Davis Scott Holmen	04-01-87	04-01-97	Tree/Brush Competition Demonstration	360
87-4	Now 89-2	John Helms Robert Heald	09-01-87	10-01-02	Giant Sequoia Growing Stock Level Study	
87-3	Complete	Richard Dodd	04-01-87	12-31-89	Differential Cambial Response to Applied Auxin in Douglas Fir	
87-2	Complete	Richard Dodd	04-01-87	12-31-87	Periodicity of Cambial Activity & Shoot Growth in Douglas Fir & Incense Cedar	

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87-1 refer to BF01-23D	ACTIVE	D. L. Dahlsten	01-87	06-01	Response of Ips paraconfusus parasitoids to host tree & associated fungal factors	
86-7	Complete	Edward C. Stone	05-01-86	12-30-86	A conceptual framework for predicting & controlling tree growth as a function of asym-metrical growing space	
86-6	Complete	Marcel Rejmanek	07-01-86	12-30-93	Mechanisms of interactions between woody weeds & planted conifers	
86-5	Complete	B. Allen Robert Heald	04-01-85	12-30-94	Forage production utilization & management on mixed-conifer plantations	370
86-4	Complete	Fields W. Cobb	08-01-84	12-30-93	Epidemiology & stand-site factors associated w/white pine blister rust on Blodgett Forest & control/management recommendations	50, 481
86-3	Complete	John G. Kie	06-01-86	09-01-89	Habitat use by cattle & forage selection within habitats	
86-2	Complete	J. R. Parmeter	05-01-86	10-01-88	Can fir engraver beetle Scolytus ventralis successfully feed on Abies concolor, without Tricholsporium endobioticum	
86-1	Complete	J. R. Parmeter	10-01-83	10-01-88	Epidemiology of fir canker	
85-9	Complete	R. C. Heald F. G. Schurr	07-08-85	12-30-93	Description & Dynamics of Uneven-Aged Stands	110, 130, 160, 230, 410
85-8	Complete	J. R. Anderson	02-16-85	06-30-86	Biological Response of Mosquitoes with Lambornella clarki	
85-7	Complete	J. R. Parmeter	06-01-85	00-01-05	Field studies of Fomes annosus in true fir	
85-6	(see 88-05)	R. C. Heald F. G. Schurr B. Allen-Diaz	10-15-85	01-01-00	Mixed conifer plantation study	330, 480
85-5	Complete	Lenny Vincent	07-25-85	09-14-85	Field ecology of Atypoides riversi, Calif. Turret Spider	
85-4	Now86-1	Mark Schultz	10-01-83	06-01-85	Epidemiology of fir canker, late 1985	

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85-3	Now86-2	J. R. Parmeter	07-08-85	07-00-87	Can fir engraver beetle Scolytus ventralis successfully feed on white fir Abies concolor without Tricholsporium endobioticum	
85-2	Complete	J. G. McColl	07-85	12-99	Organo-aluminum interactions in soil solutions of forested ecosystems	220
85-1	Now87-6	Joe McBride	06-01-85	06-01-85	Chemical composition of tree rings following fires	
84-7	Complete	Tara Barrett	06-01-83	12-01-00	Mathematical programming to compare uneven-age & even-aged management systems for forest ownership	bfrs database
84-6	Complete	James Bartolome	08-01-84	12-30-93	Effects of cattle grazing on a regenerating seed tree cut	301
84-5	Aband.	John A. Helms	05-01-85	01-01-88	Productivity of coniferous forests as influenced by enhanced CO2	
84-4 Refer BF01-22D	ACTIVE	D. L. Dahlsten	1984	12-99	Attraction of Predators, Parasites of Economic Important Bark Beetles Calif. to Pheromones	
84-3 Refer BF01-19D	ACTIVE	D. L. Dahlsten	07-84	01-04	Nest site selection for mountain (MC) & chestnut backed chickadees (CBC)	80, 110, 292, 440, 570, 600
84-2	Aband.	Robert Martin	05-15-84	08-15-85	Mortality of tanoak seedlings subjected to various levels of fuel consumption	
84-1	Complete	John Miles	05-01-84	10-30-90	Residue Collection Study	
83-7	Complete	R. Martin	09-01-83	12-30-93	A preliminary investigation of feasibility of pre-harvest burning for shrub control	621, 622
83-6	Complete	David L. Wood	07-01-85	12-30-93	Host selection behavior of Dendroctonus valens & other bark beetles attacking ponderosa	
83-5	Now84-6	J. Bartolome	01-01-83	01-01-84	Cattle Grazing Effects on a Regenerating Shelterwood	
83-4	Complete	L. S. Davis	06-83	12-03	Costs, fuel characteristics, wildlife habitat & aesthetics resulting from different pre-commercial thinning	580

BFRS PROJECT NO.	STATUS	PRINCIPAL INVESTIGATORS	BEGIN DATE	COMPLETE DATE	PROJECT TITLE	COMPART-MENT
					methods	
83-3	Complete	Michael Morrison Robert Heald	05-01-83	12-30-93	The use of "high-cut" stumps by cavity nesting birds	
83-2	Complete	E. C. Stone	06-01-83	06-01-83	Determination of the accuracy, bias, & precision of a method being developed for estimating volume & growth of structural-aggregations	
83-1	Now87-8	E. A. Paul	07-01-83	06-30-87	Process controls & nitrogen transformations in terrestrial ecosystems	
82-5	Complete	Michael Morrison	09-24-82	12-30-92	Avian Habitat Models	
82-4	Complete	John Helms	06-01-83	12-01-88	Effect of brush competition on physiology & growth of regeneration	
82-3 (refer01-24)	Complete	John Helms	06-01-82	12-30-93	Conifer spacing study	151
82-2	Active	Fields Cobb Robert C. Heald Tina Popenuck	04-01-81	06-01	Effect of Ceratocystis wagneri disease centers on new conifer plantations	461, 462, 511
82-1	Aband.	Paul Violett	06-15-83	11-15-83	Blodgett Forest fuel management plan	
81-5	Complete	Herman Spieth	01-01-81	12-30-86	Systematic Collection of Native Drosophila & Their Larval Substrates	
81-4	Complete	John Helms	05-01-81	12-01-93	Shelterwood microclimate & regeneration	280
81-3	Complete	Paul Zinke	05-01-81	12-01-88	Assessment of fertility problems inherent in site preparation at Blodgett Forest	
81-2	Complete	Steve Radosevich	00-00-76	12-30-93	Shrub-Conifer Competition, Phase II White Fir & Phase I PP	563, 612
81-1	Now97-7	William Libby	03-01-81	12-30-94	Giant Sequoia--Ceanothus interaction	
80-1	Aband.	Don Gasser	01-01-80	12-01-80	Relationship between spacing & quantity & quality of output in ponderosa pine plantations	
78-2	Complete	Reg Barrett	02-01-80	02-01-81	Survey methods for wildlife management problems in California	

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77-6	Complete	William Libby	01-01-77	12-01-89	White fir seed source	
77-5	Complete	D. L. Dahlsten	01-01-78	01-01-92	Survey of endemic orgyia pseudotsugata populations of white fir in California	
77-4	Complete	D. L. Wood	01-01-77		Classification, bionomics, ecology & control of bark beetles infesting California	
77-3	Complete	D. L. Dahlsten			Biological Control of Forest Insects	
77-2	Now87-7	James Bartolome	01-01-77	01-01-85	Forage production & utilization on forest range	
77-1	Complete	Edward Stone D. L. Dahlsten R. C. Heald	01-01-77	10-01-88	Silvicultural treatment of ponderosa pine aggregations to reduce probabilities of bark beetle caused tree mortality	
NA-84-1	Complete	Don Gasser	05-01-84	10-30-85	Removal of Pre-Commercial Thinnings	
NA-85-1	Denied	W. B. McHenry	06-10-85	06-30-85	Res. Control of Shrub Chinquapin with Pre-Site Preparation Herbicide Application	
NA-85-2	Denied	W. B. McHenry	06-10-85	09-30-85	Shrub Control Efficacy of New Herbicides	
87-12	Denied	Fields W. Cobb	09-17-86	07-01-89	Control of Blister Rust with a Systemic Fungicide	

RUSSELL PROJECT NO.	STATUS	PRINCIPAL INVESTIGATORS	BEGIN DATE	COMPLETE DATE	PROJECT TITLE	COMPART-MENT
RR03-03B	ACTIVE	Dennis Baldocchi Theresa Krebs	04-03	09-03	Rigidity and Plasticity Among Quercus Species	
RR03-02S	Proposed	Scott Stephens	05-03	12-03	Bark thickness in Monterey pine from diverse populations	
RR03-01W	ACTIVE	David L. Wood Steven J. Seybold	03-03	06-03	Geographic Variation in the Response of the Red Turpentine Beetle,	

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RUSSELL PROJECT NO.	STATUS	PRINCIPAL INVESTIGATORS	BEGIN DATE	COMPLETE DATE	PROJECT TITLE	COMPARTMENT
		Andy Graves			*Dendroctonuc valens*, to alpha- and beta-Pinene	
RR02-03 W	Proposed	Stephen Welter	07-02	10-03	Evaluation of UV effects on the stability of semiochemicals within microencapsulated formulations	
RR02-02 D	ACTIVE	Richard Dodd William Libby Vladimir Douhovnikoff	03-02	12-02	The Molecular genetics of *Sequoia sempervirens* and the development of a redwood gene bank	
RR02-01 M	ACTIVE	Joe McBride John Battles John Stella	02-02	10-02	San Joaquin Basin Riparian Model: Russell Field Studies	
RR01-02 B	ACTIVE	Dave Burger John Church	04-01	09-01	Microcalorimetric Measurement of *Sequoia semperviren* and *Sequoiadendron giganteum*	
RR01-01	Complete	Thomas R. Gordon D. Dekker-Robertson Detlev Vogler	04-01	07-01	Testing for a relationship between pitch canker susceptibility and western gall rust susceptibility	
RR00-03	ACTIVE	Bill Karavakas Barbara Romanowicz	10-00	12-05	Seismic Observatory	
RR00-02	Complete	Toni Withers Melody Keena	05-00	07-2000	Survival & Development of the nun moth, *Lymantria monacha L.*, and the gypsy moth, *Lymantria dispar* on New Zealand improved strains of *Pinus radiata*	133A
RR00-01	Proposed	Sharon Fleming Patsy Kauffman			Growing Grounds at Russell Tree Farm	
RR99-04	ACTIVE	Leo Blitz William J. Welch	12-99	01-2003	A small array of antennas for radio astronomy	
RR99-03	Aban-doned	Susan Jean Frankel Thomas Gordon Paul Stover	09-99	06-2000	Inheritance of pitch canker resistance in Monterey pines of known parentage	
RR99-02	ACTIVE	Tom Gordon Det Vogler	09-99	06-05	Observation plots for monitoring development of pitch canker	
RR99-01	ACTIVE	Tom Gordon Bill Libby	06-99	06-05	Field tests for resistance to gall rust and pitch canker	

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WHITAKER PROJECT NO.	STATUS	PRINCIPAL INVESTIGATORS	BEGIN DATE	COMPLETE DATE	PROJECT TITLE	COMPART-MENT
WF01-01B	Proposed	Frank Beall Robert Heald William J. Libby	11-01	06-03	Giant Sequoia as a planted and plantation species	BFRS Whitaker Mt. Home
WF00-01	ACTIVE	Thomas D. Bruns Martin Bidartondo	06/00		Mycorrhizal ecology of the Monotropoideae	
WF99-05	ACTIVE	Robert C. Heald Frieder G. Schurr John Battles Kevin O'Hara	06-99	09-09	Restructuring of Ancient Sequoia Forest Components and Function	
WF99-04	ACTIVE	Reg Barrett	06-99	09-09	Survey Methods for Terrestrial Vertebrate in California	
WF99-03	ACTIVE	Martin Cody UCLA	1992	??	[*Viola lobata*]	
WF99-02	ACTIVE	Martin Cody UCLA	1992	??	[Moss on logs, tree trunks and rocks]	
WF99-01	ACTIVE	Martin Cody UCLA	1992	??	[*Smilacina recemosa*]	