BLODGETT FOREST RESEARCH STATION

ABSTRACTS

Research Symposium 2001

2001 Blodgett Forest Research Symposium

Table of Contents

ABSTRACTS:

ILLUSTRATIONS:

TITLE:

The validity of computer-generated images for representing forest structure

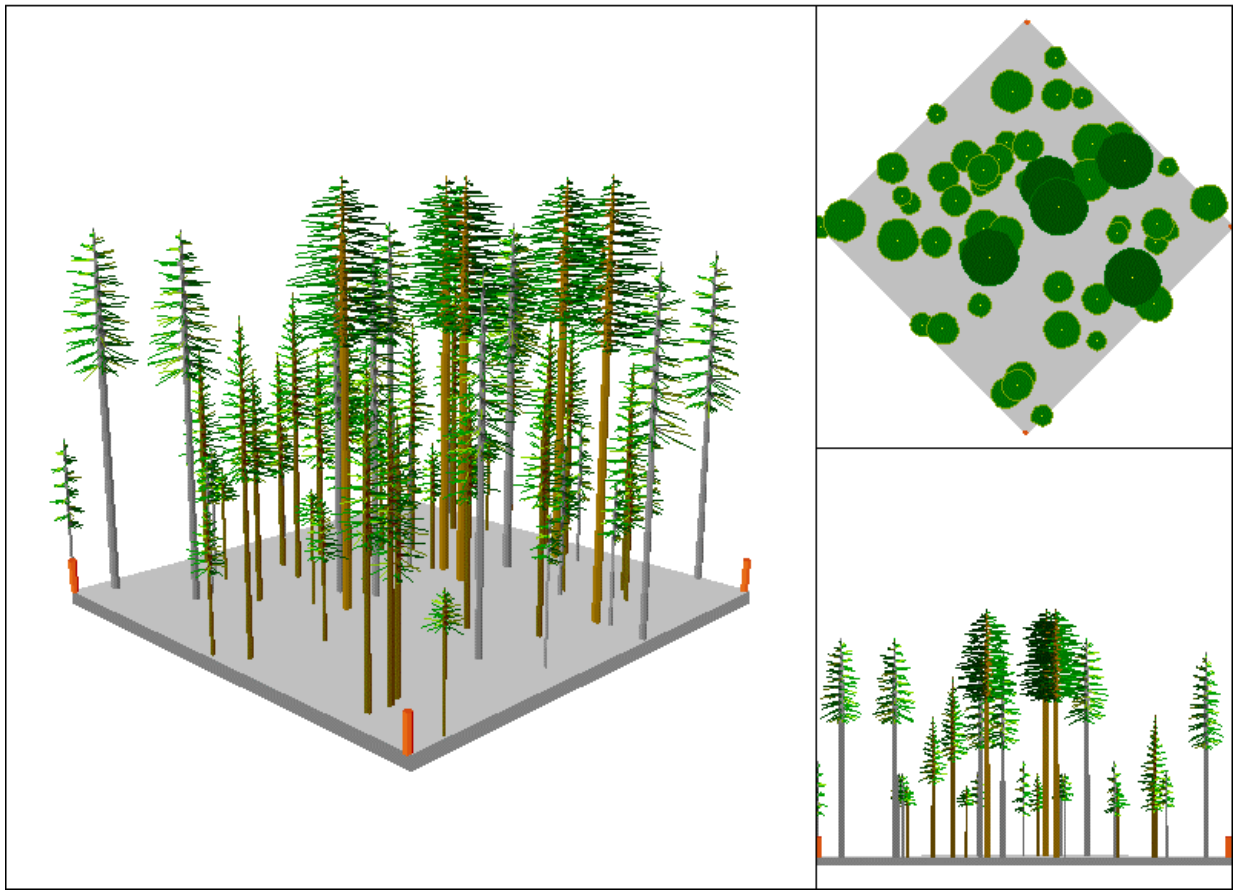
AUTHORS: Tara Barrett, Frieder Schurr

ADDRESS OF LEAD AUTHOR:
School of Forestry
University of Montana
Missoula, MT 59812-0576
(406) 243-6459
tara@forestry.umt.edu

Abstract:

The Stand Visualization System (SVS), a software program that depicts trees, is frequently used to create images for forest plans, public presentations, and research reports. For this case study, we are comparing people's perceptions of SVS images to their perceptions of real plots in the forest, to see if the classification of forest structure is identical. In the fall of 2000, four groups of visitors to Blodgett Forest viewed a 20-minute Powerpoint presentation containing SVS images (fig. 1). For each image, visitors answered 5 questions about stand size class, age, and canopy density. Visitors then participated in a 1-hour walk to the 7 plots used to generate the SVS images and answered the same set of questions. Structure classes in the questionnaire were based on those of the California Wildlife Habitat Relationships system. Results are currently being analyzed to see if classification responses differ between real and virtual plots, between SVS images of 0.10 acre and 0.50 acre plots, and between individuals with different self-rated levels of know-ledge about forests. The research is intended to be useful to those who use SVS to communicate with the public about forest issues.

Figure 1. SVS 0.50 acre image of Blodgett Forest compartment 230 plot 28.



TITLE:

Understory Light climates at Blodgett Forest: Shadelight influences on sapling growth and morphology

AUTHOR: John J. Battles

ADDRESS OF LEAD AUTHOR:
Environmental Science, Policy,
and Management
University of California, Berkeley
151 Hilgard Hall
Berkeley, CA 94720-3110
(510) 643-0684
jbattles@nature.berkeley.edu

Abstract:

Results from an array of studies at Blodgett Forest were summarized in order to describe the broad gradient of light environments maintained by the current management regime and to correlate the quantity and quality of the light resource to plant form and function. It is an axiom of ecological understanding that trees in productive forests must grow tall in order to survive and reproduce. Thus, competition for light is often considered the key biological process that structures forest communities. Consequently I expected to find morphological responses as well as growth responses to differences in the light climate. In particular, saplings in more shaded understories should express a "shade morphology" in addition to lower overall growth rates.

I quantified morphological patterns by calculating the root weight ration (RWR:root weight/total sapling weight) and the branch length ratio (BLR: sum of all the lateral branch lengths/total stem length). Low RWR and BLR indicate shade morphologies (more allocation to stem growth over root and branch growth). I examined three conifer species native to these forests: Douglas-fir, sugar pine, and ponderosa pine. Light climates were characterized with hemispherical photography calibrated with detailed direct measures of photon flux. Light quality was expressed as the ratio of red light to far-red light (R:FR)

based on repeated instantaneous spectral scans of incident radiation taken with 2 hours of solar noon. R:FR values below 0.8 can induce a shade-response.

As designed, management regimes created a significant gradient in understory light climates. In the interior of one ha groups, 89% of the incident radiation reached the understory compared to only 12% under reserve stands. Interestingly, single-tree selection created canopy openings that received significantly more light than the average “natural” gap in the reserve stands (28% vs 20%). For all three species, relative height growth was positively correlated with transmitted radiation. Douglas-fir and sugar pine demonstrated strong morphological responses to shadelight with lower relative allocation to roots and branches in the more shaded environments. In contrast, ponderosa pine showed no consistent allometric differences to increased shadelight. A study is underway to test experimentally these observed patterns.

Table 1. Summary of the light regime in the contrasting understory environments at Blodgett Forest. Reported values are means with standard deviations in parentheses. Light regime summarized for the growing season: 5/1 to 8/31.

	Comp	n	Open Sky %	Total Radiation %	Direct Beam %	Overhead R:FR	Reflected R:FR
Group selection							
1 ha groups	20, 40	15	56 (6)	89 (4)	93 (4)	> 1.0	0.45 (0.06)
matrix	20, 40	8	12 (4)	12 (7)	15 (5)	--	--
Shelterwood	440	20	38 (3)	59 (12)	61 (14)	~1.0	0.46 (0.09)
Single-tree openings	130	12	17 (13)	28 (21)	30 (22)	--	--
Reserve							
grid	220	16	8 (3)	12 (6)	12 (7)	0.75 (0.3)	0.58 (0.1)
grid	292	16	7 (2)	13 (4)	14 (5)	0.65 (0.4)	0.33 (0.2)
gaps	220, 292	14	10 (3)	20 (7)	21 (9)	0.90 (0.3)	0.38 (0.1)
Above canopy reference	BFRS	--	100 %	625 (µmols m^{-2} s^{-1})	468 (µmols m^{-2} s^{-1})	1.1	0.9

Table 2. Morphology and growth of tree seedlings along a gradient of understory environments at Blodgett Forest. Species codes: DF = Douglas-fir; SP = sugar pine; PP = ponderosa pine. Reported values are means with standard deviations in parentheses.

	Root Weight Ratio (root mass/total mass)			Branch Length Ratio (branch length/stem length)			Relative Height Growth (%)		
Environment	DF	SP	PP	DF	SP	PP	DF	SP	PP
1 ha groups	0.42 (0.02)	--	0.28 (0.03)	11.0 (1.6)	3.60 (0.92)	0.355 (0.46)	0.567 (0.099)	--	0.315 (0.20)
Shelterwood	--	0.28 (0.05)	--	--	2.71 (1.4)	--	--	0.297 (0.194)	--
Single-tree openings	0.39 (0.05)	--	0.38 (0.04)	3.39 (1.83)	--	0.466 (0.62)	0.218 (0.16)	--	0.214 (0.21)
Reserve gaps	0.32 (0.1)	--	--	1.01 (0.66)	0.426 (0.46)	--	0.163 (0.21)	0.0960 (0.17)	--

TITLE:

Systemic effects of Heterobasidion annosum (Basidiomycotina) infection on the phenolic metabolism of ponderosa pine and the feeding behavior of Ips paraconfusus (Coleoptera: Scolytidae)

AUTHORS: Pierluigi Bonello, Andrew J. Storer, William R. McNee, Thomas R. Gordon, David L. Wood, Werner Heller

ADDRESS OF LEAD AUTHOR:
Department of Plant Pathology
The Ohio State University
201 Kottman Hall
2021 Coffey Road
Columbus, OH 43210, USA
e-mail: bonello.2@osu.edu
Tel.: (614) 688-5401, Fax (614)-292-4455

Abstract:

The tendency for diseased forest trees to suffer more insect damage than healthy trees is well known, but the biochemical changes that mediate this effect are largely unknown. In general, knowledge of the systemic interactions between forest trees, fungal pathogens and insects lags that of herbaceous plant systems. In order to contribute to the understanding of the chemical interactions between fungal root pathogens, conifers and bark beetles, two hypotheses were tested: 1) root infection of ponderosa pine induces systemic changes in phloem phenolics; and 2) these changes affect beetle feeding behavior.

Concentrations of soluble phenolics and lignin in the phloem of ponderosa pines inoculated with the pathogen, *Heterobasidion annosum*, were followed over a period of two years in a 35-year-old plantation at Blodgett Forest Research Station. The major effect of the pathogen on phloem soluble phenolics consisted of a significant accumulation of ferulic acid glucoside: 503 ng/mg FW, compared with 366 ± 26 ng/mg FW for mock treated and 386 ± 27 ng/mg FW for control trees. There was a reduction in lignin content of the cell walls, and lignin content

was negatively correlated with ferulic acid glucoside concentration. While ferulic acid glucoside did not stimulate or inhibit *Ips paraconfusus* feeding in an artificial medium, it is hypothesized that lower lignification may facilitate the growth of beetle-associated fungi, resulting in greater susceptibility of the host to bark beetle colonization.

A.J. Storer • W.R. McNee • D.L. Wood
Division of Insect Biology, 201 Wellman Hall, University of California, Berkeley, CA 94720, USA

T.R. Gordon
Department of Plant Pathology, 1 Shields Ave., University of California, Davis, CA 95616, USA

W. Heller
Institut für Biochemische Pflanzenpathologie, GSF-Forschunszentrum, Neuherberg, Postfach 1129, D-85758 Oberschleissheim, Germany

Blodgett File photos

WILDLIFE MONITORING:
Wildlife is detected and identified using standardized wildlife survey methods or through incidental observations. Camera bait traps, live traps, pit traps, acoustic detection and visual sightings have identified 28 mammals, 13 reptiles, 4 amphibians, and 83 birds.

A wildlife monitoring program for terrestrial habitat has been in place at Blodgett Forest since 1977, under the direction of Dr. Reginald Barrett, University of California, Berkeley. Data is used to confirm changes in the overall wildlife community and provides opportunity for autecological studies of the terrestrial vertebrates known to inhabit Blodgett Forest.

TITLE:

Preliminary Results from a Study of Root Dynamics and Rhizosphere CO_2 Flux in a Forest Using a Natural ^{13}C Tracer Method

AUTHORS:
Weixin Cheng, Richard Susfalk, Environmental Studies,UC Santa Cruz
Dale Johnson, Roger Walker, ERS, University of Nevada-Reno
Paul Verburg, David Schorran, Desert Research Institute, Reno

ADDRESS OF LEAD AUTHOR:
Environmental Studies Department
Natural Sciences 2
University of California, Santa Cruz
1156 High Street
Santa Cruz, CA 95064
(831) 459-3791

ABSTRACT:

Forest rhizosphere respiration releases a significant portion of the terrestrial carbon to the atmosphere. However, direct quantification of forest rhizosphere respiration has been technically challenging. To face this challenge, a research project has been initiated at a Sierra pine site near the Blodgett Forest Station. One of the objectives of this project was to assess rhizosphere respiration in the forest using a natural ^{13}C tracer method. In this experiment, a C_4-derived soil from Konza Tallgrass prairie was "transplanted" into four soil pits in the forest. Each pit was positioned at the drip line of a mature ponderosa pine tree. Carbon dioxide samples from soil air were collected at the center of each Konza soil pit and nearby in native soils, and analyzed for ^{13}C natural abundance. Surprisingly, the $\delta^{13}C$ values were similar for both C_3 (-22.6‰) and transplanted C_4 Konza (-21.9‰) soil pits, indicating the disappearance of the expected $d^{13}C$ difference due to some unknown causes. Minirhizotron tubes were also installed in both native (6 tubes per replication) and Konza (2 per replication) soil plots. Digital images of the upper soil-tube interface were taken monthly starting in April 2000. Data from these minirhizotron images are forthcoming.

A MINI-REPORT:

In forest ecosystems, plant respiration may account for 50% of the primary production. A major portion of this respiration occurs in the roots. Carbon dioxide respired by a system of living roots and soil has two sources: (1) rhizosphere respiration (RR) including root respiration and rhizo-microbial respiration utilizing carbon from live roots, and (2) microbial respiration using carbon from soil and detritus. According to rough estimates, RR may contribute up to 90% of the CO_2 released from belowground components in forest ecosystems. Therefore, RR is one of the most important belowground processes responsible for carbon release. Direct measurements of RR have been rare, mostly due to difficulties involved in separating RR from total soil respiration in field conditions. Labeling with carbon isotopes has unsolvable problems for forest ecosystems. The most difficult limitation of all is to uniformly label large trees in a forest due to the high cost, long time required, and other logistical considerations. It is not surprising that these labeling approaches have rarely been used in true forest conditions. To circumvent these problems, a natural ^{13}C tracer approach was tried in a research project (funded by NSF) initiated at a site near the Blodgett Forest Station in the fall of 1999. The principle of this natural ^{13}C tracer method is based on the difference in ^{13}C:^{12}C ratio between plants with the C_3 photosynthetic pathway and plants with the C_4 pathway, and on the subsequent difference in ^{13}C isotopic composition between soil C derived from the two types of plants. By using a C_4-derived soil in a C_3 plant-dominated system such as a forest, the carbon entering the soil via roots will have a different ^{13}C signature than the ^{13}C signature of the soil. Thereby RR can be separated from the total soil CO_2 efflux by monitoring the ^{13}C signature of the respired C. In this experiment, a C_4-derived soil from Konza Tallgrass prairie near the long-term ecological research site was "transplanted" into four soil pits in a mixed Sierra Nevada conifer stand. Pit dimensions were approximately 75 X 75 X 45L cm (W, L, D), and each pit was positioned at the drip line of a mature ponderosa pine tree. The excavations were performed such that roots were

retained in the pits. Photographs of each pit made prior to filling them with the Konza soil permitted root quantification, including estimates of root dimensions, volume, surface area, and mass. In August 2000, soil CO_2 gas samples were collected near the center of each Konza soil pit and nearby in native soils. The $\delta^{13}C$ values were similar for both C_3 (-22.6‰) and transplanted C_4 Konza (-21.9‰) soil pits, indicating the disappearance of the expected difference. The exact causes of these results are unknown at the present time.

Minirhizotron tube were also installed in both native (6 tubes per replication) and Konza (2 per replication) soil plots. Digital images of the upper soil-tube interface were taken monthly starting in April 2000. Example root images were posted at: <http://www2.ucsc.edu/people/rbs/mrt/>.

As part of the project, soil temperature, moisture, surface CO_2 effluxes, root biomass from soil cores, and mycorrhization have been measured both in the native plots and in the Konza soil plots.

TITLE:

Application of chemical ecology to conservation and augmentation of bark beetle predators

AUTHORS: D. L. Dahlsten, D. L. Six, D. L. Rowney, K. F. Raffa, W. A. Copper, and A. Lawson

ADDRESS OF LEAD AUTHOR:
Center for Biological Control
201 Wellman Hall
Univ. of California, Berkeley
94720-3112
(510)643-5325
email:
donaldd@nature.berkeley.edu

ABSTRACT:

This is a three year project focusing on the chemical ecology of the pine engraver, *Ips pini,* and its predators in Northern California. The goal of this research is to develop means to reduce the removal of predators during bark beetle trap out programs and to increase predator-to-prey ratios in bark beetle-attractive timber harvest sites.

Three studies were carried out:

a. **To determine which synthetic lures attract actual ratios of predator-to-bark beetles that arrive at host trees.** In this experiment, nine treatments were presented in a behavioral choice test:

b.

1.	3%(+):97%(-) ipsdienol	6.	75%(+):25%(-) ipsdienol plus lanierone
2.	50%(+):50%(-) ipsdienol	7.	*Ips pini*-infested bolt
3.	75%(+):25%(-) ipsdienol	8.	uninfested bolt
4.	3%(+):97%(-) ipsdienol plus lanierone	9.	blank
5.	50%(+):50%(-) ipsdienol plus lanierone		

Three lines of nine Lindgren funnel traps were deployed. Each trap in a given line was assigned one of the nine treatments. Traps were sampled and re-randomized every 4 days for 24 days. This schedule was repeated twice during the spring/summer field season to sample the two flights of *I. pini* that occur in this area. Ratios of predators to *Ips pini* (3 major predators, *T. chlorodia*, *E.*

lecontei, and *E. sphegeus* combined) varied from 0.4:1 to 10:1 in 1997, and 0.01:1 to 3.25:1 in 1998 . The synthetic lure most attractive to *Ips* (# 1) had a predator/*Ips* ratio of 0.08 in 1997 and .01 in 1998. The lure most attractive to predators (#5, mostly *E. lecontei*) in 1997 had a ratio of 10.0 predators/*Ips*, while in 1998 lure #6 (mostly *T. chlorodia*), had a ratio of 1.8 predators/*Ips*.

b. To determine which combinations of synthetic attractants generate the highest bark beetle-to-predator ratios during simulated trap out. This experiment was presented as a series of no-choice tests in a Latin square design. Six plots were used. Within each plot, nine traps were deployed in a 3X3 grid and baited with one lure type (using the same six synthetic lures as in objective 1). For two years with two runs each year, *Ips pini* was attracted to two lures (#1 and #4) in significantly higher numbers than all other lures. Also for both years, the predator *Enoclerus lecontei* was significantly more attracted to lures (#6 and #5) that were not highly attractive to *Ips pini.* Ratios of *E. lecontei* to *Ips pini* caught varied from 6.7 to 1.5 (mean 2.1) for these two lures. The predator *Temnochila chlorodia* was much more abundant in 1998, run 1 than in the other three runs. The ratios of *T. chlorodia* per *Ips* caught were highest for lures 2, 3, 5, and 6 (4 to 5.9 *T. chlorodia* per *Ips*). Combining *Enoclerus* sp. and *T. chlorodia* for both years, the treatment lure with 50%(+):50%(-) ipsdienol plus lanierone, gives the best predator to *Ips pini* ratio (4.96).

c. To determine the synthetic attractants that would most augment predator arrival rates.

This experiment was presented as ten pairs of prepared slash piles, with one pile of each pair selected randomly and treated with three units of 50%(+):50%(-) ipsdienol plus lanierone attractant. This lure (from experiments above) attracted the highest predator/Ips ratio with the greatest total attraction of both the common predators *E. lecontei* and *T. chlorodia*. Each pile pair consisted of two limbed trees cut into four 1.5m bolts, with two bolts from each tree in each pile (four bolts per pile). Piles were covered with freshly cut limbs from the cut trees

to shade them from the sun. Each pair of piles was separated by 40m and within the pair by 20m. Two 20cm-square sticky screens were attached with duplex nails just off the surface of the bark of the top bolt, on shade side, 1/4 of the length in from each cut ends of the bolt. The experiment was started on 28 May, 1999, when Ips began to be detected in survey traps. Screens were changed every 3 days for the next three weeks. On the last collection day three 30cm bolts were cut from logs in each pile and returned to our laboratory for rearing. All screens were examined for numbers of Ips, predators, and other associated insects by species, and we recorded all insects emerging from the laboratory-rearing bolts. The data from capture on screens has been analyzed: we found that the ratio of the bark beetle predators to *Ips pini* was only 0.16:1, much lower than expected from the studies in 1997-1998. We also found much higher numbers of anthocorids compared to the trap studies. These results may indicate that artificial trap catches may not be representative of actual arrival rates on slash piles.

REGENERATION:
An average of 22,000 seedlings are planted at Blodgett Forest every year. Cones are harvested in the fall from the best trees of each species – the tallest, straightest, fastest-growing – and seeds extracted. The seeds are taken to a forestry nursery and planted to be retrieved for planting at two years and 8 to 12 inches tall. Seedlings are planted approximately 400 to the acre.

Photos courtesy of California Conservation Corp, Greenwood

Left:
Giant Sequoia seedlings were planted in a wagon wheel spoke design to study biomass production of giant sequoia.

(Blodgett file photo)

Seedling survival at Blodgett averages 85%-90%. For specific spacing studies such as this one, replanting may be done to replace ones that die.

TITLE:

NO_y detection by thermal decomposition with Laser Induced Fluorescence

AUTHORS: Douglas A. Day and Ronald C. Cohen

ADDRESS OF LEAD AUTHOR:
University of California, Berkeley
Department of Chemistry
Berkeley, CA 94720
Pollywog@uclink4.berkeley.edu

Abstract:

Nitrogen oxide radicals (NO_x = NO + NO_2) are important in regulating tropospheric ozone. Outside of urban source regions, NO_x is stored in reservoirs (known as NO_y) that include HNO_3, peroxynitrates (RO_2NO_2), and alkylnitrates (RNO_3). Formation of these species terminates the catalytic cycles that produce ozone via oxidation of NO to NO_2. The reservoirs are then deposited to the Earth's surface or transported out of the formation region to the remote atmosphere, where NO_x can be released photochemically to restart the catalytic production of ozone. Increases in export of NO_x to the remote atmosphere is thought to be responsible for the three-fold increase in tropospheric ozone that has occurred since pre-industrial times. A detailed knowledge of the concentration of these reservoirs is necessary in order to test the accuracy of our understanding of NO_x photochemistry and to predict the effects of regional scale processes, such as those occurring at Blodgett Forest, on local and on global ozone concentrations. However, there are currently no techniques capable of rapid, precise and accurate observation of all of the NO_y species. We have developed a prototype instrument that uses a new approach to obtain *in situ* observations of the concentrations of the four major NO_y reservoirs with high accuracy, precision and sensitivity (15ppt/10 seconds). In our instrument, ambient air passes through a heated quartz tube where the NO_y species are thermally dissociated to produce NO_2 which is then detected by laser induced fluorescence. Each of the four categories of NO_y reservoirs decompose at

different temperature. We measure the abundance of the sum of compounds corresponding to each category by varying the temperature in the dissociation region. This technique has been employed at Blodgett Forest in Fall 1999 and Fall 2000 demonstrating its capabilities for autonomous, continuous observation of an array of NO_y species. A discussion of the instrument and the preliminary data from the field measurements at Blodgett Forest will be presented.

TITLE:

Temporal and spatial variability in aquatic insect assemblages: Implications for biological monitoring

AUTHORS: Rosalie B. del Rosario and Vincent H. Resh

ADDRESS OF LEAD AUTHOR:
Division of Insect Biology
201 Wellman Hall
University of California
Berkeley, CA 94720
(510) 642-5913
rosalie@nature.berkeley.edu

ABSTRACT:

Aquatic insects are commonly used as biological indicators of water quality. The underlying premise in their use is that changes in their assemblages may indicate anthropogenic impacts to stream ecosystems. We examined a fundamental assumption in biological assessments: that aquatic organisms in undisturbed streams are temporally persistent. We also addressed the validity of using several independent streams as spatial replicates in biological assessments. Lastly, we estimated ranges of biological measures against which future planned or unplanned disturbances at Blodgett Forest Research Station can be measured.

Using four years of data collected from nine sites in six streams draining unimpaired catchments at Blodgett Forest, we detected significant temporal and spatial variability in aquatic insect assemblages. In particular, assemblages collected in 1995 were distinct from the other three years (1996-1998), which may be explained by the low flow year in 1994. Comparisons of assemblages were conducted at three spatial scales: 1) upstream and downstream sites; 2) adjacent streams; and 3) four streams draining a catchment. Insect assemblages were variable, and there was no distinct pattern across space or time. The ability of using independent streams as replicates decreased with the number of streams examined. The use of a Before-After-Control-Impact-Pairs

(BACIP) design is described as a means to control for natural temporal and spatial variability in insect assemblages. The inclusion of several years of baseline data in a BACIP study would allow for resource managers to distinguish ecological from statistical significance of a potentially impairing anthropogenic disturbance (e.g., prescribed burns) to stream ecosystems.

TITLE:

The Chemical Evolution of the Sacramento Urban Plume – Implications for Ozone within the Sierra Nevada Mountains.

AUTHORS: Michael B. Dillon[1,2], J. A. Thornton[1], D. A. Day[1], P. J. Wooldridge[1], M. S. Lamanna[3], G. W. Schade[3], A. H. Goldstein[2,3], and R. C. Cohen[1,2,4]

ADDRESS OF LEAD AUTHOR:
Department of Chemistry
B45 Hildebrand Hall
University of California, Berkeley
Berkeley, CA 94720-1460
e-mail: dillon@uclink4.berkeley.edu

ABSTRACT:

The Sacramento urban plume provides a unique opportunity to study the production and deposition of ozone and the coupling of ozone to the nitrogen oxide cycle. The mesoscale meteorological patterns in this region are extremely regular on daily, seasonal, and annual timescales. This regularity results in an reproducible daily plume evolution starting in the morning (10:00 PST) from the Sacramento urban core and ending in the late afternoon (17:00 PST) at the University of California – Blodgett Forest Research Station (UC-BFRS). We describe a Langrangian model of the Sacramento urban plume's physical and chemical evolution constrained by observations of anthropogenic hydrocarbons, nitrogen oxides, and ozone in the Sacramento urban core and at the UC-BFRS. The model demonstrates the potential for soil emissions of nitrogen oxides to affect ozone abundances and deposition in the Sierra Nevada mountains.

[1] Department of Chemistry, University of California, Berkeley, CA 94720-1460, USA
[2] Energy and Environmental Technologies Division, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA
[3] Division of Ecosystem Sciences, Department of Environmental Science, Policy, and Management, University of California, Berkeley, CA 94720-3110, USA
[4]Department of Earth and Planetary Sciences, University of California, Berkeley, CA 94720-4767, USA

Title:

Observational Constraints on the Contribution of Isoprene Oxidation to Ozone Production

AUTHORS: Gabrielle B. Dreyfus, Gunnar W. Schade, and Allen H. Goldstein

ADDRESS OF LEAD AUTHOR:
151 Hilgard Hall
ESPM
University of California
Berkeley, CA 94720-3110

Abstract:

Measurements of isoprene, its oxidation products methacrolein (MACR) and methyl vinyl ketone (MVK), and ozone were used to calculate the contribution of isoprene oxidation to ozone production downwind of Sacramento, CA. Oxidation of isoprene by OH in the atmosphere leads to the production of both MVK and ozone in distinct quantities. During the early afternoon, mixing ratios of MVK and ozone were highly correlated at our measurement site on the western slope of the Sierra Nevada mountains. We analyzed the slope of this correlation for individual days from July 12 through October 31, 1998, and compared it to the theoretical value of ozone per MVK produced in the oxidation of isoprene. The ratio of calculated to measured slope indicates the contribution of isoprene oxidation to the region's ozone production. Isoprene's contribution was found to increase exponentially with temperature, which is consistent with its temperature dependent emission from plants. Ozone production was dominated by isoprene oxidation on over 40% of the observed days and 66% of hot days (Tmax > 26C). This suggests that reducing anthropogenic hydrocarbon emissions in the Sacramento valley would not be a good strategy for reducing ozone levels in the Sierra Nevada mountains.

TITLE:

Tools for a physiologically based model of tree growth in multiaged mixed-conifer forests at Blodgett Forest Research Station.

AUTHORS: Rolf Gersonde and Kevin O'Hara

ADDRESS OF LEAD AUTHOR:
Department of Environmental Science,
Policy & Management
239 Mulford Hall
University of California, Berkeley
Berkeley, CA 94720-3114
(510) 643-2025
e-mail: gersonde@nature.berkeley.edu

Abstract:

Tree leaf area has been used to express three-dimensional growing space and to determine growth efficiency of individual trees in uneven-aged stands. In complex stand structures of multi-aged mixed-conifer forests growth efficiency varies remarkably with canopy position and species. In our study of stand dynamics of Sierra Nevada mixed-conifer forests, we are developing tools to describe structure and growth of multiaged forests on a physiological basis. Six species in various canopy positions were sampled to develop leaf area - sapwood area relationships. With the use of these relationships it is possible to determine leaf area on a per tree basis from increment cores. We collected site and tree specific data of vapor pressure deficit and water potential to isolate factors influencing the leaf area – sapwood area ratio. Knowledge of these variables will help us to apply the LA/SA ratio over a range of sites with different environmental conditions.

In light limited environments, tree growth efficiency is influenced by the amount of light the tree crown receives, which depends on the position of the crown within the canopy and the spatial arrangement of trees. We hope to isolate this relationship by modeling the amount of light, which a particular crown receives, using a spatially explicit light transition model. In order to calibrate the model to

this particular forest type, we took hemispherical photographs in a two-cohort stand and determined gap light index in collaboration with Dr. John Battles. 60 hemispherical photographs were taken at two different heights using a nested plot design. Understory light intensity (gap light index) will be compared with values calculated with the light model.

Overstory and understory trees on 1 ha of this two-cohort stand were mapped. We took allometric measurements of tree crowns and increment cores of stems at breast height. This stand represents the first in a sequence of stands with multiple cohorts where we will determine tree growth efficiency, expressed as stem volume increment per unit leaf area, and local light environment. This stand sequence will enable us to model the growth of trees in various canopy positions and spatial arrangements, and to develop stocking guidelines for multi-aged mixed-conifer stands.

Left photo by Bob Heald

Photo below by Frieder Schurr

TIMBER HARVESTING:
A mainstay of the Georgetown Divide since the 1850s, logging was introduced to Blodgett Forest in 1956. Timber harvesting began to be used as a major silvicultural management tool in 1976. Harvest activities are scheduled between June and October of each year, starting when the ground is no longer completely saturated, to prevent soil compaction, and ending when the rainy season is expected and the ground will be moist.

Environmental impact is kept to a minimum. Snags are left standing for wildlife recruitment, litter and duff are left in place to decrease erosion. Roads are repaired, replaced or abandoned, as needed, and water bars or direct erosion controls are put into place wherever required to protect watershed.

The average age of a tree cut during a Blodgett Forest harvest is 89-90 years in group cuts, and 30-40 years in a single tree selection harvest. A typical 80 year old Ponderosa Pine tree will be approximately 130 feet high, two to three feet in diameter, and contain an average of 1,000 thousand board feet.

Harvesting at Blodgett is nearly all done by “tractor” methods, ground skidding. The type of harvest is determined by access and slope.

Photo by Bob Heald

TITLE:

Methylbutenol Production by Ponderosa Pine: Ecological Controls and Biological Functions

Authors: Dennis W. Gray[a], Manuel T. Lerdau[a], Allen H. Goldstein[b]

ADDRESS FOR LEAD AUTHOR::
Department of Ecology and Evolution
State University of New York
Stony Brook, NY 111994-5245
(516) 632-7626
e-mail: denwgray@life.bio.sunysb.edu

Abstract:

Methylbutenol is a 5 carbon alcohol produced in the foliage of pines in the subsections ponderosae, contortae and oocarpae of the subgenus pinus. Production of methylbutenol is light dependent and closely follows the light response of photosynthesis; however these processes respond very differently to temperature. In response to increasing temperature photosynthesis declines whereas MBO emission increases almost exponentially following a pattern described by enzyme kinetics.

Methylbutenol is of interest for two disparate reasons. First, it is photochemically reactive and can lead to the formation of tropospheric ozone when it reacts with the nitrogen oxides released in car exhaust. Second, its production represents a large expenditure of carbon by the plant for which there is no currently accepted function. On average MBO production costs ponderosa pine 0.5% of the carbon it fixes through photosynthesis, an amount tenfold higher than that allocated to the production of defensive monoterpenes. The goals of my research at Blodgett have likewise been twofold. I have attempted to develop a better understanding of the environmental parameters influencing rates of MBO emission into the atmosphere; and through these and other experiments I have attempted to test hypotheses about the biological function that MBO may play for the plant.

In 1998 I began looking at the influence of ambient temperature, ambient light environment, needle age, and seasonal drought on the emission capacity of

MBO. Despite the large effect that water stress had on photosynthetic rate, MBO emission capacity was not affected. Conversely ambient growth temperature had little effect on PS rate, but MBO emission capacity increased linearly with ambient temp. Altering the ambient light environment of ponderosa pine foliage using shade cloth affected neither photosynthesis nor MBO emission capacity. The emission capacity of needles was also found to decline with age.

Given the high MBO production rates of ponderosa pine as well as the fact that the European bark beetle *Ips typographus* uses MBO as part of its aggregation pheromone, I conducted an experiment to test whether MBO acts as a defensive compound. Using Lindgren funnel traps baited with pheromone and vials releasing MBO at controlled rates, I compared the capture rates of *Ips paraconfusus* and *Dendroctonus Brevicomis*. Neither bark beetle species nor their predators responded to MBO.

[a] Department of Ecology and Evolution, State University of New York, Stony Brook, NY 11994-5245
[b] Department of Environmental Science, Policy, and Management (ESPM), University of California at Berkeley,
151 Hilgard Hall, Berkeley CA, 94720

TITLE:

Sequoia Pruning Timing Study

AUTHORS: Robert C. Heald and Wm. David Rambeau

ADDRESS OF LEAD AUTHOR:
Director, Center for Forestry
University of California, Berkeley
Blodgett Forest Research Station
4501 Blodgett Forest Road
Georgetown, CA 95634
(530) 333-4475
e-mail: bheald@nature.berkeley.edu

ABSTRACT:

Problem issue:

Recent growth and yield data for young growth Giant Sequoia (*Sequoiadendron giganteum*) (Heald/Barrett) has demonstrated the wide variation in early (0-10 yr.) growth rates of sequoia as affected by planting density. The species has excellent potential wood quality for various high value end products (fence boards, decking, interior and exterior trim) quite similar to Coastal Redwood (*Sequoia sempervirens*). A vast area of the middle elevation west-side Sierra Nevada mixed-conifer vegetation type seems suitable for sustainable production of Sierra Sequoia young growth. This potential could drastically reduce the market demand pressure for increasingly short rotation management of coastal redwood stands.

However, the higher value redwood end products require clear heartwood. Sierra Sequoia exhibits virtually no self-pruning even at the closest spacings (2 M) in planted stands through age 30. Naturally regenerated extremely high-density (>5,000 TPHa) stands (Metcalf) also show little effective self-pruning for their first century of growth.

The number of branches per unit of stem length seems little effected by early stand density in planted stands. Average branch diameters at age 10 range from about 1.2 cm to 2.4 cm in diameter as spacing increases from 2 M to 6 M. thus, while spacing does affect diameter and height, branch sizes remain

well within the range that can easily be pruned by standard lopper and saw pruning tools.

Little is known about the stem growth, epicormic branching potential, heartwood formation and stem taper effects of pruning Giant Sequoia. Studies underway at Blodgett Forest (1996 Heald/Schurr) indicate very little epicormic branching after pruning 15 year old sequoia in mixed species plantations to 2 m, 3.5 M, and 5.5 M in one lift where plantation canopies were nearly closed and trees averaged 10 M in height. Anecdotal observations of other sequoia prunings show a wide range of epicormic branching response to pruning.

Methods:

This study will prune plantation sequoias over a wide range of spacing and live crown removal intensities throughout an entire calendar year. Two variables will be introduced:

T: Time of pruning; replicated each calendar month.

I: Pruning intensity: 20% to 90% of total stem height.

C: Control – No treatments.

The study is located within an existing sequoia density study at Blodgett Forest in its 12th growing season. The guard row trees in each of 3 replications of the 9 initial spacings will be randomly selected for treatment. Forty-five Sequoias will be pruned each month, some to each of 2 M., 3.5 M, and 5.5 M heights.

Initial Data Collected:

Presence of existing branch and branch collar epicormic branches. Tree height, height to base of live crown, and height to base of pruned live crown. Stem diameter at base, breast height, 2 M, 3.5 M, and 5.5 M. Interior branchlets alive or dead on uppermost pruned branches.

Response Data:

Initial appearance month, number, location and size of new epicormic branches will be tracked each month for the first year, epicormic branch and size will be measured once annually for 3 years. Total height and height to base of live crowns, stem diameter and heartwood formation at base, breast height, 2 M, 3.5 M, and 5.5 M will be measured after 3 years.

TITLE:

The impact of site preparation on soil organic matter and long-term soil fertility in California forests

AUTHORS: William R. Horwath, Thais Winsome[1], Armando Gomez-Guerrero[1], Robert F. Powers[2], Michael J. Singer[1]

ADDRESS OF LEAD AUTHOR:
Land, Air, and Water Resources
University of California, Davis
One Shields Avenue
Davis, CA 95616-8627
(530) 784-6029
wrhorwath@ucdavis.edu

Abstract:

Understanding the effects of harvest and site preparation practices on long-term nutrient dynamics in forest plantations is required to ensure long-term sustainability in these intensively-managed systems. Two levels of soil compaction (SC) and forest floor removal (FFR), were used to assess their impact on tree growth, N uptake and N status on ponderosa pine in plantations on soils of different textures. Tree growth results showed that in the site with loamy soil, compaction was beneficial to tree growth if the forest floor was retained. Compaction effect was not significant with forest floor removed. In clayey soil SC depressed tree growth in the absence of forest floor. In sandy loam soil, SC positively influenced growth in the absence of forest floor. The recovery of isotopically-labeled N fertilizer in foliage of the upper crown was clearly detectable at all the sites. In loamy and clayey soils, SC positively influenced recovery if the forest floor was present, but no significant effects of compaction on N uptake were observed with total removal of the forest floor. In sandy-loam, the contribution of SC to the variation of recovery was significant in both conditions, with and without forest floor. Results for the loamy and clayey sites suggest that in compacted soils, when the litter was retained, SC favored N uptake through improved unsaturated water flow and root:soil contact or decreased microbial activity. In sandy soils the positive effects of compaction on N uptake may have been influenced by increased soil pore connectivity.

[1]Land, Air & Water Resources, University of California, Davis
[2]USDA Forest Service, Pacific Southwest Research Station

TITLE:

Annual Ozone Deposition to a Sierra Nevada Ponderosa Pine Plantation

AUTHORS: M.R. Kurpius, M. McKay, A.H. Goldstein

ADDRESS OF LEAD AUTHOR:
Department of Environmental Science,
Policy & Management
Ecosystem Science
151 Hilgard Hall
University of California
Berkeley, CA 94720-3110
mbauer@nature.berkeley.edu

ABSTRACT:

Ozone concentration and ecosystem scale fluxes were measured continuously from June 1999 to June 2000 above a ponderosa pine plantation at Blodgett Forest, an Ameriflux site located ~75 km northeast of Sacramento, CA (1300 m). Ponderosa pine is one of the plants most susceptible to ozone damage in the Sierra Nevada Mountains. Most previous studies on ozone deposition have focused on the summer months because that is when the highest ozone concentrations occur. However, lowered defense systems in fall, winter, and spring may make plants more susceptible to ozone damage during these times even though ozone concentration is lower. Our measurements show that ponderosa pine trees were most active during the summer but maintained a low level of activity during the fall, winter, and spring. Seasonal daytime mean ozone concentration for summer, fall, winter, and spring was 66 ppb, 55 ppb, 37 ppb, and 49 ppb, respectively (daytime defined as hours 800 – 1800 PST). Seasonal daytime mean ozone deposition velocity was 0.47 cm/s, 0.33 cm/s, 0.35 cm/s, and 0.41 cm/s, respectively for the same periods. This indicates that the ecosystem was effective at taking up ozone throughout the year. It is also notable that the ecosystem was more effective at taking up ozone in the winter than in the fall. Cumulative ozone flux for the year was 114 mmol/m^2 with the contribution for each season being 37% for summer, 20% for fall, 16% for winter, and 27% for spring. While ozone deposition to this ecosystem was highest in the

summer, the combined deposition during fall, winter, and spring was twice that of summer. We also found that the environmental variables that control stomatal conductance had varying effects on ozone deposition at different times of the year. Therefore, to understand the controls on ozone deposition and the effect of ozone on this and other ecosystems that remain physiologically active in non-summer months, it is critical to quantify ozone deposition on a year-round basis.

TITLE:

A Preliminary Phylogeny of Social Galling Aphids on Manzanita And Madrone

AUTHORS: Donald G. Miller III, Bernard J. Crespi

ADDRESS OF LEAD AUTHOR:
Department of Biology
Trinity University
715 Stadium Drive
San Antonio, TX 78212
(210) 999-7233
e-mail: dmiller@trinity.edu

Abstract:

The genus *Tamalia* comprises upwards of six species of aphid occupying galls on shrubs in the Heath family (Ericaceae). My research at Blodgett Forest Research Station and elsewhere in California and Arizona has investigated the social habits of *Tamalia coweni* (the Manzanita Leaf-gall Aphid) on several species of *Arctostaphylos* (manzanita) including their consequences and possible causes, in the context of the evolution of social behavior. I have identified and formally described a congener, *Tamalia inquilinus*, co-occupying galls of *T. coweni* obligately, so acting as a social parasite. Generally, I wish to know whether the pattern of coevolution between *T. coweni* and *T. inquilinus* fits Emory's Rule, viz., that socially parasitic species and their hosts share immediate common ancestors, as opposed to the alternative scenario of a distinct origin of the social parasite clade.

I have undertaken a molecular phylogeny of the genus *Tamalia* with Dr. Bernie Crespi of Simon Fraser University and we have preliminary results. We sampled *Tamalia* aphids of four putative species on seven host plant taxa and constructed a phylogeny based on the cytochrome oxidase I mtDNA region, using the neighbor-joining bootstrap method with outgroup to generate a 50% majority-rule consensus tree. These results give both a phylogram and estimates of genetic distance among the aphid taxa.

Tamalia inquilinus in various species of host galls appears to constitute a monophyletic group distinct from its gall-causing hosts, and may have had a single origin from a gall-causing ancestor. Therefore, Emory's Rule is NOT supported by these preliminary data and instead an ancestral inquiline taxon may have radiated to at least three distinct types of host gall, one on *Arctostaphylos viscida* and two on *Arctostaphylos patula*. Further, the inquiline taxa appear to have evolved much faster than their hosts, perhaps because of a history of genetic bottlenecks. More data will give us further confidence in interpreting correctly Emory's Rule in light of the origins of social behavior and social parasitism in the genus *Tamalia* on its host plants *Arctostaphylos* and *Arbutus*.

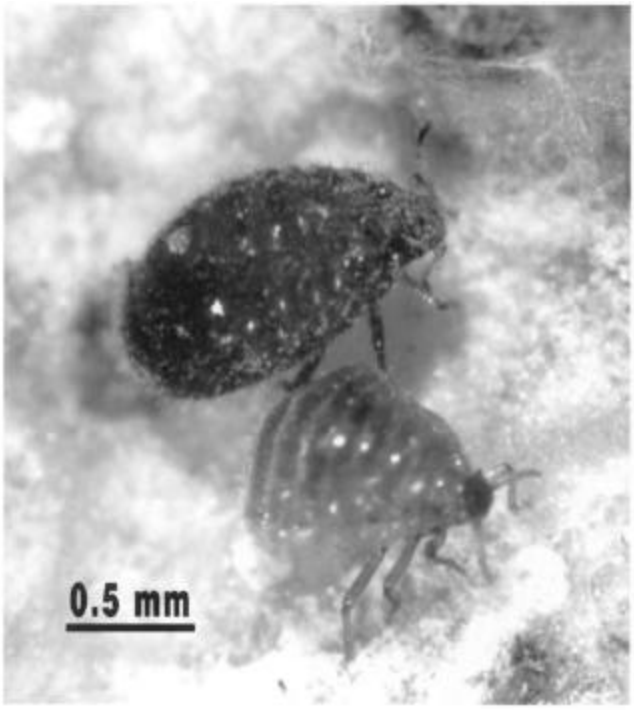


Figure 1. Two species of aphid co-occupying a gall on *Arctostaphylos patula* (Green-leaf Manzanita) at Blodgett Forest Research Station, July 1996. The aphid below is a wingless female foundress of *Tamalia coweni*, the Manzanita Leaf-gall Aphid. The aphid above is a wingless female of a newly described socially parasitic species, *Tamalia inquilinus.*

TITLE:

Pruning to Reduce Blister Rust Incidence in Sugar Pine

AUTHORS: Kevin L. O'Hara, Tudor Stancioiu, Mark Spencer, and Rolf Gersonde

ADDRESS OF LEAD AUTHOR:
Department of Environmental Science,
Policy & Management
207 Mulford Hall
University of California, Berkeley
Berkeley, CA 94720-3114
(510) 642-2127
e-mail: ohara@nature.berkeley.edu

Abstract:

Pruning of lower limbs of eastern white pine and western white pine has been an effective treatment for reducing white pine blister rust (*Cronartium ribicola*) infections. By removing limbs and therefore foliage, infection sites are removed, and resultant infections are substantially reduced. It is assumed that infections are more common near the ground because of higher humidity and the requirement of high humidity for spore infection in needle fascicles. No results have been reported for pruning sugar pine to reduce white pine blister rust infection.

During the summer of 2000, sugar pine trees were pruned at two study areas in California. At Blodgett trees were pruned in 7 different compartments. Two stands on Roseburg Forest Products lands near Lake Almanor were also pruned. At both study areas, trees between approximately 8 and 20 feet (2.4 - 6.1 m) tall were selected. Sample trees were required to show no visible effects of blister rust, and to be free of any other damage (animal, logging, etc.). Every alternate tree that met the sampling requirements was pruned to half its total height, but never more than 8 feet (2.4 m). Loppers were used to remove all living and dead branches to the pruning height. All needle fascicles below the pruning height were also removed. Alternate trees were unpruned. All trees were tagged and measured for height, diameter, height to base of live crown or pruning height,

and branch whorls above breast height were counted to determine breast height age.

At Blodgett, the total tree sample included 127 trees: half of which were pruned. At Lake Almanor, 156 trees were sampled: half were pruned. Our future plans with this study are to monitor sample trees for mortality effect on an annual basis. At present, we plan to complete a remeasurement in 2005 to determine growth effects of pruning and document pruning effects on blister rust mortality. This timeline may be accelerated if mortality or infection rates appear to differ between pruned and unpruned trees in our monitoring.

TITLE:

Bounding the Soil Respiration Models: Lessons from Field Measurements

AUTHORS: Ye Qi and Ming Xu

ADDRESS OF LEAD AUTHOR:
University of California, Berkeley
Department of ESPM
135 Giannini Hall
Berkeley, CA 94720-3312
(510) 643-0259
yqi@nature.berkeley.edu

Abstract:

Soil carbon emission is a major source of uncertainty in estimation of terrestrial carbon budget. The simulation result of soil respiration generated with some major ecosystem models may vary substantially depending on the values of model parameters. We examined the uncertainty bounds of these ecosystem models based on the spatial and temporal variability in a key model parameter, the temperature sensitivity of soil respiration, as revealed by analyses of data from long-term, systematic field measurements. We first demonstrated the large ranges of the spatial and temporal variations of Q10, an index for the temperature sensitivity, based on our field measurement at a forest ecosystem in the Sierra Nevada, California. The Q_{10} values derived from soil temperatures at 10cm depth ranges of 1.21-2.63 with averages of 1.7. Q_{10} also showed a strong seasonal variation with the annual minimum occurring in mid summer and maximum in winter. Soil temperature and moisture explained 93% of the seasonal variation in Q10. The Q_{10} variations calculated from different locations and from soil temperature depths have significant effects on the simulation results. These variations tend to affect the seasonality more than on the annual average. Our simulations indicated that the variations of Q10 and its dependence on soil moisture and temperature had important implications for regional and global ecosystem carbon modeling, in particular for predicting the responses of terrestrial ecosystems to future global warming. We showed in this study how we should and could set a confidence bound on the results of the so-called process-based ecosystem models.

TITLE:

DO TREES GET DRUNK?

AUTHORS: Gunnar W. Schade and Allen H. Goldstein

ADDRESS OF LEAD AUTHOR:
University of California, Berkeley
Department of Environmental Science,
Policy, and Management
Ecosystem Science Division
151 Hilgard Hall
Berkeley, CA 94720-3110
(510) 643-6449
gws@nature.berkeley.edu

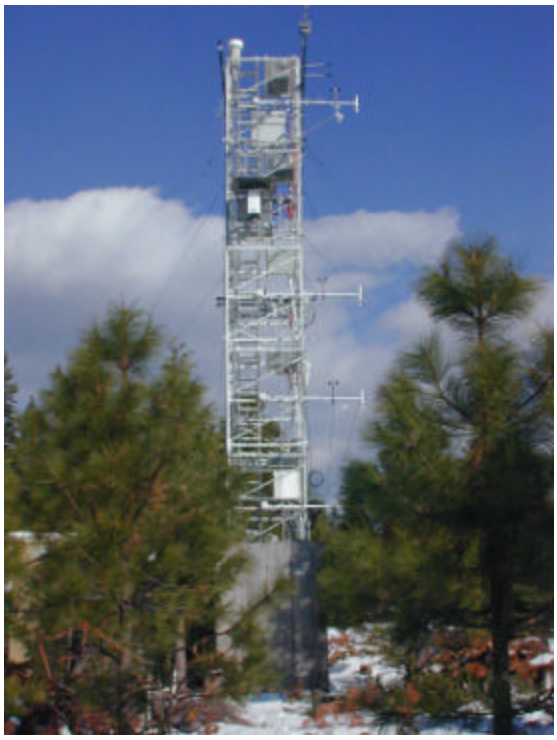
Abstract:

We measure canopy scale fluxes of alcohols (2-methyl-3-buten-2-ol (MBO), methanol, and ethanol) above a ponderosa pine plantation near Blodgett Forest Research station since summer 1999. Emissions show diurnal cycles with maximum fluxes around noon. Mean daytime MBO and methanol emissions were ~1.3 mg C m-2 h-1, ethanol emissions were five times lower. Both methanol and ethanol daytime emissions appear to be influenced by stomatal opening as suggested from correlations between the measured fluxes and light, vapor pressure deficit, and ozone deposition. In addition, ethanol fluxes decreased with soil moisture in 1999, suggesting a possible influence of anaerobic production in the tree's roots. This may explain high ethanol mixing ratios in the air above the plantation during the rainy season. MBO fluxes were compared to a detailed leaf level emission model, showing that the tree's emission potential dropped after a frontal passage with low air temperatures, and then recovered after the onset of warmer temperatures. The origin and function of that alcohol within the plant is the same than for isoprene in oak trees. The origin and function of the alcohols methanol, and ethanol in plants is currently under investigation. Our data suggests that ponderosa pine resorts to ethanolic fermentation as a more robust, though inefficient way to produce energy when it is under (ozone or draught) stress.

ATMOSPHERIC TESTING:
Under the direction of Dr. Allen Goldstein, a research site to assess factors controlling ozone deposition to the forest and to study forest response was established in 1997 in a Sierra Pacific Industries owned ponderosa pine plantation immediately adjacent to Blodgett Forest.

A 70-foot tower was erected with multiple monitoring devices attached, operated by an electrical generating system. A temperature controlled instrument building and generator shed have been added.

This site has expanded to year-round operation, with multi-disciplinary research and numerous researchers establishing projects, making this one of the most active individual research sites on Blodgett Forest.



Photos by Gunnar Schade

Meredith Kurpius operating the first down of sap velocity measurements.

Jeanne Panek taking tree physiological measurements.

TITLE:

Blodgett Forest Stream Flows and Temperatures

AUTHOR: Frieder G. Schurr

ADDRESS OF LEAD AUTHOR:
Center for Forestry
University of California, Berkeley
Blodgett Forest Research Station
4501 Blodgett Forest Road
Georgetown, CA 95634
(530) 333-4475
fax: (530) 333-2012
e-mail: freschur@nature.berkeley.edu

Abstract:

Blodgett Forest Research Station currently monitors three stream gauging stations on the forest, two with associated rain gauges. The stations on Bacon and Dark Canyon creeks have been operating since February 1995 and have the two rain gauges with them. The station on Gaddis Creek was installed in late 1997. All the gauges are installed near the lowest end of the drainage that is still on Blodgett Forest. In 1997 water and air temperature sensors were added to each gauging station. Water temperature on these creeks as well as on Mutton Creek, Deep Canyon Creek and Pilot Creek were intermittently monitored during the summer months between 1994 and 1997 with Hobo temperature sensors at various points along the streams.

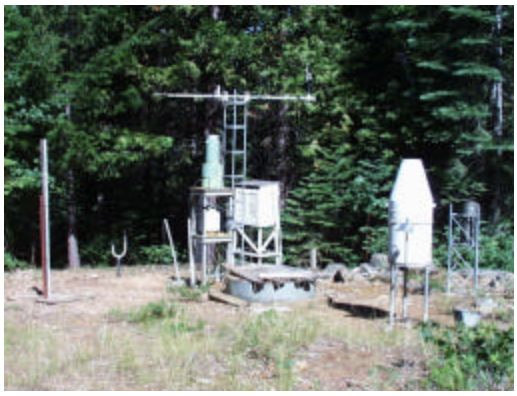
Flow rates in the 2nd Order streams range from lows of between 0.5 to 1.5 cubic feet per second during the late part of September and early October to highs of well over 100 cfs during the large rain on snow event of New Years 1997.

Water temperatures at the gauging stations of the 2nd order streams range from lows in the mid 30^{o} F range during extreme cold spells in the winter to highs in the mid 50^{o} F during the hottest parts of July and August. These temperatures are well within suitable habitat ranges for local fish species. Air temperatures

immediately adjacent to the streams at the gauges at these times are in the single digits to mid teens and in the low nineties receptively.

Water temperatures along the entire lengths of the perennial portions of the streams may reach highs in the low 60's in mid summer. However, the upper reaches of these streams frequently dry up in during the summer months. Water temperatures in these portions of the streams may exceed 70 degrees just prior to this point.

In summary, stream flows on Blodgett Forest can vary by up to two orders of magnitude during the course of an average year and water temperatures can vary by about 20 degrees during the same period. Flows and temperatures are adequate for maintaining fish populations in most stretches of the streams during the entire year although headwater reaches may not be available due to low water conditions during the summer and fall months.



Blodgett weather station
photo by Frieder Schurr)

WEATHER & STREAM GAUGE INFORMATION
The first weather station was established at the forest in 1961 measuring precipitation and air temperatures. This original station is still in operation, expanded to incorporate more than a dozen monitoring instruments. In 1969 NOAA installed a precipitation gauge at this site and started collected data here that is part of the national atmospheric monitoring network. Blodgett also has stream gauging stations, monitoring water levels, water temperatures, and air temperatures on 3 of the 4 streams whose headwaters originate on the forest. Two of the three gauging stations also have associated rain gauges in the watersheds to monitor rainfall/stream level interactions. Additional stream temperature readings are taken on an intermittent basis to monitor changes along the entire length of our streams to help us identify impacts from management activities.

Right:
Frieder Schurr downloading stream gauges

Photo by Dave Rambeau

Stream gauge station
Photo by Toney Sargenti

Stream gauge pickup lying in the water
Photo by Dave Rambeau

TITLE:

DEMOGRAPHY OF THE SPOTTED OWL IN THE CENTRAL SIERRA NEVADA

AUTHORS: Mark E. Seamans, and R .J. Gutiérrez

ADDRESS OF LEAD AUTHOR
Fisheries and Wildlife Department
University of Minnesota
200 Hodson Hall
St. Paul, MN 55108
(612)624-7709
seama005@tc.umn.edu

Abstract:

We studied the population dynamics of California spotted owls (*Strix occidentalis occidentalis*) in the central Sierra Nevada. We assessed reproductive status at 62 territories on 253 occasions over a 10 year period and recorded 714 captures of 210 individuals over a 14 year period. Reproduction varied temporally but did not exhibit any noticeable trends whereas survival followed a quadratic pattern, with owls experiencing higher survival during the middle of the study. Demographic parameter estimates indicated that the population was declining at 5.2% (SE = 2.6) per year from 1990-99. Although conditions behind this decline may change in the future, these results suggest a conservative approach to management of spotted owls and their habitat in the central Sierra Nevada.

TITLE:

The Biochemistry and Molecular Biology of Aggregation Pheromone Production in the California Fivespined Ips, Ips paraconfusus

AUTHOR: Steve Seybold

ADDRESS OF LEAD AUTHOR:
Department of Entomology and
Forest Resources
219 Hodson Hall, 1980 Folwell Avenue
University of Minnesota
St. Paul, MN 55108-6125
(612) 624-3715
sseybold@tc.umn.edu

ABSTRACT

Since 1993 my research associates and I have conducted basic research on the regulation and production of pheromones in several bark beetle species. One of the key species in these studies has been the California fivespined ips, *Ips paraconfusus* Lanier. Our research on this species has been done with insects collected exclusively from Blodgett Research Forest in ponderosa pine, *Pinus ponderosa*, and this practice has maintained the fidelity set by the original pheromone isolation from this insect by D.L. Wood and colleagues in the 1960's.

Using radiolabeling techniques we have shown that this species can synthesize its pheromone components ipsenol and ipsdienol *de novo* from acetate or mevalonate, suggesting that bark beetles can produce their pheromones with some measure of independence from their host pines [Seybold, S.J. *et al.* 1995. *Proc. Nat. Acad. Sci. USA* 92:8393-8397.]. From this species we have also isolated the first gene from a bark beetle and demonstrated that this gene [which codes for the enzyme 3-hydroxy-3-methylglutaryl-CoA reductase (HMG-R)] is involved in pheromone biosynthesis and is under the control of an insect hormone called juvenile hormone [Tittiger, C., *et al.* 1999. *Cell. Molec. Life Sci.* 55:121-127.]. Most recently we have found that *I. paraconfusus* and the related species *I. pini* may regulate pheromone biosynthesis differently and that *I. paraconfusus* may have an additional hormone necessary to turn on pheromone production. This research is leading to the discovery of unique and specific biochemical targets for the management of bark beetles and to the discovery of enzymes that might

be used in industrial processes to synthesize highly pure pheromones for use in monitoring or mass trapping programs. These studies have been supported by extramural funding from the USDA NRI-CGP, from the NSF, from the USDA Forest Service, and recently from the University of Minnesota Graduate School. The technical support provided by the Blodgett Research Forest Staff is also acknowledged and greatly appreciated.

TITLE:

Diurnal Measurements of Atmospheric 2-hydroxy-2-methylpropanal, Glycolaldehyde, Hydroxyacetone, and Methylglyoxal at Blodgett Forest

AUTHORS: Reggie S. Spaulding and M. Judith Charles

ADDRESS OF LEAD AUTHOR:
Department of Environmental Toxicology
University of California, Davis
One Shields Avenue
Davis, CA 95616
(530) 752-2541
e-mail: szreggie@mailbox.ucdavis.edu

ABSTRACT:

Biogenic hydrocarbons contribute significantly to production of tropospheric ozone in both rural and urban areas. Complete mechanisms of the reactions of dominant biogenic hydrocarbons and the mixing ratios of reaction products in the atmosphere is therefore of interest and will be useful in production of accurate photochemical models that predict tropospheric ozone formation. Two important biogenic hydrocarbons in western North America are isoprene and 2-methyl-3-buten-2-ol (MBO). Primary products from the reaction of isoprene with OH radical include methyl vinyl ketone, methacrolein, formaldehyde, and 3-methylfuran. Methyl vinyl ketone and methacrolein also react with OH, producing hydroxyacetone, glycolaldehyde, methylglyoxal, and other hydroxycarbonyls. MBO reacts with OH to produce acetone, formaldehyde, glycolaldehyde, and 2-hydroxy-2-methylpropanal. The hydroxycarbonyl and dicarbonyl products have been difficult to analyze in the atmosphere due to their high polarity and the expected low mixing ratios. Herein we report collection of hydroxycarbonyl and dicarbonyl compounds in a Cofer Scrubber using and O-(2,3,4,5,6-pentafluorobenzyl)-hydroxylamine (PFBHA) derivatization of carbonyl groups followed by bis(trimethylsilyl)trifluoroacetamide (BSTFA) derivatization of -OH groups. Identification and quantification is accomplished by using gas chromatography with ion trap mass spectrometry. We report diurnal trends in mixing ratios of glycolaldehyde, hydroxyacetone, 2-hydroxy-2-methylpropanal, and methylglyoxal at the Blodgett Forest for three days during the summer of 2000.

TITLE:

A Study of the Consequences of Fire and Fire Surrogate Treatments: The Blodgett Forest Research Study Site- Current Activities and Future Plans.

AUTHORS: Scott L. Stephens and Jason Moghaddas[1]

ADDRESS OF LEAD AUTHOR:
Department of Environmental Science,
Policy and Management
University of California, Berkeley
145 Mulford Hall #3114
Berkeley, CA 94720-3114
(510) 642-7304
stephens@nature.berkeley.edu

Abstract:

Many North American forests, especially those with historically short-interval, low- to-moderate severity fire regimes, are extremely dense with excessive quantities of fuels. Widespread treatments are needed to restore ecological integrity and reduce wildfire hazard in these forests. Among possible restorative treatments the appropriate balance among silvicultural treatments, mechanical fuel treatments, and prescribed fire is often unclear. The focus of the Fire and Fire Surrogate Study is to provide quantitative information on the use of the following silvicultural treatments: (1) harvesting and mechanical fuel treatments in the absence of fire, (2) fire alone, with no harvesting or mechanical treatment, (3) a combination of harvesting, mechanical fuel treatments, and prescribed fire, and (4) a control, with no treatments. The treatment effects will be examined through broad ecological disciplines including: fire and fuels, vegetation, wildlife, entomology, pathology, soils, and utilization/economics. These treatments are being implemented at 10 other sites across the United States. At Blodgett, each of the 4 treatments will be carried out on three 40-60 acre group selection compartments.

A core interdisciplinary team of scientists including University of California professors, postdoctoral students, and Extension specialists is developing sampling protocols. Immediate field activities include plot layout, tree marking, and testing small scale prescribed burns. Field measurements will begin at Blodgett in spring of 2001. Harvesting of the mechanical treatment units will begin in August 2001. Prescribed burning will be carried out in the fall of 2002. Successive measurements will occur in the summer of 2003 and 2004. Data will be analyzed locally and across all national sites. Funding for this project has been obtained through the U.S. Joint Fire Science Program in Washington D.C.

[1]Site Manager for the Fire and Fire Surrogate Study
moghad@nature.berkeley.edu

FIRE SURROGATE STUDY:
Blodgett Forest is part of a national network of research sites designated for study to quantify the consequences and tradeoffs of alternative fire and fire surrogate treatments, including ecological, economic and social aspects. Research is aimed at cause and effect relationships. Prescribed burns are one of four fire surrogate treatments that will be implemented at each research site.

Photos by Jason Moghaddas and Emily Greinke

TITLE:

Effects of Artificial Inoculation of Heterobasidion annosum on Landing Rates of Bark Beetles (Coleoptera: Scolytidae) on Ponderosa Pine

AUTHORS: Andrew J. Storer, Pierluigi Bonello [1,2], William R. McNee, Thomas R. Gordon[1], and David L. Wood[3]

ADDRESS OF LEAD AUTHOR:
Division of Insect Biology
201 Wellman Hall
University of California, Berkeley
Berkeley, CA 94720
(510) 642-5806
e-mail: storer@nature.berkeley.edu

Abstract:

A considerable body of evidence points to predisposition of root-diseased conifers to colonization by tree-killing bark beetles. To determine whether root diseased trees are more attractive to bark beetles, landing rates were monitored on trees inoculated with the root and butt rot fungus, *Heterobasidion annosum*, and compared with landing rates on mock inoculated and uninoculated control trees.

In 1997, thirty trees were inoculated at the root collar, thirty mock-inoculated and thirty used as controls in each of two adjacent, stands of 35 year old ponderosa pine (referred to as east and west plots) at the University of California's Blodgett Forest Research Station (BFRS), Georgetown, El Dorado County, California. Four equally-spaced wooden dowels colonized by *H. annosum* were inserted at the base of inoculated trees, and four un-colonized, sterilized dowels were inserted at the base of mock inoculated trees. Each of the 180 trees was fitted with four, 0.22 m^2 sticky traps made of 3 mm hardware cloth coated with Tanglefoot and sprayed to runoff with the insecticide carbaryl (Sevin, Ortho). Two of the four traps were tied to the trunk 4-5 m above ground, while the other two were tied at the base. All scoytids were removed from the traps in July and November, 1997, and again in July and November 1998, and in November 1999 (the traps were re-coated with Tanglefoot and re-sprayed with

carbaryl in May 1998 and May 1999). Differences between the treatments and plots were tested for each species of bark beetle using ANOVA. Trees under attack were eliminated from the analysis as pheromone induced-landings would confound treatment effects.

Independently of plot, treatment and year, the mean number of beetles/trap/date in decreasing order of frequency were: *Hylastes* spp. (0.702), *Gnathotrichus* spp. (0.340), *Ips latidens* (0.161), *Dendroctonus brevicomis* (0.156), *I. paraconfusus* (0.136), and *D. ponderosae* (0.043). Differences among treatments were non-significant ($\alpha = 0.05$), with the exception of *I. latidens* in the first period of 1998. Overall, the east plot was characterized by higher trapping rates than the west plot (0.308 vs. 0.204, respectively), but the differences between plots were non-significant. However, catches for individual genera/species at each date often differed by plot. Representative data for western pine beetle and the California 5-spined ips are shown in Table 1. Thus, under the conditions of our experiment, bark beetles appear to land on their hosts at random, irrespective of inoculation status. This study will be

Table 1. Mean number of beetles/trap/date for *Ips paraconfusus* and *Dendroctonus brevicomis*. Date refers to the dates that insects were removed from the traps.

	Date	West Plot	East Plot	Inoculated	Mock-	Control
Ips paraconfusus	July 1997	0.008a	0.886b	0.358	0.508	0.475
California 5-pined ips	Nov 1997	0.155a	0.172a	0.117	0.200	0.175
	July 1998	0.019a	0.028a	0.017	0.042	0.012
	Nov 1998	0.003a	0.008a	0.004	0.008	0.004
	Nov 1999	0.008a	0.069b	0.038	0.060	0.017
Dendroctonus brevicomis	July 1997	0.000a	0.125b	0.033	0.079	0.075
Western pine beetle	Nov 1997	0.219a	0.111b	0.142	0.167	0.188
	July 1998	0.585a	0.087b	0.371	0.250	0.387
	Nov 1998	0.044a	0.036a	0.047	0.038	0.038
	Nov 1999	0.197a	0.158a	0.169	0.207	0.157

Values for the same species on the same date in different plots followed by different lower case letters differ significantly ($P<0.05$; ANOVA of square root transformed data). Differences among treatments were non-significant. Key to dates: 1997-1 = July 1997, 1997-2 = November 1997, 1998-1 = July, 1998- 2 = November 1998, 1999 = November 1999.

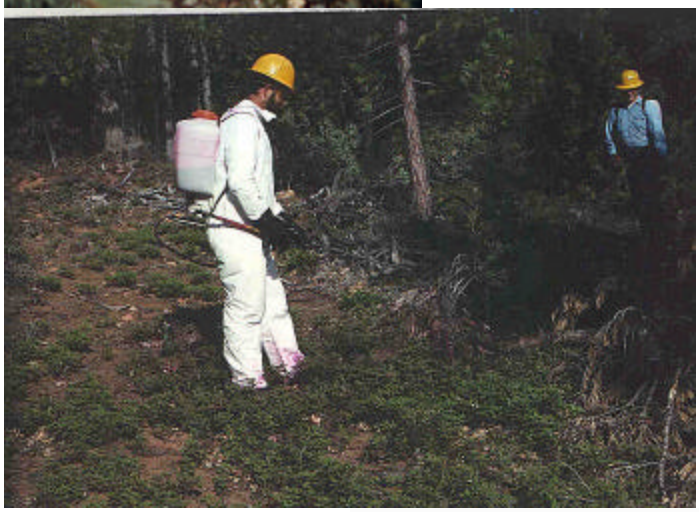
expanded to correlate bark beetle landing rates with local population sizes and incidence of bark beetle associated tree mortality. In addition, the landing rates of bark beetles on other tree species will be monitored to determine whether landing is host specific in mixed stands of trees.

[1] Department of Plant Pathology, University of California, Davis, CA95616
[2] Current address: Dept. of Plant Pathology, The Ohio State University, 201 Kottman Hall, 2021 Coffey Road, Columbus, OH 43210
[3]Division of Insect Biology, University of California, Berkeley

VEGETATION CONTROL:
Vegetation control around growing trees offers optimum growing conditions, eliminating competition for sunlight, water and soil nutrients.

Hand mechanical clearing of brush and small volunteer trees is done regularly by chainsaw and brush cutters. Larger clearing is done by slash machinery or earth moving equipment. Hand grubbing, weeding by hand and hoe, is also done occasionally.

Some herbicides are used, sprayed directly on the leaves of the plants to be eliminated, once or twice during the lifetime of the stand. Only benign poisons are used, those less lethal than the average agricultural herbicides.



Upper left:
Pre-commercial thinning by chainsaw

Left:
Herbicide application

Blodgett file photos

Right:
A masticator efficiently pre-commercial thins an average of 3-4 acres per day.

Photo by
Gunnar Schade

TITLE:

US Forest Service, Genetic Resource Program for California – an Introduction.

AUTHOR: Paul Stover

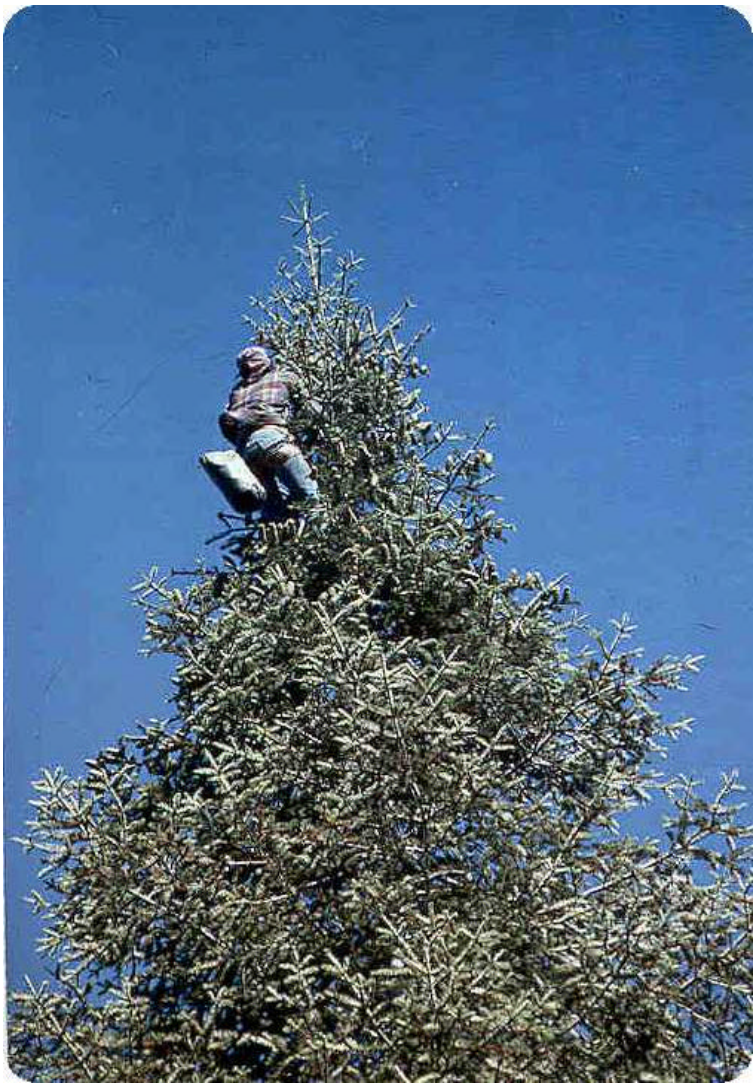
ADDRESS OF LEAD AUTHOR:
Central Zone Geneticist, Placerville Nursery
2375 Fruitridge Road
Camino, CA 95709
(530) 642-5000

Abstract:

The Genetic Resource Program for the National Forest System within California began with the selection and propagation of blister rust resistant sugar pine in the 1950's. A master plan was produced by Dr Jay Kitzmiller and approved in 1976. Vigorous, disease and insect free "superior selections" followed for sugar pine and other important conifers as part of a Tree Improvement Plan in the 1970's and 80's. A central office and major orchard site exists at the Genetic Resource Center in Chico. Two zone offices exist in Yreka and Placerville. Three important orchard facilities also exist at the Foresthill Genetics Center, Badger Hill Arboretum, near Placerville and the Happy Camp Arboretum and Disease Resistance Evaluation Garden. Personnel practice their skills in genetics, horticulture, forestry and related fields in a wide variety of projects involving many cooperators both within and outside the agency.

Opportunities for using even disease resistant seed have substantially declined with the changing emphasis in forest management practices within public lands. However, an important collection of genetic diversity for sugar pine, ponderosa pine, Douglas fir, white fir and other conifers has resulted from the program's effort.

It is estimated more than 15,000 individual sugar pine parent seed collections are currently stored at 0º C at the Placerville Nursery. For ponderosa pine, Douglas fir, and white fir up to a thousand individual tree seed collections for each species



have been collected from northern California. A smaller number of pollen collections exist for ponderosa pine, sugar pine and Douglas fir. More than 600,000 seedlings have been planted in nearly a hundred progeny evaluations. Finally, 270 acres of grafted orchard have been established for ponderosa pine, Douglas fir, sugar pine and white fir. These collections are unique in their breadth of sampling the conifer genetic diversity in the state. They continue to present many opportunities for the study of genetic diversity, disease resistance, basic biology and promoting education for these important conifers.

TITLE:

Ecosystem respiration in a young ponderosa pine plantation in the Sierra Nevada Mountains, California

AUTHORS: Ming Xu, Terry A. Debiase, Ye Qi, Jianwu Tang, Allen Goldstein, and Zhigang Liu

ADDRESS OF LEAD AUTHOR:
Department of Environmental Science, Policy, and Management
University of California
135 Giannini Hall #3312
Berkeley, CA 94720-3312, USA
(510) 643-3263, Fax – (510) 643-5438
email - mingxu@nature.berkeley.edu

ABSTRACT:

We estimated the total ecosystem respiration from a ponderosa pine (*Pinus ponderosa* Dougl. ex Laws.) plantation in the Sierra Nevada Mountains (close to the Blodgett Forest Research Station at UC Berkeley) near Georgetown, California from June to October 1998. We apportioned the ecosystem respiration between heterotrophic, root, stem, and foliage based on relationships for each component that considered microclimate and vegetation characteristics. We measured each respiration component at selected sampling points, and scaled the measurements up to the ecosystem based on modeled relationships. Over the study period, total mean ecosystem respiration (ER) was 5.7 ± 1.3 μmol m-2 s-1 (based on daily mean), comprised of about 67% from soil surface CO_2 efflux, 10% from stem and branch (stem+branch) respiration, and 23% from foliage respiration. Shrub leaves contributed about 24% to total foliage respiration, and current-year needles (1998 age class) accounted for 40% of total tree needle respiration. Root respiration accounted for 47% of soil surface CO_2 efflux. Ecosystem respiration can be estimated based on daily mean air and soil temperatures through exponential relationships with R2 values of 0.85 and 0.87, respectively. When based on both air and soil temperatures, about 91% of the variation in ER could be explained through a linear regression.

Keywords: Soil surface CO_2 efflux, soil respiration, stem respiration, leaf respiration, Q_{10}, microclimate.

TITLE:

Edge effects in mixed conifer group selection openings: Tree height response to resource gradients

AUTHORS: Robert A. York, John J. Battles, and Robert C. Heald

ADDRESS OF LEAD AUTHOR:
151 Hilgard Hall
Berkeley, CA 94720-3110
(510) 643-2450
e-mail: ryork@nature.berkeley.edu

Abstract:

Group selection has been proposed as an alternative to clearcutting that potentially maintains economic viability while preserving ecosystem integrity. However, questions remain about the appropriate size of the openings and the subsequent effect of edges on tree performance. To address these uncertainties for Sierran mixed conifer forests, replicated circular openings ranging in size from 0.1 ha to 1 ha were cleared in 1996 at the Blodgett Forest Research Station. Native conifer species were replanted every 3 m along north-south transects. After three years of growth, heights of all the saplings were recorded. During the summer of 2000, we measured differences along the north-south transects in extension growth, pre-dawn water potential, and light availability for three species of trees: giant sequoia, ponderosa pine, and Douglas-fir.

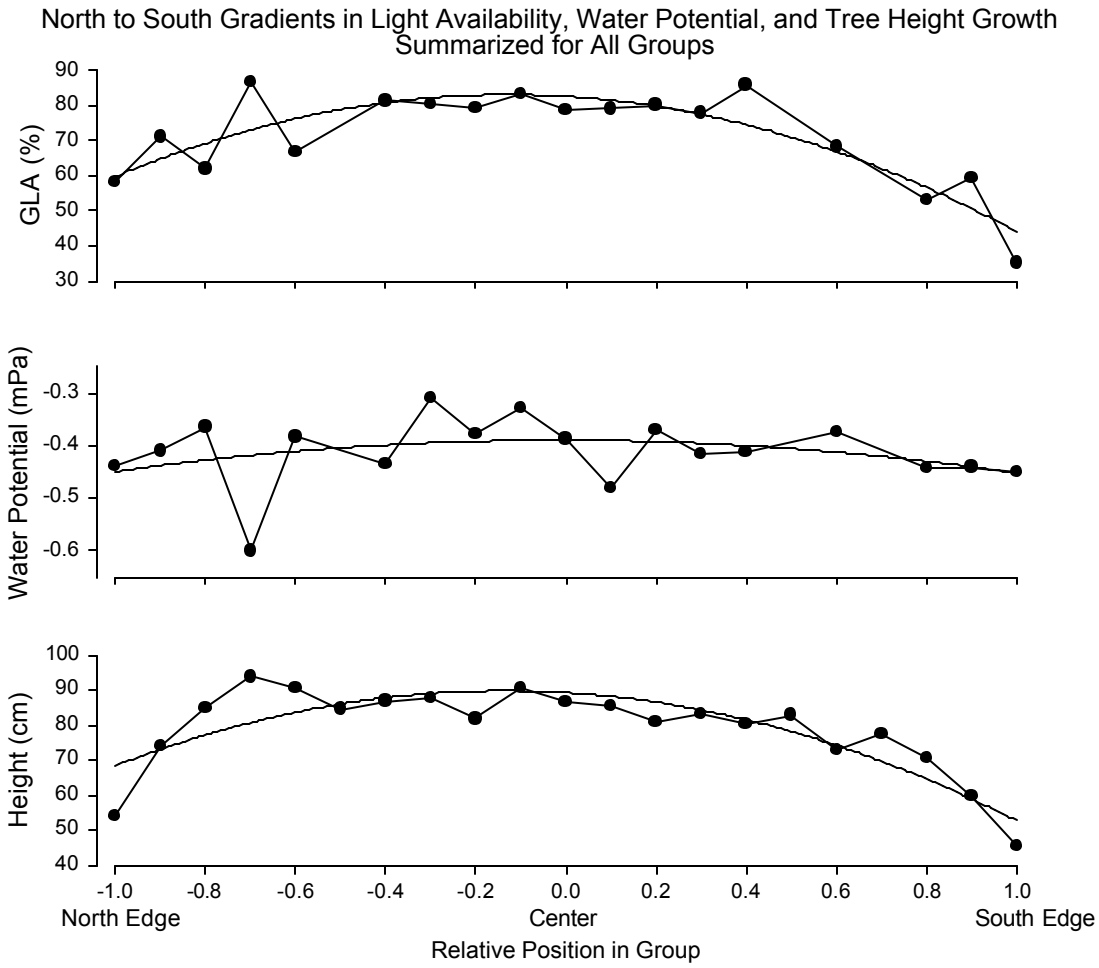
For all but the smallest openings (0.1 ha -- no water gradient), there were significant gradients in light and water supply related to distance from the edge. The relative importance of edge effects on tree height varied slightly by opening size. The edge area occupied 13% of the 0.1 ha groups compared to 7% of the 1 ha groups. As expected resource availability was greatest near the center and least near the edges with north edges receiving significantly more light than southern edges. In general, observed edge effects on sapling height growth were correlated with light and water supply. However there were important differences among species in the nature of the co-limitation. Giant sequoia growth was most sensitive to light and water availability. Together they explained more than 32%

of the observed variation in giant sequoia height. In contrast, only light was a significant predictor of ponderosa pine performance. Douglas-fir heights were significantly related to both light and water but there was more unexplained variability in the Douglas-fir model.

These results reflect typical classifications of drought and shade tolerance for Douglas-fir and ponderosa pine. Giant sequoia is the most sensitive to edge environment conditions. We recommend planting designs that reserve north edges for drought tolerant species, and avoid planting species intolerant to both shade and drought along the edges.

Table 1. Summary of sapling extension growth, transmitted radiation, and xylem water potential for three conifer species across north-south transects in group selection openings. Saplings were measured during the fourth growing season after planting. Means reported with standard errors in parentheses. Groups ranged in size from 0.1 ha to 1.0 ha. Groups were located in a mature mixed conifer forest, Blodgett Forest Research Station, Georgetown California.

Species	Location	Extension growth (cm)	Total Transmitted Light (%)	Water Potential (mPa)
Douglas-fir	South edge	20 (2)	50.2 (2.9)	-0.45 (0.02)
	Center	35 (2)	77.5 (1.8)	-0.42 (0.02)
	North edge	24 (3)	62.9 (2.8)	-0.45 (0.03)
Giant sequoia	South edge	23 (2)	50.3 (3.8)	-0.39 (0.02)
	Center	55 (2)	78.4 (1.8)	-0.35 (0.02)
	North edge	34 (4)	62.7 (2.8)	-0.33 (0.03)
Ponderosa pine	South edge	24 (2)	50.3 (3.8)	-0.45 (0.02)
	Center	41 (2)	79.7 (1.7)	-0.44 (0.02)
	North edge	31 (3)	65.5 (2.5)	-0.46 (0.02)


North to South Gradients in Light Availability, Water Potential, and Tree Height Growth
Summarized for All Groups
GLA (%)
90
80
70
60
50
40
30
Water Potential (mPa)
-0.3
-0.4
-0.5
-0.6
Height (cm)
100
90
80
70
60
50
40
-1.0
-0.8
-0.6
-0.4
-0.2
0.0
0.2
0.4
0.6
0.8
1.0
North Edge
Center
South Edge
Relative Position in Group

TITLE:

Sugar pine blister rust resistance screening program – historical roots and new challenges

AUTHOR: Paul Zambino.

ADDRESS OF LEAD AUTHOR:
Director, Region 5 Disease Resistance Screening
USFS Placerville Nursery
2375 Fruitridge Road
Camino, CA 95709
e-mail: pzambino@fs.fed.us

ABSTRACT:

The objective of the sugar pine blister rust program is to identify forms of resistance that will have long-term effectiveness against the white pine blister rust fungus (*Cronartium ribicola*) in sufficient individuals to preserve sugar pine's genetic diversity.

The method of assessing resistance has been crafted largely through the work of Dr. Brohun Kinloch, PSW, and three events: 1) identification of a form of resistance (Major Gene Resistance, a.k.a. MGR) that is easily identified by needle symptoms and is conferred by a single dominant gene; 2) recognition that MGR resistance can be overcome by a virulent race of blister rust; 3) realization that the Happy Camp Outplant Site where the virulent race first occurred is ideal for testing MGR-resistant sugar pine seedlings for additional forms of resistance collectively known as slow rusting resistance (SR).

Seedlings of candidate trees are screened for MGR at the Placerville Nursery. A preliminary goal of 20 resistant trees per 500 ft elevation band per seed zone, set to preserve adaptation to current and future environmental challenges, has been reached for many middle elevations in the Central Sierra. Planting MGR progeny at Happy Camp has allowed individuals with both MGR and SR to be identified and grafted into seed orchards and clone banks. A new method for identifying heritable SR in young seedlings is being tested, and may prove more useful than

current methods for candidates from northern California where MGR is rare. Given that MGR seed is now available, a new challenge will be to promote planting of MGR seedlings of this “Queen of the Sierras”, possibly using silvicultural methods beyond traditional reforestation prescriptions.