BLODGETT FOREST RESEARCH STATION

2000 RESEARCH SYMPOSIUM

2000 Blodgett Forest Research Symposium

BARRETT, REG
Professor, Wildlife Ecology and Management
ESPM
UC Berkeley

BATTLES, John J.
Assistant Professor, Forest Community Ecology
ESPM
UC Berkeley

GERSONDE, Rolf
Graduate Student
ESPM
UC Berkeley
[Kevin O'Hara]

GILLESS, J. KEITH
Associate Dean of Forestry
ESPM
UC Berkeley

GOLDSTEIN, Allen H.
Assistant Professor of Biogeochemistry
Ecosystem Sciences
UC Berkeley

HEALD, Robert C.
Co-Director
Center for Forestry
UC Berkeley

HORVATH, W. R.
Assistant Professor
Land, Air and Water Resources
UC Davis

JAMES, Cajun
Ph.D Candidate
UC Berkeley

KRUMLAND, Bruce
Associate Research Specialist – Programmer/Analyst
ESPM
UC Berkeley

LIBBY, William J.
Professor Forestry and Genetics, Emeritus
UC Berkeley

MCNEE, William R.
Ph.D Candidate
Division of Insect Biology
UC Berkeley
[Dave Wood]

QI, Ye
Assistant Professor
Agricultural Sciences, ESPM
UC Berkeley

SCHURR, Frieder G.
Assistant Properties Manager
Center for Forestry
UC Berkeley

STEPHENS, Scott L.
Assistant Professor of Fire Science and Ecology
Dept. of Natural Resources Management
California Polytechnic State University

Ming Xu
Ph.D Candidate
Ecosystem Dynamics and Management
UC Berkeley
[Ye Qi}

TITLE:

Seedling demography in a mature mixed-conifer stand at Blodgett Forest

AUTHORS: John J. Battles, Robert A. York, and Anna L. Levin

ADDRESS OF LEAD AUTHOR:
ASSISTANT PROFESSOR
FOREST COMMUNITY ECOLOGY
UNIVERSITY OF CALIFORNIA, BERKELEY
Department of Environmental Science, Policy, and Management

151 Hilgard Hall
Berkeley, CA 94720-3110
(510) 643-0684
jbattles@nature.berkeley.edu

Abstract:

The silvics of the trees species found in the Sierran mixed conifer forest are remarkably well documented. However there is relatively little information regarding the regeneration ecology of these species in unmanaged stands. Given that a large fraction of this Sierran forest community is in mature and old-growth stands where fire is actively suppressed, we need to understand the current understory dynamics even if this regime represent a departure from natural conditions. Thus in 1997, we began a long-term study of conifer seedling demography in a mature, mixed conifer stand at Blodgett Forest.

In 1998, we established a 1 ha permanent plot in the center of compartment 220 (reserve status, approximately 85 years old). This plot was gridded with 36 evenly spaced (20 m apart) points. All trees ?19.5 cm in diameter at breast height (dbh, 1.37 cm) were tagged, identified, measured, and mapped. Hemispherical photographs of the canopy were taken a 1-m heights at each grid point. In 1998, a central subplot 0.36 ha in size (16 grid points) was used for detailed characterization of the understory tree community. At each interior grid point, we inventoried all subcanopy trees (< 19.5 cm dbh and ?1.37 m tall) within a 5-m radius of the point (78.5 m^2) and mapped and measured all tree seedlings (< 0.5 m tall and > 1 year old) and tree saplings (0.5 m < height < 1.37 m) in transects (36 m^2) centered on the point. In 1997, we located canopy gaps in the stand and identified a cohort of established advance regeneration (trees < 0.3 m tall and 4-6 years old). We also estimated the light regime in these gaps with hemispherical photographs taken near gap center. Each fall, we measure the survival

and growth of the seedlings in the transects and gaps. To get some insight into the seasonal phenology of young trees, we located newly germinated and 1-yo old seedlings in 14, 36 m^2 sampling transects centered on exterior grid points. During 1999, we visited the young-of-the-year transects at 2 week intervals from June to October to chart seedling survival.

The research stand is a dense (300 canopy trees/ha), closed-canopy forest (93% canopy closure) dominated by a mix of Sierran conifer species (27.6 m^2 ha^{-1} Douglas-fir; 18.0 m^2 ha^{-1} sugar pine; 16.9 m^2 ha^{-1} incense-cedar; 9.1 m^2 ha^{-1} ponderosa pine; and 8.2 m^2 ha^{-1} white fir). Mean canopy tree height is 32.2 m (std = 9.5 m) and on average 11.6 % (std = 4.9%) of the incident radiation reaches the understory. Canopy gaps receive nearly double the average incident understory radiation (mean = 22.1%; std = 7.2%).

In 1998, seedling density was 20,729 stems/ha (n = 1037); 75% of these seedlings were incense-cedar with Douglas-fir, black oak, and white fir accounting for about 8% each of the seedlings present. We found no ponderosa pine seedlings in the understory and only 8 sugar pine seedlings > 1 year old. Average seedling height was 11 cm. Between 1998 and 1999, approximately half of the Douglas-fir and white fir seedlings died; incense-cedar had a significantly lower annual mortality of 10% yr^{-1}. Regardless of species, taller seedlings had significantly lower mortality. Between 1997 to 1998, the mortality of the established seedlings in gaps was comparatively low. Douglas-fir and white fir had similar mortality rates -- approximately 15% yr^{-1}; incense-cedar mortality was even lower (7% yr^{-1}). However, neither species nor height was a significant predictor of mortality in gaps with the exception of sugar pine. Sugar pine in gaps had a death rate of 13% in 1998 with the dead trees significantly shorter in 1997 than the surviving seedlings (8.0 cm tall vs. 11.8 cm tall). Seedling mortality in gaps between 1998 and 1999 was much lower for all species. 1999 mortality for sugar pine was 8%; for Douglas-fir, white fir, and incense-cedar, 1999 mortality in gaps was < 2%. In 1999, most of the seeds that germinated were sugar pine. By mid-June, there were 95 germinants in our transects (1,885 seedlings/ha). Survival through the summer followed a negative exponential curve. By mid-October, there were only 27 live sugar pine seedlings. In 1999, we also followed a cohort of 45, 1-yo white fir seedlings (893

seedlings/ha). White fir also followed a negative exponential decay through the growing season however white fir survival was much greater than the sugar pine with 32 trees surviving to mid-October.

Species differences in seedling mortality tracked the established hierarchy of shade tolerance with the species considered more shade tolerant having lower mortality. Seedling height was often but not always significantly correlated with survival. The 1999 gap results suggest that once individual seedlings survive to a given size (or age), the risk of mortality greatly decreases. We observed the expected seasonal trend in seedling mortality – a trend likely associated with the summer dry-down. We will continue to quantify patterns in seedling demography as well as expand our study of the environmental (light, water) and biological (competition, mutualism, herbivory) factors that influence establishment success.

TITLE:

Comparison of the effects of cow manure and other food sources on the growth and development rates of aquatic insects.

AUTHORS: E. A. Betts, R. B. del Rosario, V. H. Resh,

ADDRESS OF LEAD AUTHOR:
UNIVERSITY OF CALIFORNIA, BERKELEY
Division of Insect Biology
201 Wellman Hall
Berkeley, CA 94720-3112
(510) 642-5913
ebetts@nature.berkeley.edu

Abstract:

We conducted laboratory studies to examine the effects of increased organic inputs in streams on the growth and emergence patterns of aquatic insects. Specifically, we asked whether an increase in food resources, from cow manure deposited in streams, increases the growth and development rates of the stonefly *Malenka* (Plecoptera: Nemouridae) and the mayfly *Paraleptophlebia* (Ephemeroptera: Leptophlebiidae). Our insects were collected from first–order streams at Blodgett Research Forest in Eldorado County, CA and reared in a temperature-controlled room in the Natural Resources Center at the Oxford Tract Facility of University of California, Berkeley. We compared growth rates and emergence time of insects fed cow manure and detritus to those fed detritus only. In comparing the final and initial weights of the study insects, we found the growth rates of the insects from the manure and detritus treatment were similar to the growth rates of the insects from the detritus only treatment. Similarly, the times to adult emergence were similar for the manure and detritus and detritus only treatments.

TITLE:

USING CARBON ISOTOPES AND COMMUNITY MEASURES TO EVALUATE BENTHIC INSECT RESPONSE TO MANURE ENRICHMENT IN STREAMS.

AUTHORS: R. B. DEL ROSARIO, E.A. BETTS, AND V. H. RESH,

ADDRESS OF LEAD AUTHOR:

UNIVERSITY OF CALIFORNIA, BERKELEY
Division of Insect Biology
201 Wellman Hall
Berkeley, CA 94720-3112
(510) 642-1279
rosalie@nature.berkeley.edu

Abstract:

We investigated the response of aquatic insects to nutrient enrichment from cow manure in isolation from the physical disturbances of cattle grazing. Using a fixed block design in 4 streams in Blodgett Forest, we introduced manure on a weekly basis for eight weeks to examine both temporal and spatial responses. The manure was collected from penned cattle fed a diet of corn silage, which has a distinctly higher $\delta^{13}C$ ($^{13}C/^{12}C$) value compared to leaf litter that enters streams ($\delta^{13}C_{introduced\ manure}$ = -15‰ cf $\delta^{13}C_{leaf\ litter}$ ~ -28 ‰). We found a positive correlation between increasing $\delta^{13}C$ values in insects and their proximity to the site of manure input. In addition we found a temporal trend of increasing $\delta^{13}C$ values in insects exposed to incremental manure enrichment over time. In a parallel study that we are conducting in 3 streams in the Coast Range, we have found that these spatial and temporal patterns of $\delta^{13}C$ are further corroborated by community measures showing that the proximity of insect assemblages to the site of manure input was positively correlated with total insect densities and negatively correlated with both taxon richness and species diversity. Examination of community measures of insect assemblages in Blodgett Forest streams will determine if insects in the two regions of California respond similarly to manure enrichment.

TITLE:

Hydrologic Research at the Blodgett Forest Research Station

AUTHOR: Fred Euphrat

ADDRESS OF LEAD AUTHOR:
Forest, Soil & Water, Inc. (707) 433-5544
Box 1802, Healdsburg, Ca. 95448 woodrat@mail.monitor.net

Abstract:

During the years 1994 through 1996, the streams channels and the road system of Blodgett Forest Research Station (BFRS) were evaluated for their hydrologic and geomorphic characteristics. The purpose of this research was to (1) document baseline data for future research, (2) reduce erosion from roads, and (3) to evaluate the efficacy, repeatability and relative costs of monitoring systems. Data collection was concurrent with upgrade and replacement of BFRS climate and hydrologic instrumentation, so future analysis can be conducted on the impact to streamflows from storms.

Data collected include:

- Stream surveys using a modified Washington State protocol (WFPB 1992);
- Sketch maps of monumented stream sections;
- Stream typing with the California Department of Fish and Game's application of the Rosgen (1994) protocols;
- Stream habitat typing using the Bisson (1982) protocols;
- Analysis of pools using a modified V* approach (Lisle and Hilton 1992);
- Quantification of large woody debris in the stream zone;
- Chemical and biological analysis of streamflow;
- Temperature monitoring of streamflow;
- Road analysis for erosion and condition; and
- Sediment Transport Corridor evaluation, to identify erosion sources.

We evaluated Mutton Creek, Bacon Creek, Dark Canyon Creek, the East and West Forks of Gaddis Creek, Deep Canyon Creek, and Pilot Creek. This research served as a touchstone for road closure and reconstruction, turbidity and water quality monitoring, and consideration of stream restoration. Further research will, with baselines and instrumentation established, be able to look at linkages between precipitation, runoff, channel condition and fish habitat.

Bisson, P.A., J.L. Nielsen, R.A. Palmson and L.E. Grove. 1982. A system of naming habitat units in small streams, with examples of habitat utilization by salmonids during low stream flow. in: Symposium on acquisition and utilization of aquatic habitat inventory information. Western Div., Am. Fisheries Soc. Bethesda, Md.

Euphrat, F. et al. 1994, 1995, 1996. Annual Report for Blodgett Forest Research Station. Forest, Soil & Water, inc. Healdsburg, Ca. (3 vol.)

Lisle, T.E. and S. Hilton. 1992. The volume of fine sediment in pools: an index of sediment supply in gravel-bedded streams. Water Res. Bull. 28(2):371-383

Rosgen, D.L. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, Colo.

Washington State Forest Practices Board. 1994. Standard Methodology for Conducting Watershed Analysis. Ver. 2.1

TITLE:

Stand Structure and Height Growth Dynamics of a Sierra Nevada Mixed Conifer Forest

AUTHORS: Rolf Gersonde and Kevin O'Hara

ADDRESS OF LEAD AUTHOR:

UNIVERSITY OF CALIFORNIA, BERKELEY
DEPARTMENT OF ENVIRONMENTAL SCIENCE, POLICY AND MANAGEMENT
Division of Forest Science
207 Mulford Hall
BERKELEY, CA 94720-3114
(510) 642-2127

Abstract.

The objective of the study was to reconstruct past height growth and diameter growth of selected trees in a single cohort stand and to describe the differentiation of trees within a representative 0.2 ha plot. Ultimately we hope to use this information on mixed-conifer stand dynamics to guide management of complex structures in this stand type. Data from a young growth reserve stand at Blodgett Forest Research Station was collected beginning in 1999 to describe stand structure and growth dynamics in a mixed-conifer forest.

During the first year of this study, we collected individual tree data, including increment cores, to determine base age and sapwood diameter of all trees on one plot at Blodgett. We felled and cut sections from 17 trees to determine past height growth. Past height growth of three pines was determined by measuring the height of branch nodes. All overstory trees were mapped and regeneration was sampled in 5% of the plot area.

The stand, which had entered the understory reinitiation phase, consisted of three cohorts. The main cohort (60-80 years old) consisted of white fir, Douglas fir, ponderosa pine, sugar pine, incense cedar, and black oak, and it was well differentiated into crown classes. No single species dominated the stand. Incense cedar of the main cohort formed a lower canopy stratum. An older cohort consisting of black oak and incense cedar (100+ years old) had been released during past harvesting and had grown into dominant canopy positions. The stand recently experienced damage from snow break and tree fall, and a patchy regeneration (2-9 years old) of shade tolerant species was established.

TITLE:

Why are there high concentrations of acetone at Blodgett Forest? Quantifying the biogenic and anthropogenic contributions.

AUTHORS: Allen H. Goldstein and Gunnar W. Schade

ADDRESS OF LEAD AUTHOR:
Assistant Professor of Biogeochemistry
University of California, Berkeley
Division of Ecosystem Sciences
Department of Environmental Science, Policy and Management

330 Hilgard Hall
Berkeley, CA 94720-3110
(510) 643-2451
ahg@nature.berkeley.edu

Abstract:

Acetone was one of the most abundant volatile organic compounds (VOCs) observed in the Sierra Nevada Mountains (California, USA). Mixing ratios were measured hourly above a ponderosa pine plantation using an automated in-situ dual-channel GC-FID system throughout July 1997, from July through October 1998, and fluxes were measured with a relaxed eddy accumulator from July through September 1999. Acetone mixing ratios ranged from 1.4 to 7.8 ppb in July 1997, 1.1 to 7.8 ppb in July 1998, and 1.0 to 9.4 ppb in July 1999, and were highly correlated with compounds of biogenic and anthropogenic origin.

During sunny periods in 1997 (PAR > 1300 mmol/cm/s) acetone was correlated with methylbutenol (biogenic emission from ponderosa pine, r2 = 0.48). Under the same conditions, acetone was also correlated with acetylene (anthropogenic emission, r2 = 0.52), yet acetylene and methylbutenol were not correlated with each other (r2 = 0.06). A linear combination of 1.34 x methylbutenol + 9.64 x acetylene was highly correlated with acetone mixing ratios (r2 = 0.80), suggesting that almost all of the observed acetone could be accounted for by a combination of biogenic and anthropogenic sources associated with methylbutenol and acetylene. Based on this correlation, 44 % of the observed acetone could be attributed to biogenic sources, 15 % to anthropogenic sources, and 40 % to the regional background level.

Based on a comparison with direct emission ratios from tailpipe exhaust, the anthropogenic contribution to acetone mixing ratios could be attributed almost completely to secondary photochemical production (99 %), with only a minor contribution from direct fuel combustion emissions (1 %). Based on direct measurements of ecosystem scale fluxes, the biogenic contribution to acetone mixing ratios could be attributed to direct emissions (34 %), methylbutenol oxidation (65 %), and terpene oxidation (1 %).

TITLE:

Influence of Site Factors on P Cycling in Douglas-fir and Cedar Stands of California and Washington

Authors: Emily E.Y. Greinke, B.J. Cade-Menun, J.G. McColl, and **R.L. EDMONDS**

ADDRESS OF LEAD AUTHOR:
University of California, Berkeley
Department of Environmental Science, Policy and Management
327 Hilgard Hall
Berkeley, CA 94720-3110
(510) 299-2603
egreinke@nature.berkeley.edu

Abstract:

Forest soils from different climatic regions may contain different P forms. Soils of the Pacific Northwest, with cool, moist, reducing conditions, often contain more complex P forms than those of the Sierra Nevada, CA, with warmer, drier, oxidizing conditions. This study investigates the role of climate and decomposition on P cycling in these two contrasting regions. Sierran study sites are located at Blodgett Forest Research Station and Challenge Experimental Forest; WA sites are on the Olympic Peninsula. In each state, stands of ectomycorrhizal Douglas-fir and arbuscular mycorrhizal cedar (incense cedar in CA; western red cedar in WA) were chosen for investigation. Soil analysis using classical analytical techniques and ^{31}P-NMR spectroscopy suggest that climate may not be the primary factor controlling P forms: tree species and mycorrhizae may be important. Under cedar stands in WA, 80% of total P was organic compared to 30% under Douglas-fir there. In CA, differences between species were smaller.

In addition to dramatic climatic differences, the CA and WA sites differ in soils and vegetation. A measure of relative decomposition rates was used to integrate these disparate site factors to help interpret the P data. White birch tongue depressors were buried for 6, 12, and 16 months and analyzed for mass loss, C, N, and other elements. After 6 and 16 months, sticks buried in WA had greater mass loss than those buried in CA. These sampling dates followed relatively warm, dry periods in CA compared to warm, moist conditions in WA. For any given mass loss after 6 months, sticks buried in WA had greater C/N values than those buried in CA. These differences were not found between species in either state. These data together with soil and vegetation analysis will be used to synthesize a best fit model to help explain differences in P cycling among the study sites.

TITLE:
Survival and Early Growth of Conifers in Group Selection Clearings

AUTHOR: Robert C. Heald

ADDRESS OF LEAD AUTHOR:
Co-Director
Center for Forestry
University of California, Berkeley
College of Natural Resources
Blodgett Forest Research Station

4501 Blodgett Forest Road
Georgetown, CA 95634
(530) 333-4475
bheald@nature.berkeley.edu

Abstract:

Six native commercial conifer species – ponderosa pine, Douglas-fir, white fir, sugar pine, incense cedar, and giant sequoia – were planted on north/south and east/west transects through a range of group selection clearing sizes. Circular openings of ¼, ¾, 1 ½, and 2 ½ acres were each replicated three times in a 1996 timber harvest. The openings were cut in 80 year old, naturally regenerated Sierra mixed conifer stands at Blodgett Forest Research Station in El Dorado County, California. The stands averaged 120 feet in main canopy height with 80% to 100% upper canopy cover density. The stand surrounding the openings was not harvested and remains as densely stocked tall tree margin surrounding each group regeneration clearing.

The clearings were prepared for planting by piling harvest debris with a rake on a small crawler tractor. The piles were burned during the winter of 1996-1997. All six conifers were double planted at 10 foot spacings beginning in each cardinal direction at the residual surrounding tall tree canopy drip line through to each opening center. Germinating shrubs and thistles were hand weeded each summer from 1997 through 1999. Non tree vegetation has never reached the 1% cover level. White fir, Douglas-fir, and incense cedar trees were protected from possible deer and rabbit browsing by 3 foot tall vexar tube covers.

Initial (fall 1997) mortality varied significantly by species: giant sequoia-3%; incense cedar-11%; ponderosa pine-13%; sugar pine-11%; Douglas-fir-13%, white fir-39%; but rarely by group opening size. Only the 1 ½ acre openings had regularly less average mortality among the species. Duplicate plantings at each spot were removed at the end of the third growing season. Net occupancy at the 10'x10' spacings ranged

from near 100% (giant sequoia, incense cedar) to 95% (Douglas-fir, sugar pine, ponderosa pine) and 85% for white fir.

After three growing seasons, average height of seedlings trended slightly up from the smallest (1/4 acre) through largest (2 ½ acre) openings for each species. This trend was significant only for giant sequoia (45% height increase from ¼ to 2 ½ acre groups) and incense cedar (56% increase from ¼ to 2 ½ acre groups). Average seedling height varied significantly among species, ranging from 117 cm for giant sequoia and incense cedar in 2 ½ acre openings to 38 cm in sugar pine in ¼ acre gaps.

Distance from surrounding residual tall tree canopy drip line (outside group perimeter) effected seedling height in interesting and varied patterns. For ¾ acre groups for all species the smallest (5%) trees averaged 9 feet from tall canopy edge while the largest (5%) seedlings averaged 47 feet from the residual canopy edge. Median distance from the edge for all ¾ acre clearing study trees was 30 feet. For 2 ½ acre openings, the smallest (5%) trees averaged 49 feet from tall canopy edge while the largest (5%) seedlings averaged 68 feet from the residual canopy edge. Median distance from the edge for all 2 ½ acre clearing study trees was 65 feet. Thus, taller seedlings were significantly more toward the center of ¾ acre gaps while not different than average distance from edge in 2 ½ acre openings. The shortest seedlings in both ¾ and 1 ½ acre gaps were close to the gap edge.

Distance from edge in ¼ acre openings were anomalous. The tallest giant sequoia and incense cedar seedlings were closer to the tall tree perimeter canopy drip line (north edge where the most sunlight is received) than the shortest giant sequoia and incense seedlings. Douglas-fir, white fir, ponderosa pine, and sugar pine in ¼ acre openings showed no significant trends in height as a function of distance to group edge.

TITLE:
The influence of understory vegetation on soil organic matter dynamics in California forest plantations

AUTHORS: W.R. Horwath, T. Winsome, R. F. Powers, and K. M. Scow

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

Abstract:

The growing emphasis on plantation forestry as a primary source of forest products requires that forest managers maximize yield through intensive management and frequent rotations. Careful stewardship of soil quality is thus critical to ensure long-term sustainable yields. Removal of understory vegetation and non-commercial tree species to facilitate replanting and increase tree yield is a common practice to reduce competition for moisture and nutrients. However, recent research suggests that changes in litter composition due to understory removal may lead to a decrease in soil quality. Our research will address this problem through a long-term field investigation of the influence of litter quality (mixed species vs. single-species litters) on soil organic matter (SOM) dynamics in ponderosa pine plantations.

Our central hypothesis is that mixed-species litters have a beneficial influence on the decomposer community (soil microorganisms and fauna) resulting in enhanced soil quality by increasing the amount of SOM and its nutrient content. Our approach will be to carry out a 2-year incubation of single and mixed-species litter labeled with stable isotope tracers (^{13}C and ^{15}N) in plantations with and without understory. The isotope tracers in conjunction with chemical and biological analyses of SOM constituents will be used to follow quantitative changes in microbial populations and nutrients in the litter and SOM. Our overall objective is to apply our data to the development of practicable strategies to preserve soil quality and enhance productivity of forest plantations.

TITLE:

How Do Eight Different Clearcut Buffer Widths Affect Stream Temperature, Riparian Microclimate and Aquatic Organisms?

AUTHOR: CAJUN JAMES

ADDRESS OF LEAD AUTHOR:

Ph.D. Candidate
Department of Environmental Science, Policy and Management
University of California, Berkeley

P.O. Box 879, Anderson, CA 96007
(530) 244-9144
cjames@spi-ind.com

Abstract:

Currently, the California Board of Forestry and the National Marine Fisheries Service are proposing regulations to determine new buffer widths for Watercourse and Lake Protection Zone's adjacent to Class I, II, and III streams (California Forest Practice Rule 936.4). Much speculation exists on the impact of harvesting next to streams. However, few studies have collected both pre and post harvest measurements to determine the extent of the impacts of harvesting on the riparian zone. The focus of this pilot study was to detect changes in microclimatic edge effects, stream water temperature and the response of aquatic organisms following timber harvesting adjacent to a perennial watercourse. Eight different buffer widths ranging from 23m to 92m were harvested and monitored during the months of August, September and October 1999. The abiotic and biotic variables measured included: stream water temperature, air temperature, ground temperature, soil temperature, soil moisture content, relative humidity, insolation, precipitation, wind speed and wind direction, benthic macroinvertebrates and vegetative canopy cover. This experiment was conducted on Millseat Creek, a Class I stream, located in Shasta County, California. To date, I have only analyzed the stream water temperature data. No significant effect on stream water temperature was found following any of the 8 different buffer widths in this experiment. This spring I will finish work on the microclimate edge effects and the aquatic insect data sets. The results of this study will offer policy makers and forest managers a solid foundation to assess the potential ecological impacts of harvesting different buffer widths adjacent to a perennial, Class I, watercourse. This experiment was performed in conjunction with Dr. Morgan Hannaford of Shasta Community College and Sierra Pacific Industries.

TITLE:

Assessment and Recommendations for Site Index Models and Stand Site Index Estimation Procedures in California

AUTHOR: Bruce Krumland

ADDRESS OF LEAD AUTHOR:

Associate Research Specialist – Programmer/Analyst
University of California, Berkeley
Department of Environmental Science, Policy and Management

145 Mulford Hall
Berkeley, CA 94720-3114
(510) – 339-3248
brucek@california.com

ABSTRACT

SITE INDEX HAS BEEN, AND IN ALL LIKELIHOOD, WILL CONTINUE TO BE THE PRIMARY MEANS OF RATING THE PRODUCTIVE CAPACITY OF FORESTLAND IN CALIFORNIA. THE PRIMARY USES OF SITE INDEX IN THE STATE ARE 1) COMPLIANCE WITH BOARD OF FORESTRY (BOF) REGULATIONS; 2) INDEPENDENT VARIABLES IN GROWTH AND YIELD MODELING AND 3) REQUIRED INPUT FOR GROWTH AND YIELD FORECASTING. THIS STUDY PROPOSES TO EXAMINE THE STATE OF SITE INDEX MODELS CURRENTLY IN USE IN CALIFORNIA, METHODS USED TO ESTIMATE STAND SITE INDEX, AND PROVIDE RECOMMENDATIONS BASED ON THE CURRENT STATE OF KNOWLEDGE AND DATA AVAILABILITY. IMPETUS FOR THIS STUDY HAS COME FROM SEVERAL SOURCES, CHIEF OF WHICH ARE:

a) In both the Coast and Sierra regions of the state, two or more site index models are currently in use for several major commercial conifer species. Different models can produce stand site index estimates that differ by as much as two full site classes.
b) Stand site index estimation rules requires both an applicable site index model and a tree selection (sampling) rule. Tree selection rules are often vague in applications requiring stand site index. Informal analysis indicates that differences in site tree sampling rules based on 'main canopy trees', representative dominants/codominants, tallest 100/acre, 'best tree', etc can be in excess of one site class for a given research plot.

c) Common growth simulators in use in the state require site indices by species. Quite often, only one or two species are 'measured' for site index. The remainder are 'guessed' at. Estimators for site index relationships between species in different environments are sparse.

d) Informal experimentation with common growth simulators (Cryptos, Cactos, Systum-1) indicates that an increase in site index of about one site class results in an increase in predicted growth of 10-30+% depending on stand conditions. It would appear that the accuracy of site index estimates has a highly significant impact on stand specific planning.

.....In general, there are problems in the application of the site index concept in California that affect its accuracy as a forest management tool. These include bias, precision (measurement rules/ sample sizes), and consistency (sampling rules). Recent suggestions of using remeasured permanent plot site trees as an alternative to stem analysis have shown to be promising in evaluating and developing site index modes. This project aims at an ongoing assimilation of all available permanent growth plot records and stem analysis into one state wide data base. Best recommendations will be published periodically.

TITLE:

Provenance Variation in Giant Sequoia Plantations

AUTHOR: William J. Libby

ADDRESS OF LEAD AUTHOR:
Professor of Forestry and Genetics
Emeritus
University of California, Berkeley

28 Valencia Road, Orinda, CA 94563
(915) 376-5896
100232.213@Compuserve.com

[*This research was not actually done at Blodgett, but populations included in the studies (particularly Whitaker Forest-Redwood Mountain) are used in research at Blodgett]*

Abstract.

In general, organisms that are long-lived and sessile maintain high levels of genetic variability. Research begun in the 1970s in Germany, California and New Zealand consistently indicates that giant sequoia is an exception to that generalization, with only modest levels of within- and among-population genetic variation. Furthermore, the expected reasonably-predictable changes in such adaptive traits as spring flush, height growth and diameter growth with differences in grove latitude, longitude or elevation could not be demonstrated in these common-garden tests.

Last year, as reliable histories and measures of tree numbers and areas occupied became available for the groves sampled for these studies, it began to look like logging history and grove size were both related to performance of samples of these groves in common-garden plantations. I've now completed analyses of 16- and 22-year data of four experiments, three nearby at Foresthill and one on South Island, New Zealand. Analyses of height, diameter, and volume, the variances of these measures, their coefficients of variation, and ratios of upper-half and lower-half data, all implicate grove size in offspring performance. Offspring from groves that have been heavily logged grow better than those that have been lightly logged, and those from unlogged groves grow the least. However, that appears to be an artifact, as the largest groves were logged the most and the smaller groves were generally left alone.

An interesting fallout from these analyses was that the statistical significance of among-grove differences were consistently and substantially increased when only the upper or lower halves of the data were analyzed. Although "n" was halved, within-grove

variances were sufficiently reduced while among-grove differences stayed at similar levels, thus accounting for the increased significance levels.

The results suggest that inbreeding is implicated, and future molecular or biochemical analyses of inbreeding structure of the various native groves will probably be interesting. Meanwhile, it is suggested that seeds for production plantations be obtained from the larger groves, and that landraces broadly based on several groves may be even better.

These results are being prepared for journal submission.

TITLE:

The Effect of *Heterobasidion annosum* Infection in Ponderosa Pine on the Feeding Behavior of the Bark Beetle, *Ips paraconfusus*

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

Address of Lead Author:
University of California, Berkeley
Division of Insect Biology
Dept. of Environmental Science, Policy, and Management
201 Wellman Hall
Berkeley, CA 94720-3112
(510) 642-5538
wmcnee@nature.berkeley.edu

Abstract:

Bark beetle-pathogen-tree interactions include the preferential colonization of disease-weakened trees by bark beetles, and the vectoring of pathogens such as those causing pitch canker and Dutch elm disease. Following infection by a pathogen such as *Heterobasidion annosum*, changes in the physiology of pines are known to occur. These include the production of resins, resin acids, and stilbenes, and reduced concentrations of nutrients such as sugars and amino acids. It has been hypothesized that fungal infection in a host tree may make the phloem more or less stimulatory to bark beetle feeding, due to changes in the tree's biochemistry or to metabolites produced by the pathogen, or to a combination of both. Our research group has been studying the feeding behavior of the California five-spined ips, *Ips paraconfusus*, in response to: 1) extra-cellular metabolites from a liquid culture (broth) of *Heterobasidion annosum*; 2) pathogen-induced metabolites present in the phloem of infected trees; and 3) the intact phloem of *H. annosum*-infected ponderosa pine.

Bioassay of broth extracts indicated that significantly lower feeding occurred in both polar and non-polar preparations originally containing the pathogen, compared to a control broth from which the fungus was absent. Pinosylvin and pinosylvin methyl ether had no observed effects on feeding over the range of concentrations used in this study. After accounting for inter-tree variation in phloem thickness, the mean length of phloem in the digestive tracts of male *I. paraconfusus* feeding in trees inoculated with *H. annosum* was significantly lower than in those beetles feeding in trees which were uninoculated or mock-inoculated and did not contain the pathogen.

TITLE:

Soil Surface CO_2 and Its Spatial and Temporal Variation in a Young Ponderosa Pine Plantation in California

AUTHORS: Ming Xu and Ye Qi

ADDRESS OF LEAD AUTHOR:

Ph.D Candidate
Ecosystem Dynamics and Management
University of California, Berkeley
Department of Environmental Science, Policy and Management

207 Giannini Hall
Berkeley, CA 94720-3310
(510) 643-3263
mingxu@nature.berkeley.edu

Abstract:

We examined soil surface CO_2 efflux in an 8-year-old ponderosa pine plantation in Sierra Nevada Mountains, California, from June 1998 to August 1999 using an LI-6400 Soil CO_2 Flux System. We established two 20'20 m sampling plots and measured soil CO_2 efflux and soil temperatures (10 and 20 cm in depth) on a 3'3 matrix spacing 10 m apart in each plot. Microbial biomass, fine root (<5 mm) biomass, and soil physical and chemical properties were also measured at each sampling location. We found that the mean soil CO_2 efflux in the plantation was 4.43 mmolm-2s-1 in growing season and 3.12 mmolm-2s-1 in nongrowing season. The annual maximum and minimum CO_2 efflux was 5.87 and 1.67 mmolm-2s-1 respectively with the maximum occurring in the end of May and early June and the minimum in December. The dirunal fluctuation of CO_2 efflux was relatively small (<20%) with the minimum appearing around 9:00 and the maximum around 14:00. Daytime measurements of soil CO_2 efflux overestimated the daily average of soil CO_2 efflux by 4-6%. Using the measurements between 9:00 a.m. and 11:00 a.m. (local time) to estimate the daily mean soil CO_2 efflux can reduce the sampling error to 0.9-1.5%. The spatial variation of soil CO_2 efflux was high with a coefficient of variation around 30%. The relationship between soil CO_2 efflux and soil temperature was significantly controlled by soil moisture with the Q10 value of 1.4 when soil moisture <15% and 1.8 when soil moisture >15%. A model including soil temperature and moisture explained 76% and 95% of the variance of soil

CO_2 efflux when moisture <19% and >19% respectively. Microbial biomass, fine root biomass, soil nitrogen content, organic matter content, and magnesium content were significantly and positively correlated with soil CO_2 efflux, whereas bulk density and pH value were negatively correlated with CO_2 efflux. Soil temperature and moisture explained most of the temporal variation in soil CO_2 efflux, but they explained little spatial variation of CO_2 efflux. The spatial variation of CO_2 efflux was well explained by microbial biomass, fine root biomass, and soil physical and chemical properties.

TITLE:

Uncertainties in Estimating Terrestrial Carbon Budget by Ecosystem Models: Lessons from the Blodgett Measurements

AUTHORS: Ye Qi and Ming Xu

ADDRESS OF LEAD AUTHOR:
Assistant Professor
University of California, Berkeley
Department of Environmental Science, Policy and Management

207 Giannini Hall
Berkeley, CA 94720-3310
(510)643-0259
yqi@nature.berkeley.edu

Abstract:

Ecosystem models are essential tools for estimating the terrestrial carbon budget. Assumptions about parameters and relationships among variables are necessary due to incomplete knowledge and data about the systems. However, uncertainties associated with the models are often not as explicit as needed for understanding the carbon budget. We examined a number of formulations of plant and soil respiration and the uncertainties of parameters based on our measurements at Blodgett Forest. We found that estimates of respiration terms alone may result in an uncertain range much greater than normally specified in the results of various of ecosystem models. For example, the Q10 value deduced from our measurements of soil temperature and respiration is about 1.4, 30% smaller than Q10 = 2.0 used in the Terrestrial Ecosystem Model (Mellilo 1993, Tian 1998). This difference in Q10 may result in more that 50% difference in soil respiration at temperature of 20oC. Both spatial and temporal variations are considered in extrapolating site measurements. Bootstrap method is introduced to characterize the uncertainties.

TITLE:

Initial Inventories and Future Research Possibilities at Whitaker Forest

AUTHOR: Frieder G. Schurr

ADDRESS OF LEAD AUTHOR:
Assistant Properties Manager
Center for Forestry
University of California, Berkeley
4501 Blodgett Forest Road
Georgetown, CA 95634
(530) 333-4475
freschur@nature.berkeley.edu

Abstract:

Whitaker Forest is a 320-acre forest property located in the Giant Sequoia-Mixed Conifer vegetation type on the western slope of the southern portion of the Sierra Nevada Mountain Range. The property was donated to the University by Horace Whitaker in 1910 who originally bought the property to stop logging of the Old growth Giant Sequoia that grew there in the late 19th century. Research commenced at the forest in 1915 when management responsibilities for the property were given to the new School of Forestry at the Berkeley Campus. Most of the initial research was spearheaded by Professor Woodbridge Metcalf and later by Professor Harold Biswell. Much of the data and results from this research are not readily available. Efforts are underway to find and organize any of these data.

The Center for Forestry received management responsibilities for Whitaker Forest in 1998. During 1999 the Center has been evaluating the property for current and future research opportunities. Contact has been made with both the National Park Service (Sequoia/Kings Canyon NP) and the United States Forest Service (Sequoia National Forest). These two entities, along with Whitaker Forest control 99% of the Redwood Mountain Giant Sequoia Grove and have expressed great interest in a cooperative research project investigating restoration possibilities for GS groves. Research would look at a range of manipulation strategies ranging from purely mechanical methods to purely natural processes (fire) with a range of combinations in between for restoration. The primary goal of such research would be to determine the physical conditions needed for the long term growth, regeneration and maintenance of Giant Sequoia-Mixed Conifer ecosystems.

The first step in the research was to create a set of base information for the forest. A full forest inventory of 87 1/10th acre plots was established during the summer of 1999. Plot data included tree, regeneration, fuel, snag, and understory vegetation information. Approximately 50% of these plots were also used to conduct a multi-level terrestrial vertebrate inventory.

In addition, a 100% survey of Old Growth Giant Sequoia trees and stumps was conducted. This survey collected all the data collected for trees and stumps for the 1/10th acre plot data as well as information on fire scares, distance to water and physical locations for each stump or tree.

The data is currently being analyzed to get an initial understanding of the distribution of old growth GS across the landscape prior to the harvesting in the late 19th century as well as the success of regeneration of GS and other mixed conifer species during the intervening 130 years.

TITLE:

A Study Of The Consequences Of Fire And Fire Surrogate Treatments

AUTHOR: Scott L. Stephens

ADDRESS OF LEAD AUTHOR:
Assistant Professor of Fire Science and Ecology,
CALIFORNIA POLYTECHNIC STATE UNIVERSITY,
NATURAL RESOURCES MANAGEMENT DEPARTMENT
San Luis Obispo, CA. 93407

(805) 756-2751
sstephen@calpoly.edu

Abstract:

Many North American forests, especially those with historically short-interval, low- to moderate-severity fire regimes, are too dense and have excessive quantities of fuels. Widespread treatments are needed to restore ecological integrity and reduce wildfire hazard in these forests. Among possible restorative treatments, however, the appropriate balance among silvicultural cuttings, mechanical fuel treatments, and prescribed fire is often unclear.

To support better decision making, we need much better information about the ecological and other consequences of alternative management practices involving fire and silvicultural "fire surrogates." To address this problem a network of 11 sites will be established with most sites located in western coniferous forests (including Blodgett), with a smaller number in southern pine and central hardwoods. The proposed research is intended to assess a wide range of ecological and other consequences of producing and maintaining one or more desired stand conditions using (1) cuttings and mechanical fuel treatments alone (i.e., without fire), (2) fire alone (via multiple prescribed burns), and (3) a combination of cuttings, mechanical fuel treatments, and prescribed fire. Untreated controls will also be included. Each study site will include 3 replications of these four core treatments (including control). Each treatment plot will be approximately 14 ha in size (including buffer). Linking results across research sites will be enabled not

only by common treatments, but also by a common set of response variables and measurement protocols.

These core response variables and protocols have been determined by and coordinated among several teams of scientists representing broad disciplinary groups-fire and fuels, vegetation, wildlife, entomology/pathology, soils, and utilization/economics. Funding has been obtained through the U.S. Joint Fire Science Program, Washington D.C.