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Change in Reporting Schedule

The written reporting schedule to the Memorandum of Understanding Partners (MOUP) has changed from quarterly to annually. The purpose of this report is to summarize the past year's work accomplished, findings, and challenges. Updates are also usually given to MOUP during quarterly conference calls throughout the year. All reports and updates are posted to the SNAMP website at [http://snamp.cnr.berkeley.edu/](http://snamp.cnr.berkeley.edu/). Note that this report covers the time period from Jan 1 2009 to current, except the Fisher team which may include results from the entire 08/09 winter season. Research summaries are main highlights only. Each science team also communicates their work at Integration Team meetings, SNAMP field trips and workshops, presentations at scientific conferences, and publications in scientific journals.

Project Integration and Management (John Battles)

1) Overall Goal

Our work is divided into three themes: fostering science integration; managing the SNAMP budget; and serving as a communication hub within the Science Team (UCST) and to the MOUP. Our overarching goal is to ensure that at the end of this project, UCST will deliver SNAMP's intended result: a multi-resource assessment of US Forest Service land management practices on Water, Wildlife, Fire, Forest Health, and Public Participation on a fireshed scale using an adaptive management framework, innovative research, and stakeholder participation. The work of the Spatial Team is fundamental to fulfilling the science integration and innovative research goals. Our team works to keep the Science Team functional as an integrated whole, building science integration and ensuring that teams will be able to report their findings on a common scale – the fireshed.

2) What Has Been Done – and Learned – in 2009

Nuts and bolts project management

- SNAMP budget, contracts and grants administration
  - Negotiated a 15% temporary budget reduction of science team budgets to temporarily compensate for the state funding shortfall.
  - Worked with state and federal SNAMP partners to arrange for forwarded funds from USFS to help cover state funding shortfall.
- Communication with MOUP
  - Maintained regular communication with MOUP members
  - Reached agreement between UCST and USFS Districts to delay treatments in Water Team treatment catchments for both study sites until 2011.
  - Swiftly dealt with housing issues that arose at Forest Service barracks.
  - Coordinated all reports to MOUP and conference calls.
  - Co-coordinated SNAMP 2009 Annual Meeting on October 20th.
- Internal UCST communication
  - Led and organized 2-day “All UCST Scientists Meeting” on September 17-18th.
o Coordinated data integration workshop between Spatial, Water, and FFEH teams to discuss data-model integration and to explore information needs from LiDAR results.

o Maintained frequent, open communication with all science teams.

o Led and organized bimonthly UCST conference calls.

o Prepared and distributed monthly team updates to all science teams.

o Visited teams in the field, attended IT meetings and workshops.

o Maintained collaborative internal UCST website (bSpace).

Science Integration
We held an “All UCST Scientists” meeting on September 17th and 18th. The purpose of the meeting was to accomplish two main goals: 1) achieve a working understanding among teams of SNAMP research to date, and 2) build science integration between teams by identifying specific areas for collaborative research.

We completed a preliminary vegetation classification system for both study sites. We used the FFEH forest inventory tree data and perform a cluster analysis on the total basal area of live trees for each plot to categorize the plots into broad tree-based vegetation classes. This work will be used by the forest health research, and can be used as a starting point for the development of a vegetation map for the two study sites.

Dr. David Saah, a member of our team, led and completed the analysis for the first SNAMP meta-analysis study. Dave and the others of the study (see Research Products) compared the performance of a range of management strategies currently being implemented on US Forest Service lands in the Sierra Nevada. Five studies were selected based on their data availability: Sagehen Experimental Forest, the Last Chance SNAMP research site, and the Sugar Pine SNAMP research site, which are all implanting strategically placed land area treatments (SPLATs), while the Plumas-Lassen Administrative Study has implemented defensible fuel profile zone (DFPZ) treatments. For comparison, they also included the Kings River Experimental Watershed where an uneven-aged management strategy is planned.

Initial results indicate that all management strategies were successful at changing fire behavior to differing degrees. Both real-world SPLAT and DFPZ designs seemed to work as predicted. For example SPLAT fuel treatments that covered approximately 1/3 of Sagehen Creek Basin could be arranged in the landscape so that key aspects of the fire behavior were modified for the entire fireshed. The highly detailed field approach proved to be generally consistent with landscape level datasets (ie LANDFIRE) when designing fuel treatments. And most importantly, the judgment of local experts is essential to obtaining models with realistic fire behavior and support from affected communities.

3) Plans for the Rest of 2009 and 2010
We will continue to work towards the goals stated previously (item no.1). In the next year, we will also explore ways to have a consistent statistical framework across the various disciplines of the SNAMP project. We will look into inviting a statistician to work with the Science Team to advise us
on error propagation to accurately assess uncertainty in our models, scaling issues, and statistically appropriate methods for combining datasets from the different teams.

We will facilitate science integration by following up with teams on specific integration ideas that were suggested at the UC Science Team Meeting in September, and coordinate sub-team science integration workshops. We will hold another UC Science Team meeting in 2010. Dave Saah will submit a manuscript to publish the results of the meta-analysis study. We are considering potential topics for the next meta-replication study.

We will continue to look for ways to standardize common metrics between teams, so they are able to be combined for analysis at a common scale. Last year we worked with teams so they collected tree canopy data in a consistent way. Next year we will work with teams so they collect data on treatments in all SNAMP study areas in a consistent manner.

4) Integration Efforts Initiated or Completed in 2009 – Please refer to item no.2.

5) Research Products in 2009

David S. Saah presented Meta-analysis of fire hazard assessments within the Sierra Nevada of California at the Annual Meeting of the Ecological Society of America on August 5, 2009. Other authors for the study include: John J. Battles, Scott Stephens, Peter A. Stine, Max A. Moritz, Carolyn Hunsaker, Brandon Collins, Jason Moghadas, David J. Ganz, Kurt Menning, Kevin Deniz, and Travis Kay-Rugen.

John Battles presented SNAMP as an example of a federal-state partnership working to address pressing questions regarding the management of the natural resources. Presentation included a poster display and table at a reception for Congressional members and their staffs. SNAMP was invited to represent the best effort of UC Berkeley’s collaborative partnerships. Reception was part of the National Association of State Universities and Land-Grand Colleges Conference in Washington, D.C. on March 23, 2009.

John Battles presented a poster at the American Geophysical Union’s Annual Meeting (December 2008). Title: “Research design for hydrologic response to watershed treatments in the mixed conifer zone of California’s Sierra Nevada” by John Battles, Roger Bales, Martha Conklin, Philip Saksa, and Sarah Martin.

6) Current and Near-term Challenges

Currently, the greatest challenge to keeping SNAMP running is the delay in state funds for the Spatial and Water Teams. The US Forest Service has forwarded funds that are covering a portion of the Spatial Team until the Department of Water Resources state funding can be released. However, the UC Merced Spatial Team members have been operating with no funding for months. The Water Team is also operating with no funding, except for direct support for one researcher’s salary and previous equipment purchases.
Because of past and current state funding delays for the Water Team, the Water Team is behind the other research teams for some of their critical parameters by two years. The UCST has requested a one year delay in treatments for the Water Team catchments, which will give them at least one year of pre-treatment data, but possibly not the two years of pre-treatment data laid out in the original study plan.

The continual work involved in managing the funding shortfalls since the beginning of the SNAMP project in 2007 threatens the innovative quality of SNAMP research because it displaces time and effort that could be spent on science.

**SNAMP Budget**

As noted above, the absence of state funds for the water and spatial team are clearly the most pressing budget questions. The Department of Water Resources remains supportive but they do not yet have the funds to spend. We also never identified additional sources to replace the anticipated $123,000 of funding from the second Sierra Nevada Conservancy Grant (SNC). It was a component of our Year 3 funding. Even before the suspension of funds, we seemed unlikely to qualify given the revised funding guidelines issued by the SNC. This shortfall together with suspension of approximately $50,000 in Year 2 funding from SNC required the UCST to reduce its non-DWR supported budget by 15%.

We have managed this reduction (Table 1). No team is more than 5% over budget (FFEH). The balance for the fisher team is exaggerated. There was late summer turnover of two full time wildlife technicians. By August ledgers we had seen the separations but not the new rehires. Also we know that the UC Davis necropsy lab is notoriously late in sending their bills. In short, we seem “on budget” for Year 3 in regard to USFS funding.

We have also recently received permission to use approximately $32,000 of the suspended Year 2 funding we received from the Sierra Nevada Conservancy. However, we are still working through the details and this added funding is not reflected in these budget projections.

Year 4 funding projections are difficult to make at this point. We expect increases in our costs related to increases in UC benefit but these increases have not been set. We are continuing efforts to raise support from foundations and other sources but there are no prospects on the horizon. The USFS did increase their direct support (8,000 over Yr3 and 19% over their baseline). However, the key is DWR funding. There is no way to replace the extent of their contribution and maintain the core goals of SNAMP.
Table 1. Summary of expenditures of the Sierra Nevada Adaptive Management Project for Year 3 from 1/1/09 - 8/31/09. Budgeted amounts were based on reduced Year 3 budget. Received amounts reflect actual transfers of funds to the contracting institutions. Balance reflects account balance as of 8/31/09. Encumbered amounts reflect funds already committed to pay salaries (as specified in hiring agreements) and ordered supplies/services. Projected balances are the difference between available funds and encumbered funds. All amounts in USD($).

<table>
<thead>
<tr>
<th>Research Theme</th>
<th>Contracting Institution</th>
<th>Budgeted Year 3</th>
<th>Received 1/1/09</th>
<th>Balance 8/31/09</th>
<th>Encumbered thru 12/31/09</th>
<th>Projected Balance 12/30/09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial¹</td>
<td>UC Berkeley²</td>
<td>37,328</td>
<td>37,325 (bridge from USFS)</td>
<td>20,891</td>
<td>pending</td>
<td>Pending</td>
</tr>
<tr>
<td></td>
<td>UC Merced³</td>
<td>46,953</td>
<td>0</td>
<td>--</td>
<td>--</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>Imagery</td>
<td>0</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Fire and Forest Health</td>
<td>UC Berkeley</td>
<td>188,581</td>
<td>188,581</td>
<td>59,488</td>
<td>70,175</td>
<td>-10,687</td>
</tr>
<tr>
<td>Wildlife</td>
<td>UC Berkeley (fisher)</td>
<td>548,510</td>
<td>548,510</td>
<td>253,961</td>
<td>100,945</td>
<td>153,016</td>
</tr>
<tr>
<td></td>
<td>U Minnesota (owl)³</td>
<td>155,422</td>
<td>155,422</td>
<td>?</td>
<td>155,422</td>
<td>0</td>
</tr>
<tr>
<td>Water¹</td>
<td>UC Merced³</td>
<td>254,343</td>
<td>0</td>
<td>--</td>
<td>--</td>
<td>?</td>
</tr>
<tr>
<td>Project integration</td>
<td>UC Berkeley</td>
<td>128,368</td>
<td>128,368</td>
<td>16,280</td>
<td>14,869</td>
<td>1,411</td>
</tr>
<tr>
<td>Public participation</td>
<td>UC Cooperative Ext⁴</td>
<td>126,214</td>
<td>126,214</td>
<td>?</td>
<td>126,214</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>UC Berkeley</td>
<td>80,286</td>
<td>80,286</td>
<td>37,023</td>
<td>29,036</td>
<td>7,987</td>
</tr>
<tr>
<td>TOTAL</td>
<td>UC Science Team</td>
<td>1,566,005</td>
<td>1,264,706</td>
<td>387,643</td>
<td>496,661</td>
<td>151,727</td>
</tr>
</tbody>
</table>
NOTES

1. Spatial and water components are funded by DWR. We have not yet received Year 3 DWR funding. Also budgeted amounts reflect initial estimates yet due to delays in receipt of funding, revised estimates of imagery costs, and direct purchase of equipment, both the spatial and water budgets will need to be revised to reflect these changes.

2. Allocation to Spatial-Berkeley in Year 3 was bridge funding provided by USFS. The expectation is the DWR funding will replace these funds when available. Bridge funds were necessary to make commitments to graduate students working on the project.

3. We do not yet track subaward finances as closely as the awards held at UC Berkeley. However, given USFS information needs, we have asked for monthly ledgers from the subaward institutions and have been providing this information directly.

4. The public participation subcontract with UC Cooperative Extension was from 1 May 08 to 30 April 2009. Thus it is the only award that extends past the calendar year for Year 2. Year 3 started on 1 May 1, 2009 and continues to 30 April 2010.
1) **Overall Goal**

One of the central questions of the SNAMP and thus the priority for FFEH is:

> **How well do strategically placed area fuel treatments (SPLATs) reduce the fire risk and fire hazard across the entire fireshed?**

In terms of forest health, we have built on the idea that tree survivorship is an essential component of forest health. It is also a parameter that we think we can quantify the impact of landscape treatments at a relevant management scale (i.e., the fireshed). We acknowledge that canopy tree survivorship does not encompass the totality of the forest ecosystem. But at the same time, it is hard to envision classifying any forest as “healthy” with an abundance of dead and dying trees. In short, we are arguing that tree survivorship is a necessary but not sufficient condition of forest health. Determining a sustainable level of tree mortality is an important question but given our BACI design, we have narrowed our question to:

> **Does forest management in the treated firesheds significantly shift the tree vulnerability profiles relative to the changes observed in the reference firesheds?**

2) **What has been done - and learned – in 2009**

**Field and laboratory work**

The field work necessary to characterize the composition and structure of the forests and develop the necessary information for the fire models was completed in 2008.

Also in 2008, we completed the field collection of pairs of tree cores. We used a case control sampling approach where the “case” is a recently dead tree (rare, hard to find) and then matched it with a “control” (a nearby tree of the same species and size). From both sites we collected 1,553 pairs from six conifer species. During the last year, we have been analyzing these cores on a species by site basis. To date, we have complete, cross-checked ring width chronologies for 30% of these cores.

**Table 1.** Update on tree ring collection and analysis. Field work was completed in August 2009. Laboratory work is ongoing.

<table>
<thead>
<tr>
<th>Tree status</th>
<th>Collected (field)</th>
<th>Prepared (mounted/sanded)</th>
<th>Analyzed (rings read)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model pairs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Live</td>
<td>1553</td>
<td>56</td>
<td>567</td>
</tr>
<tr>
<td>Dead</td>
<td>1553</td>
<td>140</td>
<td>353</td>
</tr>
<tr>
<td>Pre-treatment samples</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Live only (includes subsamples with 2 cores per one tree)</td>
<td>1194</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
In 2009, we completed the field collection of tree cores from live trees for both sites (Table 2). These cores will be analyzed to build pre-treatment vulnerability profiles. Currently these cores are air-drying and in the queue for analysis. Once dried, cores can be processed at a rate of 2 per hour. During the last year, we have developed a quality control and quality assurance manual for the analysis of tree cores with particular attention to the challenges of reading dead trees accurately.

Table 2. Pre-treatment tree core samples from research firesheds. To construct robust vulnerability profiles for each species, target sample size is 100 samples. Sampling was stratified by size class. Sampling was concentrated in intensive watersheds in both treatment and reference firesheds.

<table>
<thead>
<tr>
<th>Species</th>
<th>Last Chance</th>
<th>Sugar Pine</th>
</tr>
</thead>
<tbody>
<tr>
<td>White fir</td>
<td>113</td>
<td>151</td>
</tr>
<tr>
<td>Sugar pine</td>
<td>98</td>
<td>91</td>
</tr>
<tr>
<td>Red fir</td>
<td>91</td>
<td>17</td>
</tr>
<tr>
<td>Ponderosa pine</td>
<td>126</td>
<td>79</td>
</tr>
<tr>
<td>Incense-cedar</td>
<td>103</td>
<td>85</td>
</tr>
<tr>
<td>Douglas-fir</td>
<td>110</td>
<td>not present</td>
</tr>
</tbody>
</table>

Public participation and education. In 2009, the FEFH team led two public field trips to discuss the concept of forest health and to provide a hands-on experience with our approach. Each meeting included a detailed hand-out, specifically designed for a public audience that explains the concept of forest health in general followed by explanation of the SNAMP approach – namely the development of tree vulnerability profiles. Field trip exercises allowed participants the chance to core trees and inspect the core for evidence of survival probability. We also wrote a brief primer on forest health that we have shared with many audiences.

Ecologically informed transfers of survival probability models. One of the major limitations of any empirically based model is the data demand. In our case, we need to collect live/dead pairs of cores (approximately 100 each for every species) and then develop growth chronologies. The effort in terms of person hours just to collect and process our model data (1,553 core pairs Table 1) is approximately 1,800 person-hours (equivalent to 45 weeks for one full-time technician). We have been working on approaches to transfer survival models developed at one site or for one species to other sites and similar species (e.g. white fir models for red fir).

We have identified two factors particularly relevant to our comparison of pre-treatment to post-treatment response: 1) differences in population size structure, and 2) differences in stand age. Treatments will clearly influence both of these parameters. Our initial results
show that ecologically informed transfers of these models can perform well without additional data. For example, changing the measure of annual growth from absolute measures that seem to work best in all-sized forests (unmanaged mature forests) to relative measures that seem to work best in more even-sized forests (e.g., managed forests). For sugar pine, we found that relative measures of growth provided more discrimination between dead and live trees (Fig. 1).

Figure 1. For sugar pine trees in a managed forest, relative measure of growth (1b, 1c) provide better separation in growth trend between live and dead trees.

Since these relative measures are calculated from the same data, performance is improved without having to collect additional data. Also encouraging was the nearly equivalent performance of models developed for one species and then applied to similar species in the same genus. For example, a white fir survival model predicted red fir survival from the growth record as well as a model built for red fir.

3) Plans for the Rest of 2009 and 2010
Our immediate emphasis is to continue processing the tree core samples. As cores are completed for each species, we will develop the master chronologies necessary to estimate the age of our dead trees. With a complete set of cores for live and dead trees, we will use growth rates and trends to build the most reliable predictors of tree survival following the
approach described in Das et al. (2007). Our objectives are to have survival probability models for the major species finished by May 2010.

Once we have survival models for all species at both sites, we will build the pretreatment vulnerability profiles. Thus by the end of 2010, we want to have our pre-treatment (i.e., baseline) assessment of forest health completed.

We also plan to continue the work on the ecologically informed transfer of survival models. We have a manuscript that is nearly ready for submission to Forest Ecology and Management. Continue working on the southern SNAMP site to evaluate potential fire behavior and effects. We will collaborate with the spatial team in this work and will incorporate the information generated from their analysis of the LiDAR data.

4) Integration Efforts Initiated or Completed in 2009

All of the forest inventory data has been uploaded the UCST data server and has been made publically available to UCST colleagues, the MOUP, and the public.

We also produced a summary of the forest composition and structure by forest type for Sugar Pine as part of a public meeting to discuss the planned fuel treatments.

At the all-scientists meeting, we started the discussion among UCST regarding a more inclusive definition of forest health that integrates results from other science teams (e.g., water quality, sensitive species habitat, fire hazard, public perception). We will continue this effort in 2010.

5) Research Products in 2009

Two publications were written this year, one is currently in press at the Journal of Forestry and the 2nd is currently in review at Forest Science. Abstracts from these publications are given below:

Brandon Collins, Scott Stephens, Jason Moghaddas, and John Battles

Challenges and approaches in planning fuel treatments across fire-excluded forested landscapes

Placing fuel reduction treatments across entire landscapes such that impacts associated with high-intensity fire are lessened is a difficult goal to achieve, largely due to the immense area needing treatment. As such, fire scientists and managers have conceptually developed and are refining methodologies for strategic placement of fuel treatments that more efficiently limit the spread and severity of fire across forested landscapes. While these methodologies undoubtedly improve managers’ ability to plan and evaluate various landscape fuel treatment scenarios, there is still a considerable gap between modeling landscape fuel treatments and actually implementing these treatments “on the ground.” In this paper we explore this gap in light of decisions managers make with regards to the type, intensity, placement/pattern, and size of fuel treatments. Additionally, we
highlight several critical constraints acting on managers when implementing fuel treatments across landscapes and offer some suggestions for dealing with these constraints. Journal of Forestry (in press).

Brandon Collins, Scott Stephens, Gary Roller, and John Battles

Simulating fire and forest dynamics for a coordinated landscape fuel treatment project in the Sierra Nevada.

Both the extent at which recent wildland fires are impacting forests and the increasing magnitude of fire-related effects necessitate landscape-scale mitigation efforts. We evaluate an actual coordinated landscape fuel treatment project that was designed by local U. S. Forest Service managers in the northern Sierra Nevada. We model the effectiveness of this project at reducing landscape-level fire behavior at multiple time steps, up to nearly 30 yr beyond treatment implementation. Additionally, we modeled treatments under multiple diameter-limited thinning scenarios to assess potential impacts on fuel treatment effectiveness. As designed, the coordinated fuel treatments reduced modeled burn probabilities and fire sizes substantially across the landscape. This reduction was evident approximately 20 yr following simulated treatment implementation. Although diameter-limited thinning scenarios resulted in different forest stand structures, we detected no real differences in modeled landscape-scale burn probabilities and fire sizes. The modeling adaptations we made with respect to fuel model selection and simulated regeneration/ingrowth over simulated time, as well incorporation of variable winds in fire simulations, collectively contribute to a robust analysis of the study area. (in review at Forest Science)

6) Current and Near-term Challenges for FFEH
We see no obstacles to meeting our goals for 2010.
Public Participation Team (PPT)
The following summary includes updates for STRATEGIC FACILITATION (Kim Rodrigues), PROGRAM ANALYSIS (Lynn Huntsinger), and INTERNET DISCUSSION BOARD AND WEBGIS Internet Discussion Board (Maggi Kelly).

1) Overall Goal
Our goal is to contribute to the development of effective forest management for fire hazard reduction by developing and modeling best practices for public participation, and by researching the institutional arrangements that enhance or constrain the ability to manage Sierra forests and engage the public in that management. Below is an outline of our Team’s efforts in 2009.

I. Best practices for participation
   - Modeling participation, including our commitment to facilitation, transparency, opportunities for face-to-face communication among stakeholders, the public, and scientists.
   - An interactive website that engages stakeholders, the public, and scientists in dialogue about management and research for SNAMP.
   - A commitment to pursuing social and environmental equity in our relationships with each other and the public.

II. Institutional arrangements for management
   - How is participation and stakeholder engagement achieved within the SNAMP/current management framework?
   - Are we successfully using adaptive management and does this integrate with participation?
   - What is the impact of a third party science and outreach provider?

2) What was Done – and Learned – in 2009
Outreach activities
The pace and scale of SNAMP public outreach increased dramatically in the last year reaching 1760 people (duplicated, some people counted more than once) through 71 separate events during fiscal year 2008-2009 (see graphs below). This increase is a consequence of assembling a full UC Cooperative Extension (UCCE) outreach team, including a southern site program representative (hired in October 2007), an advisor (May 2008), and a northern site representative (July 2008). UCCE staff made connections to the local communities and across the state to increase public participation in the project and foster two-way learning between the science team, the public and project partners.

Events organized by PPT included the following: Integration Team meetings and the annual SNAMP meeting (co-organized with PIM team); field trips and lectures by other SNAMP science teams; individual presentations to local, state and regional groups about SNAMP; and representing SNAMP at non-SNAMP events.
Integration Team (IT) meetings: Integration Team meetings are held to engage the public, the University of California, and natural resource agencies in a process of mutual learning as we proceed through the adaptive management cycle. Part of each meeting is devoted to learning about UC research and data, as well as USFS treatments, so that the participants in the IT can evaluate and understand the tradeoffs as research information is integrated within the adaptive management project and into Forest Service management.

IT meetings held during this time period include:
- Fisher mitigations in the treatment design fieldtrip, Sugar Pine, October 08
- Treatment design for fisher with the USFS, North Fork, February 09
- Public Participation Team, May 09 (see below for more detail)
- Fisher Team, Fresno, July 09
- Owl Team, Foresthill, August 09

PPT facilitated field trips and presentations by other SNMP science teams:
- Owl team field trips in Foresthill, May and July 09
- Fisher Team presentation to the Mountain Home School in Oakhurst, May 09
- Forest Health Team fieldtrips in Oakhurst, May 09 and Foresthill, August 09
- Water team field trips in Oakhurst and Foresthill, August and September 09
- Spatial Team Lidar workshops in Foresthill and Oakhurst, June 09

Other PPT facilitated events:
- SNAMP Annual meeting, Sacramento, November 08
- PPT - Forest Service Workshop, Sacramento, January 09 (see below for more detail)

Individual presentations were made to:

**Oakhurst area**
- Fresno County Board of Supervisors
- Kern County Board of Supervisors
- Mariposa Resource Conservation District
- Tuolumne Resource Conservation District
- Mariposa Chamber of Commerce
- Oakhurst Board of Realtors meeting
- San Joaquin Valley Society of American Foresters
- Oakhurst area 4H camp
- Jack Boyd's Outdoor Ed School

**Foresthill area**
- Placer County Board of Supervisors
- El Dorado Fire Safe Council
- Sac-Tahoe Society of American Foresters
- Amador-El Dorado Forest Forum
- Central Sierra Resource Conservation Districts
- Nevada County Fire Safe Council
- The Divide Home & Business Show
- Foresthill Forum
- Foresthill High School Regional Occupational Program
- Wildfire on the Divide'
- Foresthill Lions Club
- American River Ranger District All Hands Meeting
Other:
- Sierra Day at the Capital, Sacramento
- CA Indian Partnership Fair, Chico
- Sierra Nevada Alliance Conference, King’s Beach
- Society of American Foresters National Convention, Reno
- UC Cooperative Extension County Directors

Total Participation at SNAMP Public Involvement Events since 12/05
(1760 including duplicated)

SNAMP Public Involvement Events per Month (71 events)
Report to USFS January 27, 2009 Sacramento, CA: Research results were presented to district rangers, regional personnel, and public relations representatives of the USFS by the research arm of the PPT with input from the outreach side as well. Data were presented from assessment of USFS NEPA processes in the two study sites as well as preliminary interview data.

Highlights of Preliminary Research Findings on the NEPA Process

- Experience was generally positive.
- An institutionalized requirement giving them a guaranteed opportunity to comment.
- An important benefit of the NEPA process was networking with other people who cared about the topic.
- About half of those interviewed said they felt heard during the NEPA process.

Highlights of Preliminary Interview Results

- Though concerned or frustrated with Forest Service management and responsiveness, local level, face to face contact is appreciated.
- They see many barriers to Forest Service responsiveness
- Recognize USFS constraints: funding limits, litigation and personnel changes
- Almost all believe “adaptive management” a good idea.
- Many definitions of ‘forest health’: this could be examined in conjunction with the Fire and Forest Ecosystem Health team.

Public Participation Team’s IT Meeting May 19, 2009 Davis, CA: This IT meeting covered the website, outreach, and research sides of the PPT. The purpose of this meeting was to inform stakeholders about SNAMP public participation research, get feedback on outreach strategies, and further develop how best to include the public in adaptive management.

Newsletters: The PPT published the following newsletters this year:
- Spring 2009 SNAMP Newsletter: Vol. 3 No. 1 - Public Participation Team
- Fall 2008 SNAMP Newsletter: Vol. 2. No 3 - Spatial Team
- Fall 2008 SNAMP Newsletter: Vol 2. No 2 - Spotted Owl Team Research.
All are available at the SNAMP website.

Website: The SNAMP website (snamp.cnr.berkeley.edu) received 6,555 hits last year (2008-2009), of those 3,273 visits were unique. Recently, our weekly rate is about 200 hits per week. Our users come from 98 countries, but the US and California are the most important country and state. In California, we have regular users from across the state. Nearly half of our users are first time viewers, and another third of our users return numerous times. Their interests are varied. The most popular page on the website is the general front page, followed by the fisher team page, the documents page, the about page, and the events page. We continue to update the website daily and have started sending out an email every
other month containing links to new items on the website to encourage visitation and improve transparency.

**Research Activities**
During 2009 the research portion of the PPT completed the first round of interviews regarding SNAMP with MOUP, USFS, and the public focusing on active and lightly active participants as well as non-participants, culminating in a total of 35 interviews. These interview transcripts have been coded and entered into the social software analysis program called NVivo. In addition, historical interviews were completed in the southern site. Initial review and analysis of the USFS NEPA processes was presented to the USFS in January 2009 (see above) as well as draft interview results presented at the IT meeting in May 2009 (see above). The team has also focused on creating an evaluation framework for the analysis of the overall SNAMP program based in the literature for public participation, collaborative management, and adaptive management as well as interview data from participants in SNAMP.

3) **Plans for the Rest of 2009 and 2010**

**Outreach:** Outreach will include hosting of the SNAMP annual meeting and Integration Team meetings with each SNAMP science team. We anticipate the next IT meetings to be with the Fire Forest Ecosystem Health and the Water Teams. We also hope to host an educational workshop with project partners on science best practices including making inferences and modeling. We are planning a media outreach campaign to coincide with treatment implementation. We will continue to reach out and present information on SNAMP to local, state, and regional groups.

**Web:** Over the next year, the web team will maintain and continue to develop the website to increase access and transparency as well as develop a manuscript that focuses on the role of the web in adaptive management.

**Research:** The research arm of the PPT will finish the local historical work and complete historical interviews in the northern site; conduct interview and observational data analysis; contribute to publications of which the PPT has three in draft form; and continue to develop the evaluation framework for the overall SNAMP program analysis. Eventually we may conduct a second survey towards the end of this period or the beginning of the next, with the appropriate permissions.

4) **Integration Efforts Initiated or Completed in 2009** - Included above.

5) **Research Products in 2009**

Results presented at USFS and IT workshops, development of evaluation framework as described above, continued development to paper on co-management and other publications as described above.

6) **Current and Near-term Challenges**

**Outreach:** Our challenge is to keep up to date with the science team findings, and anticipate the information needs and desires of the public and partners as the project matures. In addition, we will need to stay flexible about our media campaign, as the actual dates of treatment implementation of the USFS projects are not yet known.

**Research:** No specific challenges save continued financial support.

**Web:** No specific challenges foreseen.
Wildlife

A. Pacific Fisher (Reg Barrett)

1) Overall Goal

Our overall project goal is to develop detailed information on habitat occupancy, resource use, survival, reproduction, and dispersal by Pacific fishers in and around landscapes altered by fuel reduction treatments. These data will be used to assess the potential impacts of fuel reduction treatments on fishers, and to identify the current population limiting factors for fishers in the southern Sierra Nevada.

2) What Has Been Done – and Learned - from October 15, 2008 to October 15, 2009

- We completed the second complete year of camera-based surveys for fishers in the SNAMP Fisher Study Area. A total 120 1-km² grids were re-surveyed in the Key Watersheds area, and fishers were detected in 66 of those grids (55% naïve occupancy). 345 grids were surveyed for fishers over the entire study area, and fishers were detected in 204 of all surveyed grids (59% naïve occupancy).

Figure 1. Distribution of 1 km² grids in the SNAMP Fisher Project area that were surveyed with camera traps during the period from October 15, 2008 to October 11, 2009. Blackened grids are those where fishers were detected.
As part of our effort to evaluate how fuel reduction treatments may contribute to changes in resource use and survival of fishers, we used location records from aerial radiotelemetry to estimate the number of adult-aged fishers actively using the Key Watersheds area based on home range overlap. Fixed kernel home range analyses were calculated using location records collected from August 2008 to February 29, 2009, and the total number of animals using the Key Watersheds was calculated as the sum of the proportion of each adult fishers’ home range included within the boundary of the Key Watersheds. During the period from August 2008 to February 29, 2009, a total 8.5 adult fishers (2.8 adult males and 5.7 adult females) were identified as using some part of the Key Watersheds to forage, reproduce, and for refuge.

In association with camera surveys performed during 2008-09, we completed an assessment of a habitat suitability model developed by the Conservation Biology Institute (Spencer et al. 2008) for Pacific fishers in the southern Sierra Nevada. All 1 km² grids in our study area were assigned to one of four habitat suitability groups based on the mean CBI value for each grid determined by analyses in ArcGIS. Approximately equal numbers of grids in each group were then identified for camera surveys in three different regions of the study area. Camera surveys that were completed in these randomly selected grids, in addition to data from all 120 grids in the Key Watersheds, provided good support for the CBI Fisher Habitat Model: *empirical estimates of occupancy were higher in grid areas with higher predicted habitat suitability.*

Figure 2. Summary of results from camera surveys during January to April 2009 for assessing the efficacy of the CBI Fisher Habitat Model for predicting fisher occurrence in the Sierra Nevada. For additional details please refer to our presentation at the Fisher Integration Meeting in Fresno on July 15, 2009 (http://snamp.cnr.berkeley.edu/documents/254/).

During the current reporting period we captured and radiocollared 24 individual fishers. We are presently monitoring 25 collared fisher in the study area. From January to October 2008 we had previously captured and monitored 27 total individual fishers.
During the current reporting period we documented 13 mortalities of collared fishers, and two mortalities of noncollared fishers. Both current year mortalities of noncollared fishers were roadkills along Highway 41 in Yosemite National Park. From January to October 2008 we had previously documented five mortalities of radiocollared fishers and two mortalities of noncollared/unknown fishers.

Combined information on mortalities from the first two years of research indicated that predation, roadkill, and disease were the three most important sources of mortality for fishers in our study area.

Necropsies completed on the carcasses of recovered fishers indicated that three of our collared fishers died by active infection with canine distemper virus, and one animal died from exposure to *Toxoplasma gondii*, a protozoan parasite increasingly common among carnivores.

DNA analyses by one of our collaborators revealed that bobcats killed two of our collared fishers, and that mountain lions killed two of our collared fishers. DNA tests to determine the carnivores responsible for the other five predator-killed fishers are either inconclusive or not yet completed.

We identified 12 natal den trees and 25 maternal den trees used by adult female fishers in our study area during the March to June denning season this year. Information on the locations of known den trees was provided to Bass Lake Ranger District Wildlife Biologist Kevin Williams to aid the Forest Service in management for buffer areas around den structures.

Thirteen of 16 adult females in the study area produced kits during spring 2009 (81%). Fecundity was estimated as $1.45 \pm 0.52$ kits/female for 11 of these adult females in 2009.

Preliminary analyses of data on survival of radiocollared fishers in our study population revealed that the overall pattern of survival was the same for male and female fishers (i.e., there were no sex differences in survival). Survival for radiocollared fishers was significantly lower during the spring period (0.47, 95%
confidence interval 0.26 – 0.64), compared to the rest of the year (0.74 95% C.I. 0.52 – 0.89). Also, we estimated that the overall annual rate of survival the study area was 0.67 or 67% (95% C.I. 49 – 80%) during the period from April 1, 2008 to March 31, 2009.

- During this reporting period we have been working in collaboration with the Kings River Fisher Study to integrate GPS radiocollar technology into our research plan. In spring 2009 we deployed two prototype mini-GPS radiocollars on fishers in the SNAMP Fisher Study area to assess function and reliability. The results were mixed; one of the collars ceased functioning 10 days after being deployed, whereas the other worked well during the 2.5 months it was on the study animal. Following repairs and several design improvements to the prototype collars by the manufacturer (Telemetry Solutions, Concord, CA), we recently deployed three mini-GPS radiocollars on fishers in the study area, including two on fishers residing within the Key Watersheds. We anticipate that GPS collars will provide detailed information on foraging habitats used by fishers during the evening and nighttime when it is very difficult to monitor them using standard radiotelemetry or fixed wing aircraft.

3) The Plan for rest of 2009 to October 2010

- We have already initiated our Year 3 Camera Survey, which will be a major ongoing research activity over the next 11-12 months.
- Daily aerial radiotelemetry flights will continue for determining survival status and locations for radiocollared fishers.
- Intensive research to locate den trees and to estimate reproduction and fecundity will be initiated in mid March 2010.
- Analyze and summarize data from 1st two years of research.
- Continue to maintain a high level of research activity for achieving project goals and objectives.

4) Integration Efforts Initiated or Completed in 2009

- Fisher Integration Meeting, Fresno, July 15, 2009. Here we provided a status report on the SNAMP Fisher Project, as well as detailed information on the diverse sources of fisher mortality identified during the research. We also presented an overview of the types of data we will generate annually for use in understanding the management status of fishers in the Key Watersheds and across the study area.
- See below for presentations we have given in different forums to disseminate and integrate our research.

5) Research Products in 2009

SNAMP Fisher Study Presentations:

- Annual Meeting Western Section of The Wildlife Society, January 22, 2009, Sacramento CA.
- Forest Carnivore Working Group, January 23, 2009, Sacramento, CA.
6) **Current and Near-term Challenges**

- Although we are working diligently to integrate GPS radiocollar technology into our research methods, the devices are very costly ($2600/unit) and our budget will constrain us from deploying more than 4-5 GPS radiocollars on study animals at any one time.
- Winter access to most of our study area requires snowmobiles due to deep snow conditions. We currently have two snowmobiles available for the project. A 3rd project snowmobile would greatly improve our ability to perform field research during winter.
- The salaries we offer our project staff are low compared to the salaries of biologists performing similar research for the Forest Service. We have been unable to reward our high performing staff with salary increases because of the statewide fiscal crisis and the debilitating effects of budget cuts on the University of California system. The result has been low morale and relatively high turnover.
- Staffing levels – our project is in critical need of one additional staff position to aid with project paperwork and database management.
B. SPOTTED OWL (Rocky Gutiérrez)

1) Overall Goal

We will assess the potential effects of SPLATs on spotted owl occupancy, survival, and reproduction. We will continue to participate in Owl Integration Team (IT) meetings and other public outreach efforts involving all interested stakeholders.

2) What Has Been Done - and Learned – in 2009

2009 Field Surveys: On the Last Chance Owl Study Area, we resighted (or captured and banded) 9 owl pairs and 1 single bird (see Table 1 below) and assessed their reproduction. We identified 6 nests and we banded 7 out of the 8 fledglings. We completed 4 rounds of night surveys in the Last Chance Owl Study Area. We completed post-treatment vegetation surveys at the HeyJoe SPLAT site for the units that had been treated by August 2009.

We revised the owl team workplan in May 2009 to include data collected on the Eldorado Study Area as part of the SNAMP data set.

We acquired land ownership information for all parcels on the Eldorado and Last Chance Owl Study Areas. Information was obtained from the Eldorado and Placer County Assessor's Offices.

We acquired shapefiles for 2008-2009 timber harvest activity from Lone Star Timber Company, the primary private landowner on both owl study areas. We are still waiting for timber harvest shapefiles from SPI.

Table 1. Spotted owl occupancy and reproduction at territories within the Last Chance Owl Study Area, April–August 2009.

<table>
<thead>
<tr>
<th>Territory</th>
<th>Social Status</th>
<th>Repro Status</th>
<th>Number Fledglings</th>
<th>Male</th>
<th>Female</th>
<th>Replacements</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHILL</td>
<td>Unoccupied</td>
<td>NA</td>
<td>0</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>DEADN</td>
<td>Unoccupied</td>
<td>NA</td>
<td>0</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>DEADW</td>
<td>Unoccupied</td>
<td>NA</td>
<td>0</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>DIXQM</td>
<td>Pair</td>
<td>Nest</td>
<td>1</td>
<td>Resight</td>
<td>Resight</td>
<td>Male from HARDC '08</td>
</tr>
<tr>
<td>GLENN</td>
<td>Pair</td>
<td>Nest</td>
<td>2</td>
<td>Resight</td>
<td>Resight</td>
<td>Female from GLENN '07</td>
</tr>
<tr>
<td>GREEK</td>
<td>Pair</td>
<td>Nest</td>
<td>2</td>
<td>Resight</td>
<td>Resight</td>
<td>Male from DIXQM '08</td>
</tr>
<tr>
<td>HARDC</td>
<td>Pair</td>
<td>No</td>
<td>0</td>
<td>Resight</td>
<td>Resight</td>
<td>Male from DEADW '08</td>
</tr>
<tr>
<td>LASTC</td>
<td>Pair</td>
<td>No</td>
<td>0</td>
<td>Resight</td>
<td>Resight</td>
<td></td>
</tr>
<tr>
<td>MOSQU</td>
<td>Pair</td>
<td>No</td>
<td>0</td>
<td>Resight</td>
<td>Captured</td>
<td>Male from GREEK '08</td>
</tr>
<tr>
<td>OAKFL</td>
<td>Pair</td>
<td>Nest</td>
<td>1</td>
<td>Resight</td>
<td>Resight</td>
<td></td>
</tr>
<tr>
<td>SAIIFL</td>
<td>Pair</td>
<td>No</td>
<td>0</td>
<td>Resight</td>
<td>Resight</td>
<td></td>
</tr>
<tr>
<td>SCREW</td>
<td>Pair</td>
<td>Nest</td>
<td>1</td>
<td>Resight</td>
<td>Resight</td>
<td></td>
</tr>
<tr>
<td>SECCA</td>
<td>Single</td>
<td>No</td>
<td>1</td>
<td>Resight</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>SUMMARY</td>
<td>9 Pairs/1 Single</td>
<td>5 Nests</td>
<td>8 Fledglings</td>
<td>10 Resights</td>
<td>8 Resights / 1 capture</td>
<td>5 Replacements</td>
</tr>
</tbody>
</table>
3) The Plan for Rest of 2009 and 2010

Rest of 2009: We will continue to update our vegetation classification map for the owl study areas using Digital Orthophoto Quads. We will construct occupancy and capture-recapture survey histories for the data collected thus far (2007-2009).

2010: From April to August, we will continue to survey the Last Chance Owl and Eldorado Study Areas. We will conduct post-treatment vegetation surveys at SPLAT sites that are be completed by the summer of 2010.

4) Integration Efforts Initiated or Completed in 2009

We led 2 field trips this past summer. The first was attended by Foresthill High School students, and the second was attended by members of the public and staff from the American River Ranger District (Tahoe NF).

We participated in an Owl IT meeting in August 2009 at Foresthill, CA.

We shared the public/private landowner information that we obtained for both owl study areas (see above) with the Spatial Team. We also shared the owl nest locations within the Last Chance Owl Study Area with the Spatial Team, and we are currently collaborating with them on a publication regarding the use of Lidar in assessing spotted owl habitat conditions.

We shared owl detection data with the USFS and posted all owl data from the Last Chance Owl Study Area onto the SNAMP Science Team data server.

5) Research Products in 2009

We are collaborating with the Spatial Team on a manuscript which is currently in the draft stages (see above).

6) Current and Near-term Challenges

We anticipated completing more post-treatment vegetation surveys at SPLAT sites. However, some treatments were delayed or had not started by the end of our field season. Nonetheless, we should be able to complete post-treatment vegetation surveys in future years.
1) **Overall Goal**

The goal of the Water Team is to better understand the timing and movement of water through the catchments (i.e. - how and when the water beginning as precipitation, moves through the system as soil moisture and eventually reaches the stream, exiting the system as discharge) and to look at the effects forest treatments might have on the route and timing of the water, and its effect on erosion. Our working hypothesis is that treatments will alter the timing of flows and increase water quantity in the streams. Any changes in water quality (such as turbidity) will be due to in-stream changes from the increased discharges.

2) **What Has Been Done - and Learned - in 2009**

Over the past year we have installed 150 soil moisture sensors at all sites, as well as water quality sondes and pressure transducers for stream stage in all four study streams. This compliments the snow sensors and meteorological stations that were installed previously. During installation of the soil moisture sensors, bulk soil and core samples were taken for each location. The core samples were analyzed for moisture and bulk density. Other field efforts have included resurveying bank erosion pins in the Sugar Pine catchments and establishing permanent cross-sections in the Last Chance catchments for continued measurements of in-stream erosion. Efforts have also focused on repairing and strengthening infrastructure for the upcoming snow season due to minor damage from rodents and snow loads. Finally, we have been working on setting up the DHSVM hydrologic model.

As data streams have begun to come in and preliminary analysis has begun, two important concepts have come to light. Based on our preliminary analysis of the 2009 snowmelt season, stream characteristics such as stage, dissolved oxygen, turbidity, specific conductivity, and temperature seem to track well between our control and treatments catchments (Figure 1, next page). This suggests that control and treatment pairs were well chosen and that comparisons between treated and controlled catchments should be solid. Storm and melt events match up well with subsequent stream response in our meteorological and stream data (Figure 2, next page). Reviewing data and field observations over the year, it has also become apparent that stream response variables are tied to water quantity. Improved discharge measurements are needed for more precise stream measurements.
Last Chance Stream Data  
Spring 2009 Snow Melt

Figure 1. Data from water quality sondes for two month period during spring snow melt shows that parameters track well between treatment (Frazier) and control (Bear Trap). Gaps and missing Frazier Creek data are due to battery failure.

Last Chance Storm Sequence Data  
Spring 2009 Snow Melt

Figure 2. Meteorological data for two month period during spring snow melt showing multiple storm and melt events. The first event shows a drop in air temp associated with storm fronts, precipitation falling as snow, and little to no stream signal (precipitation held in snow pack and doesn’t enter stream). The later event shows a rain dominated storm, marked by a steep increase in depth and turbidity (rain transmitted to stream channel).
3) The Plan for Rest of 2009 and 2010
We continue to make progress on installation of a weir and stilling wells at our stream sites for accurate discharge measurements. Plans are being finalized for drilling auger holes to obtain the depth to bedrock at Big Sandy Creek. These measurements will serve as control points for a ground-penetrating radar survey of the area, from which we will be able to determine bedrock depth over our entire proposed weir location. Once we have the bedrock surveyed, the feasibility of building a weir can be determined and construction plans will be drawn up and carried out as soon as possible.

We are now completing the process of wiring up all the soil moisture sensors installed this summer and programming the data loggers to record measurements. Along with strengthening our existing instrument infrastructure, these will be finished before snowfall for the winter season. Periodic field visits will be done throughout the winter to download data and maintain instrumentation.

In the spring, we plan on making stream discharge measurements to improve the rating curves and taking water samples. The information obtained from these activities will be critical to meeting our stated project goals. Stream erosion measurements (cross section and bank pin surveys) will be done following snowmelt. Summer field work will most likely involve installation of a wireless network throughout our sites. This will reduce instrument failure due to wiring problems and enable remote real-time data streams for all our instruments, not just the met stations.

Assuming we receive both scour pans (or possibly scour chains) and ISCO automatic water samplers, we will install both as quickly as possible, given field conditions. Bulk soil samples obtained during the summer will undergo texture and nutrient analysis. We will be parameterizing DHSVM and RHESSys hydrological models with our distributed soil moisture and snow data, as well as the spatial data sets for vegetation and vegetation. Our pre-treatment and control basin will be used for model calibration. Both models will be used to predict changes in stream flow and sediment delivery.

4) Integration Efforts Initiated or Completed in 2009
Within the UCST, we have communicated with the Spatial Team regarding our needs for hydrological model inputs. This includes the LiDAR elevation model, individual tree product, and canopy cover product, along with potential Leaf Area Index and understory products. To support this effort, we have assisted the Spatial Team in gathering Leaf Area Index measurements from both sites. Organized by the Public Participation Team, we have also led public field trips at both sites this past summer.

Outside of the UCST, we have collaborated with multiple public agencies to collect and provide data. Working with the Sierra National Forest, we have been able to collect stream erosion measurements for our streams at Sugar Pine. Additionally we are working with the ARS Northwest Watershed Research Center to determine the location, design, and construction of a weir at Big Sandy Creek and stilling wells at the other research streams. Finally we have continued to provide our meteorological station data publicly through the California Data Exchange Center (CDEC).
5) **Research Products in 2009**

- An overview presentation of SNAMP was given to the USDA Agricultural Research Service in Boise, ID.
- A poster was presented at the fall meeting of the American Geophysical Union in December 2008.
- Several presentations and publications are planned for next year.

6) **Current and Near-term Challenges**

Continued funding issues, tied to the state budget situation and associated funds provided by the Department of Water Resources, have delayed complete instrumentation of the research sites. Scour pans needed to measure stream bedload have been paid for, but are undergoing an engineering redesign at the only company that produces them, delaying production and delivery. We are also still waiting on order and delivery of the ISCO automatic water samplers. These delays have also interfered with obtaining supplies which has delayed fieldwork.

Obtaining good discharge estimations has been a challenge in these streams, which have extreme ranges of flow and a significant subsurface component. Installation of additional structures for measuring discharge, such as weirs and stilling wells, along with periodic field measurements, should improve these estimations.
1) **Overall Goal**

The spatial team will provide support for the other SNAMP science teams through spatial data acquisition and analysis; and conduct independent original research in processing and analysis of lidar and other spatial data.

2) **What Has Been Done - and Learned – in 2009**

**Data collection.** LiDAR for two study areas: Sugar Pine and Last Chance has been collected and delivered. We contracted with the National Center for Airborne LiDAR Mapping (NCALM) for our data. They collected the data using the Optech GEMINI instrument at approximately 600 m above ground level, with 67% swath overlap. The instrument collected 4 discrete returns per pulse at 125kHz laser pulse repetition frequency; the delivered data has an average density of 9 points per m².

**Data analysis.**

At the plot level, the following forest-related variables can be calculated at pixel size of 10m and larger. Notes on whether the data has been processed are in the text.

- Canopy Bulk Density – mass of available canopy fuel per unit volume (e.g. kg/m³); **IN PROGRESS**
- Canopy Base Height – the lowest height above the ground at which there is sufficient available canopy fuel to propagate fire vertically through the canopy; **COMPLETED for Sugar Pine**;
- Canopy Height – average height of the dominant and co-dominant trees; **COMPLETED for Sugar Pine**;
- Canopy Cover - horizontal percentage of the ground surface that is covered by tree crowns; **COMPLETED for Sugar Pine**;
- Diameter at Breast Height; **COMPLETED for Sugar Pine**;
- Leaf area index; Ground true data collected, upscaling; **IN PROGRESS**.

At the individual tree level, the following algorithms have been developed:

- Location of individual trees
- Individual tree height, DBH, crown size
- Stem map of trees; and
- Location of individual residual trees (e.g. > 45m in height).

The following ground-based variables can be calculated at pixel size of 1m and larger.

- Slope (%); **COMPLETED for Sugar Pine**;
- Aspect (degrees); **COMPLETED for Sugar Pine**;
- Elevation (m); **COMPLETED for Sugar Pine**.

3) **The Plan for Rest of 2009 and 2010**

Repeat the processing for the Last Change study area, and develop team specific products to meet the UCST need.
4) Integration Efforts Initiated or Completed in 2009

Extra-UCST efforts: The spatial team developed and presented two workshops for extra-UCST (although several UCST attended), one in each study area, in the summer of 2009. All workshop materials are available at the SNAMP website. In addition, all the aforementioned completed products are also available at the SNAMP data server at snamp.ucmerced.edu.

Intra-UCST efforts: We have also initiated several intra-UCST integration efforts, including Spatial/wildlife integration, Spatial/Fire integration, and Spatial/Water integration.

5) Research Products in 2009

Presentations:
SNAMP Lidar Workshops: June 2009
Ecosystem Sciences Seminar Series Presentation by Maggi Kelly, Nov. 2009

Articles:
Effects of Topographic Variability and Lidar Sampling Density on Several DEM Interpolation Methods by Guo et al, submitted to Photogrammetric Engineering and Remote Sensing

6) Current and Near-term Challenges

Our challenges are in continued budget support, man-power and time. The Spatial Team at UC Merced has not yet received Yr3 SNAMP budget; and there might be continued challenges in receiving state funding for the team.