Sierra Watershed Ecosystem Enhancement Project

Welcome to our first SWEEP newsletter! In these periodic letters to the public, we will explain the SWEEP project and highlight recent progress. In this first edition, we explain the project background, the science team and our the proposed study sites. For more information, please visit the project website at: http://ucanr.edu/sweep/.

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Inside this issue:

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For more information:
http://ucanr.edu/sweep/

Introducing SWEEP!

The goal of the Sierra Nevada Watershed Ecosystem Enhancement Project is to quantify the potential for thinning of Sierra mixed conifer forests to enhance the ecosystem services they produce including fire resiliency, carbon storage in trees, and water in streams. Much of the Sierra Nevada is covered with forests that are dramatically denser than before fire suppression policies led to extinguishing all wildfires over a hundred years ago. The forest is denser because smaller trees that would have been killed by fires have grown to mature size. Forest restoration involves thinning to reduce the density of trees and shift species composition to a more sparse and fire resilient historic level.

Today's denser forests are more prone to experiencing high severity fire in which most trees are killed and forest litter is consumed. This can lead to soil erosion, reduced ability of forests to absorb precipitation, and increased risk of flooding.

Compared to historic forests, dense forests store more of their carbon in smaller trees that historically would have been killed by frequent low and moderate severity fires. There is a higher risk in the Sierra Nevada of losing much of this stored carbon to high severity fires. Climate change also means that the risk of wildfire is increasing as the snowpack melts faster and the annual fire season is lengthening.

Dense forests also use more water than less dense forests and physically interfere with the ability of snow and rain to reach the forest floor. This decreases the amount of precipitation that is eventually discharged into streams and available for use by downstream water users. Dense shrubs will also transpire much more water than grassy meadows or bare ground.

Thinning reduces the number of smaller trees and removes ladder fuels which reduces wildfire risk and severity, meaning it is more likely that trees and ground cover will survive fires that do occur. This reduces the soil erosion potential created by wildfires. Biomass stored on site is more likely to maintained into the future. If forest products are captured from thinning, these products also store biomass. Thinning also reduces the amount of vegetation using water and so results in more precipitation, particularly snowmelt, infiltrating into the soil and eventually running off as stream water. In west-side Sierra forests, the snowpack provides an important seasonal storage of water that, when melted, is transmitted downstream and used throughout California.

Example of a dense Sierra Nevada watershed

SWEEP will use scientific methods to learn how forest thinning in the Sierra Nevada affects the fire risk, carbon storage and water yield provided. Water research will measure a number of hydrological parameters and will leverage instrumentation and results from other sites to rigorously quantify the effect of thinning on stream flow. We will then use economics to identify the value of increases in fire resiliency, carbon storage, and water yield in collaboration with forest stakeholders. Multiple research sites will be used to allow for analysis of how tradeoffs between these ecosystem services differ in different locations.

SWEEP Study Design

The field measurement program will collect data on high-density and intermediate-density forests, as well as on recently burned forests for another end-member point of comparison. This will inform analysis and modeling of how water yield will respond to both thinning and climate change over larger areas. This will allow us to develop a measurement framework to value ecosystem services to support potential future public and private investments.

The overarching goal is to use the American River area as an informative case study for measuring and valuing water-based ecosystem services, assessing the impact and importance of those services to local stakeholders, and determining competition between services.

For more information consult the SWEEP report: ***Forests and Water in the Sierra Nevada: Sierra Nevada Watershed Ecosystem Enhancement Project*** by Roger C. Bales, John J. Battles, Yihsu Chen, Martha H. Conklin, Eric Holst, Kevin L. O'Hara, Philip Saksa, William Stewart, November 29, 2011. Available online at: http://ucanr.edu/sweep/.

Snow covering a Sierra Nevada watershed. Snowpack accumulation will be measured by SWEEP.

SWEEP Parameters to be Measured

A suite of measurements will be collected during the SWEEP project, including:

- *Snowpack* accumulation and melting is measured by acoustic depth sensors.
- *Soil moisture* is measured by soil moisture sensors at multiple depths.
- *Stream runoff* is measured using stage recorders at natural control sections, and weirs or flumes.
- *Leaf area index* (LAI) is the sum of all the leaf surface areas projected downward per unit area of ground beneath the canopy. LAI will be calculated by felling about 10 trees (of varying sizes) per tree species and measuring all the area on the leaves allowing construction of a curve relating tree size to LAI.
- *Evapotranspiration* is the conversion of water (in the soil or within plants) into water vapor released to the atmosphere. This will be measured by sap flux, estimated using meteorological methods and through basin-scale water balances.

Additional meteorology, snowcover, soils and forest structure measurements are available from other research programs.

Key Project Tasks 2012-2015

•Determine rates of evapotranspiration (ET) in Sierran mixed-conifer/true fir forests
•Determine water use efficiency of trees and shrubs in Sierran mixed-conifer and true fir forests
•Determine the potential for forest management to delay snowmelt in Sierran forests
•Determine potential economic tradeoffs of forest management treatments to affect water yield and other ecosystem services
•Involve stakeholders in decision-making regarding forest management and watershed effects
In the 2012 summer season, we plan to start measurements needed to calibrate the 'forest/water' model.

Installing a snow measurement instrument in the Sierra Nevada.

Collaborating Project Locations

The Phase I SWEEP report identified catchments in the American River basin as potential research sites. Use of this watershed for SWEEP would allow for leverage of other ongoing research, and a committed and active group of stakeholders who recognize the need for the research. Further evaluation of project sites, involving additional measurements, and discussions and collaboration with local water and land managers will be done in the coming year. New research sites need to have a potential to undergo thinning treatments in the future and be suitable for stream and forest instrumentation.

Current research sites that are collaborating with SWEEP include:

- *Last Chance Project Study site*: Tahoe National Forest near Foresthill, Placer County, California, part of the Sierra Nevada Adaptive Management Project
- King's River Experimental Watershed: Sierra National Forest, part of the Critical Zone Observatory project

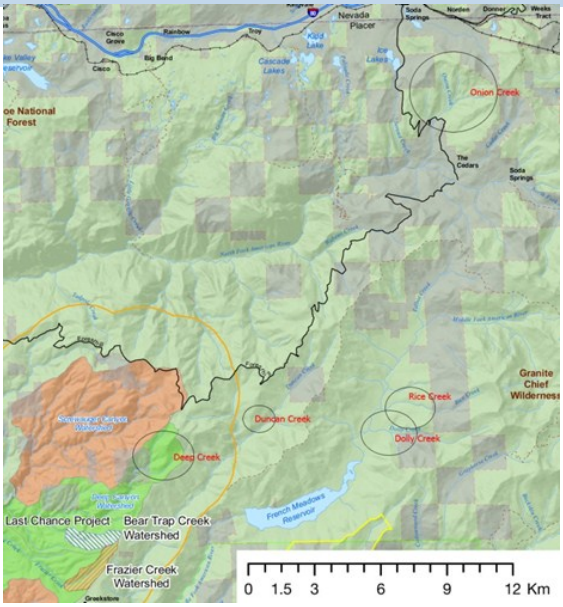

Figure 1. Location of field measurements, in Middle and North forks of American River-5 areas noted by circles and labeled in red. SNAMP study area shown in lower left.

Sierra Nevada mixed conifer forest with a range of different tree species and sizes.

Public Involvement in SWEEP

The Sierra Watershed Ecosystem Enhancement Project is actively encouraging involvement in the project by agencies, landowners and other stakeholders.

Stakeholder input is sought to help identify appropriate research sites, implement forest thinning treatments, and collaborate on the economic valuation of ecosystem services provided by the forest both before and after thinning.

We are planning a public meeting in Summer 2012 to get public input on SWEEP methods and design and explore connections with other ongoing forest and water yield research projects.

To be kept informed about SWEEP, please join the mailing list at http://ucanr.edu/sweep/

SWEEP People and Funds

The Sierra Watershed Ecosystem Enhance Project involves researchers from the University of California at Berkeley and Merced, the US Forest Service Pacific Southwest Research Station, the University of California Cooperative Extension, and non profits including the Environmental Defense Fund.

- Dr. Roger Bales, *University of California, Merced*, Hydrologist, rbales@ucmerced.edu
- Dr. John Battles, *University of California, Berkeley*, Forest Ecologist, jbattles@berkeley.edu
- Dr. Yihsu Chen, *University of California, Merced*, Economist, ychen26@ucmerced.edu
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- Dr. William Stewart, *University of California, Berkeley*, Forest Economist, billstewart@berkeley.edu

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Wireless Networks could Improve State Water Forecasting

A new wireless data collection system deployed at Duncan Peak, located near the town of Foresthill on the Middle Fork of the American River basin, is part of a prototype water information system for California. This extensively distributed sensor network will allow for better characterization on the amount of water stored in the snow and the soil throughout the watershed.

This wireless system is part of the research being conducted by University of California researchers as part of the Sierra Nevada Adaptive Management Project (SNAMP) to investigate the impacts of fuels treatment projects on water quality and quantity and how water is routed through catchments. Information collected from these wireless systems includes measurements of snow depth, temperature, relative humidity, soil moisture, and solar radiation. The data will also be integrated into models which will extend the results to areas where no measurements are being made.

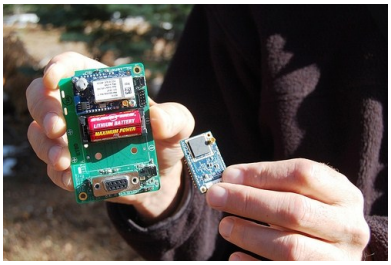
Using one base station to log all the measurements and broadcast out over the landscape, it connects wirelessly to sensors up to 350 feet away, a distance that can be extended multiple times by placing "hoppers," or signal relays, between the sensors and base station. This 'mesh network' insures multiple readings so no data is lost during transmission. Twenty more base stations are planned for instillation in the American River Basin.

The wireless system is made possible by the development of ultra-low power radios that can run on two AA batteries for up to two years and which can transmit data over long distances using the same technology as a home internet wireless network. Researchers Steve Glaser and Branko Kerkez from UC Berkeley, working with Roger Bales, have also installed a sensor network at their Critical Zone Observatory research site near Shaver Lake to monitor the same hydrologic variables as in the SNAMP sites. If the wireless system drops out due to extreme conditions, such as a snow storm or other malfunction, no problem! Each sensor also logs to a USB stick, from which the data can also be easily retrieved.

More precise estimates on water storage within a basin will lead to increasingly accurate predictions of water availability for use in hydropower, irrigation, habitat and household consumption.

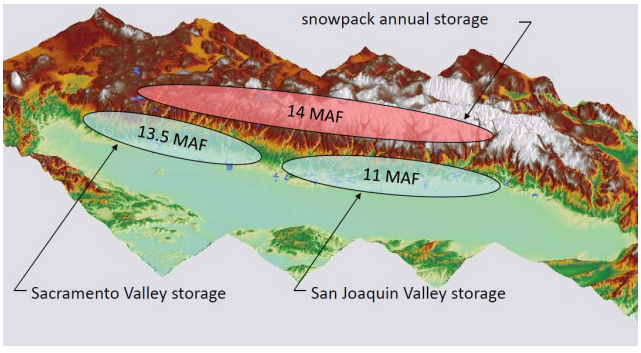
Story by Kim Ingram, reprinted from the UCANR Green Blog—see http://ucanr.org/blogs/Green/ for more.

Dr. Bales is Professor of Engineering at the University of California, Merced where he organized the Mountain Hydrology Research Group, which is deploying new research instrumentation at several Sierra Nevada sites.



Low power computer components used in the snow depth wireless sensor network.

Climate Change Threatens California Water Supply



Likely loss of 20-30% of snowpack storage with 3 degrees temperature increase. MAF: Million Acre Feet. Data from DWR.

For full story see http://www.ucmerced.edu/news/scientists-propose-thinning-sierra-forests-enhance-water-runoff

SWEEP results may inform efforts to mitigate the effects of climate change on California water supply, which has been diminished by drought in recent years. Climate change is only exacerbating this problem. Warmer temperatures mean more rain and less snow, which leads to runoff that comes earlier in the year. Warming can also lengthen the growing season for trees and other plants, reducing runoff, and the warmer, drier conditions have been shown to increase the frequency and severity of wildfires.

Reducing forest density can help counter the effects of climate warming on runoff, they said, in addition to enhancing the runoff directly.

"Climate change is having and will have direct effects on the water supply and storage capacity of the Sierra Nevada forests," said UC Berkeley Professor John Battles, one of the researchers on the project.

"Management with an eye toward the water balance provides one potentially important mitigation tool."

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