

PSW Accomplishment Report FY 2008 Climate Change



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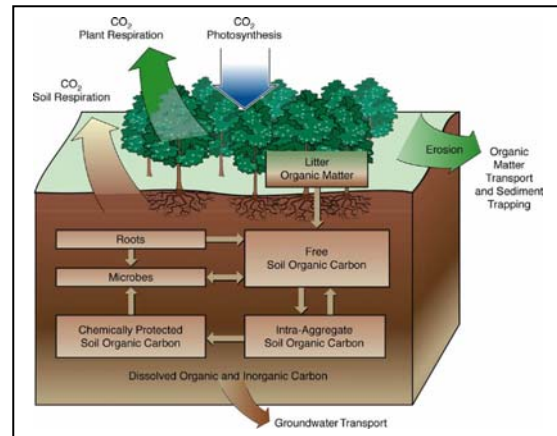


1. Management Tools, Communication, & Policy: Adaptation

- *Completed US Climate Change Science Program mandated SAP 4.4 report (Millar co-author): Joyce, L.A., G.M. Blate, J.S. Littell, S.G. McNulty, C.I. Millar, S.C. Moser, R.P. Neilson, K. O'Halloran, D.L. Peterson. 2008. Adaptation options for climate-sensitive ecosystems and resources: National Forests. Chapter 3 in Preliminary review of adaptation options for climate-sensitive ecosystems and resources. Synthesis and Assessment Product 4.4, U.S. Climate Change Science Program 126 pgs*
- *Submitted proposal and granted award (\$400k) for Developing a WestWide Climate Toolkit with USFS Managers – USFS National Office (Millar with lead co-PIs Peterson-PNW, Neilson-PNW, Joyce-RMRS) See separate FY 08 Accomplishment Report*
- *Completed Phase I Case Study in Climate-Management, Tahoe National Forest (Millar) and initiated Phase II Case Study Tahoe National Forest and NPS Devils Postpile National Monument (Millar, Yeh, Smith, Dulen-NPS)*
- *Designed, developed, and launched climate-reference website for USFS resource managers, Climate Change Resource Center (Furniss & Millar lead with PNW & PSW colleagues) See separate FY 08 Accomplishment Report*
- *Conducted HJ Andrews Climate Videotaping and ThinkTank Retreat (Furniss & Millar, lead). Manuscript in prep*
- *Convened S. Sierra Climate Conference; developed S. Sierra MOU (Stine) See separate FY 08 Accomplishment Report*
- *Maintained and updated climate websites: PSW Climate Topics, CIRMOUNT Consortium, MtnClim Climate Conferences (Delany & Millar)*
- *Organized and convened MtnClim 2008 climate conference (Silverton, CO) and CEREC (Climates, Ecosystems and Resources of Eastern California, Bishop, CA) climate conference, and AGU special mountain-climate sessions (Millar, lead organizer)*
- *Co-led CIRMOUNT (Consortium for Integrated Climate in Western Mountains), a westwide science consortium with over 1000+ members – 5th year (Millar with Diaz-NOAA)*
- *Organized and convened PSW Research Station Climate Workshop (Placerville). Presentations online at PSW Climate website (Millar & Delany)*
- *Drafted PSW Research Station Strategic Framework (Millar)*
- *Delivered 17 climate-toolkit presentations, presented 4 climate-toolkit posters, and published (or in press) 8 climate-mgmt papers (Millar)*

2. Carbon Sequestration and Greenhouse Gas Emissions – Mitigation

- Represented PSW as Climate Science Policy coordinator for PSW region. Primarily working with the state of California (Nechodom)
- Completed work on the Alder Springs Project Phase I: A case study in carbon benefits accounting and wildfire greenhouse gas reduction. Part of the Biomass to Energy Project and Carbon Life Cycles Analysis (Nechodom)
Website: www.fs.fed.us/psw/biomass2energy/
- Completed final report for WESTCARB Phase II lead by WINROCK International – Modeling carbon sequestration in managed forests (Powers, Zhang, and Skinner)
- Continued to investigate carbon allocation in trees and shrubs for plantations under different forest management regimes. (Powers and Zhang)
- Developed feature article about reforestation after severe wildfire in terms of carbon flux – a case study of the Fountain Fire in northern California to appear in December (2008) Journal of Forestry (Zhang and others)
- Presented talk on carbon sequestration under intensive management scenarios using 3-PG at the 29th Annual Forest Vegetation Management Conference, Redding, California, January 15-17, 2008 (Zhang and Powers)
- Presented talk on carbon stocks under managed and unmanaged forest to the Chinese Academy of Sciences, Institute of Applied Ecology, Huitong, Hunan Province, People's Republic of China, March 3-4, 2008 (Zhang)
- Developed models and long-term measurements at the Teakettle Experimental Forest to determine how management practices affect carbon dynamics with and without wildfire. See separate FY 08 Accomplishment Report, Fuel Treatment Affects on Forest Carbon Storage and Emissions under Modeled Wildfire Scenarios (North)
- Continued ongoing studies of wood formation in poplar to develop genetic tools for carbon sequestration and biofuels research (Grover)
- Published – Groover, Andrew. (2007) Will Genomics Guide a Greener Forest Biotech? Trends in Plant Science 12(6): 234-238
- Led a stakeholder-driven process to develop the first Urban Forest Reporting Protocol that establishes eligibility rules, methods to calculate reductions (Tree Carbon Calculator), performance-monitoring instructions and procedures for reporting project information. Adopted by the California Climate Action Registry and California Air Resources Board August 2008 (CUFR, McPherson)
Website: www.fs.fed.us/psw/programs/cufr
- Advised Los Angeles Regional Climate Change Collaborative (regional municipalities and agencies) on a NSF funded project directed towards implementation of the Los Angeles Million Tree planting initiative (Pincetl)



- *Initiated a 2-year study: Indo-Pacific Forest Carbon Study – Quantification of carbon pools and dynamics of tropical peatland soils of the western Pacific: implications for adaptation/mitigation strategies of climate change. Joint funding from the US Forest Service and the International Center of Forest Research (CIFOR) (Kauffman)*
- *Initiated a 2-year study in the Hawaii Experimental Tropical Forest to examine how rising temperature and land-use interact to regulate carbon input, allocation, and loss in a model study system, thereby enhancing capacity to predict how terrestrial ecosystems will respond to the interactive effects of warming and land-use. Joint funding by PSW and NSF – Ecosystems Science Cluster (Giardina)*

3. Biotic Interactions with Climate (disease, insects, wildlife, and vegetation)

Disease and Insects

- *Co-sponsored workshop, Climate Change and Forest Insects and Diseases, in Sedona AZ. (Frankel)*
- *Published – Frankel et.al. (2008) Climate and Forest Diseases of Western North America: A Literature Review. General Technical Report. PSW-GTR-number pending*
- *Developed a searchable database, annotated bibliography of climate and forest diseases of western North America (Frankel)
Website: www.fs.fed.us/psw/topics/climate_change/forest_disease/fdbib/index.php?author=*
- *Established 180 recruitment plots in the Tahoe Basin to monitor the fate of the next generation of white pine species in the region. Joint research with Dr. Patricia Maloney, Department of Plant Pathology, UC Davis (Vogler)*
- *Continued investigations of bark beetle and host interactions – the effect of variations in climate on tree drought stress, its effects on the palatability and nutrition of the host tree, and its effects on tree terpene emissions will be quantified with the goal of identifying level of risk for tree mortality. (Seybold)*
- *Continued research linking variability in precipitation (extreme or prolonged drought) with successful bark beetle attack on yellow pine – ultimately, climate change induced tree drought stress and bark beetle epidemics will significantly modify forest structure, composition, carbon and water balance, and ecosystem susceptibility to wildfire. This research will help quantify level of risk for successful bark beetle attack in stands of differing tree densities and under differing climatic regimes. (Grulke/Seybold)*
- *Continued work to develop statistical models to quantify, assess and forecast effects of various climate change scenarios on insect attacks (Preisler)*
- *Continued work on models to understand the interactions between fire severity, insect attacks and climate variables (Preisler)*



Wildlife

- Developed rapid-assessment method for American pika (which has been petitioned for state & federal status as endangered due to climate change), surveyed >360 populations in CA & NV, assessed distributional, climatic and geomorphic relationships, and summarized findings that pika populations are widespread in the Sierra Nevada; Convened meeting with CDF&G and UC mammalogists to develop coordinated monitoring strategy for pika; designated PSW-Millar team as coordinating office (Millar)
- Initiated field study on water temperature differences in grazed and ungrazed areas of the Golden Trout Wilderness to determine if future climate warming may result in lethal temperatures (Matthews)
- Published – Lacan, Igor, Kathleen Matthews, and Krishna Feldman. (2008) Interaction of an introduced predator with future effects of climate change in the recruitment dynamics of the imperiled Sierra Nevada yellow-legged frog (*Rana sierrae*). *Herpetological Conservation and Biology* 3(2):211-223
www.herpconbio.org/Volume_3/Issue_2/Lacan_etal_2008.pdf



Forest Ecosystem

- Completed study – Impacts of Climate Change on the Ecosystem Services of Micronesian Mangrove Forests (IPIF, MacKenzie)
- Completed study documenting first observed incidence in the Sierra Nevada of subalpine forest mortality as a result of "global-warming style" drought. Published: Millar, C.I., R.D. Westfall, and D.L. Delany. 2007. Response of high-elevation limber pine (*Pinus flexilis*) to multi-year droughts and 20th-century warming; Sierra Nevada, California, USA. *Canadian Journal of Forest Research* vol 37: pp 2508-2520. Initiated and completed field work for subsequent drought impact to a different high-elevation conifer (whitebark pine). 4 talks and 2 posters presented. (Millar)
- Documented previously unexplored and potentially widespread bias in climatic interpretation of high-elevation deadwood due to prehistoric human wood-gathering, a bias that would significantly alter interpretations that have been made about the severity of global climate change relative to past millennia. Published: Grayson, D.K. and C.I. Millar. 2008. Prehistoric human influence on the abundance and distribution of deadwood in alpine landscapes. *Perspectives in Plant Ecology, Evolution and Systematics* 10(2008): pgs101-108. (Millar)
- Completed fieldwork on high-elevation recruitment of conifers in response to 20th and 21st century climate change. 2 talks and a poster presented. (Millar)
- Continued to investigate the genetic signature of current climate change and to develop decision support tools for determining appropriate provenances and genomes for future climates. Continued investigations into winter chill requirement in coastal Douglas-fir (IFG, Grover, Wright, Jermstad, and Vogler)
- Continued work to develop a web-based decision support tool that can be used by forest managers to select appropriate seed sources for a given species, planting site and climate change scenario. (IFG)
- Assayed for 84 neutral loci and 300 candidate genes, selected for relevance to climate change e.g. drought tolerance, heat/cold tolerance, flood tolerance, phenological traits (timing of dormancy and vernalization). (Wright)

4. Abiotic Interactions with Climate (“stressors”, fire, air, watershed)

Fire

- Continued collaboration with A.H. Taylor (Penn. St. Univ.), C. Whitlock (Montana St. Univ.), S.L. Stephens (U.C. Berkeley), and V.M.L. Trouet (Swiss Federal Research Institute) on fire and climate interactions focusing on the Pacific Coast of North American with an emphasis on the Mediterranean Climate Region (Skinner)
- Delivered 8 presentations at professional meetings on subject of Climate Change and Fire (Skinner)
- Completed report – Skinner, C.N.; A.H. Taylor; A. Carleton; S.L. Stephens (October 2007) *Fire-climate interactions and predicting fire season severity in the Mediterranean Climate areas of California, southern Oregon, and western Nevada. Final report to USDA/USDI Joint Fire Science Program for project 03-1-1-22. Available online at: www.firescience.gov/projects/03-1-1-22/project/03-1-1-22_final_report.pdf*
- Published – Skinner, C.N.; Burk, J.H.; Barbour, M.G.; Franco-Vizcaíno, E.; Stephens, S.L. (2008) *Influences of climate on fire regimes in montane forests of north-western Mexico. Journal of Biogeography* 35: 1436-1451
- Published – Taylor, A.H.; Trouet, V.; Skinner, C.N. (2008). *Climatic influences on fire regimes in montane forests of the southern Cascades, California, USA. International Jour. of Wildland Fire* 17: 60-71
- Published – Trouet, V., Taylor, A.H., Carleton, A.M., Skinner, C.N. (2008) *Interannual variations in fire weather, fire extent, and synoptic-scale circulation patterns in northern California and Oregon. Theoretical and Applied Climatology. doi: 10.1007/s00704-008-0012-x*
- Continued promotion, research and development of an integrated weather/fire behavior modeling system and economic risk assessment procedure to support decision-making with scientific models that incorporate uncertainties of prediction. This R&D will enhance the Wildland Fire Decision Support System prototype under development at the national level, and provide a framework for examining economic impacts of fire under different climate change scenarios. (Fujioka, Gonzalez-Caban, Chen, Preisler)
- Initiated research joint venture between PSW and UC Merced – Report “Climate-Wildfire Interactions in the Western United States.” (Westerling, Preisler, Stine)
See separate FY 08 Accomplishment Report
- Developed a statistical model to forecast wildland fires in California using lagged climate variables including temperature and moisture deficit. We are working on models to understand the interactions between fire severity, insect attacks and climate variables. (Preisler)



Air Pollution

FY08 research findings pertinent to climate and air quality include:

- Nitrogen deposition and ozone stress increase fuel accumulation in southern California forests and enhance drought and bark beetle induced mortality, leading to greater risk of fire and associated greenhouse gas emissions. (Fenn)
- Forest and chaparral areas in exceedance of the nitrogen deposition critical load emit high levels of nitrogenous greenhouse trace gases from soil. (Fenn)
- Although peak ozone concentrations have greatly decreased in the San Bernardino Mountains very high ozone phytotoxic potential remains. (Bytnerowicz)
- Preliminary findings indicate that highly elevated levels of ozone, ammonia and nitric acid result from wildland fires in the southern Sierra Nevada. (Bytnerowicz)
- High concentrations of nitric acid and ammonia in southern California result in increased deposition of nitrogen and biomass production that predispose the desert, coastal sage, chaparral and mixed conifer forest ecosystems to catastrophic fires. (Bytnerowicz)
- Moderately elevated O_3 negates elevated CO_2 -induced increase in photosynthetic carbon gain, but further increases leaf water use efficiency. In future chemical atmospheric conditions, plants will sequester less carbon than expected but will reduce plant water use. (Gulke)
- High O_3 concentration, at levels anticipated to be background global concentrations in two or three decades, will likely increase tree transpiration, and decrease watershed stream outflow. (Gulke)
- There is a link between high O_3 exposure and N deposition, increased tree susceptibility to drought stress, and increased successful bark beetle attack. (Gulke)
- Foliar O_3 injury is greater for trees with intermittent water availability relative to those that have perennial water available, but only for trees already in poor health. (Gulke)
- Nitrogen deposition increases foliar O_3 injury in Jeffrey pine, but only for trees already in poor health. (Gulke)



Elected to a 4-year term on the Executive Committee for the National Atmospheric Deposition Program. (Padgett)

Worked with Forest Health Protection and the 4 Southern Province National forests assessing climate change effects on native oak woodlands and chaparral and to improve understanding of the relationship between climate, insects and diseases and abiotic stressors. (Padgett)

Water and Watersheds

- Continued multi-phase research on the Kings River Watershed (Hunsaker)
See separate FY 08 Accomplishment Report, Southern Sierra Forests, Climate and Water Phase I.
- Continued research to assess vulnerability of coastal watersheds to climate change (Lisle)
- Developed a classification system and inventory of rock glaciers and related periglacial features for the Sierra Nevada, analyzed distributional and climatic relationships of active and Pleistocene features. Initiated and completed field work for Phase II studies on plant & pika dynamics on rock glacier soil patches, hydrologic output of rock glaciers, and significance of rock glaciers as hydrologic reserves during global warming. Published: Millar, C.I. and R.D. Westfall. 2008. Rock glaciers and periglacial rock-ice features in the Sierra Nevada; Classification, distribution, and climate relationships. *Quaternary International*, 188: 90-104. (Millar)

5. Monitoring

- Submitted a 5-year, \$20 million proposal to the National Science Foundation's Experimental Program to Stimulate Competitive Research (EPSCoR). This proposal builds on research previously funded that led to establishment of the Hawaii Permanent Plot Network. Climate change research and monitoring is a central focus. In conjunction with the University of Hawaii (IPIF)
- The National Science Foundation designated Hawaii Experimental Tropical Forest as a National Ecological Observatory Network (NEON) site. (IPIF, Cordell, Giardina)
- Coordinated North American Chapter of GLORIA (the Global Observation Research Initiative in Alpine Environments, an international program for monitoring response of alpine vegetation to climate change). Installed new GLORIA Target Region in Great Basin National Park, NV; continued monitoring 4 GLORIA Target Regions in CA and prepared for first 5-yr re-measurement in 2009. (Millar)
- Continued research on amphibians and their habitat in regards to climate variables (Lind, Welsh)
- Continued to monitor forest bird populations, habitat, nesting success, and elevational shifts in abundance, especially as they relate to weather conditions (Purcell)

