

## **Final Report, Joint Fire Science Program Project 05-4-1-10**

**Project Title: Fuel treatments and forest health: A film and interactive DVD**

**Project Location: Teakettle Experimental Forest, Sierra National Forest, Fresno Co., CA**

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### **Brief Description of Project**

The project is developed an interactive DVD presenting the results of the Teakettle Experiment as outreach material. This is a new medium with promising potential. The DVD has different layers of information geared to different knowledge levels so the viewers can tailor their learning to their level of expertise. The DVD contains 6 films, over 60 publications and more than 60 websites providing an array of information about fuels treatment effects on ecosystem processes.

### **Summary of Teakettle Experiment DVD:**

Over 2500 copies of the DVD have been requested and mailed out. The DVD has been widely viewed by managers in California, many federal agency personnel in the western U.S., copies have been mailed to 42 of the 50 states and 7 foreign countries. The feedback has been overwhelmingly positive with the common remark being this should be done more often. Outreach is also starting for getting the DVD to teachers, particularly instructors of undergraduate science classes.

Proposed	Delivered/Status
Final Product	The Teakettle Experiment: Fire and Forest Health. An interactive DVD with one 30 min summary film, 5 special feature films, a library of 65 publications (30 from the Teakettle Experiment), suggested class lessons for instructors, information for managers, and more than 60 websites.
Annual progress reports	Completed
Publications in scientific journals	<p>Meyer, M., D. Kelt, and M. North. 2007. Effects of burning and thinning on lodgepole chipmunks (<i>Neotamias speciosus</i>) in the Sierra Nevada, California. <i>Northwestern Naturalist</i> 88: 61-72.</p> <p>Meyer, M., M. North, A. Gray, and H. Zald. 2007. Influence of soil thickness on stand characteristics in a Sierra Nevada mixed-conifer forest. <i>Plant and Soil</i> 294: 113-123.</p> <p>Hurteau, M., H. Zald. and M. North. 2007. Species-specific response to climate reconstruction in upper-elevation mixed-conifer forests of the western Sierra Nevada, California, USA. <i>Canadian Journal of Forest Research</i> 37: 1681-1691.</p> <p>North, M., J. Innes, and H. Zald. 2007. Comparison of thinning and prescribed fire restoration treatments to Sierran mixed-conifer historic conditions. <i>Canadian Journal of Forest Research</i> 37: 331-342.</p> <p>Plamboeck, A.H., T.E. Dawson, L.M. Egerton-Warburton, M. North, T.D. Bruns and J.I. Querejeta. 2007. Water transfer via ectomycorrhizal fungal hyphae to conifer seedlings. <i>Mycorrhiza</i> 17: 439-447.</p> <p>Meyer, M.D., M.P. North and D.A. Kelt. 2007. Nest tress of northern flying squirrels in Yosemite National Park, California. <i>The Southwestern Naturalist</i> 52: 157-161.</p> <p>Wayman, R. and M. North. 2007. Initial response of a mixed-conifer understory plant community to burning and thinning restoration treatments. <i>Forest Ecology and Management</i> 239: 32-44.</p> <p>Meyer, M., D. Kelt, and M. North. 2007. Microhabit associations of northern flying squirrels in burned and thinned stands of the Sierra Nevada. <i>American Midland Naturalist</i> 157: 202-211.</p> <p>Innes, J., M. North and N. Williamson. 2006. Effect of thinning and prescribed fire restoration treatments on woody debris and snag dynamics in a Sierran old-growth mixed-conifer forest. <i>Canadian Journal of Forest Research</i> 36: 3183-3193.</p> <p>Oakley, B., M. North and J. Franklin. 2006. Facilitative and competitive effects of a N-fixing shrub on white fir saplings. <i>Forest Ecology and Management</i> 233: 100-107.</p> <p>Concilio, A., S. Rhu, S. Ma, M. North, and J. Chen. 2006. Soil respiration response to experimental disturbances over three years. <i>Forest Ecology and Management</i> 228: 82-90.</p> <p>Concilio, A., S. Ma, Q. Li, J. LeMoine, J. Chen, M. North, D. Moorhead, and R. Jensen. 2005. Soil respiration response to prescribed burning and thinning in mixed conifer and hardwood forests. <i>Canadian Journal of Forest Research</i> 35: 1581-1591</p> <p>Meyer, M. D., and M. North. 2005. Truffle abundance in riparian and upland forests of California's southern Sierra Nevada. <i>Canadian</i></p>

	<p>Journal of Botany 83: 1015-1020.</p> <p>Meyer, M. D., M. P. North and D. A. Kelt. 2005. Short-term effects of fire and forest thinning on truffle abundance and consumption by <i>Neotamias speciosus</i> in the southern Sierra Nevada of California. Canadian Journal of Forest Research 35: 1061-1070.</p> <p>Meyer, M., D. Kelt, and M. North. 2005. Nest trees of northern flying squirrels in the Sierra Nevada. Journal of Mammalogy 86: 275-280.</p> <p>North, M., B. Oakley, R. Fiegenger, A. Gray and M. Barbour. 2005. Influence of light and soil moisture on Sierran mixed-conifer understory communities. Plant Ecology 177(1): 13-24.</p> <p>Meyer, M. D., M. North and D. A. Kelt. 2005. Fungi in the diets of northern flying squirrels and lodgepole chipmunks in the Sierra Nevada. Canadian Journal of Zoology 83: 1581-1589.</p> <p>North, M and J. Chen. 2005. Introduction to the Teakettle Special Issue. Forest Science 51(3): 185-186.</p> <p>North, M., M. Hurteau, R. Fiegenger, and M. Barbour. 2005. Influence of fire and El Niño on tree recruitment varies by species in Sierran mixed conifer. Forest Science 51(3): 187-197.</p> <p>Gray, A., H. Zald, R. Kern, and M. North. 2005. Stand conditions associated with tree regeneration in Sierran mixed-conifer forests. Forest Science 51(3): 198-210.</p> <p>Ma, S., J. Chen, J. Butnor, M. North, E. Euskirchen, and B. Oakley. 2005. Biophysical Controls on Soil Respiration in the Dominant Patch Types of an Old-Growth, Mixed-Conifer Forest. Forest Science 51(3): 221-232.</p> <p>Izzo, A. D., M. D. Meyer, J. M. Trappe, M. North, and T. Bruns. 2005. Hypogeous ectomycorrhizal fungal species on roots and in small mammal diet in a mixed-conifer forest. Forest Science 51(3): 243-254.</p> <p>Smith, T., D. Rizzo and M. North. 2005. Patterns of Mortality in an Old-Growth Mixed-Conifer Forest of the Southern Sierra Nevada, California. Forest Science 51(3): 266-275.</p> <p>Oakley, B., M. North, J. Franklin, B. Hedlund, and J. Staley. 2004. Diversity and distribution of Frankia strains symbiotic with Ceanothus in California. Applied and Environmental Microbiology 70: 6444-6452.</p> <p>North, M., J. Chen, B. Oakley, B. Song, M. Rudnicki, A. Gray and J. Innes. 2004. Forest stand structure and pattern of old-growth western hemlock/Douglas-fir and mixed-conifer forest. Forest Science 50 (3):299-311.</p> <p>Ma, S., J. Chen, M. North, H. Erickson, M. Bresee, and J. Le Moine. 2004. Short-term effects of experimental treatments on soil respiration in an old-growth, mixed-conifer forest. Environmental Management 33(1): 148-159.</p> <p>Oakley B, North M, Franklin J. 2003 The effects of fire on soil nitrogen associated with patches of the actinorhizal shrub Ceanothus cordulatus. Plant and Soil 254:35-46.</p>
General Technical	North, M., B. Oakley, J. Chen, H. Erickson, A. Gray, A. Izzo, D. Johnson,

Report	S. Ma, J. Marra, M. D. Meyer, K. Purcell, T. Rambo, D. Rizzo, B. Roath, and T. Schowalter. 2002. Vegetation and ecological characteristics of mixed conifer and red fir forests at Teakettle Experimental Forest. <i>U. S. Forest Service PSW-General Technical Report PSW-GTR-186.</i>
Website	Information related to publications, presentations, and data provided on [ <a href="http://teakettle.ucdavis.edu">http://teakettle.ucdavis.edu</a> ].
Fact Sheet	North, M. and A. Rosenthal. 2006. Restoring forest health: Fire and thinning effects on mixed-conifer forests. USDA PSW Science Perspective 7.
National Conference Presentations	<ol style="list-style-type: none"> <li>1. Ma, S., J. Chen, M. North, M. Jurgensen, and B. Oakley. 2001. Temporal and spatial variability of air and soil temperatures in a Sierra Nevada old-growth mixed conifer forest. Annual meeting of the Ecological Society of America. Madison, WI.</li> <li>2. North, M. Past and present spatial structure of Sierra mixed-conifer forest. Annual meeting of the Ecological Society of America. Madison, WI.</li> <li>3. Oakley, B. and M. North. Molecular diversity of <i>Ceanothus</i>-infective <i>Frankia</i> in the southern Sierra Nevada mountains of California. 12th International Meeting on <i>Frankia</i> and Actinorhizal Plants. June, 2001. Carry-le-Rouet, France.</li> <li>4. Song, B., J. Chen, M. Moer, M. Rudnicki, K. Bible, D. Shaw, M. North, and D. Braun. 2001. Coherent spatial relationships of species distribution and production in an old-growth <i>Pseudotsuga-Tsuga</i> forest. Annual meeting of the Ecological Society of America. Madison, WI.</li> <li>5. Meyer, M. D., D. A. Kelt, and M. North. 2002. Impact of fire and thinning on truffle production and consumption in a Sierra Nevada mixed-conifer and red fir forest. Annual Meeting of the Association for Fire Ecology.</li> <li>6. Ma, S., J. Chen, M. North, and J. Innes. 2003. Effects of burning and thinning treatments on sunfleck duration and below-canopy reference evapotranspiration in an old-growth, mixed-conifer forest. The 4th North American Forest Ecology Workshop. Corvallis, OR.</li> <li>7. North, M., B. Oakley, R. Fiegenger, A. Gray, and M. Barbour. 2003. Influence of Light and Soil Moisture on the Sierra Mixed-Conifer Understory Community. The 4th North American Forest Ecology Workshop. Corvallis, OR.</li> <li>8. North, M., M. Hurteau, R. Fiegenger, and M. Barbour. 2003. Influence of fire and El Niño on tree recruitment varies by species in Sierran mixed conifer. The 4th North American Forest Ecology Workshop. Corvallis, OR.</li> <li>9. Bigelow, S., M. North, and W. Horwath. 2004. Soil moisture affects conifer shade tolerance. Annual meeting of the Ecological Society of America. Portland, OR.</li> <li>10. Concilio, A., S. Ma, Q. Li, J. LeMoine, J.Chen, M. North, R. Jensen, and D. Moorhead. 2004. Disturbance effects on soil respiration at two sites. Annual meeting of the Ecological Society of America. Portland,</li> </ol>

OR.

11. Hurteau, M., H. Zald, and M. North. 2004. Species specific growth patterns and El Nino reconstruction using tree-rings in the southern Sierra Nevada. Annual meeting of the Ecological Society of America. Portland, OR.
12. Innes, J. and M. North. 2004. Effect of silvicultural treatments and prescribed fire on coarse woody debris dynamics in a Sierran old-growth mixed-conifer forest. Annual meeting of the Ecological Society of America. Portland, OR.
13. Izzo, A., M. Meyer, J. Trappe, M. North and T. Bruns. 2004. Hypogeous ectomycorrhizal fungi on *Abies* spp. roots and in small mammal diet in a Sierra Nevada mixed-conifer forest. International Conference on Mycorrhizae.
14. Ma, S., M. North, J. Chen, S. Mather, M. Jurgensen, and B. Oakley. 2004. Within-stand interactions of forest structure and microclimate variability in an old-growth, mixed-conifer forest. Annual meeting of the Ecological Society of America. Portland, OR.
15. Meyer, M., M. North and D. Kelt. 2004. Forests, fungi, and small mammals: The impact of fire and thinning on truffle production and consumption. Annual meeting of the Ecological Society of America. Portland, OR.
16. North, M., Innes, J. and B. Oakley. 2004. Changes in forest structure, spatial pattern and composition from prescribed fire and thinning in Sierra mixed conifer. International Association of Vegetation Science. Kona, Hawaii.
17. Oakley, B., M. North, J. Franklin, B. Hedlund, and J. Staley. 2004. Biogeography of the N-fixing bacteria *Frankia* symbiotic with *Ceanothus* in California. International Society of Molecular Ecology.
18. Parks, S., M. North, J. Innes, and B. Oakley. 2004. Changes in forest structure, spatial pattern and composition from prescribed fire and thinning in Sierra mixed conifer. Annual meeting of the Ecological Society of America. Portland, OR.
19. Ryu, S., A. Concilio, J. Chen, D. Neher, S. Ma, and M. North. 2004. Effects of experimental burning and thinning on soil respiration and belowground characteristics. Annual meeting of the Ecological Society of America. Portland, OR.
20. Wayman, R. and M. North. 2004. Initial response of mixed-conifer understory to fire and thinning restoration treatments. Annual meeting of the Ecological Society of America. Portland, OR.
21. North, M. 2005. Demonstrating the ecological effects of prescribed fire and thinning fuel treatments on mixed-conifer ecosystems. Joint Fire Science annual investigator meeting. San Diego, CA.
22. Meyer, M. and North, M. 2005. Fire and fuel treatment effects on a key Sierra food web. Joint Fire Science annual investigator meeting. San Diego, CA.
23. Gray, A., H. Zald, R. Kern and M. North. 2005. Tree regeneration and soil moisture response to fuel reduction treatments. Joint Fire Science annual investigator meeting. San Diego, CA.
24. North, M. J. Chen and A. Gray. 2006. Different ecological effects of prescribed fire and thinning restoration treatments on mixed conifer.

	<p>3<sup>rd</sup> International Fire Ecology and Management Conference, San Diego, CA.</p> <p>25. Meyer, M., M. North, and D. Kelt. 2006. Microhabitat association of northern flying squirrels in burned and thinned forest stands of the Sierra Nevada. 3<sup>rd</sup> International Fire Ecology and Management Conference, San Diego, CA.</p> <p>26. Hurteau, M. and M. North. 2006. Forest response to global climate change and atmospheric pollution: Implications for fire management. 3<sup>rd</sup> International Fire Ecology and Management Conference, San Diego, CA.</p> <p>27. Hanson, C., D. Odion, and M. North. 2006. Historic occurrence of high severity fire in the northern Sierra Nevada, California. 3<sup>rd</sup> International Fire Ecology and Management Conference, San Diego, CA.</p> <p>28. Bigelow, S., M. North, and C. Salk. 2007. Light thresholds for competitive reversals in Sierran conifers: Enhancing the restoration component of fuels-reduction canopy thinnings. Ecological Society of America annual meeting, San Jose, CA.</p> <p>29. North, M. 2007. Communicating science: The Teakettle Experiment interactive DVD. Ecological Society of America annual meeting, San Jose, CA.</p>
Regional Presentations	<ol style="list-style-type: none"> <li>1. Oakley, B. and M. North. 2000. Effects of controlled burning on soil resource islands associated with patches of the N-fixing shrub, <i>Ceanothus cordulatus</i>. First National Congress on Fire Ecology, Prevention, and Management. San Diego, CA.</li> <li>2. Gray, A., H. Zald., and M. North. 2002. Soil moisture and tree sapling distributions in a mature mixed-conifer forest. Sierra Nevada Symposium, Lake Tahoe, CA.</li> <li>3. Ma, S., J. Chen, and M. North. 2002. Increases in soil respiration following burning and thinning treatments in an old-growth, mixed-conifer forest. USDA Symposium on Natural Resource Management to Offset Greenhouse Gas Emissions. Raleigh, NC.</li> <li>4. Meyer, M. D., D. A. Kelt, and M. North. 2002. The importance of riparian habitat to northern flying squirrels at the Teakettle Experimental Forest. Sierra Nevada Science Symposium, Lake Tahoe, CA.</li> <li>5. North, M., B. Oakley, J. Chen, H. Erickson, A. Gray, A. Izzo, D. Johnson, S. Ma, J. Marra, M. Meyer, B. Roath, T. Rambo, D. Rizzo, T. Schowalter, and T. Smith. 2002. The Teakettle Experiment. Sierra Nevada Science Symposium, Lake Tahoe, CA.</li> <li>6. North, M., J. Chen, and B. Oakley. 2002. Differences in Stand Structure and Pattern of Sierra and Pacific Northwest Old-Growth Forests. Sierra Nevada Science Symposium, Lake Tahoe, CA.</li> <li>7. North, M., B. Oakley, R. Fiegenger, A. Gray, and M. Barbour. 2002. Influence of Light and Soil Moisture on the Sierra Mixed-Conifer Understory Community. Sierra Nevada Science Symposium, Lake Tahoe, CA.</li> </ol>

	<p>8. Oakley, B. and M. North. 2002. The effects of fire on soil nitrogen and <i>Frankia</i> associated with patches of the actinorhizal shrub <i>Ceanothus cordulatus</i>. Sierra Nevada Science Symposium, Lake Tahoe, CA.</p> <p>9. Concilio, A., S. Ma, Q. Li, J. LeMoine, J.Chen, M. North, R. Jensen, and D. Moorhead 2004. Soil respiration response to management in mixed-conifer and hardwood forests. Fire Science in Forestry Management Workshop. Charleston, SC.</p>
University presentations	4 class lectures at U.C. Davis in Forest Ecology, Forest Pest Pathogen, Fire Ecology and Restoration Ecology courses
Site Presentations/Tours	3 tours given to Sierra National Forest, Region 5, and UC Davis Ecology class.
Multimedia presentations	The Teakettle Experiment: Fire and Thinning effects on Mixed-Conifer Ecosystems. A 37-slide presentation of the Teakettle Experiment with details of different ecosystem components and summary for forest managers, silviculturists, and fire management officers by M. North.