

# Christopher R. Keyes

Director and Professor, School of Agricultural Sciences & Forestry, Louisiana Tech University  
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## EDUCATION

### **2002 Ph.D. Oregon State University (Corvallis, Oregon)**

Forestry – Silviculture w/ Minor in Integrated Forest Protection

*Dissertation: Recruitment of Ponderosa Pine Seedlings Beneath Partial Overstories*

### **1996 M.S. University of Montana (Missoula, Montana)**

Forestry – Silviculture & Forest Stand Dynamics

*Thesis: Structures and Silvicultural Strategies to Prevent Crown Fires in Northern Rocky Mountain Forests*

### **1990 B.A. College of the Holy Cross (Worcester, Massachusetts)**

Political Science – International Development

## CREDENTIALS

2010 Certified Forester (CF) #4013, Society of American Foresters

## EMPLOYMENT

### **Louisiana Tech University, College of Applied & Natural Sciences (Ruston, Louisiana)**

2021-present Director and Professor, School of Agricultural Sciences & Forestry

### **University of Montana, W.A. Franke College of Forestry & Conservation (Missoula, Montana)**

2017-2021 Associate Director, Montana Forest & Conservation Experiment Station

2020 Interim Director, Montana Forest & Conservation Experiment Station

2007-17 Director, Applied Forest Management Program

2014-2021 Research Professor, Department of Forest Management

2007-14 Research Associate Professor, Department of Forest Management

### **Cal Poly Humboldt, Department of Forestry & Wildland Resources (Arcata, California)**

2007 Associate Professor of Forestry - Awarded Tenure

2001-07 Assistant Professor of Forestry

### **Oregon State University, Department of Forest Resources (Corvallis, Oregon)**

1997-2001 Graduate Research Assistant

### **USDA Forest Service, Northeastern Research Station (Rangeley, Maine)**

1995-96 Forester

### **University of Montana, School of Forestry (Missoula, Montana)**

1993-95 Graduate Research Assistant

### **Gainesville Tree Farm (Gainesville, Florida)**

1991 Tree Seedling Nursery Technician

## **ADMINISTRATIVE EXPERIENCE**

### **Louisiana Tech University, College of Applied & Natural Sciences**

Director, School of Agricultural Sciences & Forestry, 2021-present

- Chief academic officer for strategic resource development, comprehensive fiscal planning, and administrative operation of an academic unit delivering curricula to 380 students in five B.S. degree programs:
  - B.S. Agricultural Business – Business Management and Plant Science concentrations
  - B.S. Agricultural Education
  - B.S. Animal Science – Applied Animal Science and Pre-Veterinary Medicine concentrations
  - B.S. Forestry (Forest Management and Wildlife Habitat Management concentrations)
  - B.S. Geographic Information Science
- Supervise 27 School personnel – 9 Agricultural Science faculty, 9 Forestry faculty, and 9 administrative, farm, and horticultural staff – including personnel recruitment, development, duty assignment, performance evaluation, promotion and tenure
- Oversee the School's 1,150-acre Tech Farm operations, farm staff, and student workers, including 100-head Beef Cattle Unit, Hog Barn, Equine Center, Meats Processing Laboratory, Tech Farm Salesroom, and associated farm facilities and equipment
- Oversee the School's horticultural facilities, greenhouse staff, and student workers, including the year-round crop cultivation of foliage plants, bedding plants, vegetables, and tree seedlings via a 28,000 ft<sup>2</sup> greenhouse complex comprised of 26 growing rooms, plus a glass-roofed conservatory, hoop houses, raised beds, and demonstration/teaching gardens
- Develop and sustain external relations with existing and potential School partners and stakeholders, including advisory board, alumni, industry and agency employers, research collaborators, and agricultural and forestry professional societies; administer and develop Louisiana Tech Foundation auxiliary accounts – endowment, revenue, and scholarship funds

### **University of Montana, W.A. Franke College of Forestry & Conservation**

Associate Director, Montana Forest & Conservation Experiment Station, 2017-2021

Interim Director, Montana Forest & Conservation Experiment Station, May-October 2020

- Administer 21,400-acre Lubrecht Experimental Forest and 3,600-acre Bandy Experimental Ranch, including staff supervision, resource allocation, policy development, and oversight of ~\$500,00 in timber, hay, beef, grazing leases, fees, facility rental and lodging revenues
- Develop and manage station budgets, strategically expend UM Foundation gift accounts, and acquire and manage grants that advance ranch and forest management operations
- Develop a \$8.2 million forest carbon project under California's Compliance Offset Protocols
- Develop a Ranch-to-Campus grass-fed beef program in collaboration with Campus Dining
- Conduct reporting in support of the Station's \$2.6 million biennial legislative appropriation
- Administer \$668,662 annual federal appropriation of McIntire-Stennis capacity funds; coordinate projects, budgets, cost-match and reporting; and serve as liaison to National Association of University Forest Resources Programs (NAUFRP)
- Cultivate relations with agencies, conservation organizations, and community stakeholders
- Recruit, coordinate, and facilitate research projects at Bandy Ranch and Lubrecht Forest

## **SERVICE & LEADERSHIP**

2011-21 Steering Committee Member, Inland Empire Tree Improvement Cooperative  
2013-19 Faculty Advisor, Society of American Foresters Student Chapter, Univ. of Montana  
2010-18 IUFRO Deputy Coordinator, Temperate Forest Regeneration Unit 1.01.03  
2013-17 Associate Editor, Forest Science  
2011-13 Associate Editor, Western Journal of Applied Forestry  
2011-13 Chair & Chair-Elect, Inland Empire Reforestation Council  
2011-12 USAID Technical Advisor, Lebanon Reforestation Initiative  
2009-10 Chair & Chair-Elect, Society of American Foresters, Missoula Chapter, Montana  
2004-07 Faculty Advisor, Xi Sigma Pi forestry honor society, Cal Poly Humboldt  
2001-04 Faculty Advisor, SAF Student Chapter, Cal Poly Humboldt

## **AWARDS & HONORS**

2021 Wambach Faculty Service Award, University of Montana  
2017 Merit Award for Outstanding Performance, University of Montana  
2013 Merit Award for Outstanding Performance, University of Montana  
2013 Award for Contributions, Service and Leadership, Inland Empire Reforestation Council  
2010 Outstanding Service Award, Society of American Foresters, Missoula Chapter  
2008 Outstanding Effort Award, Montana Department of Natural Resources & Conservation  
2006 McCrone Promising Faculty Scholar Award, Cal Poly Humboldt  
2002 Forestry Club Faculty Award, Cal Poly Humboldt  
2001 J. Richard Dilworth Memorial Award (graduate student), Oregon State University  
1998 Xi Sigma Pi National Forestry Honor Society  
1996 Kenneth P. Davis Memorial Scholarship (graduate student), University of Montana  
1995 Maine Forest Inventory Perseverance and Dedication Award, USDA Forest Service  
1994 Earl F. Clark Memorial Scholarship (graduate student), University of Montana

## **PROFESSIONAL AFFILIATIONS**

### **Current**

National Association of Colleges & Teachers of Agriculture	2021-present
Non-Land-Grant Agricultural & Renewable Resources Universities	2022-present
Louisiana Forestry Association	2021-present
North Louisiana Agri-Business Council	2021-present
National Christmas Tree Association	2021-present
Research Center Administrators Society	2019-present
Society for Range Management	2018-present
Society of American Foresters	1992-present

### **Past**

Inland Empire Reforestation Council	2010-15
Intermountain Container Seedling Growers Association	2011-15
Western Forest and Conservation Nursery Association	2012-15
Society for Ecological Restoration	2001-13
Forest Vegetation Management Conference	1999-2007
California Forest Pest Council	2001-07

## GRANTS & CONTRACTS

*Total funded project value: \$7,529,802*

*Contracts value administered by Keyes: \$2,419,995*

*44 contracts managed by Keyes; 17 funding sources*

2022	\$80,000	Old-Growth Forest Restoration at Crater Lake National Park. USDI National Park Service.
2020	\$29,998	ASCC Larch Forest Community Seedling Drought Resistance Experiment (PI). USDA Forest Service Rocky Mountain Research Station.
	\$20,092	Lodgepole Pine Forest Stand Dynamics following Mountain Pine Beetle Outbreak and Salvage Logging at Lubrecht Experimental Forest. USDA McIntire-Stennis Forestry Research Program.
2019	\$58,738	Forest Management Plan for Eielson Air Force Base (PI). US Army Corps of Engineers and Natural Resources Program, Eielson Air Force Base (Alaska).
2018	\$15,000	Data Archiving and Climate Change Experiments at Coram Experimental Forest Phase IV (PI). USDA Forest Service Rocky Mountain Research Station.
	\$219,369	Control of Annual Invasive Grasses in Rocky Mountain Intermountain Montane Grasslands with Esplanade (Indaziflam) Herbicide and No-till Seeding (Co-PI). USDA-NIFA Tribal College Research Grant Program. Keyes share = \$65,708.
	\$57,998	Forest, Range, and Stream Enhancement on Bandy Ranch (Co-PI). Landscape Scale Restoration Grant Program, Montana Department of Natural Resources & Conservation.
	\$3,900	Lubrecht Experimental Forest Camp Lodge/Duplex/Shop – Wood Biomass Energy Preliminary Feasibility Assessment Grant (PI). Wood Energy Program, Montana Department of Natural Resources and Conservation.
	\$12,000	Lubrecht Forest – Nordic Ski Trail Grooming Machine (PI). Recreational Trails Program, Montana Fish, Wildlife & Parks.
2017	\$10,505	Phase II - Data Archiving and Treatment Analysis at Lick Creek Demonstration-Research Forest (PI). USDA Forest Service Rocky Mountain Research Station.
	\$44,995	Phase I - Data Archiving and Treatment Analysis at Lick Creek Demonstration-Research Forest (PI). USDA Forest Service Rocky Mountain Research Station.
	\$10,000	Phase III - Data Archiving and Climate Change Experiments at Coram Experimental Forest (PI). USDA Forest Service Rocky Mountain Research Station.
2016	\$39,492	Multi-Regional Development of Stand Density Index-Based Susceptibility Guidelines for Western Yellow Pine Forests (Project Cooperator). Special Technology Development Program, Forest Health Protection (Region 1), USDA Forest Service. Keyes Co-Author; funds managed by USFS-R1FHP.
	\$35,000	Phase II - Data Archiving and Climate Change Experiments at Coram Experimental Forest (PI). USDA Forest Service Rocky Mountain Research Station.
2015	\$295,443	Lick Creek Demonstration-Research Forest: 25-Year Fire and Cutting Effects on Vegetation and Fuels (PI). USDI Joint Fire Science Program.
	\$24,000	Phase I - Data Archiving and Climate Change Experiments at Coram Experimental Forest (PI). USDA Forest Service Rocky Mountain Research Station.
	\$8,000	Lubrecht Experimental Forest Cross Country Ski Trail Maintenance (Co-PI). Recreational Trails Program, Montana Fish, Wildlife & Parks.
	\$48,115	Guatemala Altiplano Forest Regeneration and Protection Initiative: Research and Technical Transfer Program (PI). USDA Forest Service International Programs.

	\$57,000	Adaptive Management for Climate Change: Dry Douglas-fir/Western Larch (Co-PI). Resource Information Management Board, USDA Forest Service (Northern Region). Keyes Co-Author; funds managed by USFS-RMRS.
2014	\$88,938	Assessment of Primary Ecological Factors Influencing Widespread and Severe Mountain Pine Beetle-Caused Mortality Events in Lodgepole Pine Forests within the Western United States (PI). USDA Forest Service Northern Region (Forest Health Protection).
2013	\$24,000	Phase III – Effects of Variable-Retention Silvicultural Treatments in Lodgepole Pine on Mountain Pine Beetle Activity, Wildfire Hazard, and Their Interactions (Co-PI). Special Technology Development Program, USDA Forest Service (Forest Health Protection).
	\$98,069	Effects of Fire and Fire Surrogate Treatments on Ponderosa Pine Crown Fuel Dynamics at Lubrecht Experimental Forest. USDA McIntire-Stennis Forestry Research Program.
2012	\$50,700	Phase II – Effects of Variable-Retention Silvicultural Treatments in Lodgepole Pine on Mountain Pine Beetle Activity, Wildfire Hazard, and Their Interactions (Co-PI). Special Technology Development Program, USDA Forest Service (Forest Health Protection).
2011	\$5,073,000	Integration of Biofuels and Bioproducts Production in Forest Products Supply Chains Using Modular Biomass Gasification and Carbon Activation (Co-PI). USDA-NIFA Biomass Research and Development Initiative. Keyes share = \$474,689.
	\$40,000	Phase I – Effects of Variable-Retention Silvicultural Treatments in Lodgepole Pine on Mountain Pine Beetle Activity, Wildfire Hazard, and their Interactions (Co-PI). Special Technology Development Program, USDA Forest Service (Forest Health Protection).
	\$23,576	Belowground impacts of pile burning in the inland Northwest U.S. (Co-PI). USDI Joint Fire Science Program.
	\$1,800	Supplement – Inventory of Forest Structure and Composition and the Development of Site-Specific Prescriptions for Two Mechanical Treatment Units in Whiskeytown National Recreation Area. USDI National Park Service.
2010	\$166,964	Ecological and Social Dynamics of Mountain Pine Beetle Outbreaks in Western Montana (Lead PI). USDA McIntire-Stennis Forestry Research Program.
	\$3,850	Western Mensurationists' Conference – Special Session and Workshop on Quantification of Tree Crowns and Canopies (Co-PI). USDI Joint Fire Science Program.
2009	\$308,598	A Comprehensive Guide to Fuels Management Practices for Ponderosa Pine – Mixed-Conifer Forests (Co-PI). USDI Joint Fire Science Program. Keyes share = \$47,255.
	\$30,000	Improved Restoration Burning in Old-Growth Forests at Whiskeytown National Recreation Area: Decision-Support for Predictable Duff Consumption under Varying Burning and Field Conditions. USDI National Park Service.
	\$34,956	Vegetation Management and Restoration at Palo Alto Battlefield National Historic Park – Plan and Environmental Assessment. USDI National Park Service.
	\$13,842	The Pines Recreation Area: Stand Analysis, Inventory, and Reports. U.S. Army Corps of Engineers.
2008	\$30,000	Stand Structure, Understory Vegetation Condition, Fuels Status, and Potential Fire Behavior Before and After Restoration Treatments in Fire-Excluded Old Growth

- Ponderosa Pine and Western Larch Stands in Western Montana. USDA Forest Service Rocky Mountain Research Station.
- \$30,000 Inventory of Forest Structure and Composition and the Development of Site-Specific Prescriptions for Two Mechanical Treatment Units in Whiskeytown National Recreation Area. USDI National Park Service.
- 2007 \$35,000 Experimental Silvicultural Forest Restoration Treatments at Panther Creek: Implementation and Analysis. California State Parks.
- 2006 \$65,000 Design & Evaluation of Silvicultural Treatments to Restore Watershed Function at Humboldt Redwoods State Park. California State Parks.
- \$150,000 Natural Resource Condition Assessment for Redwood National and State Parks, Whiskeytown National Recreation Area, and Oregon Caves National Monument. USDI National Park Service.
- \$25,019 Monitoring & Evaluation of a Technique for Efficient Variable-Density Thinning in Young Stands. California State Parks.
- 2005 \$34,000 Inventory and Analysis of Second-Growth Encroachment in Relict Forest Ecosystems at Whiskeytown National Recreation Area. USDI National Park Service.
- \$19,657 Stand Composition, Structure, and Development of Pre-Commercially Thinned Redwood-Douglas-fir Forests. Save-the-Redwoods League Research Grant.
- \$8,188 Prescription for Forest Restoration: Panther Creek, Humboldt Redwoods State Park. California State Parks.
- 2004 \$17,000 25-Year Assessment of Redwood Ecosystem Response to Restorative Thinning. Save-the-Redwoods League Research Grant.
- 2003 \$9,982 Strategies for Reforestation and Forest Restoration at Humboldt Redwoods State Park. California State Parks.
- 2002 \$50,000 Ecology and Management of Stump Sprouting in Coast Redwoods (Co-PI). USDA McIntire-Stennis Forestry Research Program.
- \$55,000 Comparison of Silvicultural Treatments for Abatement of Wildfire Hazard. USDA McIntire-Stennis Forestry Research Program.

## PUBLICATIONS

### Refereed Journal Articles (n=49)

- 2021 Jang, W., J.C. Crotteau, Y.K. Ortega, S.M. Hood, **C.R. Keyes**, D.E. Pearson, D.C. Lutes, and A. Sala. 2021. Native and non-native understory vegetation responses to restoration treatments in a dry conifer forest over 23 years. *Forest Ecology and Management* 481:118684. DOI:10.1016/j.foreco.2020.118684.
- 2020 Tepley, A.J., S.M. Hood, **C.R. Keyes**, and A. Sala. 2020. Forest restoration treatments in a ponderosa pine forest enhance physiological activity and growth under climatic stress. *Ecological Applications* 30(8):e2188. DOI:10.1002/eap.2188.
- Hood, S.M., **C.R. Keyes**, K.J. Bowen, D.C. Lutes, and C. Seielstad. 2020. Fuel treatment longevity in ponderosa pine-dominated forest 24 years after cutting and prescribed burning. *Frontiers in Forests and Global Change* 3(78):1-16. DOI:10.3389/ffgc.2020.00078.
- Crotteau, J.S., and **C.R. Keyes**. 2020. Restoration treatments improve overstory tree disturbance resistance attributes and growth in a ponderosa pine/Douglas-fir forest. *Forests* 11(5):574. DOI:10.3390/f11050574.

- Crotteau, J.S., **C.R. Keyes**, S.M. Hood, and A.J. Larson. 2020. Vegetation dynamics following compound disturbance in a dry pine forest: Fuel treatment then bark beetle outbreak. *Ecological Applications* 30(2):e02023. DOI:10.1002/eap.2023.
- 2019 Crotteau, J.S., E.K. Sutherland, T.B. Jain, D.K. Wright, M.M. Jenkins, **C.R. Keyes**, and L.M. Nagel. 2019. Initiating climate adaptation in a western larch forest. *Forest Science* 65(4):528-536. DOI:10.1093/forsci/fxz024.
- 2018 Crotteau, J.S., **C.R. Keyes**, S.M. Hood, D.L.R. Affleck, and A. Sala. 2018. Fuel changes after a bark beetle outbreak impacts experimental fuel treatments. *Fire Ecology* 14:13. DOI:10.1186/s42408-018-0016-6.
- Crotteau, J.S., S.M. Hood, D.C. Lutes, **C.R. Keyes**, A. Sala, and M.G. Harrington. 2018. Management and succession at the Lick Creek Demonstration/Research Forest, Montana. *Journal of Forestry* 116(5):481-486. DOI:10.1093/jofore/fvy030.
- Crotteau, J.S., **C.R. Keyes**, S.M. Hood, A.J. Larson, E.K. Sutherland, D.K. Wright, and J.M. Egan. 2018. Stand dynamics 11 years after retention harvest in a lodgepole pine forest. *Forest Ecology and Management* 427:169-181. DOI:10.1016/j.foreco.2018.05.013.
- Jang, W., **C.R. Keyes**, and D.S. Page-Dumroese. 2018. Negligible impacts of biomass removal on Douglas-fir growth 29 years after outplanting in the northern Rocky Mountains. *Biomass & Bioenergy* 108:236-243. DOI:10.1016/j.biombioe.2017.11.012.
- Matt, C.P., **C.R. Keyes**, and R.K. Dumroese. 2018. Biochar effects on the nursery propagation of 4 northern Rocky Mountain native plant species. *Native Plants Journal* 19(1):14-26.
- Williams, H., S.M. Hood, **C.R. Keyes**, J.M. Egan, and J. Negron. 2018. Subwatershed-level lodgepole pine attributes associated with a mountain pine beetle outbreak. *Forests* 9(9):552, 17 p. DOI:10.3390/f9090552.
- 2017 Clyatt, K.A., **C.R. Keyes**, and S.M. Hood. 2017. Long-term effects of fuel treatments on aboveground biomass accumulation in ponderosa pine forests of the northern Rocky Mountains. *Forest Ecology and Management* 400:587-599. DOI:10.1016/j.foreco.2017.06.021.
- Keyes, C.R.**, and C.M. Brissette. 2017. Effect of container size and design on morphological attributes of *Cercocarpus ledifolius* Nutt. (curlleaf mountain mahogany) seedlings. *Tree Planters' Notes* 60(1):37-43.
- Jang, W., **C.R. Keyes**, and D.S. Page-Dumroese. 2017. Long-term regeneration responses to overstory retention and understory vegetation treatments in the northern Rocky Mountains. *Forest Science* 63:136-146. DOI:10.5849/forsci.16-044.
- 2016 Jang, W., **C.R. Keyes**, and D.S. Page-Dumroese. 2016. Recovery and diversity of the forest shrub community 38 years after biomass harvesting in the northern Rocky Mountains. *Biomass & Bioenergy* 92:88-97. DOI:10.1016/j.biombioe.2016.06.009.
- Jang, W., D. S. Page-Dumroese, and **C.R. Keyes**. 2016. Long-term soil changes from forest harvesting and residue management in the northern Rocky Mountains. *Soil Science Society of America Journal* 80:727-741. DOI:10.2136/sssaj2015.11.0413.
- Crotteau, J.C., **C.R. Keyes**, E.K. Sutherland, D.K. Wright, and J.M. Egan. 2016. Forest fuels and potential fire behaviour twelve years after variable-retention harvest in lodgepole pine. *International Journal of Wildland Fire* 25:633-645. DOI:10.1071/WF14223.

- Jang, W., **C.R. Keyes**, and J.M. Graham. 2016. Evaluation of predictive models for Douglas-fir bark thickness following 12 biomass harvest treatments. *Biomass & Bioenergy* 84:118-123. DOI:10.1016/j.biombioe.2015.11.015.
- Stover, K.C., and **C.R. Keyes**. 2016. Forest fuels and wildfire hazard in two fire-excluded old-growth ponderosa pine stands: Contrasting stand-average calculations with measures of spatial heterogeneity. *Journal of Biodiversity Management and Forestry* 5:2. DOI:10.4172/2327-4417.1000158. 8 p.
- 2015 Jang, W., **C.R. Keyes**, and D.S. Page-Dumroese. 2015. Long-term effects on distribution of forest biomass following different harvesting levels in the northern Rocky Mountains. *Forest Ecology and Management* 358:281-290. DOI:10.1016/j.foreco.2015.09.024.
- Keyes, C.R.**, and R. Manso. 2015. Climate-influenced ponderosa pine (*Pinus ponderosa*) seed masting trends in western Montana, USA. *Forest Systems* 24(1):e021. 7 p. DOI:10.5424/fs/2015241-05606.
- Dodson, E.M., S. Hayes, J. Meek, and **C.R. Keyes**. 2015. Montana logging machine rates. *International Journal of Forest Engineering* 26(2). 11 p. DOI:10.1080/14942119.2015.1069497.
- Jang, W., **C.R. Keyes**, S.W. Running, J.-H. Lim, and P.S. Park. 2015. Climate-growth relationships of relict *Picea jezoensis* at Mt. Gyebang, South Korea. *Forest Science and Technology* 11(1):19-26. DOI:10.1080/21580103.2014.940001.
- 2014 **Keyes, C.R.**, T.E. Perry, E.K. Sutherland, D.K. Wright, and J.M. Egan. 2014. Variable-retention harvesting as a silvicultural option for lodgepole pine. *Journal of Forestry* 112(5):440-445. DOI:10.5849/jof.13-100.
- Keyes, C.R.**, and E.K. Teraoka. 2014. Structure and composition of old-growth and second-growth riparian forests at Redwood National Park, USA. *Forests* 5:256-268. DOI:10.3390/f5020256.
- 2013 Jang, W., **C.R. Keyes**, and J.-H. Lim. 2013. Application of mathematical models in the spatial analysis of early tree seedling distribution patterns within a treefall gap at Gwangneung Experimental Forest, Korea. *Journal of Plant Biology* 56:283-289. DOI: 10.1007/s12374-013-0044-3.
- Garlough, E.C., and **C.R. Keyes**. 2013. Properties of long-unburned duff mounds in an old-growth ponderosa pine stand. *Advances in Forestry Letters* 2:57-60. <http://www.afl-journal.org/paperInfo.aspx?ID=7141>.
- 2012 Affleck, D.L.R., **C.R. Keyes**, and J.M. Goodburn. 2012. Conifer crown fuel modeling: Current limits and potential for improvement. *Western Journal of Applied Forestry* 27:165-169. DOI:10.5849/wjaf.11-039.
- Larson, A.J., K.C. Stover, and **C.R. Keyes**. 2012. Effects of restoration thinning on spatial heterogeneity in old-growth mixed-conifer forest. *Canadian Journal of Forest Research* 42:1505-1517. DOI: 10.1139/X2012-100.
- Manso, R., M. Pardos, **C.R. Keyes**, and R. Calama. 2012. Modelling the spatio-temporal pattern of primary dispersal in stone pine (*Pinus pinea* L.) stands in the northern plateau (Spain). *Ecological Modelling* 226:11-21. DOI: 10.1016/j.ecolmodel.2011.11.028.
- O'Hara, K.L., L.P. Leonard, and **C.R. Keyes**. 2012. Variable-density thinning and a marking paradox: Comparing prescription protocols to attain stand variability in coast redwood. *Western Journal of Applied Forestry* 27:143-149. DOI:10.5849/wjaf.11-042.



- Plummer, J.F., **C.R. Keyes**, and J.M. Varner. 2012. Early-stage thinning for the restoration of young redwood – Douglas-fir forests in northern coastal California, USA. *ISRN Ecology* Vol. 2012, Article ID 725827. 9 p. DOI: 10.5402/2012/725827.
- 2011 Garlough, E.C. and **C.R. Keyes**. 2011. Influences of moisture content, mineral content, and bulk density on smouldering combustion of ponderosa pine duff mounds. *International Journal of Wildland Fire* 20:589-596. DOI:10.1071/WF10048.
- Keyes, C.R.** 2011. Thinning promotes the restoration of branch structure in second-growth redwoods at Redwood National Park. *Ecological Restoration* 29:325-327. DOI:10.3368/er.29.4.325.
- Teraoka, J.R. and **C.R. Keyes**. 2011. Low thinning as a forest restoration tool at Redwood National Park. *Western Journal of Applied Forestry* 26:91-93.
- 2010 Leonzo, C.M. and **C.R. Keyes**. 2010. Fire-excluded forests in the southeastern Klamath Mountains, California. *Fire Ecology* 6(3):62-76. DOI:10.4996/fireecology.0603062.
- 2009 **Keyes, C.R.**, D.A. Maguire, and J.C. Tappeiner. 2009. Recruitment of ponderosa pine seedlings in the Cascade Range. *Forest Ecology and Management* 257:495-501. DOI:10.1016/j.foreco.2008.09.024.
- 2008 **Keyes, C.R.** and D.A. Maguire. 2008. Some shrub shading effects on the mid-summer microenvironment of ponderosa pine seedlings in central Oregon. *Northwest Science* 82:245-250.
- Keyes, C.R.**, P.J. Matzka, K.C. Wright, R. Glebocki, and H-S Han. 2008. Early precommercial thinning of coast redwood sprout clumps: Evaluation of four techniques. *International Journal of Forest Engineering* 19(2):28-36.
- 2007 **Keyes, C.R.** and D.A. Maguire. 2007. Seed rain of ponderosa pine beneath partial overstories. *New Forests* 34:107-114. DOI: 10.1007/s11056-007-9040-0.
- Keyes, C.R.**, D.A. Maguire, and J.C. Tappeiner. 2007. Observed dynamics of ponderosa pine (*Pinus ponderosa* var. *ponderosa* Dougl. ex Laws.) seedling recruitment in the Cascade Range, USA. *New Forests* 34:95-105. DOI: 10.1007/s11056-007-9041-z.
- 2006 **Keyes, C.R.** 2006. Role of foliar moisture content in the silvicultural management of forest fuels. *Western Journal of Applied Forestry* 21(4):228-231.
- 2005 **Keyes, C.R.**, D.A. Jaramillo, B.M. Woolley, and M.S. Lancaster. 2005. Creation times and costs for five tree-based wildlife cavity structures (California). *Ecological Restoration* 23(3):207-208. DOI:10.3368/er.23.3.196.
- 2002 **Keyes, C.R.** and K.L. O'Hara. 2002. Quantifying stand targets for silvicultural prevention of crown fires. *Western Journal of Applied Forestry* 17(2):101-109.
- 2001 DeBell, D.S., **C.R. Keyes**, and B.L. Gartner. 2001. Wood density of *Eucalyptus saligna* grown in Hawaiian plantations: Effects of silvicultural practices and relation to growth rate. *Australian Forestry* 64(2):106-110.
- Keyes, C.R.**, S.A. Acker, and S.E. Greene. 2001. Overstory and shrub influences on seedling recruitment patterns in an old-growth ponderosa pine stand. *Northwest Science* 75(3):204-210.
- 2000 **Keyes, C.R.** 2000. Natural regeneration of ponderosa pine: Pest management strategies for seed predators. *Forestry Chronicle* 76(4):623-626. DOI: 10.5558/tfc76623-4.
- Keyes, C.R.** and M.G. Keyes. 2000. Silvopastoral agroforestry: A key to longleaf pine restoration. *Ecological Restoration* 18(2):93-99.

### Monographs & Book Chapters (n=3)

- 2018 O'Hara, K.L., L.P. Leonard, **C.R. Keyes**, and L. Narayan. 2018. Ch. 12 – Actividades de restauración en bosques jóvenes de *Sequoia sempervirens*: Implicaciones para la restauración de otros tipos de bosques (Restoration activities in young *Sequoia sempervirens* forests: Implications for restoration in other forest types). Pp. 233-244 in: P.J Donoso, A. Promis, and D.P. Soto, eds., *Silvicultura en Bosques Nativos: Avances en la Investigación en Chile, Argentina, y Nueva Zelandia*. Oregon State University Press, Corvallis, OR.
- 2015 Jang, W., **C.R. Keyes**, and D. Page-Dumroese. 2015. *Impact of Biomass Harvesting on Forest Soil Productivity in the Northern Rocky Mountains*. USDA Forest Service General Technical Report RMRS-GTR-341. 35 p.
- 2012 Jain, T.B., M.A. Battaglia, H-S. Han, R.T. Graham, **C.R. Keyes**, J.S. Fried, and J. Sandquist. 2012. *A Comprehensive Guide to Fuels Management Practices for Dry Mixed Conifer Forests of the Northwestern United States*. General Technical Report RMRS-GTR-292. 331 p.

### Published Conference Proceedings Papers (n=13)

- 2020 Bowen, K.J., **C.R. Keyes**, S.M. Hood, C. Seielstad, and D.C. Lutes. 2020. Comparison of two methods for quantifying coarse surface fuel loading. Pp. 22-30 in *Proceedings – The Fire Continuum Conference: Preparing for the Future of Wildland Fire*. USDA Forest Service Rocky Mountain Research Station RMRS-P-78.
- 2017 Teraoka, J.R., P.J. van Mantgem, and **C.R. Keyes**. 2017. Low thinning and crown thinning of two intensities as restoration tools at Redwood National Park. Pp. 259-266 in *Proceedings of the Coast Redwood Forest Symposium – 2016*. USDA Forest Service General Technical Report PSW-GTR-258.
- 2013 Jang, W., **C.R. Keyes**, and T.E. Perry. 2013. Long-term biomass harvesting effects on forest productivity under three silvicultural systems in the northern Rocky Mountains. In: *Proceedings – Council on Forest Engineering Annual Meeting*, Missoula, MT, 7-10 July 2013.
- 2012 O'Hara, K.L., L.P. Leonard, and **C.R. Keyes**. 2012. Variable-density thinning in coast redwood: A comparison of marking strategies to attain stand variability. Pp. 525-526 in *Proceedings of Coast Redwood Forests in a Changing California: A Symposium for Scientists and Managers*. USDA Forest Service General Technical Report PSW-GTR-238.
- 2010 **Keyes, C.R.** and T.E. Perry. 2010. Built for the future: New directions in silviculture research and demonstration at Montana's Lubrecht Experimental Forest. Pp. 267-270 in *Proceedings of the 2009 National Silviculture Workshop*. USDA Forest Service Proceedings RMRS-P-61.
- Keyes, C.R.**, T.E. Perry, and J.F. Plummer. 2010. Variable-density thinning for parks and reserves: An experimental case study at Humboldt Redwoods State Park, California. Pp. 227-237 in *Proceedings of the 2009 National Silviculture Workshop*. USDA Forest Service Proceedings RMRS-P-61.
- Wynsma, B. and **C.R. Keyes**. 2010. Biomass utilization to achieve diverse silvicultural goals. Pp. 135-143 in *Proceedings of the 2009 National Silviculture Workshop*. USDA Forest Service Proceedings RMRS-P-61.
- 2007 **Keyes, C.R.** and J.M. Varner. 2007. Putting out fire with gasoline: Pitfalls in the silvicultural treatment of canopy fuels. P. 301 in *Proceedings of the 2005 National Silviculture Workshop*. USDA Forest Service General Technical Report PSW-GTR-203.

- Chittick, A.J. and **C.R. Keyes**. 2007. Holter Ridge Thinning Study, Redwood National Park: Preliminary results of a 25-year retrospective. Pp. 270-280 in *Proceedings of the Redwood Region Forest Science Symposium*. USDA Forest Service General Technical Report PSW-GTR-194.
- 2006 **Keyes, C.R.** 2006. Foliar moisture contents of North American conifers. Pp. 395-399 in *Fuels Management – How to Measure Success: Proceedings of the 1<sup>st</sup> Fire Behavior and Fuels Conference*. USDA Forest Service Proceedings RMRS-P-41.
- 2005 **Keyes, C.R.** and P.J. Matzka. 2005. Intensive management of stump sprout reproduction in coppice-regenerated coast redwoods (*Sequoia sempervirens*). Pp. 51-55 in *The Thin Green Line: A Symposium on the State-of-the-Art in Reforestation* (Proceedings). Ontario Forest Research Institute Forest Research Information Paper No. 160. Ontario Ministry of Natural Resources, Sault Ste. Marie, Ontario, Canada.
- Keyes, C.R.** and D.A. Maguire. 2005. Positive seedling-shrub relationships in natural regeneration of ponderosa pine. Pp. 95-107 in *Proceedings of the Symposium on Ponderosa Pine: Issues, Trends, and Management*. USDA Forest Service General Technical Report PSW-GTR-198.
- 2000 **Keyes, C.R.**, and D.A. Maguire. 2000. A long-term study of ponderosa pine seedling recruitment and growth under partial overstories. Pp. 560-561 in *Pioneering New Trails: Proceedings of the Society of American Foresters National Convention*, Society of American Foresters, Bethesda, MD.

#### Technical Transfer Articles (n=14)

- 2021 Crotteau, J.S., S.M. Hood, Y.K. Ortega, D.E. Pearson, and **C.R. Keyes**. 2021. Invasive plant booms can lurk behind distinct forest restoration benefits. *Invasive Species Science Update* 13:4-6. Bozeman, MT: USDA Forest Service, Rocky Mountain Research Station, Invasive Species Working Group.
- Hood, S.M., D.C. Lutes, J.S. Crotteau, Y.K. Ortega, D.E. Pearson, **C.R. Keyes**, and A. Sala. 2021. Seeing the big picture: Long term studies at Lick Creek demonstrate how fuel treatments impact a changing forest. *Science You Can Use Bulletin*. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO. 2 p.
- 2020 Tepley, A.J., S.M. Hood, **C.R. Keyes**, and A. Sala. 2020. Forest restoration treatments in a ponderosa pine forest enhance physiological activity and growth under climatic stress. *Bulletin of the Ecological Society of America* 101(4):e01772. DOI: 10.1002/bes2.1772.
- Crotteau, J.S., S.M. Hood, and **C.R. Keyes**. 2020. Invasive plant cover increases after dry forest restoration, then fades away. *Invasive Species Science Update* 12:3. Bozeman, MT: USDA Forest Service, Rocky Mountain Research Station, Invasive Species Working Group. [https://www.fs.fed.us/rm/pubs\\_journals/2020/rmrs\\_2020\\_runyon\\_j003.pdf](https://www.fs.fed.us/rm/pubs_journals/2020/rmrs_2020_runyon_j003.pdf)
- 2014 Miller, S., M. Essen, N. Anderson, W. Chung, W. Elliot, D. Page-Dumroese, H-S Han, J. Hogland, and **C.R. Keyes**. 2014. Burgeoning biomass: Creating efficient and sustainable forest biomass supply chains in the Rockies. *Science You Can Use Bulletin*, Issue 13. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO. 10 p.
- Jain, T.B., M.A. Battaglia, H-S. Han, R.T. Graham, **C.R. Keyes**, J.S. Fried, and J. Sandquist. 2014. A comprehensive guide to fuels management practices for dry mixed conifer forests of the northwestern United States: Inventory and model-based economic analysis of mechanical fuel treatments. USDA Forest Service Research Note RMRS-RN-64. 2 p.

- Jain, T.B., M.A. Battaglia, H-S. Han, R.T. Graham, **C.R. Keyes**, J.S. Fried, and J. Sandquist. 2014. A comprehensive guide to fuels management practices for dry mixed conifer forests of the northwestern United States: Monitoring. USDA Forest Service Research Note RMRS-RN-63. 2 p.
- Jain, T.B., M.A. Battaglia, H-S. Han, R.T. Graham, **C.R. Keyes**, J.S. Fried, and J. Sandquist. 2014. A comprehensive guide to fuels management practices for dry mixed conifer forests of the northwestern United States: Prescribed fire. USDA Forest Service Research Note RMRS-RN-62. 2 p.
- Jain, T.B., M.A. Battaglia, H-S. Han, R.T. Graham, **C.R. Keyes**, J.S. Fried, and J. Sandquist. 2014. A comprehensive guide to fuels management practices for dry mixed conifer forests of the northwestern United States: Mechanical, chemical, and biological fuel treatment methods. USDA Forest Service Research Note RMRS-RN-61. 2 p.
- 2012 **Keyes, C.R.** 2012. A new resource for Montana Tree Farmers: Seedlings and reforestation assistance at the University of Montana's Experimental Seedling Nursery. *Montana Family Forest News* 40:10-11. Montana Tree Farm System, Missoula, MT.
- 2011 **Keyes, C.R.** 2011. Reviving the Memorial Greenhouse. P. 7 in *The University of Montana Forestry and Conservation News* December 2011.
- 2010 Garlough, E.C. and **C.R. Keyes**. 2010. Pitching theories from the duff mound. *Fire Management Today* 70(3):5-7.
- 2009 Varner, J.M. and **C.R. Keyes**. 2009. Fuels treatments and fire models: Errors and corrections. *Fire Management Today* 69(3):47-50.
- 2006 **Keyes, C.R.** and J.M. Varner. 2006. Pitfalls in the silvicultural treatment of canopy fuels. *Fire Management Today* 66(3):46-50.

### **Management Plans & Consultation Reports (n=23)**

- 2021 D. Sicular, **C.R. Keyes**, J. McGuire, T. Best, and K.G. McManigal. 2021. La Honda Creek Open Space Preserve – Forest Management Plan. Sicular Environmental Consulting and Natural Lands Management, Berkeley, CA. Prepared for Midpeninsula Regional Open Space District, Los Altos, CA. 142 p.
- D. Sicular and **C.R. Keyes**. 2021. City of Santa Cruz Watershed Lands – Opportunities and Constraints Evaluation of Forest Management Options. Sicular Environmental Consulting and Natural Lands Management, Berkeley, CA. Prepared for City of Santa Cruz Water Department, Santa Cruz, CA. 109 p.
- 2018 **C.R. Keyes**, D. Sicular, and K. Runyon. 2018. Sempervirens 236 Southern Conifer Flats Old Growth Restoration Project: Supplement to the Five-Year Monitoring Study – Statistical Analysis. Sicular Environmental Consulting and Natural Lands Management, Berkeley, CA. Prepared for Sempervirens Fund, Los Altos, CA. 6 p.
- D. Sicular, **C.R. Keyes**, J. King, J. Culver, K. Runyon, R. Teitel, and B. Vahey. 2018. Sempervirens 236 Southern Conifer Flats Old Growth Restoration Project: Five-Year Monitoring Study Final Report. Sicular Environmental Consulting and Natural Lands Management, Berkeley, CA. Prepared for Sempervirens Fund, Los Altos, CA. 65 p.
- 2017 **Keyes, C.R.**, D. Sicular, and N. Hamey. 2017. San Vicente Redwoods Deadman Gulch – Middle Big Restoration Project: Pre- and Post-Treatment Monitoring Design and Protocols.

- Sicular Environmental Consulting and Natural Lands Management, Berkeley, CA. Prepared for Peninsula Open Space Trust, Palo Alto, CA. 20 p.
- 2015 **Keyes, C.R.**, D. Sicular, and J. Culver. 2015. Chapter 4: Restoration Reserves. Pp. 4.1-4.52 in: San Vicente Redwoods Management Plan, D. Sicular and others. Sicular Environmental Consulting and Natural Lands Management, Berkeley, CA. Prepared for Peninsula Open Space Trust, Palo Alto, CA.
- 2014 **Keyes, C.R.**, D. Sicular, and J. Culver. 2014. Forest Stands within the CEMEX Redwoods Restoration Reserves: Preliminary Identification of Impaired Forest Condition Classes and Restoration Prescriptions. Sicular Environmental Consulting and Natural Lands Management, Berkeley, CA. Peninsula Open Space Trust, Palo Alto, CA. 18 p.
- 2012 **Keyes, C.R.** 2012. Strategic Plan for Evaluating Outplanting Practices via Experimental Testing. Prepared for the Lebanon Reforestation Initiative, a USAID project administered by USDA Forest Service International Programs. 7 p.
- T.E. Perry, and **C.R. Keyes**. 2012. Boulder Creek Forest Restoration Activities – 2012 Summary: Whiskeytown National Recreation Area, Whiskeytown, California. Montana Forest & Conservation Experiment Station, University of Montana, Missoula, MT. Prepared for Whiskeytown National Recreation Area, National Park Service, Whiskeytown, CA. 11 p.
- T.E. Perry, and **C.R. Keyes**. 2012. Swan Ecosystem Center Reforestation Consultation: Elk Creek Restoration. Montana Forest & Conservation Experiment Station, University of Montana, Missoula, MT. Prepared for Swan Ecosystem Center, Condon, MT. 9 p.
- Keyes, C.R.** 2012. Boosting Outplanting Performance: Review of outplanting practices. Prepared for the Lebanon Reforestation Initiative, a USAID project administered by USDA Forest Service International Programs. 27 p.
- Stringer, D.S., and **C.R. Keyes**. 2012. LRI Outplanting Practices Recommendations: Prescribed implementation of outplanting and post-planting practices. Prepared for the Lebanon Reforestation Initiative, a USAID project administered by USDA Forest Service International Programs. 23 p.
- 2011 T.E. Perry and **C.R. Keyes**. 2011. Whiskeytown National Recreation Area (Whiskeytown, California): Phase II Forest Restoration Activities. Montana Forest & Conservation Experiment Station, University of Montana, Missoula, MT. Prepared for Whiskeytown National Recreation Area, National Park Service, Whiskeytown, CA. 24 p.
- 2010 T.E. Perry and **C.R. Keyes**. 2010. Integrated Vegetation Management Plan and Environmental Assessment. Montana Forest & Conservation Experiment Station, University of Montana, Missoula, MT. Prepared for Palo Alto Battlefield National Historic Site, National Park Service, Brownsville, TX. 147 p.
- 2009 **Keyes, C.R.**, T.E. Perry, K.C. Stover, and D.L.R. Affleck. 2009. The Pines Recreation Area at Fort Peck Lake, Montana: Forest Structure and Wildland Fuels Condition Assessment. Montana Forest & Conservation Experiment Station, University of Montana, Missoula, MT. Prepared for U.S. Army Corps of Engineers, Fort Peck, MT. 58 p.
- Keyes, C.R.**, T.E. Perry, J.F. Plummer, and J.M. Varner. 2009. Variable-Density Thinning for Parks and Reserves: Panther Creek Case Study at Humboldt Redwoods State Park. Prepared for California State Parks, North Coast Sector, Eureka, CA. 69 p.

- 2008 **Keyes, C.R.**, K.C. Stover, and E.C. Garlough. 2008. Brief Summary of Forest Conditions at Coggins Park Forest Reserve, Whiskeytown National Recreation Area. Montana Forest & Conservation Experiment Station, University of Montana, Missoula, MT. Prepared for Whiskeytown National Recreation Area, National Park Service, Whiskeytown, CA. 12 p.
- 2007 **Keyes, C.R.** 2007. Brandy Creek Forest Restoration Demonstration Project, Whiskeytown National Recreation Area (California). Montana Forest & Conservation Experiment Station, University of Montana, Missoula, MT. Prepared for Whiskeytown National Recreation Area, National Park Service, Whiskeytown, CA. 17 p.
- Keyes, C.R.** 2007. Cuneo Creek Forest Restoration Project at Humboldt Redwoods State Park: Summary of Findings. Prepared for California Department of Parks and Recreation, North Coast Redwoods District, Eureka, CA. 7 p.
- Leonzo, C.M. and **C.R. Keyes**. 2007. Second-Growth Encroachment in Relictual Forest Ecosystems at Whiskeytown National Recreation Area, California. Prepared for Whiskeytown National Recreation Area, National Park Service, Whiskeytown, CA. 83 p.
- Keyes, C.R.** 2007. Panther Creek Forest Restoration Project: Final Report. Prepared for California Department of Parks and Recreation, North Coast Redwoods District, Eureka, CA. 15 p.
- 2005 **Keyes, C.R.** 2005. Ecological Basis for Old-Growth Forest Restoration: 25-year Assessment of Redwood Ecosystem Response to Restorative Thinning. Prepared for Save-the-Redwoods League, San Francisco, CA. 67 p.
- Keyes, C.R.** 2005. Forest Restoration and Reforestation Strategies for Humboldt Redwoods State Park. Prepared for California Department of Parks and Recreation, North Coast Redwoods District, Eureka, CA. 41 p.

#### **Published Archived Datasets (n=6)**

- 2021 Jang, W., J.S. Crotteau, D.K. Wright, **C.R. Keyes**, and D.S. Page-Dumroese. 2021. Long-term ecosystem responses from the Coram woody biomass and residue utilization study. Fort Collins, CO: Forest Service Research Data Archive. DOI: 10.2737/RDS-2021-0058.
- 2020 Tepley, A.J., S.M. Hood, **C.R. Keyes**, and A. Sala. 2020. Tree-ring growth and stable-carbon isotope response data to forest restoration treatments in ponderosa pine forests of the Lick Creek Demonstration-/Research Forest, Bitterroot National Forest, Montana, USA. Fort Collins, CO: Forest Service Research Data Archive. DOI: 10.2737/RDS-2020-0027.
- Lutes, D.C., S.M. Hood, **C.R. Keyes**, M.G. Harrington, D.E. Pearson, Y.K. Ortega, and A. Sala. 2020. Lick Creek Demonstration-Research Forest: Data and photo archive of 25-year fire and cutting effects on vegetation and fuels. Fort Collins, CO: Forest Service Research Data Archive. DOI:10.2737/RDS-2020-0008.
- 2019 Crotteau, J.S., **C.R. Keyes**, S.M. Hood, and A.J. Larson. 2019. Vegetation data following the Fire and Fire Surrogate Study in western Montana. Fort Collins, CO: Forest Service Research Data Archive. DOI:10.2737/RDS-2019-0040.
- 2018 Hood, S.M., D.C. Lutes, J.S. Crotteau, **C.R. Keyes**, A. Sala, M.G. Harrington, and G.T. Munger. 2018. Lick Creek historic photographic series: A century of change in a ponderosa pine forest in western Montana, US. Fort Collins, CO: Forest Service Research Data Archive. DOI:10.2737/RDS-2018-0023.

- 2017 Williams, H.L., S.M. Hood, **C.R. Keyes**, and J.M. Egan. 2017. Mountain pine beetle attack severity data in lodgepole pine in the Northern Rockies from 1998-2014. Fort Collins, CO: Forest Service Research Data Archive. DOI:10.2737/RDS-2017-0006.

### Invited Book Reviews (n=2)

- 2016 **Keyes, C.R.** 2016. Silviculture concepts tailored to the forests of the North American West. *Journal of Forestry*. 114(6):672. Invited book review: Tappeiner, J.C. II, D.A. Maguire, T.B. Harrington, and J.D. Bailey. 2015. *Silviculture and Ecology of Western U.S. Forests*, 2nd ed. Oregon State University Press, Corvallis, OR. 448 p. DOI:10.5849/jof.15-495.
- 2015 **Keyes, C.R.** 2015. An authoritative treatment of the dynamics and practical management of complex forest stands. *Ecology* 96(9):2571-2572. Invited book review: O'Hara, K.L. 2014. *Multiaged Silviculture: Managing for Complex Forest Stand Structures*. Oxford University Press, New York, NY. 213 p. DOI:10.1890/BR15-38.1.

### Theses / Dissertations (n=2)

- 2002 **Keyes, C.R.** 2002. Recruitment of Ponderosa Pine Seedlings Beneath Partial Overstories. Ph.D. dissertation, Oregon State University, Corvallis, OR. 193 p. <http://hdl.handle.net/1957/10317>.
- 1996 **Keyes, C.R.** 1996. Structures and Silvicultural Strategies to Prevent Crown Fires in Northern Rocky Mountain Forests. M.S. thesis, University of Montana, Missoula, MT. 116 p. <http://scholarworks.umt.edu/etd/3656>.

## TEACHING

*108 credits of lecture/lab courses; 6 credits of seminar/readings courses*

### Louisiana Tech University

1 cr. Forest Trees of North America 2022

### University of Montana

1 cr. Artificial Regeneration & Drought Resilience 2021  
 3 cr. Multiple-Resource Silviculture 2008-15, 2017-18, 2020  
 1 cr. Adaptive Silviculture for Climate Change 2018  
 1 cr. Silviculture Theory & Application: Current Perspectives 2015  
 1 cr. Forestry & Conservation Graduate Seminar 2014  
 2 cr. Applied Forest Restoration: Guatemala (Study-Abroad) 2013  
 1 cr. Silviculture Research – Forest Regeneration 2012  
 3 cr. Timber Stand Management 2009

### Cal Poly Humboldt

2 cr. Silvicultural Restoration of Disturbed Forests 2007  
 4 cr. Silviculture 2002-07  
 3 cr. Forestry Capstone 2001-07  
 4 cr. Forest Resource Protection 2001-06  
 3 cr. Applied Forest Ecology 2002-05  
 3 cr. Advanced Silviculture 2004  
 1 cr. Wildland Fire and Fuels Management 2003  
 1 cr. American Wildland Fire History 2003  
 3 cr. Forest Regeneration Ecology 2001

## **Oregon State University**

- 1 cr. Topics in Silviculture Seminar 1998
- 3 cr. Introduction to Forestry (Teaching Assistant) 1997

## **University of Massachusetts**

- 3 cr. Forest Ecology (Teaching Assistant) 1993

## **MENTORING**

### **Post-Graduate Scientists & Research Associates**

- 2017-19 Dr. Alan J. Tepley, Post-Doctoral Scientist (shared)
- 2018 Dr. Justin S. Crotteau, Post-Doctoral Scientist
- 2015-17 Dr. Woongsoon Jang, Post-Doctoral Scientist
- 2016 Howard Williams, GIS Analyst
- 2015 Dr. Sharon M. Hood, Post-Doctoral Scientist
- 2014-15 Christine Brissette, Research Associate, Experimental Seedling Nursery
- 2012 Léa Estrade, Research Intern, Ministère de l'Agriculture, Université de Bordeaux, France
- 2009-11 Dr. Michael A. Battaglia, Post-Doctoral Scientist (shared)
- 2010 Rubén Manso, Visiting Scholar, National Institute of Agrarian Research, Madrid, Spain

### **Graduate Students – Advisor**

- 2019 Benjamin G. O'Connor, M.S. University of Montana
- 2018 Katelynn J. Bowen, M.S. University of Montana
- 2017 Justin S. Crotteau, Ph.D. University of Montana
- 2017 Haley C. Anderson, M.S. University of Montana
- 2016 Kate A. Clyatt, M.S. University of Montana
- 2015 Woongsoon Jang, Ph.D. University of Montana
- 2015 Clarice P. Matt, M.S. University of Montana
- 2011 Kyle C. Stover, M.S. University of Montana
- 2010 Emily C. Garlough, M.S. University of Montana
- 2010 Emily K. Teraoka, M.S. Cal Poly Humboldt
- 2008 Jesse F. Plummer, M.S. Cal Poly Humboldt
- 2005 Andrew J. Chittick, M.S. Cal Poly Humboldt

### **Graduate Students – Committee Member**

- 2021 George C. Gaines, III, Ph.D. University of Montana
- 2016 Robert Campbell, Ph.D. University of Montana
- 2014 Joshua P. Meek, M.S. University of Montana
- 2009 Aaron Kash, M.S. University of Montana
- 2008 Jesse M. Kreye, M.S. Cal Poly Humboldt
- 2008 Lawrence Maurin, M.S. Humboldt State University
- 2006 Carol Ewell, M.S. Cal Poly Humboldt
- 2006 David Sperry, M.S. Cal Poly Humboldt
- 2006 Jeff Jones, M.S. Cal Poly Humboldt



## PRESENTATIONS (presenter in bold)

- 2021 Seeing the Forest for the Clumps: Characterizing Clumpy Regeneration and Ladder Fuels. **J.S. Crotteau** and C.R. Keyes. 2021 Western Mensurationists Annual Meeting, University of British Columbia (Virtual). 21-22 Jun 2021.
- McIntire-Stennis Cooperative Forestry Research Program: Background & Basics. **C.R. Keyes**. Graduate Affairs Committee, Franke College of Forestry & Conservation, University of Montana (Virtual). 22 Apr 2021.
- Survive and Advance: Observations on Relevance and Resilience for University Agriculture & Forestry Programs. **C.R. Keyes**. School of Agricultural Sciences and Forestry, Louisiana Tech University, Ruston, LA. 17 Mar 2021.
- 2020 Lubrecht Forest Carbon Project. **C.R. Keyes**. Montana Forest Products Retention Roundtable, Montana Department of Natural Resources & Conservation (Virtual). 11 Dec 2020.
- New Opportunity for Lubrecht Forest Revenue: Selling Carbon Credits. **C.R. Keyes**. Annual Meeting of the Montana Society of American Foresters, Greenough, MT. 18 Sep 2020.
- Lubrecht Forest Carbon Project: Creating New Opportunities to Serve and Engage Students. **C.R. Keyes**. 13<sup>th</sup> Biennial Conference on University Education in Natural Resources, Missoula, MT. 12-14 Mar 2020.
- 2019 A Forest Management Framework for Climate Adaptation. **J.S. Crotteau**, E.K. Sutherland, T.B. Jain, M.M. Jenkins, D.K. Wright, C.R. Keyes, L.M. Nagel, and C. Peterson. Society of American Foresters Juneau Chapter meeting, Juneau, AK. 14 Mar 2019.
- Montana Adaptive Silviculture for Climate Change: Coram Experimental Forest and Flathead National Forest. **J.S. Crotteau**, D.K. Wright, E.K. Sutherland, T.B. Jain, M.M. Jenkins, C.R. Keyes, L.M. Nagel, and C. Peterson. North American Forest Ecology Workshop, Flagstaff, AZ. 23-27 Jun 2019.
- 2018 Comparison of Two Methods for Quantifying Coarse Surface Fuel Loading. **K.J. Bowen**, C.R. Keyes, S.M. Hood and D. Lutes. The Fire Continuum Conference: Preparing for the Future of Wildland Fire, Missoula, MT. 21-24 May 2018.
- Long-term Impacts of Slash Pile Burning on Wood Decomposition and Fungal Communities. **D.S. Page-Dumroese**, M. Jurgensen, J. Stewart, C.R. Keyes, N. Klopfenstein, C. Miller, and J. Tirocke. 13<sup>th</sup> North American Forest Soils Conference: Soils-Forests Interactions in Changing Environments, Quebec City, QC, Canada. 10-14 Jun 2018.
- 2017 Impacts of Biomass Harvesting on Forest Development and Productivity. W. Jang, **C.R. Keyes**, and D.S. Page-Dumroese. Annual Meeting of the Montana Society of American Foresters, Missoula, MT. 14 Apr 2017.
- An Assessment of Biochar-Amended Soilless Media for Nursery Propagation of Rocky Mountain Native Plants. C.P. Matt, **C.R. Keyes**, R.K. Dumroese, and A.J. Larson. Annual Meeting of the Montana Society of American Foresters, Missoula, MT. 14 Apr 2017.
- Are Fuel Treatments Undone by Beetle Outbreak? Fire & Fire Surrogate Study Sheds Light. **J.S. Crotteau** and C.R. Keyes. 2017 Society of American Foresters National Convention, Albuquerque, NM. 15-19 Nov 2017.
- Stand dynamics 11 years after retention harvest in Rocky Mountain lodgepole pine. **J.S. Crotteau** and C.R. Keyes. North American Forest Ecology Workshop, Edmonton, AB, Canada. 19-22 Jun 2017.

- Lessons from the Tenderfoot Project: Structural restoration in Rocky Mountain lodgepole pine. **J.S. Crotteau**, C.R. Keyes, E.K. Sutherland, D.K. Wright, and J.M. Egan. USDA Forest Service Region 1 Silviculture Workshop, Missoula, MT. 18 Apr 2017.
- Ponderosa pine growth responses to biochar, fertilizer or woody biomass mastication. **H.C. Anderson**, C.R. Keyes, D.S. Page-Dumroese, and M.D. Coleman. Annual Meeting of the Montana Society of American Foresters, Missoula, MT. 14 Apr 2017.
- Long-term impacts of fuel treatments on aboveground biomass in ponderosa pine forests of the Intermountain West. **K.A. Clyatt**, C.R. Keyes, D.S. Page-Dumroese, and S.M. Hood. Annual Meeting of the Montana Society of American Foresters, Missoula, MT. 14 Apr 2017.
- Fuels dynamics and potential fire behavior after variable retention harvest in lodgepole pine. **J.S. Crotteau**, C.R. Keyes, E.K. Sutherland, D.K. Wright, and J.M. Egan. Annual Meeting of the Montana Society of American Foresters, Missoula, MT. 14 Apr 2017.
- Back to the Fire and Fire Surrogate Study for wisdom on fuels treatment longevity. **J.S. Crotteau** and C.R. Keyes. Annual Meeting of the Montana Society of American Foresters, Missoula, MT. 14 Apr 2017.
- Effectiveness and longevity of ponderosa pine fuels reduction treatments at Lick Creek Demonstration/Research Forest, Montana. **K.J. Jenkins**, C.R. Keyes, S.M. Hood, and A. Sala. Annual Meeting of the Montana Society of American Foresters, Missoula, MT. 14 Apr 2017.
- Stand dynamics 11 years after retention harvest in Rocky Mountain lodgepole pine. **J.S. Crotteau** and C.R. Keyes. Inland Growth and Yield Cooperative Technical Meeting, Spokane Valley, WA. 13 Mar 2017.
- 2016 BRDI's-eye view of biomass harvesting impacts on northern Rocky Mountain forests. **C.R. Keyes**, D.S. Page-Dumroese, W. Jang, K.A. Clyatt, H.C. Anderson, and K.J. Jenkins. 2016 Annual Biomass Research and Development Initiative Meeting, Missoula, MT. 21 Apr 2016. (Invited).
- Summary of biochar amendment effects on greenhouse propagated native plant seedling growth and water use. **C.R. Keyes**, C.P. Matt, and R.K. Dumroese. 2016 Annual Biomass Research and Development Initiative Meeting, Missoula, MT. 20 Apr 2016. (Invited).
- An assessment of biochar-amended soilless media for nursery propagation of Rocky Mountain native plants. C.P. Matt, **C.R. Keyes**, R.K. Dumroese, and A.J. Larson. 2016 Annual Biomass Research and Development Initiative Meeting, Missoula, MT. 19 Apr 2016.
- Advances in using biochar as a media amendment. **C.P. Matt**, C.R. Keyes, and R.K. Dumroese. 7<sup>th</sup> Western Native Plant Conference, Vancouver, WA. 7-8 Dec 2016.
- Longevity of fuel reduction treatments at Lick Creek Demonstration / Research Forest. **K.J. Jenkins**, C.R. Keyes, and S.M. Hood. 3<sup>rd</sup> Southwest Fire Ecology Conference and 1<sup>st</sup> Applied Fire Science Workshop, Tucson, AZ. 28 Nov – 2 Dec 2016.
- Effectiveness and longevity of ponderosa pine fuels reduction treatments: A legacy of research at Lick Creek Demonstration/Research Forest in western Montana. **K.J. Jenkins**, C.R. Keyes, and S.M. Hood. 3<sup>rd</sup> Southwest Fire Ecology Conference and 1<sup>st</sup> Applied Fire Science Workshop, Tucson, AZ. 28 Nov – 2 Dec 2016.
- Years down the fire road: Mature tree growth responses to Montana's Fire and Fire Surrogate Study. **J.S. Crotteau** and C.R. Keyes. 2016 Society of American Foresters National Convention, Madison, WI. 2-6 Nov 2016.

Ponderosa pine growth responses to biochar, fertilization or woody biomass mastication. **H.C. Anderson**, C.R. Keyes, D.S. Page-Dumroese, and M.D. Coleman. 2016 Society of American Foresters National Convention, Madison, WI. 2-6 Nov 2016.

Effectiveness and longevity of ponderosa pine fuel reduction treatments at Lick Creek Research/Demonstration Forest, Montana. **K.J. Jenkins**, C.R. Keyes, and S.M. Hood. 2016 Society of American Foresters National Convention, Madison, WI. 2-6 Nov 2016.

Long-term impacts of fuel treatments on productivity and biomass in ponderosa pine forests of the Intermountain West. **K.A. Clyatt**, C.R. Keyes, D.S. Page-Dumroese, and S.M. Hood. 2016 Annual Biomass Research and Development Initiative Meeting, Missoula, MT. 19 Apr 2016.

Ponderosa pine ecosystem responses to thinning, biochar, fertilization or mastication in the Bitterroot National Forest: Impacts on tree growth and soil properties. **H.C. Anderson**, C.R. Keyes, D.S. Page-Dumroese, and M.D. Coleman. 2016 Annual Biomass Research and Development Initiative Meeting, Missoula, MT. 19 Apr 2016.

Seedling responses to forest biomass harvesting in the northern Rocky Mountains, USA. **W. Jang**, C.R. Keyes, and D.S. Page-Dumroese. 2016 Annual Biomass Research and Development Initiative Meeting, Missoula, MT. 19 Apr 2016.

Effectiveness and longevity of ponderosa pine fuels reduction treatments at Lick Creek Demonstration/Research Forest, Montana. **K.J. Jenkins**, C.R. Keyes, and S.M. Hood. 2016 Annual Biomass Research and Development Initiative Meeting, Missoula, MT. 19 Apr 2016.

Ponderosa pine ecosystem responses to thinning, biochar, fertilization or mastication in the Bitterroot National Forest: Impacts on tree growth and soil properties. **H.C. Anderson**, C.R. Keyes, D.S. Page-Dumroese, and M.D. Coleman. Annual Meeting of the Montana Society of American Foresters, Helena, MT. 15 Apr 2016.

Forest fuels and potential fire behavior 12 years after variable retention harvest in lodgepole pine. **J.S. Crotteau**, C.R. Keyes, E.K. Sutherland, D.K. Wright, and J.M. Egan. 5th International Fire Behavior & Fuels Conference, Portland, OR. 11-15 Apr 2016.

Back to the Fire and Fire Surrogate Study for wisdom on fuels treatment longevity. **J.S. Crotteau** and C.R. Keyes. 5th International Fire Behavior & Fuels Conference, Portland, OR. 11-15 Apr 2016.

Effectiveness and longevity of ponderosa pine fuels reduction treatments at Lick Creek Demonstration/Research Forest, Montana. **K.J. Jenkins**, C.R. Keyes, and S.M. Hood. 5th International Fire Behavior & Fuels Conference. Portland, OR. 11-15 Apr 2016.

Maintaining and improving soil and site productivity during bioenergy harvest operations. **D.S. Page-Dumroese**, C.R. Keyes, and W. Jang. IUFRO Regional Congress for Asia and Oceania 2016, Beijing, China. 24-27 Oct 2016.

Low thinning and crown thinning of varying intensities as restoration tools at Redwood National Park. **J.R. Teraoka**, P.J. van Mantgem, and C.R. Keyes. Coast Redwood Science Symposium, Eureka, CA. 13-15 Sep 2016.

Ponderosa pine responses to biochar, fertilization or mastication. **H.C. Anderson**, C.R. Keyes, **D.S. Page-Dumroese**, and M.D. Coleman. SER Europe Conference 2016 – Best Practice in Restoration, Freising, Germany. 22-26 Aug 2016.

- 2015 Stand dynamics following variable-retention harvesting in lodgepole pine. **C.R. Keyes**, J.S. Crotteau, E.K. Sutherland, D.K. Wright, J.M. Egan, and T.E. Perry. 2015 Society of American Foresters National Convention, Baton Rouge, LA. 3-7 Nov 2015.
- Regeneration and growth of lodgepole pine (*Pinus contorta*) following experimental variable-retention harvesting in the northern Rocky Mountains, USA. **C.R. Keyes**, E.K. Sutherland, D.K. Wright, J.M. Egan, and J.S. Crotteau. Reforestation Challenges: First International Symposium, Belgrade, Serbia. 3-6 Jun 2015.
- Seedling responses to forest biomass harvesting in the northern Rocky Mountains, USA. W. Jang, **C.R. Keyes**, and D.S. Page-Dumroese. Reforestation Challenges: First International Symposium, Belgrade, Serbia. 3-6 Jun 2015.
- Lodgepole pine forest dynamics and management options. **C.R. Keyes**. USDA Forest Service Northern Region Silviculture – Wildlife Workshop, Missoula, MT. 8 Apr 2015. (Invited).
- Biomass harvesting impacts on forest condition & productivity in the northern Rocky Mountains. **C.R. Keyes**. 2015 Annual Biomass Research and Development Initiative Meeting, Baton Rouge, LA. 19 Feb 2015. (Invited).
- Lick Creek Demonstration-Research Forest: 25- year fire and cutting effects on vegetation and fuels. **S.M. Hood**, C.R. Keyes, A. Sala, D.C. Lutes, K.A. Clyatt, and K.J. Jenkins. 6<sup>th</sup> International Fire Ecology & Management Congress, San Antonio, TX. 16-20 Nov 2015.
- Long-term impacts of intensive forest biomass utilization on understory shrub vegetation. **W. Jang**, C.R. Keyes, and D.S. Page-Dumroese. 2015 Society of American Foresters National Convention, Baton Rouge, LA. 3-7 Nov 2015.
- Lodgepole pine forest conditions influencing mountain pine beetle outbreaks in the western US. **S.M. Hood**, C.R. Keyes, and J.M. Egan. 2015 Society of American Foresters National Convention, Baton Rouge, LA. 3-7 Nov 2015.
- Forest fuels and potential fire behavior 12 years after variable retention harvest in lodgepole pine. **J.S. Crotteau**, C.R. Keyes, E.K. Sutherland, D.K. Wright, and J.M. Egan. 2015 Society of American Foresters National Convention, Baton Rouge, LA. 3-7 Nov 2015.
- Back to the Fire and Fire Surrogate Study for wisdom on fuels treatment longevity. **J.S. Crotteau** and C.R. Keyes. 2015 Society of American Foresters National Convention, Baton Rouge, LA. 3-7 Nov 2015.
- Long-term impacts of fuel treatments on productivity and biomass in ponderosa pine forests of the Intermountain West. **K.A. Clyatt**, C.R. Keyes, D.S. Page-Dumroese, and S.M. Hood. 2015 Society of American Foresters National Convention, Baton Rouge, LA. 3-7 Nov 2015.
- Ponderosa pine responses to biochar treatments on the Bitterroot National Forest: Impacts on tree growth and soil properties. **H.C. Anderson**, C.R. Keyes, D.S. Page-Dumroese, and M.D. Coleman. 2015 Society of American Foresters National Convention, Baton Rouge, LA. 3-7 Nov 2015.
- Effectiveness and longevity of ponderosa pine fuels reduction treatments at Lick Creek Research Forest, Montana USA. **K.J. Jenkins**, C.R. Keyes, and S.M. Hood. 2015 Society of American Foresters National Convention, Baton Rouge, LA. 3-7 Nov 2015.
- Advances in biochar as a media amendment. **C.P. Matt**, C.R. Keyes, A.J. Larson, and R.K. Dumroese. 2015 Intertribal Nursery Council Meeting, Pendleton, OR. 22-24 Sep 2015.

- Advances in biochar as a media amendment. **C.P. Matt**, C.R. Keyes, A.J. Larson, and R.K. Dumroese. 36<sup>th</sup> Intermountain Container Seedling Growers Association Annual Meeting, Moscow, ID. 16-17 Sep 2015.
- Retention forestry in the northern Rockies: Making time and space work for stand stability. **J.S. Crotteau**, C.R. Keyes, E.K. Sutherland, D.K. Wright, and J.M. Egan. 2015 10<sup>th</sup> North American Forest Ecology Workshop, Veracruz, Mexico. 14-18 Jun 2015.
- An assessment of biochar-amended soilless media for the nursery propagation of Rocky Mountain native plants. **C.P. Matt**, C.R. Keyes, R.K. Dumroese, and A.J. Larson. University of Montana Graduate Student Research Conference, Missoula, MT. 18 Apr 2015.
- Ponderosa pine forest restoration treatments in the northern Rocky Mountains: Long-term implications for residual biomass and productivity. **K.A. Clyatt**, C.R. Keyes, and D.S. Page-Dumroese. Montana Society of American Foresters Annual Meeting, Whitefish, MT. 10-11 Apr 2015.
- Seedling responses to biomass extraction in the northern Rocky Mountains, USA: Indicators of forest productivity impacts. **W. Jang**, C.R. Keyes, and D.S. Page-Dumroese. Montana Society of American Foresters Annual Meeting, Whitefish, MT. 10-11 Apr 2015.
- Fuels dynamics and potential fire behavior after variable retention harvest in lodgepole pine. **J.S. Crotteau**, C.R. Keyes, E.K. Sutherland, D.K. Wright, and J.M. Egan. Montana Society of American Foresters Annual Meeting, Whitefish, MT. 10-11 Apr 2015.
- An assessment of biochar-amended soilless media for the nursery propagation of Rocky Mountain native plants. **C.P. Matt**, C.R. Keyes, R.K. Dumroese, and A.J. Larson. Montana Society of American Foresters Annual Meeting, Whitefish, MT. 10-11 Apr 2015.
- 2014 San Vicente Redwoods Management Plan: Restoration Reserves. **C.R. Keyes** and D. Sicular. Presentation to staff of Sempervirens Fund, Save-the-Redwoods League, and Peninsula Open Space Trust, Palo Alto, CA. 21 Oct 2014. (Invited).
- Indicators of biomass harvesting effects on northern Rocky Mountain mixed conifer forest condition and productivity. **C.R. Keyes**. 2014 Annual Biomass Research and Development Initiative Meeting, Charlotte, NC. (Invited).
- Long-term planted seedling responses to forest biomass utilization intensity in the northern Rockies. **W. Jang**, C.R. Keyes, and D.S. Page-Dumroese. 14<sup>th</sup> IUFRO World Congress and 2014 Society of American Foresters National Convention. Salt Lake City, UT. 6-11 Oct 2014.
- Fuels dynamics and potential fire behavior after variable retention harvest in lodgepole pine. **J.S. Crotteau**, C.R. Keyes, E.K. Sutherland, D.K. Wright, and J.M. Egan. Large Wildland Fires: Social, Political & Ecological Effects Conference, Missoula, MT. 19-23 May 2014.
- Segmented polynomial regression provides best predictive model for Rocky Mountain Douglas-fir bark thickness following four biomass harvest utilization treatments. **W. Jang**, C.R. Keyes, and J.M. Graham. 2014 Montana Society of American Foresters Annual Meeting, Missoula, MT. 11 Apr 2014.
- Managing for stand resilience in Rocky Mountain lodgepole pine: Effects of heterogeneous stand treatments on woody fuel dynamics, postulated fire behavior. **J.S. Crotteau**, C.R. Keyes, E.K. Sutherland, D.K. Wright, and J.M. Egan. 85th Annual Northwest Scientific Association Conference, Missoula, MT. 26-29 Mar 2014.

- 2013 Evaluating dispersed and aggregated variable-retention cutting in lodgepole pine. **C.R. Keyes**. 2013 Society of American Foresters National Convention, Charleston, SC. 23-27 Oct 2013.
- Silviculture research in the Interior West: New frontiers. **C.R. Keyes**. Seminar, Forest and Woodland Ecosystems Science Program, USDA Forest Service Rocky Mountain Research Station, Missoula, MT. 23 Apr 2013. (Invited).
- Impact of biomass harvesting on forest productivity and species composition in the northern Rockies. **W. Jang**, C.R. Keyes, and D.S. Page-Dumroese. 2013 Society of American Foresters National Convention, Charleston, SC. 23-27 Oct 2013.
- Long-term biomass harvesting effects on forest productivity under three silvicultural systems in the northern Rocky Mountains. **W. Jang**, C.R. Keyes, and T.E. Perry. 2013 Council on Forest Engineering Annual Meeting, Missoula, MT. 7-10 Jul 2013.
- 2012 Biomass harvesting effects on forest condition and productivity. **C.R. Keyes**, D.S. Page-Dumroese, and W. Jang. 2012 Annual BRDI Meeting, Spokane, WA. 10 Oct 2012. (Invited).
- Silvicultural management of coppice-regenerated redwood stump sprouts. **C.R. Keyes**. Inland Empire Reforestation Council Annual Meeting, Coeur d'Alene, ID. 28 Feb 2012. (Invited).
- Thinning intensity studies and growth modeling of Montana mixed conifer forests at the University of Montana's Lubrecht Experimental Forest. **T.E. Perry** and C.R. Keyes. 2012 Inland Northwest Growth & Yield Cooperative Technical Meeting, Spokane, WA. 6-7 Mar 2012.
- Ponderosa pine seedling height growth beneath partial overstories in the central Oregon Cascade Range. **W. Jang**, C.R. Keyes, D.L.R. Affleck, and D.A. Maguire. 2012 Inland Growth & Yield Cooperative Technical Meeting, Spokane, WA. 6-7 Mar 2012.
- Evaluating the silvicultural potential of variable-retention harvesting in lodgepole pine. **T.E. Perry**, C.R. Keyes, E.K. Sutherland, D.K. Wright, J.M. Egan, and B.E. Steed. 2012 Society of American Foresters National Convention, Spokane, WA. 25-27 Oct 2012.
- Consequences of biomass harvesting on forest condition and productivity in northern Rocky Mountain forests. **W. Jang**, C.R. Keyes, and D.S. Page-Dumroese. 2012 Society of American Foresters National Convention, Spokane, WA. 25-27 Oct 2012.
- 2011 Silvicultural restoration of second-growth redwood forests: Challenges and strategies. **C.R. Keyes**. 4<sup>th</sup> World Conference on Ecological Restoration, Merida, Mexico. 21-25 Aug 2011.
- A comprehensive guide to fuels management practices for ponderosa pine / mixed conifer forests. **M.A. Battaglia**, T.B Jain, C.R. Keyes, H.-S. Han, and R.T. Graham. Interior West Fire Ecology Conference: Challenges and Opportunities in a Changing World, Snowbird Resort, UT. 14-17 Nov 2011.
- A comprehensive guide to fuels management practices for ponderosa pine / mixed conifer forests. **M.A. Battaglia**, T.B Jain, C.R. Keyes, H.-S. Han, and R.T. Graham. 2011 Society of American Foresters National Convention. Honolulu, HI. 2-6 Nov 2011.
- 2010 The Applied Forest Management Program: Research, demonstration, outreach. **C.R. Keyes** and T.E. Perry. Annual Meeting of the Montana Society of American Foresters, Missoula, MT. 22-23 Apr 2010.
- A comprehensive guide to fuels management practices for ponderosa pine / mixed conifer forests. **M.A. Battaglia**, T.B Jain, C.R. Keyes, H.-S. Han, and R.T. Graham. 3<sup>rd</sup> Fire Behavior and Fuels Conference, Spokane, WA. 25-29 Oct 2010.

- A comprehensive guide to fuels management practices for ponderosa pine / mixed conifer forests. M.A. Battaglia, T.B Jain, **C.R. Keyes**, H.-S. Han, and R.T. Graham. Annual Meeting of the Montana Society of American Foresters, Missoula, MT. 22-23 Apr 2010.
- A comprehensive guide to fuels management practices for ponderosa pine / mixed conifer forests. **M.A. Battaglia**, T.B Jain, C.R. Keyes, H.-S. Han, and R.T. Graham. USDA Forest Service Rocky Mountain Research Station All-Scientists Meeting, Fort Collins, CO. 22-24 Mar 2010.
- 2009 Built for the future: New directions in silviculture research and demonstration at Montana's Lubrecht Experimental Forest. **C.R. Keyes** and T.E. Perry. 2009 National Silviculture Workshop, Boise, ID. 15-18 Jun 2009.
- Variable-density thinning for parks and reserves: an experimental case study at Humboldt Redwoods State Park, California. **C.R. Keyes**, T.E. Perry, and J.F. Plummer. 2009 National Silviculture Workshop, Boise, ID. 15-18 Jun 2009.
- A comprehensive guide to fuels management practices for ponderosa pine / mixed conifer forests. **M.A. Battaglia**, T.B Jain, C.R. Keyes, H.-S. Han, and R.T. Graham. 4th International Fire Ecology and Management Congress, Savannah, GA. 30 Nov - 4 Dec 2009.
- 2008 From stumps to stratosphere: Emerging silvicultural applications in the redwood empire. **C.R. Keyes**. Montana Society of American Foresters, Libby Chapter Meeting, Libby, MT. 15 May 2008. (Invited).
- 2007 Variable-density thinning as a disturbance force to restore natural conditions in re-growth forests. **C.R. Keyes**. IUFRO Natural Hazards and Natural Disturbances in Mountain Forests: Challenges and Opportunities for Silviculture conference, Trento, Italy. 18-21 Apr 2007.
- New challenges and opportunities for active forest management. **C.R. Keyes**. Montana Society of American Foresters, Eastside Chapter Meeting, Helena, MT. 17 Dec 2007. (Invited).
- Active forest management: Adapting silviculture to new challenges. **C.R. Keyes**. Montana Society of American Foresters, Flathead Chapter Meeting, Kalispell, MT. 13 Dec 2007.
- Silvicultural restoration of redwood forests. **C.R. Keyes**. McCrone Promising Faculty Scholar Award Reception, Cal Poly Humboldt, Arcata, CA. 26 Apr 2007. (Invited).
- Fuels management and old-growth restoration: Silvicultural options for discordant objectives. **J.M. Varner** and C.R. Keyes. 2<sup>nd</sup> Fire Behavior and Fuels Conference, Destin, FL. 26-30 Mar 2007.
- 2006 Foliar moisture contents of North American conifers. **C.R. Keyes**. 1<sup>st</sup> Fire Behavior and Fuels Conference, Portland, OR. 28-30 Mar 2006.
- Invited Panelist. **C.R. Keyes**. Sustainable Forestry in the West: Past, Present, and Future symposium, Bill Lane Center for the American West, Stanford University, Palo Alto, CA.
- Old tool with a new edge: Thinning to restore disturbed forests. **C.R. Keyes**. City of Arcata Forest Lecture Series, Arcata, CA. 19 Jan 2006. (Invited).
- Resurrecting giants: Silvicultural forest restoration at Redwood National Park. **C.R. Keyes**. Seminar, Sustainable Forest Ecosystems in Central Appalachian Forests Science Program, USDA Forest Service Northeastern Research Station, Parsons, WV. 24 Apr 2004. (Invited).

- Stand structure and development of pre-commercially thinned coast redwood – Douglas-fir forests. **J.F. Plummer** and C.R. Keyes. 2006 Society of American Foresters National Convention, Pittsburgh, PA. 25-29 Oct 2006.
- 2005 Applying silvicultural principles to redwood forest restoration: A case study and experiment at Redwood National Park, USA. **C.R. Keyes**, A.J. Chittick, L.A. Arguello, and J.R. Teraoka. The World Conference on Ecological Restoration, Zaragoza, Spain. 12-18 Sep 2005.
- Intensive management of stump sprout reproduction in coppice-regenerated coast redwoods (*Sequoia sempervirens*). **C.R. Keyes** and P.J. Matzka. The Thin Green Line: A Symposium on the State-of-the-Art in Reforestation, Thunder Bay, Ontario, Canada. 26-28 Jul 2005.
- Putting out fire with gasoline: Pitfalls in the silvicultural treatment of canopy fuels. **C.R. Keyes** and J.M. Varner. National Silviculture Workshop, Tahoe City, CA. 6-10 Jun 2005.
- Exploratory assessment of redwood branch dimensions at the Holter Ridge Thinning Study, Redwood National Park. Y.R. King, M.J. Lombardi, and **C.R. Keyes**. 78<sup>th</sup> Annual Meeting of the Northwest Scientific Association, Corvallis, OR. 23-26 Mar 2005.
- 2004 Positive seedling-shrub relationships in natural regeneration of ponderosa pine. **C.R. Keyes** and D.A. Maguire. Ponderosa Pine: Management, Issues and Trends conference, Klamath Falls, OR. 18-21 Oct 2004. (Invited).
- Observed dynamics of ponderosa pine (*Pinus ponderosa* var. *ponderosa* Dougl. ex Laws) seedling recruitment in the Cascade Range, USA. **C.R. Keyes** and D.A. Maguire. IUFRO Regenerating Mountain Forests – Prerequisite for Sustainable Management symposium, Kloster Seon, Bavaria, Germany. 12-16 Sep 2004.
- Silvicultural treatments to control stump sprout density in coast redwoods. **C.R. Keyes** and P.J. Matzka. Redwood Region Forest Science Symposium, Rohnert Park, CA. 15-17 Mar 2004.
- Regeneration dynamics of ponderosa pine seedlings beneath partial overstories. **C.R. Keyes**. Seminar, Disturbance Ecology and Management of Oak-Dominated Forests Science Program, USDA Forest Service Northeastern Research Station, Morgantown, WV. 7 Jan 2004. (Invited).
- Holter Ridge Thinning Study, Redwood National Park: Preliminary results of a 25-year retrospective. **A.J. Chittick** and C.R. Keyes. Redwood Region Forest Science Symposium, Rohnert Park, CA. 15-17 Mar 2004.
- 2001 Primer on silvicultural practices and systems. **C.R. Keyes**. Docent Training Program, Campus Center for Appropriate Technology, Cal Poly Humboldt, Arcata, CA. Oct 2001. (Invited).
- Using silviculture to prevent crown fires. **C.R. Keyes**. Seminar, Department of Forestry and Watershed Management, Cal Poly Humboldt, Arcata, CA. Apr 2001. (Invited).
- Recruitment and growth of ponderosa pine seedlings under variable retention harvests. **C.R. Keyes**. Seminar, Department of Forestry and Watershed Management, Cal Poly Humboldt, Arcata, CA. Apr 2001. (Invited).
- 2000 Regeneration studies associated with the Demonstration of Ecosystem Management Options project: Initial findings. **C.R. Keyes** and D.A. Maguire. Demonstration of Ecosystem Management Options (DEMO) Project Cooperator's Conference, Vancouver, WA. 14 Dec 2000. (Invited).
- Growth of ponderosa pine seedlings under partial overstories. **C.R. Keyes**. Seminar, Department of Environmental Science, Policy and Management, University of California, Berkeley, CA. 30 Oct 2000. (Invited).



- 1999 A long-term study of ponderosa pine regeneration dynamics under partial overstories. **C.R. Keyes** and D.A. Maguire. 1999 Society of American Foresters National Convention, Portland, OR. 11-15 Sep 1999.
- Natural regeneration dynamics and early growth trends of two-aged ponderosa pine stands. **C.R. Keyes** and D.A. Maguire. Natural Resources Division of the Confederated Tribes of Warm Springs, Warm Springs, OR. Feb 1999. (Invited).
- 1997 Designing silvicultural guidelines to prevent crown fires in the northern Rockies. **C.R. Keyes**. Topics in Silviculture Seminar Series, Oregon State University, Corvallis, OR. 24 Nov 1997. (Invited).
- Yields from a long-rotation thinning regime in coastal Douglas-fir. **C.R. Keyes** and S.D. Stinson. Symposium on Thinning in Westside Forests, Newport, OR. 1-2 Apr 1997.
- 1996 Silvicultural opportunities for restoring low-intensity fire regimes to Northern Rocky Mountain forests. **C.R. Keyes** and K.L. O'Hara. Montana Academy of Sciences Symposium on Ecosystem Conservation, Preservation, and Restoration, Missoula, MT. Apr 1996.

## **OUTREACH & SPECIAL EVENTS**

- 2021 Congressional Field Tour: Research Studies and Operational Management at Lubrecht Experimental Forest. Montana U.S. Congressman Matt Rosendale and staffers.
- Field Tour Organizer and Presenter: Fire & Fire Surrogates Study at Lubrecht Experimental Forest. Women in the Woods Workshop.
- Guest Lecture: Lubrecht Experimental Forest Forest Carbon Project: New Opportunities Bring New Forest Planning Challenges. UM-PTRM 481 – Forest Planning.
- 2020 Facilities Tour: Managing for Recreationists and Outdoor Recreation Experiences at Lubrecht Experimental Forest. UM-PTRM 484 – Parks, Tourism, and Recreation Management Capstone.
- Field Tour Co-Leader, Fire & Carbon at Lubrecht Experimental Forest. Annual Meeting of the Montana Society of American Foresters.
- Field-Based Guest Lecture: Overview of Silviculture and Forest Management at Lubrecht Experimental Forest. UM-FORS 349 – Practice of Silviculture.
- 2018 Field Tour Co-Leader, Fire & Fire Surrogates Study at Lubrecht Experimental Forest. The Fire Continuum Conference: Preparing for the Future of Wildland Fire, Missoula, MT.
- Field Event Speaker, 1<sup>st</sup> Western RxBurn Field Tour, Lubrecht Experimental Forest. The Fire Continuum Conference: Preparing for the Future of Wildland Fire, Missoula, MT.
- Field Tour & Workshop Co-Organizer, Long-Term Fuel Treatment Effects in Ponderosa Pine and Dry Mixed Conifer Forests: 17 Years after the Fire & Fire Surrogates Study. Sponsored by Northern Rockies Fire Science Network. Lubrecht Experimental Forest, Greenough, MT.
- Invited Moderator, Session on Pre-commercial Thinning, Inland Northwest Growth & Yield Cooperative Winter Technical Meeting. Coeur d'Alene, ID.
- 2017 *Grow Your Own Seedlings* 1-day classroom/greenhouse workshop for family forest owners. Forestry Mini-College, Montana State University Extension Service. Missoula, MT.
- 2015 Invited Scientific Planning Committee Member, Reforestation Challenges: First International Symposium (IUFRO). Belgrade, Serbia.

- 2014 *Seedling Factory* 1-day reforestation/nursery practice workshop for schoolchildren. Missoula (MT) County Public Schools, Gifted Education program.
- 2013 Session Moderator, *Resource Assessment for Operational Planning*, Council on Forest Engineering Annual Meeting. Missoula, MT.  
*Reforestation Station* 1-day reforestation/nursery practice workshop for Montana & Wyoming Girl Scouts. Missoula (MT).  
*Seedling Factory* 1-day reforestation/nursery practice workshop for schoolchildren. Missoula (MT) County Public Schools, Gifted Education program.
- 2012 *Forest Regeneration* 1-day workshop for family forest owners. Forestry Mini-College, Montana State University Extension Service. Missoula, MT.  
*Seedling Factory* 1-day reforestation/nursery practice workshop for schoolchildren. Missoula (MT) County Public Schools, Gifted Education program.  
 Co-Coordinator, Inland Empire Reforestation Council Annual Meeting. Coeur d'Alene, ID.
- 2011 *Forest Regeneration* 1-day workshop for family forest owners. Forestry Mini-College, Montana State University Extension Service. Missoula, MT.  
 Organizer & Moderator, *Forest Restoration as a Dynamic Process: Concept and Application in Temperate Forests* symposium, 4<sup>th</sup> World Conference on Ecological Restoration. Merida, MX.  
*Seedling Factory* 1-day reforestation/nursery practice workshop for schoolchildren. Missoula (MT) County Public Schools, Gifted Education program.
- 2010 Organizer, Annual Meeting of the Montana Society of American Foresters. Missoula, MT.  
 Co-Organizer, Western Mensurationists' Conference. Missoula, MT.
- 2008 Field Tour Leader, Joint Fire Science Program Fire & Fire Surrogates Study Site Review Team, Lubrecht Experimental Forest, MT. Tour and overview of long-term ecological research installations.  
 Co-Organizer, Red Storm: Bark Beetles in Montana Symposium. Missoula, MT.  
 Moderator, *Management Practices and Policies* panel session, Red Storm: Bark Beetles in Montana Symposium. Missoula, MT.  
 Field Tour Leader, Forest Stewardship Council of the Montana Department of Natural Resources and Conservation. Interpretive tour of forest stewardship demonstrations at Lubrecht Experimental Forest. Greenough, MT.
- 2006 Lecturer, SAF Forestry Institute for Teachers, Arcata, CA. Lecture and field overview of silviculture and forest stand dynamics.
- 2005 Lecturer, SAF Forestry Institute for Teachers, Arcata, CA. Lecture and field overview of silviculture and forest stand dynamics.  
 Organizer & Moderator, *Resurrecting Giants: Forest Restoration in the Redwood Empire* symposium, 1<sup>st</sup> World Conference on Ecological Restoration. Zaragoza, Spain.
- 2004 Lecturer, SAF Forestry Institute for Teachers, Arcata, CA. Lecture and field overview of silviculture and forest stand dynamics.
- 2003 Lecturer, SAF Forestry Institute for Teachers, Arcata, CA. Lecture and field overview of silviculture and forest stand dynamics.

- 1996 Assistant Program Coordinator, Continuing Education in Ecosystem Management Workshop Module IV. Montana Forest & Conservation Experiment Station. Missoula, MT.
- 1995 Assistant Program Coordinator, Uneven-Aged Management: Opportunities, Constraints, and Methodologies Workshop. University of Montana. Missoula, MT.