



## THE CHANGING BASELINE FOR FRONT RANGE ECOSYSTEMS

Implications for Management and Restoration

Saturday, March 16th 9:00 - 3:00 All are welcome

Change is a constant in ecological systems, but in the Anthropocene age, human impacts are dramatically influencing the nature and pace of ecological change—literally and metaphorically changing the landscape around us. Development, drainage, fire suppression, agriculture, resource extraction, introduction of invasive species, and anthropogenic climate change are just some of these influences. In the face of such long-term, irreversible changes, the very concept of a ‘baseline’ or ‘reference state’ of an ecosystem may be unsuitable as a basis for management decisions.

This symposium will explore what we know from recent research and monitoring studies about change over decades to Front Range plant, animal and microbial communities. We will consider the implications for managing these communities for resilience: not with the goal of returning them to some idealized and static past, but by bolstering their ability to adapt to the challenges of the future.

Speakers will describe research observations of change in local ecosystems from the mountains to the plains, highlight local observations, and raise questions for nature observers and land managers. When change is such a constant, how do we think about managing for resilience? What might it mean to “restore forward” in Boulder County?

## CONFERENCE SCHEDULE

### Introductory comments

9:00-9:20 AM

Intro and overview of day - Sandra Laursen and Claudia VanWie

Elizabeth Black, artist and community organizer  
*Then and Now: Images of ecological change*

### **Block 1: The changing baseline: Ecological processes in Front Range forests**

9:20-10:00 am

Tom Veblen, Geography, CU Boulder

*Forest resilience in the Front Range in the face of a changing climate: Lessons from historical ecology*

10:00-10:20 AM

Robbie Andrus, Geography, CU Boulder

*Tree establishment in Front Range subalpine forests under an altered climate*

10:20-10:40 AM

Teresa Chapman, Geography, CU Boulder, and The Nature Conservancy

*Forest refugia following recent fires in the montane forests of the Front Range: Management opportunities for enhancing forest resilience*

10:40-10:55 AM

Q and A / discussion

10:55-11:15 AM

Coffee break

### **Block 2: The long view: Long-term monitoring for management of public lands**

11:15 AM -12:15 PM

Brian Anacker, Boulder Open Space and Mountain Parks, and friends (Jeffco, BCPOS)

*Introduction: Case studies from local agencies*

Caitlin White, Ecology & Evolutionary Biology, CU Boulder

*Grassland resilience, from drought to deluge: Lessons from 25+ years of botanical monitoring on OSMP grasslands*

Chelsea Beebe, Jefferson County Open Space

*20+ years of raptor monitoring in Jefferson County Open Space: Trends in golden eagle territory fidelity and nest selection*

Therese Glowacki, Boulder County Parks and Open Space

*Long-term monitoring of prairie dog colonies and burrowing owls*

**12:15-1:15 PM**

Lunch

**Block 3: Restoring to what? Ecological restoration in times of change**

1:15-1:45 PM

Jessie Olson, Lefthand Watershed Oversight Group

*Restoring to the future: A case study in Left Hand Creek Watershed*

1:45-2:15 PM

Nancy Shackelford, INSTAAR, CU Boulder

*Restoration goals when the post keeps moving*

2:15-2:45 PM

Q and A / discussion

2:45-3:00 PM

Thanks, evaluation and closing

## SPEAKERS

**Elizabeth Black** is a 35-year Boulder resident, living in north Boulder on an acre with irrigation rights to the Silver Lake Ditch. She works as an artist painting landscapes and has a very small U-cut Christmas tree farm and veggie stand with her husband Chris Brown. She has a lot of experience organizing events and people around environmental issues, including the 1997 Crestview West neighborhood annexation because of polluted well water, and the 2009 Ditch Project ([ditchproject.org](http://ditchproject.org)) on the irrigation ditches in and around Boulder. She has been promoting soil carbon sequestration as a mitigating strategy for climate change and has decided that her best strategy is to give tools to land stewards, so they can figure out how they can get their soil into the best shape possible, to withstand the droughts and floods ahead, and to draw down atmospheric CO<sub>2</sub>. Her new Citizen Science Soil Health Project seeks to help growers show that they are improving their soil.

**Tom Veblen** is Distinguished Professor of Geography at the University of Colorado Boulder where he has taught since 1981. Previously he taught forest ecology and silviculture in the Forestry School of the University of Southern Chile in Valdivia, Chile in 1975-1979, and in 1979-1981 he was a Postdoctoral Research Fellow with the Forest Research Institute in Christchurch, New Zealand. His research interests are in forest

ecology with a focus on disturbance ecology in the context of climate change. In Colorado, his research conducted over more than three decades has examined how climate and humans have influenced the history of fire and bark beetle outbreaks and their consequences for forest dynamics.

**Robbie Andrus** is a PhD candidate in the Biogeography Lab in the Geography Department at the University of Colorado Boulder. His research investigates the environmental conditions that limit reproduction of subalpine trees and the implications of a warming climate for subalpine forests in the Colorado Front Range. Specifically, his projects include identifying the climate conditions that were favorable for past spruce and fir seedling germination and survival and assessing seed and environmental site limitations for upslope migration of spruce and fir.

**Teresa Chapman** is a doctoral candidate in the Geography Department at the University of Colorado Boulder, and the GIS manager at the Colorado Chapter of The Nature Conservancy. Her research interests in forest ecology are currently focused on mechanisms and patterns of forest recovery in Colorado following major disturbance events, such as the mountain pine beetle epidemic and the severe fires of 2002. These projects generally evaluate the resilience of lower and upper elevation forests to major disturbances and emphasize potential management implications. She received her master's degree in 2009 at CU upon completing a landscape analysis of the mountain pine beetle outbreak in the Southern Rockies. Her goal is to apply forest ecology and disturbance science to on-the-ground management applications. As two examples, in her work at The Nature Conservancy she is involved with experiments to reforest ponderosa pine in severely burned patches of the Colorado Front Range using drone technology and to promote aspen in fuel mitigation clear cuts in Summit County.

**Brian Anacker** works for the City of Boulder's Open Space and Mountain Parks (OSMP) in the role of Science Officer. He supports and integrates staff in research and monitoring, collaborates with external scientists, and communicates OSMP scientific results to stakeholders and the community. Personal interests include his family, steep trails, bluebird days, New Mexican food, and audiobooks.

**Caitlin White** is a graduate student in the department of Ecology and Evolutionary Biology at the University of Colorado Boulder. She uses observational and experimental studies to help land managers better understand and anticipate plant community response to climate variability and environmental disturbance. Prior to joining CU Boulder, Caitlin worked in ecosystems ranging from freshwater to desert to alpine to hardwood forests through work in state and federal natural resource agencies. She holds a Masters of Public Affairs and an M.S. in Environmental Science from Indiana University, Bloomington, and a B.A. from the University of California, San Diego.

**Therese Glowacki** manages the Resource Management Division of BCPOS, a position she has held for 20 years. Her staff includes over 40 employees working in forestry, wildlife, plant ecology, weed control, resource protection, education and outreach. Her latest projects involve grassland, riparian and forest habitat restoration, bioenergy, and soil carbon sequestration. Therese has an MS in Forestry Management from Oregon State and spent 10 years working for Peace Corps as a volunteer and staff member in Senegal, Madagascar and other parts of Africa.

**Chelsea Beebe** is a wildlife ecologist currently working for Jefferson County Open Space as a Natural Resources Senior Specialist. She has been studying and monitoring wildlife populations in the Colorado Front Range for 15 years at the state, county and university levels. Chelsea has been involved with multiple projects on a variety of taxa including a study of plague dynamics in prairie dog colonies, large mammal home range monitoring, and rodent and fish population recovery following the 2013 Front Range Flood. Chelsea received her B.A. in Environmental, Population, and Organismal Biology from CU Boulder and later went on to earn her M.S. in Integrative Biology from UC Denver. She works to conserve the wildlife of Colorado through integrative research, interagency collaboration, and public education.

**Jessie Olson** is Executive Director with Lefthand Watershed Oversight Group. She has worked professionally in the field of ecological restoration since 2003, overseeing restoration and land management projects with non-profits, land trusts, and in the private sector. She holds a Master's degree in Landscape Architecture and Environmental Planning at U.C. Berkeley, where she focused on river and wetland restoration design and planning. At Lefthand Watershed Oversight Group, she is responsible for overseeing day-to-day operations and management of the organization. Most recently, she led staff and contractor teams in implementing ten million dollars of flood recovery projects on private lands. Jessie loves all things associated with restoration projects from stakeholder collaboration, to design development, to implementation, and to adaptive management.

**Nancy Shackelford** is a restoration ecologist working in the Suding Lab at the University of Colorado Boulder. She received her PhD in British Columbia studying ecosystem resilience and restoration in oak-savanna systems, and her Masters degree in Western Australia studying native woody species encroachment and fire management. Her work is focused on blending complex ecological science with practical restoration techniques. She works in any ecosystem that she finds, but her heart is always in the prairie.

## ABSTRACTS

### **Tom Veblen: Forest resilience in the Front Range in the face of a changing climate: Lessons from historical ecology.**

Warming temperatures and more severe droughts over the past two decades are increasing tree mortality across the western U.S. as reflected by forest die-offs due to extreme drought, increased outbreaks of tree-killing bark beetles, and increases in the size and number of large wildfires. In low elevation forests dominated by ponderosa pine and Douglas fir across the U.S. West there is mounting evidence that climate warming combined with high severity fire is leading to fewer opportunities for tree seedlings to establish after wildfires and may lead to transitions from forest to non-forest vegetation. What does this pattern of declining forest resilience to wildfire under climate change imply for the future of Front Range forests? How does the history of fire and other ecological disturbances related both to past climate variability and to direct human impacts inform our expectations of climate-induced forest change in the Front Range? My goal is to synthesize recent research findings on forest resilience to increased wildfire activity as well as the multiple perspectives among fire researchers across the West relevant to informing public discourse, policy and management.

### **Robbie Andrus: Tree establishment in Front Range subalpine forests under an altered climate**

Rising temperatures and drought are increasing the rate of subalpine tree mortality and shifting the suitable habitat for subalpine tree species upslope in the Colorado Front Range. To track shifts in climate and replace recent tree mortality, new seedling establishment of Engelmann spruce and subalpine fir is needed to maintain existing forest and colonize new habitats made available by warming temperatures. Successful seedling establishment occurs across the eastern slope of the Front Range when sufficient quantities of seeds disperse to suitable sites and environmental conditions allow germination and survival. In this talk, I will examine the frequency of past seedling establishment events and the climate conditions associated with these events. Then I will discuss the implications of these results for future seedling establishment within the existing extent of subalpine forests and the feasibility for upslope migration under climate warming.

### **Teresa Chapman: Forest refugia following recent fires in the montane forests of the Front Range: Management opportunities for enhancing forest resilience**

Forested fire refugia (trees that survive fires) are important resources that provide seed sources for post-fire regeneration and ecosystem recovery. Patches of surviving trees are increasingly important as conifer regeneration has been limited following

some recent large western fires, particularly in ponderosa pine (*Pinus ponderosa*) forests. We evaluated the characteristics of forested fire refugia within 23 fires in ponderosa pine-dominated forests of the Colorado Front Range from 1996-2013 using high resolution aerial imagery. We found four results that may have critical concerns for the current and future management of ponderosa pine forests in Colorado: 1) large fires are expected to have large patches approximately a third the size of the fire without surviving conifers, 2) conifers were more likely to survive fires in wetter areas and topographic low points, 3) lower forest canopy cover (as is typically found in fuel treatments) did not increase the chance of conifers surviving fires, and 4) conifers were less likely to survive under extreme fire weather and burning conditions.

### **Brian Anacker**

Long-term monitoring studies are often designed to detect trends in the status or condition of a plant, animal, plant/animal community, habitat, soil/water, etc. Such studies can also provide early warning signs of abnormal conditions, provide evidence for the effectiveness of specific management actions (such as irrigation, grazing, or thinning), and increase our understanding of the dynamic nature of the subject. Here, we present three such studies from three different agencies and explore a set of interrelated questions: What have we learned over the past 20 years from these studies? Are there major environmental events (droughts, floods, fires) that are detectable in each study? What are the costs and benefits of continuing these studies for so long? Do we need 20 more years of data? What management actions have we actually taken given the monitoring results?

### **Caitlin White: Grassland resilience, from drought to deluge: Lessons from 25+ years of botanical monitoring on OSMP grasslands**

Tallgrass prairies historically occurred in Colorado along the base of Front Range foothills, on mesa tops, and in riparian areas of the eastern plains. Today, however, tallgrass prairies in Colorado are relatively rare and an important conservation target. Boulder Open Space and Mountain Parks manages some of the largest intact tallgrass prairies remaining in the state and has annually monitored tallgrass vegetation on 18 permanent transects since 1991. This talk considers variability in climate experienced locally since 1991 and reveals long-term trends in the prairie community, potential vulnerabilities of native flora in more extreme weather years, and the role of diversity in tallgrass prairie resilience.

### **Therese Glowacki: Long-term monitoring of prairie dog colonies and burrowing owls**

Charismatic mesofauna, is that a term? In the Front Range of Colorado, prairie dogs definitely fall into the category of “charismatic.” Boulder County has been a leader in

balanced prairie dog management since 1999. We have long-term data for colonies on open space and have used that data extensively in the last 20 years to modify our management. Secondly, a dedicated group of volunteers from BCNA have helped us monitor the state-threatened burrowing owls. Data on their population has led us to direct management including modifying agricultural practices or closing trails. The benefits of these data also include helping with the public discussions. Data is the driver of what we do. This presentation will provide a brief summary of what we have seen and how we have adaptively managed both prairie dogs and burrowing owls.

### **Chelsea Beebe: 20+ years of Raptor Monitoring in Jefferson County Open Space: Trends in golden eagle territory fidelity and nest selection**

Jefferson County Open Space (JCOS) has been collecting nesting data on raptors, using volunteers and staff, for over 20 years. With a focus on one of JCOS's flagship species, the golden eagle, we will share the methods of data collection, the importance of engaging volunteers in the process, and the trends of nest selection and fidelity throughout several territories over two decades. These data are valuable for guiding management decisions that work to protect nesting raptors even as the human population of the Denver Metro area continues to expand.

### **Jessie Olson: Restoring to the future: A case study in Left Hand Creek Watershed**

Watershed groups provide an increasingly important role in the community, as they work across jurisdictional boundaries to complete projects that benefit the whole watershed. Lefthand Watershed Oversight Group is one such group, leading watershed recovery in Boulder County. As a stakeholder-driven organization, we focus on developing tools that are transferable to other communities and agencies, including a regional stream stewardship handbook, adaptive management guide, and community science program. Our approach to watershed management includes (1) conceptualizing desired future conditions; (2) monitoring and assessing the watershed conditions, comparing observed conditions to the desired future conditions; (3) engaging with citizen scientists to collect data and build a collective network of informed watershed stewards and (4) learning and adjusting based on assessments to make smarter management decisions. Given the extensive watershed restoration efforts currently underway or recently completed throughout the Front Range, this a particularly pivotal time to learn from these projects and share this information to improve future efforts.

### **Nancy Shackelford: Restoration goals when the post keeps moving**

Defining clear targets of restoration is a challenge given the current condition of shifting climates, moving species, and changing land use demands. Traditional restoration methods that aim for specific native ecosystems need to incorporate the complex, dynamic social and ecological settings that underlie restoration practice.



Additionally, alternative targets may need to be considered that allow more flexibility in restoration decision-making. This talk will overview restoration goal setting in the Anthropocene, including how to restore ecosystems that are more likely to grow and persist in an environment of near-continuous change.

## **SPONSORS**

We would like to thank all those who have helped make this ecosymposium possible:

the many members of the Boulder County Nature Association who have helped out in a multitude of ways

Colorado Native Plant Society

Boulder County Parks & Open Space

Boulder City Open Space & Mountain Parks

Boulder County Audubon Society

University of Colorado Albert A. Bartlett Science Communication Center

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University of Colorado Environmental Studies Program