NREL Today: Symposium and Distinguished Ecosystem Ecologist Lecture and Awards

Thursday, November 20, 2014

Symposium and Distinguished Ecosystem Ecologist Lecture and Awards Ceremony
1:00 - 5:00 PM
Ballroom 350 C, Lory Student Center, CSU

Reception and Poster Session
5:00-6:30
Ballroom 350 D, Lory Student Center

For more information about the event, visit http://www.nrel.colostate.edu/ecosystem-award.html or email Laurie.Richards@colostate.edu.

NREL Today: Symposium Program

1:00-1:05 **Introduction from Director of NREL**
John Moore

1:05-1:20 **Sustainability of Agriculture in the Great Plains: Historical Changes from 1870 to the Present**
William J. Parton (SUMMARY)

1:20-1:25 **From litter decomposition to SOM formation: through the eye of isotopes**
Francesca Cotrufo, Jennifer Soong, Sarah Fulton-Smith, Michelle Haddix, Eleanor Campbell and William Parton (IGNITE)

1:25-1:30 **CitSci.org: comprehensive citizen science support**
Greg Newman, Russell Scarpino, Nicole Kaplan, Stacy Lynn, and Melinda Laituri (EXCITE)

1:30-1:35 **TECHS: The most ambitious forest production project, ever**
Dan Binkley (IGNITE)

1:35-1:50 **Mountain ecosystems in a time of rapid change: observations and results from Loch Vale watershed**
Jill Baron, Daniel Bowker, Tim Fegel, Bella Oleksy, Stephanie Kampf, Claudia Boot, and Ed Hall (SUMMARY)

1:50-1:55 **Hydrologic and geomorphic response to the High Park Fire**

Stephanie Kampf, Lee MacDonald, Sarah Schmeer, Dan Brogan, Peter Nelson, Adam Johnson, Codie Wilson, Sandra Ryan-Burkett, Chuck Rhoades, Tim Covino, Ed Hall (EXCITE)

1:55-2:00 **Landscape trajectories following successive ecological disturbances: beetles, fire, and flooding in the Poudre watershed**
Monique Rocca, Michael Lefsky, Stephanie Kampf, Bill Romme, Jason Sibold (EXCITE)

2:00-2:05 **Beetlejuice - Researching Sustainable Biofuels from Beetle-Kill Wood in the Rockies**
Keith Paustian (EXCITE)

2:05-2:15 Break

2:15-2:30 **Sagebrush conservation in a changing world**
Cameron L. Aldridge (SUMMARY)

2:30-2:35 **Saving the dammed: Beavers, catchment morphology, hydrologic retention, and geochemical processing amidst widespread environmental change**
Tim Covino, Ellen Wohl, and Ed Hall (EXCITE)

2:35-2:40 **Research at the crossroads: Looking for a way forward without making a deal with the devil**
Ed Hall (IGNITE)

2:40-2:45 **Molecular biomarkers for integrated belowground metabolism: tangible links between physiology and function**
Claudia Boot (EXCITE)

2:45-2:50 **The Number One Environmental Threat of the 21st Century**
Tom Stohlgren (IGNITE)

2:50-3:05 **Future Earth: Research Pathways toward Global Development and Sustainability**
Dennis Ojima (SUMMARY)

3:05-3:10 **Unraveling climatic, biological, and physiochemical controls on Arctic soil carbon cycling**
Matt Wallenstein (EXCITE)

3:10-3:15 **Soil ecology, systems thinking, and environmental literacy: Lessons from lives underfoot**

John Moore (IGNITE)

3:15-3:30 Break

3:30-4:00 *Invited Presentation by Dr. Dave Schimel*

A History of NREL Science

4:00-4:45 *Keynote Presentation by Dr. Stuart F. Chapin, 2011 Recipient of Award of Excellence in Ecosystem Science*

Moving from Assessment to Action: Linking Top-down with Bottom-up Adaptation Planning for Global Change

4:45-5:00 **Presentation of 2014 Award of Excellence in Ecosystem Science**

5:00-6:30 Reception with graduate student posters

Posters:

1. **The biogeochemical signatures of alpine ice glaciers and rock glaciers across the American West**
   Timothy Fegel, Jill Baron, Ed K. Hall, Claudia M. Boot, Andrew Fountain, and Gunnar Johnson
2. **Crop nutrient and soil water dynamics under deficit irrigation regimes following application of biochar and manure amendments**
   Erika Foster, Neil Hansen, and M. Francesca Cotrufo
3. **Think Deep: Understanding the Importance of Rooting Depth in the Carbon Sequestration Potential of Bioenergy Crops**
   Sarah Fulton-Smith, and M. Francesca Cotrufo
4. **Modeling Nitrogen Loss and Mitigation Potentials of Enhanced-Efficiency Nitrogen Fertilizers from Agricultural Soil System**
   Ram B. Gurung, Stephen M. Ogle, Keith Paustian, F. Jay Breidt, and William J. Parton
5. **Abundance Estimation of Elk in the Estes Valley, Colorado**
   A.C. Ketz and N.T.Hobbs
6. **Integrating local pastoral knowledge, participatory mapping, and species distribution modeling for risk assessment of invasive rubber vine (*Cryptostegia grandiflora*) in Ethiopia's Afar region**
   Matthew W. Luizza, Tewodros Wakie, Paul Evangelista, and Catherine Jarnevich
7. **Tracking the fate of Arctic carbon: will Arctic shrub expansion result in a loss or gain of soil carbon?**
   Laurel Lynch, Megan Machmuller, Francesca Cotrufo, Eldor Paul, Matthew Wallenstein
8. **Terrestrial Reptile Conservation in a changing Landscape**
   Daniel Martin, Cameron Aldridge, and Larissa Bailey
9. **K.I.S.S. (Keep It Simple Silly) Approach to Estimating Historical Forest Structure**
   Megan S. Matonis, Peter M. Brown, and Dan Binkley
10. **Niveograph interpolation to estimate peak accumulation of snow water equivalent in Rocky Mountain National Park**
    Glenn G. Patterson, and Steven R. Fassnacht

11. **Assessing undergraduate student learning of systems thinking in "Systems Theory and Information Management" course at Colorado State University**
    Yamina Pressler, John C. Moore, and Nissa Yestnes
12. **Effectiveness of Biochar for Rehabilitating Decommissioned Forest Roads**
    Matt Ramlow, Chuck Rhoades, M. Francesca Cotrufo
13. **Evaluating the climatic and geographic shifts of the mountain pine beetle under past, present, and future climate conditions in the Rocky Mountains**
    Aaron Sidder, Jason Sibold, and Sunil Kumar
14. **Rapid assessment of large-magnitude snow avalanche events in Colorado**
    Sara Simonson, Thomas Stohlgren, and Steven Fassnacht
15. **Assessing the impact of MODIS pixel purity on DayCent Grain Yields**
    Shannon Spencer and Stephen Ogle
16. **Mixed Movement Strategies in Kenyan White-bearded Wildebeest**
    J.A. Stabach, R.B. Boone, G. Wittemyer, and J.G.C. Hopcraft
17. **Nitrogen Saturation in a Remote Alpine Ecosystem: Do nitrogen additions increase relative abundance of nitrifiers?**
    Lydia Tena, Claudia Boot, and Ed Hall
18. **Relating Severity of a Mountain Pine Beetle Outbreak to Forest Management History**
    Anthony Vorster, Paul Evangelista, Thomas Stohlgren, Sunil Kumar, Robert Hubbard, Tony Cheng, Kelly Elder
19. **Evaluating the interactions between landform and fluvial flux in minimally disturbed catchments of the Front Range of Colorado**
    Pamela Wegener, Tim Covino, Ed Hall, Ellen Wohl
20. **Does the current state of the Lake Yojoa (Honduras) ecosystem pose a potential health risk to people that consume it's fish?**
    Randy Welch and Ed Hall
21. **Using multitemporal spectral indices derived from Landsat 8 to evaluate the distribution of a generalist invasive species in post-wildfire landscapes**
    Amanda M West, Paul Evangelista, Catherine Jarnevich, Sunil Kumar, Matt Luizza, and Steve Chignell
22. **Effects of fire severity and mountain pine beetle on lodgepole pine seedling density following the High Park Fire**
    Micah Wright and Monique Rocca

Presentation Abstracts

Keynote Speaker: Dr. Stuart F. Chapin
Title: Moving from assessment to action: Linking top-down with bottom-up adaptation planning for global change
Abstract: Recent assessments at local-to-global scales have identified global-change risks but have seldom triggered actions sufficient to reduce these risks. Effective adaptation planning and implementation is critical if households, communities, and nations are to thrive. However, the adaptation process is challenged by the dilemma that most adaptation planning is top-down, whereas impacts and appropriate adaptive responses occur locally. Approaches to adaptation differ in the degree of integration and feedbacks between top-down and bottom-up adaptation efforts. I describe a novel boundary organization in Alaska that uses local community visions for self-reliance and sustainability as a guide to link bottom-up with top-down adaptation planning. This boundary organization focused on four processes: (1) enhancing community capacity to evaluate and choose among adaptation options, (2) providing space for community reflection on the fit of its adaptation strategy to their fundamental adaptation goal (cultural integrity), (3) communicating local community adaptation goals and needs to national/subnational actors, and (4) exploring pathways for regional diffusion of locally emergent adaption solutions. Similar boundary organizations could empower local communities to improve the fit of adaptation options to their own goals and would facilitate regional experimentation and diffusion of adaptive solutions to address rapid and heterogeneous environmental and socioeconomic change.

Invited Speaker: Dr. Dave Schimel
Title: A History of NREL Science
Abstract: The NREL has brought a distinctive style to ecosystem science for five decades. Research at the lab has linked a commitment to excellence in basic science, a passion for projects that address critical societal issues and a canny appreciation for the needs of sponsors. The lab's approach, blurring the lines between basic and applied science, has shaped key and diverse aspects of ecosystem science, and blurred or outright destroyed the boundaries between otherwise-stovepiped subdisciplines. The lab has been a focus for collaboration, providing a venue for senior ecologists (and non ecologists) to collaborate on problems requiring deep expertise on diverse topics. Scientists at the lab have studied the role of soils since its inception, introducing concepts like active and passive SOM, below ground food webs, soil biodiversity, the Cole and Heil model of pedogenesis and many other ideas now part of the common knowledge of ecologists worldwide. Research at the lab has also redefined the role of animals in ecosystems, illuminating the role of large animals in nutrient transport, herbivory as a landscape process, grazing as an evolutionary driver, and shown that animal behavior interacts with energy and nutrient cycles. Scientists at the lab have led in studying invasive species, and their role in reshaping ecosystem processes. The lab's location and origins have led to a keystone role in arid land ecology, and the development of concepts such as nonequilibrium rangelands and the human ecology of pastoral ecosystems, a paradigm that has had vast influence outside drylands. The lab's location has also led to its playing a key role in mountain ecology, with the longest continuous biogeochemical record and the

first airborne ecological campaign in the mountains. Science at the lab has had a global reach, and greatly influenced global carbon science. I'll illustrate each of the science areas with brief reviews of seminal papers, but focus more on the common elements or style of research at the lab. Work at the NREL reflects the inspiration to basic science that real world problem-solving provides, the successes that can occur when questions are placed ahead of disciplinary culture, and the creativity and insight provided by intense collaboration between scientists.

Presenter: Cameron L. Aldridge
Title: Sagebrush conversation in a changing world.
Abstract: Sagebrush habitats continue to be degraded and fragmented throughout North America, resulting in declines of sagebrush and obligate species. Agricultural activities, energy development, and exurban development remove habitat and degrade sagebrush, primarily in eastern ecosystems, while fire (wild and prescribed) and invasive plants have resulted in extensive fragmentation and loss of sagebrush in western ecosystems. The impacts of habitat alteration will expand into the future as human populations continue to grow and the demand for renewable and non-renewable energy increases. Ultimately, restoration and enhancement of fragmented and degraded habitats will be required to maintain functioning ecosystems. However the sage-grouse, which is the flagship of sagebrush ecosystems, has yet to directly benefit from such efforts. Conservation effort will continue to be challenged by increasing future drought conditions predicted by climate models. Therefore, understanding how landscape changes will affect sagebrush ecosystems and the species that require them will be necessary if sagacious management actions are to be implemented. Our current research projects directly inform management actions for sagebrush ecosystems and key wildlife species, which form the foundation of conservation planning efforts.

Presenters: Jill Baron, Daniel Bowker, Tim Fegel, Bella Oleksy, Stephanie Kampf, Claudia Boot, and Ed Hall
Title: Mountain ecosystems in a time of rapid change: observations and results from Loch Vale watershed
Abstract: Since instrumentation in 1983, observations, experiments, and paleo-reconstructions in alpine and subalpine Loch Vale watershed have revealed patterns and processes related to atmospheric deposition and climate change, yet we continue to be surprised. Even as atmospheric nitrogen deposition declines, in part due to policies developed using our results, interactions between summer warming and nutrient cycling may be altering freshwater ecosystems.

Presenter: Dan Binkley
Title: TECHS: The most ambitious forest production project, ever
Abstract: How does drought affect tree growth? We're investigating this age-old question with innovative techniques in ecophysiology and genetic mapping in 35 sites across a 2000-mile gradient from the Amazon to Uruguay. This full-rotation experiment follows trees from planting to harvesting (when they're over 100 feet tall), with 12 Eucalyptus genotypes at each site, variable spacing among trees, and with rainfall exclusion. TECHS will provide the most complete picture of ever developed of how forest growth results from ecophysiological interactions of environmental factors and genetics.

Presenter: Claudia Boot
Title: Molecular biomarkers for integrated belowground metabolism: tangible links between physiology and function
Abstract: Scaling processes from the molecular level at which they occur, to the ecosystem-level scale relevant to biogeochemical cycling is one of the most significant challenges facing biogeochemists today. Systems-level approaches are one way to address scaling challenges, and by integrating known physiological responses to environmental cues with small molecule profiles of belowground soil processes, we can begin to understand which metabolic pathways are responsive and how they ultimately relate to ecosystem function. I'll describe how this approach integrates plant, animal and microbial contributions to belowground metabolism and provide some examples of ecosystems where it may be useful.

Presenters: Francesca Cotrufo, Jennifer Soong, Sarah Fulton-Smith, Michelle Haddix, Eleanor Campbell & William Parton
Title: From litter decomposition to SOM formation: through the eye of isotopes
Abstract: Accurate modeling of the flow of C from decomposing above- and below-ground plant litter to the atmosphere (e.g., as CO2 and VOC) and soil, and its distribution among functionally distinct soil organic matter pools, remains a challenge. While we have precise knowledge and modeling capability of the controls of plant litter decomposition rates, we largely ignore transfer amounts, temporal dynamics and C:N-chemistry of litter-C and N fluxes to the soil (e.g., DOM and light fragments), as well as the environmental and litter chemistry factors controlling litter-C and –N fate. In the mineral soil, litter-derived OM will most likely persist if it is used with high efficiency by microbes and allocated to microbial products that will stabilize through interaction with the soil matrix. In the past few years, we conducted laboratory incubations and field studies with 13C and 15N enriched plant material, and developed conceptual and empirical models on the SOM formation from litter decomposition.

Presenters: Tim Covino, Ellen Wohl, and Ed Hall
Title: Saving the dammed: Beavers, catchment morphology, hydrologic retention, and geochemical processing amidst widespread environmental change
Abstract: Since the beginnings of European settlement of the North American continent, land use and management practices have fundamentally altered the geomorphic form of the landscape. This has included widespread loss of catchment features that increase the retention of water, sediment, carbon, and nutrients (wetlands, riparian areas, beaver dams). This EXCITE presentation will feature a newly funded project that seeks to develop new insight into the ways in which reach-scale retention zones modify the timing, form, and magnitude of catchment-scale fluxes of water, sediment, carbon, and nutrients.

Presenter: Ed Hall
Title: Research at the crossroads: looking for a way forward without making a deal with the devil
Abstract: NREL is an exceptionally interdisciplinary research unit. We have expertise that crosses many disciplines with researchers that could occupy faculty positions across a range of different traditional

departments and colleges. My research program sits at two important intersections for understanding fundamental ecosystem processes. On one hand I look to link microbial physiology with ecosystem scale fluxes, on the other hand I look at how the physical sciences of hydrology and geomorphology can inform us about aquatic ecosystem function including microbial habitat and associated rates. While interdisciplinary research is often talked about in broad terms in practice it can be exceptionally challenging to move beyond two disciplines. Rarely do research projects come close to addressing the n-dimensionality of the natural world that is influenced by human activities and their inherently complex motivations. Yet this is exactly what the research community is increasingly asked to do. I will talk about some of these challenges and how I attempt to address them with my research through collaborations within the NREL and how the NREL is uniquely poised to meet some of these challenges.

Presenters: Stephanie Kampf, Lee MacDonald, Sarah Schmeer, Dan Brogan, Peter Nelson, Adam Johnson, Codie Wilson, Sandra Ryan-Burkett, Chuck Rhoades, Tim Covino, Ed Hall
Title: Hydrologic and geomorphic response to the High Park Fire
Abstract: After the 2012 High Park Fire, an interdisciplinary group of NREL scientists and collaborators started documenting the post-fire ecological and physical response. The physical science team began monitoring precipitation, erosion, and channel change within the burn area in 2012, and this effort expanded in 2014 to a broader runoff and water quality monitoring network. As the landscape recovers from the fire, our research team is tracking interactions between runoff, erosion, channel geomorphic change, and water quality at hillslope to watershed scale.

Presenter: John Moore
Title: Soil ecology, systems thinking, and environmental literacy: Lessons from lives underfoot.
Abstract: Soil ecology like all sciences evolved from a descriptive natural history-based beginning to one that is systems-based integrates multiple principles across multiple scales. The systems-based approach developed by NREL scientists has provided insights into natural and human impacts on the processes governing soil formation, biogeochemical cycles, biodiversity, and community structure and dynamics. This approach has shaped research into the science and environmental literacy realm as well. How students learn and apply knowledge is critical. Most students are unprepared to critically evaluate evidence-based arguments about the environment because they do not understand the principles that govern environmental processes and are unable to reason across hierarchical scales of biological organization. We have found consistently across topics that most MS and many HS students give “force-dynamic” descriptions that frame events in terms of actors trying to achieve purposes. Few MS and HS and most undergraduate students transition to “scientific model-based” explanations wherein events and phenomena are constrained and governed by underlying scientific principles. Students who are just beginning to use “scientific” reasoning use a descriptive tone in their discourse that involves naming and describing events and processes, but that falls short of explaining phenomena using scientific principles (e.g., students may describe that plants make food, but fail to conserve carbon atoms through processes such as photosynthesis and cellular respiration). We refer to this as phenomenological reasoning. The transition undertaken by more seasoned adopters is to use hierarchical and mechanistic reasoning in their discourse, wherein explanations draw on underlying principles and mechanisms, and are imbued with an understanding of how the basic principles manifest themselves at the scale of interest and

across scales of organization. Globalization and a growing world population necessitate a citizenry able to make collective decisions about using, protecting, and managing local, regional, and global ecosystems. The ability adopt and use system thinking is critical – a lesson from our lives underfoot.

Presenter: Greg Newman, Russell Scarpino, Nicole Kaplan, Stacy Lynn, and Melinda Laituri
Title: CitSci.org: comprehensive citizen science support
Abstract: Citizen Science and community-based monitoring programs are increasing in number, breadth, and popularity. These programs operate at multiple spatial and temporal scales, address myriads of locally and globally relevant issues, generate volumes of diverse scientific data, and involve many stakeholders. To be effective, such programs must ask questions, form teams, manage members, identify protocols, collect quality data, share results, and evaluate success. To address these challenges, we built CitSci.org (www.citsci.org) - an open and comprehensive cyber-infrastructure system that supports the full spectrum of citizen science data management, analysis, and visualization needs. The system empowers program coordinators to create projects, manage members, build custom data sheets, streamline data entry, visualize data on maps, automate custom analyses, and evaluate success. CitSci.org has engaged 102+ programs resulting in 88,526 rigorous scientific measurements (29,847 species observations and 58,679 site characteristics). Here, we discuss how this innovative platform supports the interdisciplinary needs of citizen science research; connects people, nature, and science; encourages and fosters meta-analyses across domains and projects, and coordinates diverse citizen science programs to collaboratively address multi-scale sustainability issues.

Presenter: Dennis Ojima
Title: Future Earth: Research Pathways toward Global Development and Sustainability
Abstract: Future Earth is a 10 year research initiative with the goal to meet the mounting challenges of global environmental change and the transition to global sustainability by harnessing the capacity of the global research community across multiple disciplines and engaging with a wide array of stakeholders. Future Earth intends to operate at the cutting edge of the science-policy interface while training the next generation of integrated thinkers and doers on global sustainability and human wellbeing, particularly in developing countries. Sustainability challenges are global in scope, but vary with regional social and environmental conditions. Future Earth's priorities are directed toward solution-oriented research, interdisciplinary collaborations, rapid dissemination of information to policy makers, broad participation and increased capacity building. Research covers three major themes: Dynamic Planet, Global Development, and Pathways to Sustainability.

Presenter: Bill Parton
Title: Sustainability of Agriculture in the Great Plains: Historical Changes from 1870 to the Present
Abstract: The Great Plains is an agricultural production center for the global market and an important source for greenhouse gas emissions. Historical agricultural census data and ecosystem models have been used to determine changes in crop yields, greenhouse gas emissions, and livestock animal production during the past 140 years in the Great Plains. Crop yields for corn and wheat were low prior to 1940, but corn has since increased by 700% and wheat by 100%. The increases in crop production were a direct result of increased use of nitrogen fertilizer, improved crop varieties, and a dramatic

increase in irrigation. Livestock production has increased by 100% since 1890, primarily attributed to the 500% increase in nondairy cattle production. The major current sources for greenhouse gas emission include livestock CH4 and soil N2O emissions. Soil carbon sequestration in Out of Production Cropland (CRP and degraded grasslands) substantially reduces the net greenhouse gas emissions from the Great Plains. Use of improved management practices has the potential to reduce net greenhouse gas fluxes from the Great Plains by 60%.

Presenter: Keith Paustian
Title: Beetlejuice - Researching Sustainable Biofuels from Beetle-Kill Wood in the Rockies
Abstract: Infestations of pine and spruce bark beetles have caused widespread mortality in coniferous forests in the Rocky Mountains, with 10's of million acres of U.S. forests impacted over the past two decades, a trend that is likely to intensify with future global climate change. The large amount (and often high density) of beetle-kill wood, lack of competition with food or conventional forest products, and potential synergisms with forest restoration objectives, are positive attributes of this potential feedstock for biofuel production. However, significant challenges include: often remote location, it 'temporary nature' and patchy distribution, difficult topography and limited transport network. These conditions likely preclude the supply of biomass to conventional large-scale biomass conversion facilities. Consequently, the BANR project (a consortium including CSU, U-WY, U-ID, U-MT, Montana State and Oregon State) is focusing on the use of scalable modular thermochemical conversion technologies, developed by our industrial partner (Cool Planet), which enables the production of drop-in liquid fuels and co-products in close proximity to available feedstocks. The BANR project is developing a comprehensive program to address the major challenges limiting feedstock development, production, logistics, environmental sustainability, socioeconomic constraints for utilization of insect-killed trees in the Rockies.

Presenter: Monique Rocca, Michael Lefsky, Stephanie Kampf, Bill Romme, Jason Sibold
Title: Landscape trajectories following successive ecological disturbances: beetles, fire, and flooding in the Poudre watershed.
Abstract: With climate change, there is increasing likelihood that multiple ecological disturbances will overlap in short succession, yet the ecological consequences of these so called "disturbance interactions" are not well understood. The 2012 High Park Fire was preceded by a severe bark beetle outbreak, and followed by a major summer storm and flood. Our project is examining the consequences of these multiple events on the landscape, focusing initially on forest regeneration dynamics. Our project is a collaboration with NEON, and we are taking advantage of NEON's state of the art remote sensing technologies.

Presenter: Tom Stohlgren
Title: The Number One Environmental Threat of the 21st Century
Abstract: By far, invasive species have been the leading cause of animal extinctions in the past 500 years. Invasive species cost the United States over $120 Billion per year in damages--that's more than hurricanes, tornados, wildfires, and floods combined. Africanized honeybees, giant Burmese pythons, Asian carp, and plant pathogens are ripping through our ecosystems. Ebola, Chikunguya, West Nile

Virus, and other invasive diseases from other countries top the news every day. But like Rodney Dangerfield, invasive species get no respect. Far more science attention is given to space travel and climate change. It may be time to do "triage of environmental threats" to better protect the environment, our economy, and human health.

Presenter: Matt Wallenstein
Title: Unraveling climatic, biological, and physiochemical controls on Arctic soil carbon cycling
Abstract: The Arctic has experienced substantial regional warming over the past 30 years that could turn the Arctic into a net source of carbon to the atmosphere as soil organic matter (SOM) decomposes. But in addition to temperature-driven acceleration of decomposition, several additional processes could either counteract or augment warming-induced SOM losses. For example, increased plant growth under a warmer climate will increase organic matter inputs to soils, which could fuel further soil decomposition by microbes, but will also increase the production of new SOM. Whether Arctic ecosystems store or release carbon in the future depends in part on the balance between these two counteracting processes, which this project focuses on. By differentiating SOM decomposition and formation and understanding the drivers of these processes, we will better understand how these systems function. We will integrate this new knowledge into a process-based biogeochemical model to improve our ability to forecast global change impacts on Arctic carbon stocks.

Poster Abstracts

1. The biogeochemical signatures of alpine ice glaciers and rock glaciers across the American West.
   Presenters: Timothy Fegel, Jill Baron, Ed K. Hall, Claudia M. Boot, Andrew Fountain, Gunnar Johnson
   Abstract: Alpine glaciers in the American West are projected to be non-existent within the next 100 years, yet there is little research on the biological and chemical signals of rock glaciers relative to ice glaciers. In particular, differences that may exist between microbial communities at their outflow may have the potential to alter reactive elements entering the ecosystem. In our comparative study of o chemistry and biology from glaciers and rock glaciers, we hypothesized that; 1. Weathering products will be greater from rock glaciers than ice glaciers. 2. Differences in microbial communities between glaciers types may result in differential processing of reactive elements. Metals, nutrients, DOC, major ions, qPCR of the amoA gene and fluorescence scans of the CDOM were analyzed. Results show significant differences in outflow chemistry between ice and rock glaciers. Rock glaciers have higher temperatures, pH, silica, total dissolved nitrogen and metal ion content, and electrical conductivities than ice glaciers. The structure of the dissolved organic matter, as observed in excitation-emission matrices varied, suggestive of microbial sourcing in ice glaciers, while rock glacier DOM was more representative of both microbial and terrestrial sourcing. NO_3^- values varied between paired sites and appeared to be related to regional atmospheric depositional loads. Our analysis suggests meltwater from glaciers and rock glaciers are actively contributing metals and nutrients to downstream waters, and active microbial activity at the glacial terminus is shaping the nature of reactive elements that are delivered to headwater aquatic ecosystems.

2. Crop nutrient and soil water dynamics under deficit irrigation regimes following application of biochar and manure amendments
   Presenters: Erika Foster, Neil Hansen, M. Francesca Cotrufo
   Abstract: Increases in frequency and intensity of drought present imminent changes in agroecosystems. As competition for groundwater from industrial and municipal users grows, water scarcity has become a crucial issue for producers. This will require adaptation of agricultural practices through innovative soil, water and crop management strategies. This study aims to find methods to adapt semi-arid irrigated systems to drought, examining the effect of drought mitigation strategies on water and nutrient availability for two corn varieties. Do these soil amendments impact soil moisture and thus microbial processes, such as enzymatic activity? How do these strategies alter soil water and nutrient availability for corn production? This study is part of a three-year project at the CSU-Agricultural Research, Demonstration, and Education Center, established in October 2013. It is designed as a full factorial field experiment with soil amendments and irrigation combinations replicated four times with a randomized block design. The soil amendment treatments include: (1) 30t/ha pine-wood derived biochar, (2) 30t/ha manure and (3) a control with no soil amendments. The two irrigation strategies consist of full irrigation and a limited irrigation treatment with water applied only at key reproductive and growth stages. Treatment effects on C and N cycling were assessed by measuring soil CO_2 flux, microbial biomass C and N, and enzymatic activities throughout the season. This data is paired

with plant phenology and yield measurements. These results will help to illuminate the effects of biochar-manure amendments on soil moisture and plant nutrient availability under a water-saving irrigation strategy.

3. Think Deep: Understanding the Importance of Rooting Depth in the Carbon Sequestration Potential of Bioenergy Crops
   Presenters: Sarah Fulton-Smith, and M. Francesca Cotrufo
   Abstract:

4. Modeling Nitrogen Loss and Mitigation Potentials of Enhanced-Efficiency Nitrogen Fertilizers from Agricultural Soil System
   Presenters: Ram B. Gurung, Stephen M. Ogle, Keith Paustian, F. Jay Breidt, and William J. Parton
   Abstract: About half of the nitrogen fertilizer applied to crop production systems is lost to the environment via ammonia volatilization, during nitrification and denitrification, and by leaching, erosion, and runoff. It is an environmental pollutant that effects air quality, human health, ecosystems, and contributes to the greenhouse gas emissions. The rate of loss varies substantially by fertilizer types, application methods, soil types and environmental conditions. These losses mainly occur due to surplus of nitrogen in the soil susceptible to biological, physical, and chemical processes caused by a mismatch between when the nitrogen is made available and when plants take up the supplied nitrogen. Evaluating losses on nitrogen from different sources of fertilizer and management options for mitigation potentials requires a predictive modeling framework for regional analysis. Several mathematical models representing the effects of enhanced-efficiency nitrogen fertilizers including urease inhibitors, nitrification inhibitors and slow-release fertilizers are being developed to incorporating into the DAYCENT ecosystem model for this purpose. Field studies published in peer reviewed literature will be used for model development and validation. Hierarchical Bayesian inferences will be used for model formulation, calibration of model parameters, and model comparisons which includes spatio-temporal dynamics of the complex ecological processes. The new sub-models provide DAYCENT with the capability to simulate the influence of various nitrogen fertilizer types and simulate nitrogen loss and mitigation potential under enhanced-efficiency nitrogen fertilizers vs. conventional nitrogen fertilizer from site to region and global scales.

5. Abundance Estimation of Elk in the Estes Valley, Colorado
   Presenters: A.C. Ketz and N.T.Hobbs
   Abstract: The National Park Service instigated a ground-based plan for surveying elk in Rocky Mountain National Park and the greater Estes valley in order to aid management of the population on the elk winter range. For many years the park service has used dangerous and expensive aerial helicopter surveys with the benefit of accessibility to remote areas. An inter-agency agreement with the National Park Service and Colorado Parks and Wildlife has enabled us to gather park-town cross boundary movement data with radio telemetry. Additionally, monthly ground surveys executed by volunteers have been collected in the park and the town of Estes Park. We combine multiple sources of data into a mark-recapture modeling framework using Bayesian estimation. The coupling of movement estimated using telemetry data, with ground census in this model allows us to overcome the assumption of closure in a Lincoln-

Peterson estimator of population size. This estimator allows us to understand the temporal variation across the elk winter range and shows that the population of elk has been increasing over the past few years, which enables us to learn that the population of elk is at or below management targets.

6. Integrating local pastoral knowledge, participatory mapping, and species distribution modeling for risk assessment of invasive rubber vine (Cryptostegia grandiflora) in Ethiopia's Afar region
Presenters: Matthew W. Luizza, Tewodros Wakie, Paul Evangelista, and Catherine Jarnevich
Abstract: The threats posed by invasive plants span ecosystems and economies worldwide. Local knowledge of biological invasions has proven beneficial for invasive species science and management, but to date no work has explored the importance of integrating such knowledge with species distribution modeling (SDM) for risk assessments. *Cryptostegia grandiflora* Robx. Ex R.Br. (rubber vine) is an aggressive, woody vine that is invasive to Ethiopia. In this study we integrated local pastoral knowledge with SDM to assess the suitable habitat and potential impacts of rubber vine in the Afar region. In-depth focus groups were conducted across seven villages within the Amibara and Awash-Fentale districts. Rubber vine occurrence points were collected in the field with pastoralists and processed with MODIS-derived vegetation indices, topographic data and propagule dispersal vectors using Maxent software. Initial model fit was tested using a jackknife procedure and the final model validated with an independent occurrence data set collected through participatory mapping activities. Additionally, a multidimensional environmental similarity surface analysis was conducted to target areas with novel environmental conditions for future targeted surveys. Model performance revealed good model fit across the 24 jackknife models (average AUC = 0.797) and the final model (AUC = O.9953). Our results reveal the growing threat rubber vine poses to the Afar region, with suitable habitat extending downstream of its current known location in the upper Awash River basin, and demonstrates the important benefits of integrating local ecological knowledge with species distribution modeling.

7. Tracking the fate of Arctic carbon: will Arctic shrub expansion result in a loss or gain of soil carbon?
Presenters: Laurel Lynch, Megan Machmuller, Francesca Cotrufo, Eldor Paul, Matthew Wallenstein
Abstract: Northern circumpolar soils cover 16% of the total land surface area yet account for nearly 50% of the estimated global organic carbon (C) pool. Unprecedented rates of warming may convert the Arctic from a net sink to net source of atmospheric C as soil organic matter (SOM) decomposes more rapidly. Additionally, the abundance of woody shrubs is projected to increase as the climate warms, potentially increasing the total amount of labile C added to the system. Our ability to predict the response of arctic C cycling is limited by significant uncertainties in our understanding of processes that may counteract or enhance SOM loss and how this may vary with vegetation shifts. Our research objective is to improve our mechanistic understanding of the effects of labile C inputs into Arctic tundra soils. We added isotopically enriched ^{13}C-glucose to soils dominated by two dominant arctic vegetation: *Betula nana,* a woody dwarf birch species, and *Eriophorum vaginatum,* a ubiquitous tussock-forming sedge. We hypothesized labile C additions would stimulate loss of native SOM from soils under *Betula nana*

vegetation more than *Eirophorum vaginatum*. We measured $^{13}CO_2$ efflux within the first two weeks and one month following C additions. Preliminary results indicate greater respiration and ^{13}C-glucose utilization by *E. vaginatum* with no short-term native SOM loss by either vegetation type. Overall, only ~10% of ^{13}C-glucose was measured in CO_2 efflux; our future plans are to track the remaining C into soil pools and microbial biomass.

8. Terrestrial Reptile Conservation in a changing Landscape
   Presenters: Daniel Martin, Cameron Aldridge, and Larissa Bailey
   Abstract: Conservation of native reptiles is a major challenge facing natural resource managers in the future due to continued habitat degradation and climate change. Many reptile species are currently recognized as susceptible to extinction, with 68% of the 81 terrestrial reptile species in the Great Plains considered at risk (53% of 36 lizard species, 80% of 44 snake species, and the single turtle species). Due to their exothermic nature and limited dispersal abilities, reptiles are expected to be particularly susceptible to changes in climate and additional habitat loss and fragmentation. Furthermore, many land management and natural resource agencies are unable to monitor populations due to limited resources. The lack of a robust, standardized survey effort to monitor reptile populations across large landscapes also limits our abilities to detect changes in reptile populations and to implement actions to ensure persistence of these species. We are currently testing several standardized survey methods that would enable landscape-scale monitoring of changes in reptile distributions. Our effort will elucidate which environmental factors (e.g., changes in climate and/or habitat) may drive changes in reptile distributions. Furthermore, to reduce costs of future monitoring we are evaluating the ability of volunteers to conduct standardized surveys. Results will be used to guide recommendations for continued monitoring of reptiles and identification of areas likely important for reptile conservation. For more information about the project and how to volunteer, visit: www.reptilemonitor.org.

9. K.I.S.S. (Keep It Simple Silly) Approach to Estimating Historical Forest Structure
   Presenters: Megan S. Matonis, Peter M. Brown, and Dan Binkley
   Abstract: Knowledge of historical stand structures is important for designing restoration treatments. Many studies use reconstruction techniques relying on detailed tree-ring data or forest inventory data from the 1800s or early 1900s. Extensive research at a limited number of sites may not provide representative estimates of forest conditions across entire landscapes, making these approaches less insightful for managers. We developed rapid assessment techniques that involve coring a limited number of trees and utilizing morphological clues to estimate tree ages. We re-sampled 20 forest plots where researchers recently collected extensive tree-ring based data. Estimates of historical spatial patterns (i.e., random vs clustered trees) and tree densities from our rapid assessments were similar to those from detailed reconstruction techniques. Mean estimates of tree density were 125 trees/ha from the rapid assessments compared to 115 trees/ha from cross-dating techniques. However, we found that estimates of historical basal area varied between rapid assessments and more extensive cross-dating techniques (mean of 4.0 versus 7.2 m2/ha). Monte Carlo error simulations revealed that the imprecise relationship between tree size and age is the primary factor limiting the accuracy of rapid assessments. Although there was imprecision in estimates of historical basal area, rapid assessments are unlikely to lead to substantially different insights about forest structure or

decisions about restoration treatments. Our rapid assessment approach is useful and feasible for managers and public citizens who want to estimate historical forest conditions at a large number of sites.

10. Niveograph interpolation to estimate peak accumulation of snow water equivalent in Rocky Mountain National Park
    Presenters: Glenn G. Patterson and Steven R. Fassnacht
    Abstract: Snowpack trends have been evaluated using manual snowpack measurement taken monthly, usually February through May 1st by the Soil Conservation Service, now the Natural Resources Conservation Service (NRCS). Many of these data have been collected since the 1930s. However, while the April 1st measurement used to represent the annual peak snow water equivalent (SWE), it has been shown to underestimate the actual peak by as much as 12%. Since the late 1970s the Natural Resources Conservation Service (NRCS) has used snow pillows at snowpack telemetry (SNOTEL) stations to measure SWE in real-time. To better estimate peak SWE for snow-course sites and thus use the longer period of record, a procedure was developed to estimate daily niveographs (plots of SWE versus time) for these sites using median daily niveographs derived from period-of-record daily SWE values for selected nearby SNOTEL sites. Recognizing that different physical processes drive the shape of the niveograph during the accumulation, peak, and melt phases, separate techniques were used to adjust the shape of the median niveographs for each of these phases. The procedure was tested by selecting two SNOTEL sites in Rocky Mountain National Park, Colorado, and treating them as though they were snow course sites with just 4 SWE measurements per year. The estimated peak SWE values were then compared with the actual observed values. Results showed good agreement between estimated and observed peak SWE values, and an improvement over the assumption that April 1 SWE represents the peak.

11. Assessing undergraduate student learning of systems thinking in “Systems Theory and Information Management” course at Colorado State University
    Presenters: Yamina Pressler, John C. Moore, and Nissa Yestnes
    Abstract: Fostering systems thinking in undergraduate ecosystem science students is critical as we educate the next generation of scientists. The aim of this study was to investigate how undergraduate students learn systems thinking and decipher in which areas students still lack understanding. Undergraduate students in “Systems Theory and Information Management” course at Colorado State University were proposed the following question on the first day of the class: Using the image above (prairie ecosystem), identify a system(s) and describe its structural properties, functional attributes, and controls. Students were posed the same question on the last day of the course. All student answers were transcribed, shuffled, and given an ID code by a non-affiliated researcher. In a double blind analysis, we established a science learning progression rubric and qualitatively coded all answers based on content and discourse. Students received a 1 or 2 for answers that used forced dynamic reasoning (FDR) and did not fully answer the question. Students received a 3 for using principle-based reasoning (PBR) and defining a system. Students who used PBR, defined a system, and provided mechanisms received a 3.5. The highest score, 4, was reserved for students who used PBR, defined a system, provided mechanisms and considered scale. A paired T-test yielded statistically significant differences

between pre- and post-tests scores. Overall, 71% of students increased: most students began at level 3 and increased to 3.5 or 4. Most students at the 3.5 level lacked cross-scale thinking indicating a potential area for improvement in the teaching of systems thinking.

12. Effectiveness of Biochar for Rehabilitating Decommissioned Forest Roads
    Presenters: Matt Ramlow, Chuck Rhoades, M. Francesca Cotrufo
    Abstract: Road decommissioning is a common practice used by land managers for watershed and forest restoration, however few studies have compared the effectiveness of different surface amendments in rehabilitating decommissioned roads. Forest road decommissioning projects typically involve decompaction of the soil followed by surface amendments targeted at reestablishing soil organic matter, biogeochemical cycling within soils and native plant communities. This study will compare three surface amendments (mulch, biosol fertilizer and biochar) applied to recently decommissioned roads in the Roosevelt National Forest that were decompacted and seeded with native grasses. This research will evaluate how the different surface treatments impact carbon and nitrogen cycling, gas fluxes from soils and revegetation of native plants. Soil chemical and physical properties and vegetation recovery will be monitored over a four year period to evaluate the long-term impacts of such treatments. Outcomes of the treatments will be compared in terms of percent improvement in plant recovery, available nitrogen concentrations and GHG fluxes relative to the control. These results can help provide critical information to resource managers regarding the effectiveness of using different surface amendments in road decommissioning. In addition this study will identify the environmental impacts and benefits of applying biochar to degraded forest soils which is relevant to bioenergy systems considering the use of low-economic value forest biomass for biofuel production.

13. Evaluating the climatic and geographic shifts of the mountain pine beetle under past, present, and future climate conditions in the Rocky Mountains
    Presenters: Aaron Sidder, Jason Sibold, and Sunil Kumar
    Abstract: Over the last decade, western North America has experienced the largest mountain pine beetle (*Dendroctonus ponderosae*) outbreak in recorded history, and Rocky Mountain forests have been hit particularly hard. The mountain pine beetle is a major biological disturbance agent in montane and subalpine forests that can cause widespread tree mortality and substantially alter forest structure, composition, and function. Although bark beetles are indigenous to North American forests, warming temperatures and prolonged drought related to climate change, fire suppression, and reduced habitat heterogeneity have facilitated population increases and have allowed the beetle to expand its range into previously unfavorable conditions. Climate directly influences beetle physiology, life cycle, and dispersal capability and understanding the climatic drivers of mountain pine beetle outbreaks is essential for estimating current and future range expansions and climatic conditions that can support large populations. The goal of my research is to determine the past, present, and future climatic drivers of *D. ponderosae* in the Rocky Mountain region of the U.S. and how this climate space—the range of climatic variables that support a healthy beetle population—translates to the geographic range of the beetle. This analysis will use statistical modeling techniques (species distribution models), publicly available aerial detection survey data, and historic and projected climate data. This research will advance the understanding of the role of climate in shaping the distribution of the

mountain pine beetle, and will also explore interesting new approaches to species distribution modeling. Furthermore, this research will contribute to the understanding of forest ecology and the drivers of disturbance in mountain environments while helping land managers assess future forest vulnerability to biological disturbance under changing climate conditions.

14. Rapid assessment of large-magnitude snow avalanche events in Colorado
    Presenters: Sara Simonson, Thomas Stohlgren, and Steven Fassnacht
    Abstract: In the past several winter seasons, large, destructive avalanches have been reported from locations across Colorado. These recent snow slides include some of the most tragic avalanche accidents in Colorado's history. For example, on April 29, 2011, an impressive slide damaged high voltage power lines along Peru Creek, near Montezuma, CO. The large avalanche destroyed a power line tower that had been in place since the 1970's, and deposited massive piles of snow, rocks, and woody debris in the runout zone. The slide created fresh trimlines, widening the existing avalanche path area by uprooting, stripping, and breaking trees. The disturbance event left behind numerous mature downed trees and extensive areas of vegetation damage, providing a unique opportunity to improve our knowledge of local avalanche frequency and magnitude. Initially, we gathered historical records of avalanche incidents and observations, and used repeat photography to track changes in the avalanche path vegetation over time. Next, we used field measurements, maps, and imagery to survey the extent of vegetation damage, assess relative tree ages, and estimate maximum runout distances. We also collected discs and cores from the uprooted and downed trees to detect signals of past avalanche impacts recorded in woody plant tissue. To provide insight on the avalanche dynamics, we used terrain features and local snowpack observations as inputs in a one-dimensional model to estimate the avalanche velocity, height of the flowing snow, impact pressures, and mass of the debris. For Colorado, and perhaps elsewhere, we conclude that several vegetation ecology methods can be used to characterize and map local avalanche frequency and magnitude.

15. Assessing the impact of MODIS pixel purity on DayCent Grain Yields
    Presenters: Shannon Spencer and Stephen Ogle
    Abstract: The DayCent ecosystem simulation model is used to predict impacts of management on soil carbon dynamics and trace gas emissions on US agricultural lands in order to report Greenhouse Gas (GHG) emissions as part of the US's reporting requirements to the United Nations Framework Convention on Climate Change (UNFCCC). A fundamental component of DayCent is the estimation of daily biomass production; DayCent has two modes of crop production: 1) an internal crop production model and 2) a light-use efficiency production equation driven by site-specific remotely sensed vegetation reflectance index data. Enhanced Vegetation Index (EVI) data from the Moderate Resolution Imaging Spectroradiometer (MODIS), a space-based remote sensing instrument flying on two separate satellites, were used to test the impact of pixel purity (MODIS has relatively large, 250m x 250m pixels) on DayCent grain yields. EVI data from over 60,000 crop fields growing either corn or soybean were extracted and processed from a sequence of MODIS imagery from the years 2000 to 2007 in order to assess crop grain production using pixel purity values between 70-79%, 80-89%, and >90%. DayCent grain production was compared against both the DayCent internal non-EVI crop production

model (PRDX) and against the USDA's National Agricultural Statistics Service (NASS) reported crop grain yields at the county level. This poster will report the results of this analysis of driving the DayCent model with different levels of EVI input data.

16. Mixed Movement Strategies in Kenyan White-bearded Wildebeest
    Presenters: J.A. Stabach, R.B. Boone, G. Wittemyer, and J.G.C. Hopcraft
    Abstract: In order to optimize access to welfare factors, animals structure their spatial behavior by switching between different movement states, classically categorized as encampment, exploration, or nomadism. In some dynamic environments, the combination of these movement states results in migration, a tactic employed to access spatially and/or temporally varying resources. The distinction between migratory and non-migratory behavior in many systems is complex, with residents and migrants sharing the same range, or individuals switching between strategies. We investigated the movement strategies of the Loita Plains wildebeest, a subpopulation of the greater Serengeti migratory population and distinguished by their residency to the northern range. Using modern analytical techniques, we differentiated GPS collared wildebeest by total displacement distance, metrics of movement linearity, and home range statistics. Analyses, conducted in a Bayesian framework, demonstrated two distinct categories of movement, with a 'migratory' class of individuals that displaced nearly 5 times as far from initial collaring locations, moved 1.8 times the distance per day and exhibited predominantly exploratory movements during the dry season relative to the more encamped 'resident' individuals. Serengeti animals moved an even greater distance per day and migrated south at a earlier time than Loita Plains wildebeest, providing support that the two populations remain separate. Contrary to simple expectations, this work demonstrates that the resident Loita Plains wildebeest, a population that has experienced widespread decline, employs a mixture of movement strategies that likely relate to its ability to cope with changing resource dynamics and rapid landuse changes occurring across this ecosystem.

17. Nitrogen Saturation in a Remote Alpine Ecosystem: Do nitrogen additions increase relative abundance of nitrifiers?
    Presenters: Lydia Tena, Claudia Boot, and Ed Hall
    Abstract: Human derived reactive nitrogen (N) is delivered as wet (precipitation) and dry (dust) deposition in the form of ammonium (NH_4^+) and nitrate (NO_3^-) to remote regions of Rocky Mountain National Park (RMNP). While NH_4^+ is accessible to virtually all phototrophs, NO_3^- must first be converted to NH_4^+ before it can be used to synthesize amino acids by a wide range of phototrophic organisms (e.g. algae in streams and lakes). A portion of NH_4^+ is converted to NO_3^- by chemolithoautotrophic Bacteria and Archaea (nitrifiers) before it can be accessed by phototrophs. Therefore, nitrifiers cause preferred forms of reactive N to be less accessible to other organisms creating an energetic bottleneck for reactive N in alpine ecosystems and potentially contributing to the accumulation of NO_3^- in the environment. We sampled three control and three long term (18y) forested fertilization plots (25 kg NH_4NO_3 y^{-1}) in RMNP in two separate months (July and September) for two years (2011 and 2012) to see how fertilization with reactive N affected the relative abundance of Bacterial and Archaeal nitrifiers in the soil. Bacterial nitrifiers were enriched in the fertilized relative to the control plots during some sampling events. Archaeal nitrifiers were enriched in the wet months and during the wetter year

suggesting an affinity for low oxygen habitats. The differential response of Bacterial and Archaeal nitrifiers are consistent with reports of niche differentiation among the two domains and suggest that the kinetics of nitrification may vary seasonally due to shifts in the relative abundance of the dominant nitrifers.

18. Relating Severity of a Mountain Pine Beetle Outbreak to Forest Management History
    Presenters: Anthony Vorster, Paul Evangelista, Thomas Stohlgren, Sunil Kumar, Robert Hubbard, Tony Cheng, Kelly Elder
    Abstract: Harvesting is commonly proposed as a method for lowering the risk of a mountain pine beetle (*Dendroctonus ponderosae* Hopkins) infestation in a stand because harvesting reduces the average size and density of host trees. This study sought to understand how the impacts of the mountain pine beetle outbreak in areas that were harvested between 1954 and 1985 compared to areas that were not harvested. We mapped outbreak severity at a 30-m resolution using integrative spatial modeling. We predicted that: 1) outbreak severity can be accurately predicted and mapped at Fraser Experimental Forest, Colorado using stand characteristics with a boosted regression tree model, Landsat imagery, topographic data, and field data; and 2) forest stands that were unmanaged between 1954 and 1985 will have higher outbreak severity compared to stands that were treated between 1954 and 1985. Outbreak severity, measured by the ratio of dead lodgepole pine (*Pinus contorta*) basal area to the basal area of all trees, was mapped across Fraser Experimental Forest with a cross-validation correlation of 0.86 and a Spearman correlation with independently observed values of 0.64. The outbreak severity at stands harvested between 1954 and 1985 was lower than comparable uncut stands. Some areas that were harvested in the past were heavily impacted while others were lightly impacted, so a regression tree was used to explore the characteristics of cuts associated with low and high outbreak severities. The results suggest that harvesting can be used to lower the risk of a mountain pine beetle outbreak in a stand.

19. Evaluating the interactions between landform and fluvial flux in minimally disturbed catchments of the Front Range of Colorado
    Presenters: Pamela Wegener, Tim Covino, Ed Hall, Ellen Wohl
    Abstract: Channel networks draining the Colorado Front Range tend to be dominated by high-gradient streams with low retention capacities. Lack of retention and associated catchment buffering can be problematic given the increasing frequency of extreme events (drought, flood). In Rocky Mountain systems, Beaver can provide some of the most effective forms of catchment retention by creating and maintaining wet meadow complexes that store substantial amounts of water, sediment, and nutrients. In this recently established research we are quantifying temporal dynamics of fluvial fluxes across a gradient of reach types that span a continuum of retention capacities in the Front Range of Colorado. These reach types include: active beaver meadows, recently abandoned meadows, long abandoned meadows, and steep headwater streams. We seek to understand retention and transport processes across the gradient of reach types, and to decipher the way in which reach-scale dynamics influence spatial and temporal patterns observed within catchments and at their outlets. These data and analyses should not only provide insight into fundamental catchment processes but also highlight the potential for natural retention features to provide water quantity and quality benefits.

20. Does the current state of the Lake Yojoa (Honduras) ecosystem pose a potential health risk to people that consume it's fish?
    Presenters: Randy Welch and Ed Hall
    Abstract: Lake Yojoa, Honduras's only natural lake ecosystem, is currently experiencing unprecedented environmental stress due to a range of human activities in the watershed and within the lake itself. Among these, heavy metal loading from a large mining operation, along with local agricultural run off has resulted in the presence of heavy metals and persistent organic pollutants (POP) in the lake's sediments and potentially farmed and/or wild caught fish. Because the people and economy of the Lake Yojoa watershed depend on the fish supplied by the lake, we asked if metals and POP's are present in the lake's sediments and or fish. Metal concentrations in Lake Yojoa's sediments are changing noticeably with through time, with Lead (Pb) decreasing and Chromium (Cr) increasing. All metals tested were most concentrated in the north region of the lake. This finding is concerning since many of the lakes valuable resources, (aquaculture farm, hotels, restaurants) are located within this region. Many potentially harmful heavy metals were found in the lakes fish, both wild and farmed, but only in the wild caught fish did one metal's (Mercury) concentration greatly exceed the EPA's safe consumption level. Delta $D^{15}N$ data suggest that the larger, higher trophic level fish are accumulating the most Mercury and so should not be consumed by the locals. A vast array of organics pollutants were found in all samples tested, but more information is needed in order to make any conclusions on their effects within the lakes ecosystem.

21. Using multitemporal spectral indices derived from Landsat 8 to evaluate the distribution of a generalist invasive species in post-wildfire landscapes
    Presenters: Amanda M West, Paul Evangelista, Catherine Jarnevich, Sunil Kumar, Matt Luizza, and Steve Chignell
    Presenters: The Squirrel Creek wildfire (SCW) disturbed 4,450 ha in Medicine Bow National Forest, Wyoming in 2012, during the hottest and driest summer on record for the state. Wyoming experienced 33 other wildfires that year including the 40,000 ha Arapaho wildfire (AW). Among the most pressing concerns of land managers in post-wildfire landscapes are invasive species. In areas such as SCW that encompass crucial winter habitat for mule deer (*Odocoileus hemionus*) and elk (*Cervus canadensis*), the invasive cheatgrass (*Bromus tectorum*) provides inferior forage quality and quantity compared to the native perennial grass species it displaces. Furthermore, if left unmanaged cheatgrass may decrease fire intervals and increase fire extent in the future. Land managers need maps produced from the most accurate species distribution models (SDMs) to plan management efforts for invasive species. To meet this challenge in SCW, we developed multitemporal and multispectral SDMs for cheatgrass using indices derived from five months of Landsat 8 imagery that correspond to both species phenology and time of field data collection, in combination with complex topographic covariates. These models produced highly accurate maps of current cheatgrass distribution in SCW and were improved using an iterative approach in which a threshold for abundance was established from an independent dataset. We then extrapolated these results to forecast cheatgrass in Arapaho wildfire area, 100 km northeast of SCW. These models demonstrate the applicability of Landsat 8 imagery for ecological forecasting, the power of using derived indices

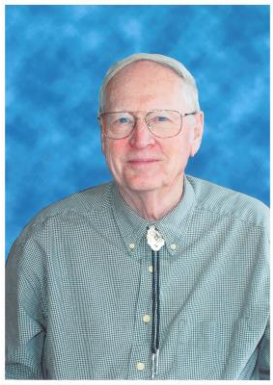
as proxies for species occurrence on the landscape, and the importance of selecting thresholds for invasive species abundance to evaluate ecological risk from SDMs.

22. Effects of fire severity and mountain pine beetle on lodgepole pine seedling density following the High Park Fire
    Presenters: Micah Wright and Monique Rocca
    Abstract: Many climate models predict an increased frequency of extreme events, including fire, bark beetles, and flood. In the Rocky Mountains of Colorado, there are concerns about the effects of these combined disturbance events in lodgepole pine (*Pinus contorta* var. *latifolia*) ecosystems. The High Park Fire burned more than 87,000 acres in 2012, including large areas of lodgepole pine that had been recently attacked by mountain pine beetle. The burned area was then subject to a major precipitation event in the year following the fire, which provided a unique opportunity to study lodgepole pine regeneration following a series of disturbances. In this study, we are investigating the factors that control the distribution of lodgepole pine seedlings at both landscape and finer scales. Twenty-five half-hectare sites were sampled for seed tree count, micro-site characteristics, seedling density, pre-fire mortality, and fire severity. Seedling density on the sampled grids was highly variable, ranging from 241 to 465,000 seedlings per hectare. Average seedling density was 64,900 per hectare. We are investigating the relationship between seedling density and fire severity, and between seedling density and mountain pine beetle severity. These findings could be used predict lodgepole regeneration patterns following compound disturbance events, important information that could be used to guide future management decisions.

Biography's

2014 Award Recipients:

Dr. Eldor A. Paul



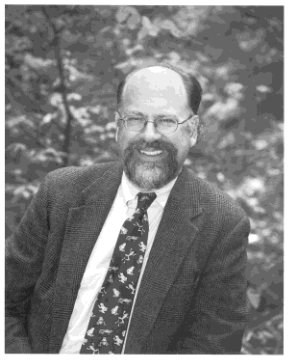
Eldor A. Paul is a Senior Research Scientist at the Natural Resource Ecology Laboratory and a Professor in the Department of Soil and Crop Sciences at Colorado State University, Fort Collins. Eldor has had a lifelong interest in teaching and research in both grassland ecology and agroecosystems, ranging from wheat fields in Canada, through corn-belt rotations in the Great Lakes region of the US, into the afforested systems in California and Colorado. Prior to coming to Colorado State University, Dr. Paul was Professor of Soil Microbiology and Biochemistry and Departmental Chair in the Department of Soil and Crop Sciences at Michigan State University. He has also served as Departmental Chair and Professor in the Department of Plant and Soil Biology at UC Berkeley, and was a faculty member of Soil Science at the University of Saskatchewan. He earned his M.Sc. at the University of Alberta and his Ph.D. at the University of Minnesota.

Eldor's research focuses on the dynamics of soil organic matter and the microbial ecology of soil organisms. His research has involved the use of tracers, such as ^{14}C, ^{13}C, and ^{15}N, as well as molecular techniques for soil organic matter characterization and microbial growth-diversity studies. He has had three editions of Soil Microbiology, Ecology, and Biochemistry published with the fourth edition now in preparation as Managing Editor. The book has been widely read and translated into both Chinese and Korean.

Eldor continues his lifelong interest in nature, people, and knowledge fed by an intense curiosity that started during his first eight years in a one room, log schoolhouse, with all years being taught by the same teacher. This teacher recognized his ever-inquisitive mind and made available to him a large, private library including books written by authors ranging from Dickens and Zane Gray to Mark Twain, in addition to a rich assortment of historical and geographical volumes. Growing up under the clear skies of Alberta with a profusion of stars, northern lights, and a diverse range of bird and animal species, where a cold climate was ever-present, led him to ask, "How does nature work?" This life-long interest and ever quizzical mind about the field of soil science and natural resource ecology drove him to increasing his knowledge and devoting his career to acquiring answers to questions about basic and applied applications in agronomic, ecological, microbiological, biochemical, and biogeochemical, which are still of great importance to the human race today. Eldor also continues to foster his mental and physical capabilities by working at a grassland–forested ranch in the foothills above Ft. Collins.

Among Eldor's awards and honors received, he is a Fellow of the American Society of Agronomy, Soil Science Society of America, Canadian Society of Soil Science, and the American Association for the Advancement of Science. He has received the Soil Ecological Society Professional Award, the SSSA Soil Research Award, and SSSA F.E. Clark Lectureship Award in Soil Biology.

Dr. William Schlesinger



William H. Schlesinger is President Emeritus of the Cary Institute of Ecosystem Studies, a private ecological research institute on the grounds of the Cary Arboretum in Millbrook, NY. Completing his A.B. at Dartmouth (1972), and Ph.D. at Cornell (1976), he moved to Duke University in 1980, where he was Dean of the Nicholas School of the Environment and Earth Sciences and James B. Duke Professor of Biogeochemistry.

Schlesinger is the author or coauthor of over 200 scientific papers on subjects of environmental chemistry and global change and the widely-adopted textbook Biogeochemistry: An analysis of global change (3rd edition with Emily S. Bernhardt, Elsevier, 2013). He was among the first to quantify the amount of carbon held in soil organic matter globally, providing subsequent estimates of the role of soils and human impacts on forests and soils in global climate change. He was elected a member of The National Academy of Sciences in 2003, and was President of the Ecological Society of America for 2003-2004. He is also a fellow in the American Geophysical Union, and the Soil Science Society of America.

His past work has taken him to diverse habitats, ranging from Okefenokee Swamp in southern Georgia to the Mojave Desert of California, and three times as a Duke alumni tour guide to Antarctica. His research has been featured on NOVA, CNN, NPR, and on the pages of *Discover, National Geographic,* the *New York Times,* and *Scientific American.* Schlesinger has testified before U.S. House and Senate Committees on a variety of environmental issues, including preservation of desert habitats, global climate change and carbon sequestration.

Schlesinger currently serves on the Board of Trustees for the Doris Duke Charitable Foundation (New York), the Natural Resources Defense Council (NRDC; New York), and the Southern Environmental Law Center (Charlottesville).

He and his wife, Lisa, live in Lubec, Maine, where they enjoy birdwatching, gourmet cooking, and coastal life.

Dr. Terry Chapin II, Keynote Speaker, 2011 Award Recipient

As director of the graduate educational program in Resilience and Adaptation at the University of Alaska, Fairbanks, Chapin studies human-fire interactions in the boreal forest. A professor of ecology in the Institute of Arctic Biology at the University of Alaska Fairbanks (Fairbanks, AK), Chapin was the first Alaskan elected to the National Academy of Sciences. His initial research concentrated on the adaptation of plants to changing environmental conditions and has evolved to investigating the dynamics of socio-ecological systems under changing conditions. Among the honors Chapin has received are the Kempe Award for Distinguished Ecologist in 1996, the Usabelli Award for the top researcher in all fields from the

University of Alaska in 2000, and the ESA Sustainability Science Award in 2008. Chapin is former president of ESA and the 2011 recipient of the NREL Excellence in Ecosystem Science Award.