IMPROVING EARLY DETECTION AND RAPID RESPONSE FOR CRYPTIC SPECIES: CURRENT ANALYTICAL TOOLS AND FUTURE DIRECTIONS

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Successful eradication of invasive species is facilitated by early detection and prompt onset of control. However, realizing or verifying that a colonization has occurred (or not) is difficult for cryptic species especially at low densities. Equally difficult is knowing when to declare successful eradication of a once established invasive population. Effective detection tools combined with advanced analytical tools can improve management efforts and decisions in both scenarios. In our various research efforts to (1) determine the absence of an incipient population of invasive reptiles after a confirmed sighting, and (2) declare an eradication successful, we developed two quantitative models to assist resource managers. We review these two models and comment on the current state of available analytical tools for improving decision making for early detection and rapid response in natural areas.

Session Topic: Early Detection and Rapid Response
Format: Oral Presentation
Student Competition: No

IDENTIFYING OPPORTUNITIES FOR COLLABORATIVE CONTROLLED BURNS ON COLORADO'S FRONT RANGE

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Increasing the pace and scale of forest restoration and fuels reduction to protect social and ecological values from uncharacteristically severe wildfire is a major initiative of numerous agencies, organizations, and collaborative groups on Colorado's Front Range. Controlled burning offers a means of substantially scaling up forest restoration and fuels reduction efforts but is challenging to implement on the Front Range due to complex social, ecological, and political contexts and numerous values at risk within the Front Range wildland-urban interface. A strategic approach that identifies high-priority areas for the use of controlled burns is needed to facilitate cross-boundary, collaborative planning and implementation of controlled burns to meet both social and ecological objectives on the Front Range. We present results of a spatial analysis intended to identify opportunities and constraints for the use of controlled burns based on criteria such as wildland-urban interface values at risk, potential for positive effects on forests and ecosystems, fuel types and conditions, presence of mechanical treatments, accessibility, and presence of containment features. Results of this work can be used in collaborative settings to develop comprehensive forest restoration and fuels reduction strategies that incorporate the safe and effective use of fire. Spatial optimization of treatment locations can be brought to bear as well in this context to prioritize treatment areas and achieve economies of scale.

Session Topic: Wildland Fire as a Management Tool
Format: Oral Presentation
Student Competition: No

PAKAPAKAKUĀUA ADOPT-A-FOREST PROGRAM, GROWING FORESTS AND THE FUTURE CONSERVATIONISTS TO MANAGE THEM

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Hawai'i is a uniquely wonderful place with the majority of its native terrestrial plants and animals endemic to Hawai'i. We have insect eating caterpillars and amphibious inchworms that breathe equally in or out of the water. However, sixty percent of our species are considered imperiled due to habitat destruction, invasive species and climate change. Yet, the youth of Hawaii are mostly unfamiliar with most of our native plants and animals and the need to protect them. And while some may know about a few of our more famous species through school or the internet, they probably haven't actually seen them. This is the result of being physically isolated from our native species, as few native plants and animals exist in the human biosphere. There is limited access to the native forest on O'ahu. And environmental education hasn't been seen as an important topic in the schools, since formal schooling has existed in Hawai'i. In 1989, only one full time Environmental Specialist existed in the Hawai'i Department of Education.

Some attempts have been made and are being made to educate our youth about the natural environment. A few public schools have created natural resource academies. However, a lack of infrastructure in place has made it difficult for students to actually experience a native ecosystem, let alone become involved with its management and protection.

Hence in 2011 of the Pakapakakuāua Adopt-A-Forest (AAF) Program was implemented to change this. But, really it has been the collaborative effort between the Division of Forestry and Wildlife, the schools, and other programs that have allowed for change. With the assistance of one particular teacher with years of experience collaborating with the Nature Conservancy, we implemented our first AAF campout at Pahole Natural Area Reserve on the island of O'ahu. This area has a private access which allows us to bring youth up into the reserve where native ecosystems can be found. The campout allowed students spend quality time in the forest and get hands on experience in invasive species control, conducting bio-surveys, and out planting native plant species including endangered ones. During our trips we try to adhere to Hawaiian cultural values and protocol such as working as a team and asking permission to enter the forest via Hawaiian chant.

We have gradually added other schools who can join us for camp outs, day trips, or both. We try to work with the schools to assist in their needs as well as those of DOFAW. We have expanded our outreach into schools and other youth programs via the KUPU Environmental Leadership Development Program which is advocating our AAF program. And our outreach has been augmented by the hiring of a Division of Forestry and Wildlife outreach specialist. This specialist has assisted us with our trips as well as the development of a website and outreach materials for the students. And now we are not only advocating bringing youth and students out to the forest, but also bringing the forest or at least the native plants to the youth. Having them adopt areas on their campus to create native gardens or adopting strand or beach ecosystems near them to restore it with native plants.

In just a few years the AAF program has helped lay the groundwork for change. Students have entered research related to AAF in the annual science fair along with the individual school science fairs. Students are choosing to enter college programs for natural resource management, horticulture, or have enrolled in environmental programs such as KUPU Hawai'i which exposes them to more opportunities to work in the environmental field. And while only a few students will actually work in the field, hopefully most learn to appreciate the Hawaiian forest, recognize its problems, and understand the need to both restore and conserve it for future generations.

Session Topic: Communicating About Natural Areas Conservation
Format: Poster Presentation
Student Competition: No

RESTORATION OF THE CACHE LA POUDRE RIVER THROUGH DOWNTOWN FORT COLLINS

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In 2013 the Fort Collins, CO Natural Areas Department initiated a series of three large river and floodplain restoration projects through downtown Fort Collins, CO. The three-year effort netted 1.5 miles of riverbank improvements, 11 acres of new wetlands, 28 acres of floodplain cottonwood forests, and 9 acres of restored native grassland. This highly collaborative project was made successful through partnerships spanning the public, private, and non-profit sectors. In 2016 the International Union for the Conservation of Nature (IUCN) selected the Poudre River restoration projects as one of ten international restoration case studies employing "*nature-based solutions*".

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries
Format: Oral Presentation
Student Competition: No

APPLICATION OF MACHINE LEARNING METHODS TO PREDICTION OF FUTURE VEGETATION COMPOSITION IN A DIKED COASTAL ESTUARY BASED ON HYDROLOGICAL PARAMETERS MODELED UNDER DIFFERENT DIKE ALTERATION AND RESTORATION SCENARIOS

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Natural area land managers often have relatively high resolution, field-mapped, and spatially accurate vegetation data at their disposal. This data can be useful for more than characterizing current conditions. Vegetation prediction methods using statistical relationships of known vegetation with existing environmental gradients are well known and frequently used for characterization of large land bases that cannot feasibly be entirely field-sampled. These same modeling approaches can be turned to the task of prediction of the future in land management situations where current conditions can be adequately explained and predicted using environmental predictors such as hydrology, temperature, and precipitation, and where these predictors can be modelled for future scenarios. Ever-increasing data availability and easy accessibility of machine learning tools in software environments such as the statistical programming language R are making it easier for land managers to build functional predictive models for future vegetation patterns and habitats. This presentation focusses on application of high resolution vegetation mapping paired with high resolution LiDAR and hydrology models to assess probable habitat change in a diked coastal estuary in Oregon under conditions of dike alteration and increased tidal influx. The predictive model is applied to predicting both habitat-level and species-level distributions, and their ramifications for restoration planting plans, rare species conservation, and prioritization of stewardship actions.

Session Topic: Technology for Land Management Success, Restoration in the Anthropocene
Format: Oral Presentation
Student Competition: No

SCALE DEPENDENCE OF OVERSTORY-UNDERSTORY RELATIONSHIPS IN DRY, MIXED-CONIFER FORESTS

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Most of the vascular plant diversity in dry, mixed-conifer forests of the western U.S. is in the herbaceous understory, in microenvironments shaped by the overstory. Therefore, understanding patterns of herbaceous diversity and predicting the results of forest management require that we understand the nature and spatial scale of overstory-understory relationships. We hypothesized that these relationships would be stronger at smaller spatial scales. Data were gathered in 2015, 9-12 years after treatment in a fuels-reduction (thinning x burning) experiment in central Washington. There were 12 units (10-ha), four of which partially burned in a 2012 wildfire. We compared relationships at three spatial scales, plot (6 per unit, each 1000 m^2), subplot (1 per plot, each 50 m^2), and quadrat (8 per plot, each 1 m^2). Overstory abundance (basal area, tree density) and understory diversity (species richness, total cover of herbaceous species) were quantified at each scale. We used model selection to identify optimal linear predictors at each scale. Overstory abundance was not related to understory diversity at either the plot or subplot scale. At the quadrat scale, richness declined as tree density increased, and cover declined as basal area increased. Our results support the hypothesis that overstory-understory relationships are stronger at smaller spatial scales. Our results also imply that managers who desire to alter the herbaceous understory in this system should focus their efforts on modifying the overstory at small spatial scales. For example, removing small groups of trees would have a disproportionately large positive effect on the herbaceous understory.

Session Topic: Forest management
Format: Oral Presentation
Student Competition: No

RESTORING CARBON SEQUESTRATION PROCESSES IN A DEGRADED WET MEADOW

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Wet meadows throughout the Sierra Nevada that were historically disturbed are currently losing both soil water holding capacity and the ability to store carbon. While these wetlands formerly functioned as sinks of carbon dioxide, they could now act as significant sources of CO2 to the atmosphere. Given the imminent threat of climate change, it is vital to explore techniques to facilitate the potential recovery of a greenhouse gas sink. Furthermore, the maintenance and addition of carbon to soil can also enhance its water holding capacity. I am testing whether the reestablishment of a sedge dominated community at Tuolumne Meadows, a high elevation wet meadow in Yosemite National Park, will restore the meadow to a carbon accumulating ecosystem. In 2016, 20,000 *Carex scopulorum* (mountain sedge) were planted into the meadow and by the end of the summer of 2018, over 100,000 more will also be planted. Gross primary production and plant respiration are being monitored to create a model of growing season carbon dynamics to determine if these treatments increase the meadow's carbon storage. The outcome of this restoration project will inform land managers facing similar issues of drying meadows with potentially large losses of CO2.

Session Topic: Restoration in the Anthropocene
Format: Poster presentation
Student Competition: Yes

ASSISTED REPRODUCTION AS A TOOL TO MITIGATE DISEASE, PRESERVE GENETICS AND FACILITATE MOVEMENT OF GENETICS ACROSS LANDSCAPES FOR BISON: THE LARAMIE FOOTHILLS BISON CONSERVATION HERD

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In 2015, 10 bison were reintroduced to the short grass prairie in northern Colorado on natural area supported and owned by the City of Fort Collins and Larimer County. These bison, the Laramie Foothills Bison Conservation Herd, represent a valuable genetic lineage that descends from bison in Yellowstone National Park, the largest herd of bison for which there is no evidence of interbreeding with cattle in their history. Unfortunately, bison herds in the greater Yellowstone area are known to have a high prevalence of the disease brucellosis which can infect people, livestock, and other wildlife; thus despite their genetic value, moving genetically valuable bison outside of this area has been difficult due to disease concerns. The founding members of the Laramie Foothills Bison Conservation Herd were part of a research project between Colorado State University and USDA-APHIS investigating the use of assisted reproductive technologies in mitigating the zoonotic disease brucellosis in bison. Three of the bison reintroduced were products of techniques that involved removing any potential bacteria that could cause brucellosis from embryos and semen prior to being used to create a pregnancy in a healthy female bison. These techniques provide a mechanism to build healthy herds with valuable genetics while eliminating the risk of bringing diseases to new areas and potentially infecting naïve animals. The Laramie Foothills Bison Herd is an example of how this kind of herd can be formed, managed, and used as a seed herd for distributing valuable genetics on a wider scale.

Session Topic: Conservation Across – Natural/Political/Cultural
Format: Oral presentation
Student Competition: No

PATTERNS OF PLANT COMMUNITY ASSEMBLY AFTER RECLAMATION WITH NATIVE PLANTS

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As unconventional gas and oil production expands in the US ecologically based restoration must be an accompanying priority. Native plant mixes are gaining traction in reclamation recommendations but their tolerance of highly disturbed soils and invasive plant propagule pressure is largely unknown in the northeastern US. To assess native plant mix establishment success in such disturbed soils we revisited a pipeline corridor seeded in 2009 with historical data on Japanese stiltgrass (*Microstegium vimineum*) distribution and abundance from 2009-2013. We expected historical *M. vimineum* spread rates would be positivity correlated with current *M. vimineum* abundance and negatively correlated with native mix establishment (cover, Simpson diversity). And, we expected current *M. vimineum* abundance to be negatively correlated with native plant mix establishment. To assess these hypotheses we conducted plant community surveys in 2016 on 20 m line transects at 81 sites with variable *M. vimineum* spread rates from 2009-2013 (not present, low, high). Our 2016 floristic survey revealed the current infestations of *M. vimineum* were positively correlated with earlier measures of spread of this invasive species and negatively correlated with the establishment of the native mix. Sites where *M. vimineum* was absent or spread rates were low had 87% higher cover of the seeded native plant mix. Land managers should prioritize *M. vimineum* control where population spread rates are high to avoid the dominance of this species. Our results provide evidence that native plant mixes can persist as the dominant cover on highly disturbed soils from energy development.

Session Topic: Role of Native Plant Materials in Restoration & Rehabilitation
Format: Oral Presentation
Student Competition: Yes

EFFECTS OF PRESCRIBED FIRE AND THINNING DURING MIDWESTERN OAK SAVANNA RESTORATION

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Oak savannas, open-canopied forests characterized by an herbaceous groundlayer, were historically common in the upper Midwest. Since European settlement, Midwestern oak savannas have been displaced by agriculture, development, and succession to closed-canopied forest following fire suppression. As with other open forests, Midwestern oak savannas are managed using a combination of prescribed fire and thinning to regain desired canopy structure, increase light availability and restore a diverse herbaceous groundlayer. However, it is unclear whether burning alone, or burning plus thinning, best achieves these goals. In 2010, we initiated experimental management of historical oak savanna in Jackson County, MI. The experiment contains 15 plots (0.2-1.2 ha), which have received semi-annual fires, a combination of repeated fire and overstory tree thinning, or no management (n=5 of each). From 2010-2016, we collected data on the physical structure (canopy cover, tree density) and the vegetation (species composition, vegetative cover) within each plot. After seven years, managed plots differed from control plots for most parameters. Thinning and burning resulted in significantly less tree density and canopy cover (e.g., more light availability) than either burned or unmanaged plots. Both management practices increased species diversity, and modified composition relative to controls. Our results illustrate how oak savanna management modifies the interplay between canopy structure and understory plant communities. Coupling thinning with burning affected more rapid change, whereas the effects of burning alone have been apparent, but less pronounced. Future work will illustrate whether burning alone overcomes initial differences induced by thinning and, if so, over what time frames.

Session Topic: Fire
Format: Oral Presentation
Student Competition: No

FOREST STRUCTURE OUTCOMES AFTER MIXED-SEVERITY WILDFIRE: DO THEY MEET RESTORATION GOALS?

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Over the past several decades, Western U.S. ponderosa pine forests have experienced a series of wildfires that have resulted in landscapes with burn mosaics ranging from low to high severity. Recent wildfires, while seemingly incompatible with management goals, may help advance them in some circumstances. Though the media, land managers, and the scientific communities tend to focus their attention on the large high-severity portions of recent large fires, significant portions also burned with a finer, more heterogeneous mosaic of burn severities. The objective of this research was to evaluate how low to moderate severity wildfire influences forest structure by examining post-wildfire spatial and non-spatial patterns of the residual forests and post-fire regeneration. We established five 4 ha plots in two wildfires and mapped all overstory and regenerating trees. We recorded tree diameter, height, and species. We categorized groups by the number of trees in a group and used spatially quantitative descriptions of forest stand structure to describe aggregation, species mixture, and horizontal and vertical structure. Post-fire residual forest structure was dominated by ponderosa pine and some Douglas-fir with tree densities ranging between 164 to 331 trees hectare^{-1}, and clear differentiation in both horizontal and vertical forest structure. Tree regeneration was dominated by ponderosa pine within 15 m of a surviving tree. These results suggest that low and moderate severity fire is moving the forest structure closer to restoration goals and show how quantifying the structural outcomes of wildfire provides a better understanding of how wildfires are supporting restoration objectives.

Session topic: Restoration in the Anthropocene; Wildland fire as a Management Tool
Format: Oral Presentation
Student Competition: No

PLANT COMMUNITY REOVERY AND SOIL DEVELOPMENT WITHIN FOUR ESTUARY RESTORATION PROJECTS IN WESTERN WASHINGTON

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Vegetation and soil within estuarine ecosystems play an integral role in atmospheric carbon sequestration, biogeochemical cycling, and habitat creation. Physical barriers, such as culverts within urban environments, reduce hydrological inputs, sediment exchange, and habitat connectivity. The restoration of estuarine habitats by culvert removal and bridge replacement results in the reconnection of the aquatic corridor, however, the recovery of plant communities and soil substrate within these systems is not well understood. This project monitored the restoration of four estuary sites of variable ages (0-12 years) in Western Washington and tested the hypothesis that there will be a linear trajectory of recovery through time. Plant community composition, soil organic carbon, soil nutrients, and the bioaccumulation of metals were assessed. Plant species diversity was significantly higher at the intermediate (9 year) and oldest post-restoration sites (12 year; $P = 0.02$). Vegetation composition was primarily native species with few invasive plants present. Percent soil carbon was significantly different among the pre-restoration (year 0) and youngest (3 year) post-restoration site ($P = 0.03$), demonstrating an initial decrease after restoration. Macronutrients were low in the system, but significantly correlated with plant biomass ($P < 0.05$). Bioaccumulation of copper and zinc, both metals associated with stormwater pollution, were significantly correlated to percent soil organic matter and soil carbon ($P < 0.05$). The results of this study show a linear pattern of recovery through time, which can aid land managers by providing a timeline for native plant and biogeochemical recovery within urbanized estuary systems.

Session Topic: Restoration in the Anthropocene
Format: Oral Presentation
Student Competition: No

WHY CARE ABOUT AIR? LINKING IMPACTS OF AIR QUALITY IN NATURAL SYSTEMS TO ECOSYSTEM SERVICES

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Anthropogenic stressors such as climate change, fire, and pollution are driving shifts in ecosystem function and resilience. Scientists generally rely on biological indicators of these stressors to signal that ecosystem conditions have been altered beyond an acceptable amount. However, these biological indicators can be non-descript or non-charasmatic species that fail to spur public interest or policy consideration. Therefore, we developed the STEPS (STressor – Ecological Production function – final ecosystem Services) Framework to develop "chains" that link an environmental stressor to a change in a biological indicator to an ecosystem component that is directly used, appreciated, or valued by humans; Final Ecosystem Goods and Services (FEGS). The ecological production function (EPF) describes distinct cause-and-effect relationships connecting the change to the biological indicator to sequential downstream impacts. The framework uses a qualitative score for each link in the EPF to classify the state of the scientific knowledge. Each EPF endpoint is linked to a discrete beneficiary of that ecosystem component. We used the Framework to assess how deposition of air pollution affects ecosystem services. We identified 47 biological indicators and linked them to 84 ecological endpoints through 183 unique EPFs. These endpoints were tied to 25 different benefiary groups, creating 1104 chains. Differentiating the strength of the chains allows researchers, managers, and policy makers to identify which chains have the greatest certainty to prioritize: future research, potential areas of management action, and future valuation. The chains present an opportunity to communicate compelling stories of the impacts of air pollution to beneficiary-specific audience values.

Session Topic: Value of Ecosystem Services and Working Landscapes
Format: Oral Presentation
Student Competition: No

THE INFLUENCE OF WARM-DRY MIXED CONIFER FOREST RESTORATION TREATMENTS ON HERBACEOUS FOOD BIOMASS FOR UNGULATES IN SOUTHWESTERN, COLORADO

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In southern Colorado, warm-dry mixed conifer forests have been affected by fire suppression for numerous years resulting in altered forest stand structure, which has potential impacts on ungulates and their food sources. The purpose of this study is twofold: 1) quantify herbaceous plant biomass by dominant functional groups and ungulate scat in three restoration treatments across the growing season, and 2) determine if there is a correlation between ungulate food resources and forest stand structure with ungulate abundance determined by scat counts and wildlife camera images. I hypothesize that overall herbaceous plant biomass will be highest in the thin/burn treatments because of an open forest stand structure and forb plant biomass and ungulate scat counts will be highest in the burn-only treatments because of increased post-fire soil nutrients and organic matter and open/closed forest stand structure. The study site has four replicated blocks of three treatments (thin/burn, burn-only and controls). Within each treatment unit, we will sample 5 plots (N=4 blocks x 5 plots x 3 treatments=60 total). We will establish a 50m transect at each plot and collect plant biomass on four (0.5 x 2.0m) subplots twice during the growing season. We will establish a 10m radius circle plot to count ungulate scat. Our study will quantify herbaceous plant productivity 13 years post-thinning and 10 years post-fire and determine how herbaceous productivity is correlated with ungulate abundance. Our findings can be incorporated into future land management regarding what types of forest restoration treatments provide quality habitat for ungulates.

Session Topic: Fire, Restoration
Format: Poster presentation
Student Competition: No

ESTIMATING COLORADO'S RETURN ON INVESTMENTS IN CONSERVATION EASEMENTS

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Private lands constitute roughly two thirds of the continental United States and provide numerous ecosystem services with significant material benefits to people. Conservation easements are a principle tool for maintaining private working farms and ranches that provide these benefits to society. Despite the large increase in the use of conservation easements as a conservation strategy and associated investments of public resources in their acquisition, significant questions remain about the public benefits of privately owned conserved areas. Here, we analyze the public benefits the State of Colorado has received in return for its investments in conservation easements through Great Outdoors Colorado and the Conservation Easement Tax Credit program. Using a benefits transfer methodology, we estimated the ecosystem service value provided by 14 ecosystem types on conserved properties in Colorado. The ecosystem service values provided annually ranged from $92 per acre to $3,979 per acre while Colorado, on average, invested $584 per acre on conservation easements. Based on these valuations, we estimate approximately a 4 to 1 return on the State's investments. The Colorado Coalition of Land Trusts is using these estimates as a tool to communicate the benefits of private lands conservation to diverse stakeholders and audiences. Critical to our analysis was the Colorado Natural Heritage Program's Ownership, Management and Protection (COMaP) service, which provided up-to-date information on conservation easements in the state. Similar data will be critical for expanded studies in other geographies.

Session Topics: Value of Ecosystem Services and Working Landscapes; Communicating About Natural Areas Conservation
Format: Oral Presentation
Student Competition: No

BEST MANAGEMENT PRACTICES FOR POLLINATORS: CREATING PRACTICES THAT ARE MEANINGFUL AND IMPLEMENTABLE FOR RANGELANDS ACROSS THE WEST

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Rangelands account for a substantial portion of the Western US. These lands are essential for the conservation of pollinators of all types. The Xerces Society is working with the U.S. Forest Service to develop meaningful and implementable Best Management Practices (BMPs) for pollinators on western rangelands with a major focus on habitat protection, management, enhancement and restoration. These guidelines will address the needs of native bees and butterflies, including the monarch butterfly. The Xerces Society is using a process that we developed working with the Federal Highway Administration on publications that provide guidance on the science and practice of roadside management for pollinators. The steps include 1) a thorough literature review of all peer-reviewed literature and technical materials on the topic of rangeland management and restoration to enhance pollinator habitat value, 2) interviews with practitioners and others that understand the science, practice, and economic issues related to pollinator conservation and habitat management in rangeland systems. All of the information is summarized into clear, concise guidance that can be used by agency staff for "real world" field application. We are specifically looking at how this body of information can be applied in western North American rangeland settings while considering feasibility relative to existing practices, guidelines, and budgetary limits. These BMPs provide a roadmap for how we can better manage rangeland pollinators and a process for successful BMP creation.

Session Topic: Role of natural areas in pollinator and invertebrate conservation
Format: Oral Presentation
Student Competition: No

USING COUNT BASED POPULATION VIABILITY ANALYSES TO ASSESS THE EFFECTS OF MULTIPLE, INTERACTING THREATS ACTING AT DIFFERENT SPATIAL SCALES ON THE EXTINCTION RISK OF A RARE PLANT

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Ensuring the best use of limited conservation resources requires comprehensively assessing the relative importance of multiple threats. Multiple threats are rarely modeled in traditional population viability analyses (PVAs) due to the high data requirements necessary to parameterize matrix population models. Count based PVAs have been shown to provide robust results and count data are readily available from monitoring programs. Despite this, we are not aware of any studies that have used count based PVAs to assess multiple threats for plant populations. We used long-term monitoring data collected by the Chicago Botanic Garden's Plants of Concern program to demonstrate the utility of count based PVAs for assessing multiple treats. We assessed two local threats (woody invasive species, browsing by deer) and one regional threat (climate change) on the viability of the rare forb, *Eurybia furcata*. We found that the presence of woody invasive species was the largest threat to the persistence of *E. furcata*. Therefore, we recommended that land managers prioritize local scale management of woody invasive species, as opposed to regional scale management aimed at decreasing the risk of extinction due to climate change. Count data are an underutilized resource for plant conservation assessments, and our study demonstrates that these data can be readily employed to assess multiple, interacting threats acting on different spatial scales and to identify which threat should be prioritized for management action. Applying this approach widely to count based data already in existence would result in robust recommendations to land managers for many species of concern.

Session Topic: Rare Species Management
Format: Poster Presentation
Student Competition: Yes

GLOBAL CHANGES OFTEN FAVOR INVASIVE SPECIES IN A SEMI-ARID GRASSLAND – 10 YEARS OF EXPERIMENTS WITH ELEVATED CO2, WARMING, ALTERED PRECIPITATION AND N DEPOSITION

Dana Blumenthal

USDA ARS

Many anthropogenic global changes not only alter environmental conditions, but also increase the availability of plant resources, which can facilitate plant invasion. Predicted changes for semi-arid ecosystems include increases in carbon availability with elevated carbon dioxide (CO2), nitrogen (N) availability with deposition, and water availability with both increased precipitation (at high latitudes) and elevated CO2. Conversely, warming may reduce water availability. Here we describe a series of studies testing how experimentally simulated global changes alter invasion in mixed-grass prairie, the largest remaining grassland in North America. Each global change increased invasion, but for different reasons. Snow-addition facilitated recruitment of Dalmatian toadflax (*Linaria dalmatica*), diffuse knapweed (*Centaurea diffusa*), and baby's breath (*Gypsophila paniculata*). Simulated N-deposition increased both recruitment and growth of toadflax. Elevated CO2 increased toadflax growth 13-fold through a combination of C-fertilization and increased soil water availability. Warming hastened the phenology of the winter-annual grass downy brome (*Bromus tectorum*), allowing it to grow larger in the early spring while competitors were inactive. Warming, which decreased soil water availability, was also the only global change observed to inhibit invasion of some species. While effects of different global changes were usually additive rather than interactive, N responses occurred only in combination with added snow. We conclude that additive effects of multiple global changes may greatly increase invasion within the mixed-grass prairie. While the mechanisms vary among global changes and species, they are consistent with the hypothesis that effects of global changes on invasion often mirror their effects on plant resource availability.

Session Topic: Climate change, Invasive species
Format: Oral Presentation
Student Competition: No

INVESTIGATION OF AN INTRODUCED POPULATION OF SOUTHERN WATERSNAKES, *NERODIA FASCIATA*, IN THE LOWER COLORADO RIVER, ARIZONA

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Incipient populations of introduced herpetofauna may be eradicated with intensive rapid response efforts, thus preventing their spread and minimizing impacts to native species. Southern watersnakes (*Nerodia fasciata*) are native to the southeastern United States but are now established at several sites in California. In 2016, we investigated the presence of a suspected introduced population at Lake Mittry, north of Yuma, Arizona. During this 50-day detection effort, we captured 20 watersnakes using 159 minnow traps in aquatic habitats. We also documented two incidental watersnake sightings and three roadkills. Trapped watersnakes measured 269-798 mm SVL and weighed 16-697 g, and included three females with follicles or embryos. This evidence indicates the existence of an established population of introduced watersnakes over a large area. Native snake species that were trapped or observed included 61 checkered garter snakes (*Thamnophis marcianus*) and seven California kingsnakes (*Lampropeltis getula californiae*). We could not assess direct effects of introduced watersnakes on other species but extensive habitat restoration of the Colorado River in this area is creating habitat for listed species that could be adversely affected. Additionally, breeding populations of this watersnake pose dispersal risks to new areas and could serve as the source of additional introductions into the region.

Session Topic: Invasive species management
Format: Oral presentation
Student Competition: No

RARE SPECIES MANAGEMENT IN THE MIDDLE TENNESSEE GLADES AND BARRENS

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This presentation addresses the recent management of “the Middle Tennessee Cedar Glades and Barrens” ecosystem where six state natural areas have undergone a transformation since 2013. The Middle Tennessee Cedar Glade and Barrens is a G1 ranked ecosystem that supports two federal listed plant species, one recently delisted federal endangered plant species, and 19 endemic plant species as well as many other rare species. Within a very short time frame, the Division of Natural Areas has begun implementing rare species management and restoration with major funding provided by partnering agencies and funding sources resulting in significant change. This presentation will discuss the management components, funding sources, and partnerships that have made these endeavors possible.

Session: Rare Species Management
Format: Oral Presentation
Student Competition: No

RESTORATION INSIDE THE FENCE: ENGAGING INCARCERATED POPULATIONS TO HELP IMPROVE GREATER-SAGE-GROUSE HABITAT THROUGH NATIVE PLANT PROPAGATION AND ECOLOGICAL EDUCATION

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The population of incarcerated adults in the United States has exceeded two million, resulting in the highest prison population in the world. While incarcerated, this large underserved population has little to no interaction with the natural world, removing the restorative benefits of environmental and personal rehabilitation. Through the "Sagebrush in Prisons Project" incarcerated adults have the opportunity to connect with nature, engage in ecological education opportunities, and gain occupational and professional skills that will extend beyond their sentence. The goal of the project is to improve habitat for greater sage-grouse by collaborating with state prison systems in production of sagebrush and engage offenders in sustainable land stewardship education. Loss of sagebrush habitat is a primary threat to the greater sage-grouse in the western United States. Production of native sagebrush within state prison systems represents an opportunity to provide urgently needed plant material on a broad scale while providing valuable personal and professional growth opportunities to men and women in custody. Institute for Applied Ecology (IAE) is currently working with 11 prisons in six states. The project is a collaboration between IAE, Department of Corrections, BLM and Sustainability in Prisons Project.

The Institute for Applied Ecology is a non-profit based in Oregon that conserves native species and habitats through restoration, research and education. They work closely with public and private partners to implement science-based restoration and provide place-based educational programs and materials.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries
Format: Poster Presentation
Student Competition: No

A SYSTEMS APPROACH THAT TARGETS ECOLOGICAL PROCESSES IS KEY TO WINTER ANNUAL GRASS MANAGEMENT

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Many approaches to control winter annual grasses like downy brome (*Bromus tectorum*) have been tried in natural areas and rangelands in the western U.S. Yet these species continue to threaten native species diversity, alter nutrient and water cycles, and increase frequency and extent of wildfires in the region. Past research shows that we can control winter annual grasses, at least in small areas and for short periods of time. A systematic literature review that evaluated the effects of management on downy brome and perennial grass abundances revealed that nearly all of the seven most commonly used management methods reduced downy brome cover in the short term (1 year), but only herbicide and revegetation led to long-term (≥ 2 years) control. Only burning, herbicide, and soil disturbance led to long-term increases in perennial grass abundance. Most treatments studied were applied only once, which may not reflect their use in actual management situations. Taking an approach that considers the system's resistance to annual grass invasion and resilience to disturbance and targets important control points in underlying system processes will lead to greater success at larger, management-relevant spatial and temporal scales.

Session Topic: Managing invasive annual grasses
Format: Oral Presentation
Student Competition: No

HEALTH BENEFITS OF NATURAL SOUNDS AND DARK NIGHT SKIES IN U.S. NATIONAL PARKS

Emma Brown[1]

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National parks have long served as destinations for their healing and restorative qualities. Many park visitors and surrounding communities value parks not just because they have outstanding scenery, but also because they offer access to natural soundscapes and dark night skies, allowing people to escape the clamor of everyday life. As development near parks expands, noise and light pollution have become increasingly pervasive threats. A growing body of research has focused on the negative health effects of excessive noise and light on humans, but the health benefits that occur in the absence of these disturbances is addressed less frequently in the scientific literature. In this presentation, we examine what is known about the health benefits of dark night skies and natural sounds in national parks to better understand the value of park ecosystems.

Session Topic: Restoration in the Anthropocene, Value of Ecosystem Services and Working Landscapes
Format: Poster presentation
Student Competition: No

SYNERGIES IN MAPPING AND CLASSIFICATION: NPS EXPERIENCE AND FUTURE DIRECTIONS

Karl Brown

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The National Vegetation Classification saw its infancy in the National Park Service vegetation mapping program in collaboration with ESRI and the Nature Conservancy. Since 1994, the NPS has partnered with industry, academia and other agencies in the collection of vegetation inventory data to support natural resource decision making. A nascent GIS industry, rudimentary GPS capabilities, and evolving ITIS and NRCS Plants databases all contributed to the conceptual bloom of taxonomic classification at a scale suitable for landscape and park mapping purposes. Competing terminology and business cases and practices prevented earlier acceptance of a "common vocabulary" for vegetation. Since that start, the National Park Service has contributed case studies, taxonomic community and committee efforts, funding, contracts, and agency and academic outreach to broaden the common vocabulary in vegetation inventories. Our field based PLOTS database and the derived plot data have and continue to fuel multiple LANDFIRE revisions, tests of quality, tools improvement, and user education. These efforts have spanned fine detail Association data to landscape scale Group and Macro-Group determinations.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries; Communicating About Natural Areas Conservation
Format: Oral Presentation
Student Competition: No

INTRODUCTION TO THE US NATIONAL VEGETATION CLASSIFICATION, VEGBANK AND THE PROCEEDINGS

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Vegetation classification is important for biological conservation and resource and for basic scientific research. These activities require that ecological units be defined and that their distributions be known and understood. A standardized method of classifying vegetation is needed to solve management and ecological problems that vary in scale and cross jurisdictional boundaries.

The National Vegetation Classification (NVC) is a central organizing framework for documentation, inventory, monitoring, and study of vegetation in the United States. It was publically released in 2016 after decades of work. Federal land managers are required to use or translate (crosswalk) local methods of classifying vegetation to the NVC to allow land managers to collaborate across ownership boundaries and manage and identify trends on a landscape. Landowners must collect enough data to be able to map or inventory vegetation using the NVC. In addition, partners developed a database for vegetation plots and a peer review system that allows for transparent and evidence-based changes to the NVC.

The USNVC has written description for over 6000 concepts at the Association level (www.usnvc.org), the lowest level of an 8-level hierarchy. All levels have written descriptions for all concepts, and completely cover all known vegetation communities in the conterminous United States. VegBank is the public database of record for the NVC and because the NVC is a dynamic classification, changes can be made to the classification in a formal peer review process. The *Proceedings* of the USNVC is the official record of changes, and the reasoning and evidence behind those changes.

Session Topics: Conservation Across (Natural/Political/Cultural) Boundaries; Communicating About Natural Areas Conservation
Format: Poster presentation
Student Competition: No

USING SOCIAL MEDIA TO BUILD AWARNESS FOR NATURAL RESOURCE ISSUES

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What if national parks, nature centers, and conservation organizations joined voices to share site-specific stories about climate change, air quality, biodiversity, invasive species and other conservation topics? The National Park Service science program has been coordinating communication campaigns around conservation issues, using site-specific stories to interpret national issues. Conservation does not stop at NPS boundaries, and joining our collective voices through new media gives us opportunities to reach more people. In this presentation, we will share how NPS uses social media to communicate about important natural resource issues.

Session Topic: Communication
Format: Oral Presentation or Poster
Student Competition: No

EVALUATING REVEGETATION OUTCOMES AT RECLAIMED WELL SITES IN THE POWDER RIVER BASIN

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One of the greatest challenges in ecological restoration is the successful reestablishment of native plant community diversity. The application of a diverse seed mix at reclamation sites frequently results in establishment of only a subset of seeded species, and resulting plant communities are often dominated by exotic weeds. Considerable information is available for decision making in seeding, including the choice of seed mix and seeding techniques. Fewer studies investigate seeding success, and specifically, the relative rates of establishment of desirable native plants. Invasive weeds present an additional challenge and risks of seeding failure often increase with competition from invasive plant species. In a study conducted in the Wyoming Powder River Basin, we surveyed vegetation at former coal bed natural gas wells to assess outcomes of reclamation seeding using protocols described in the Bureau of Land Management Assessment, Inventory and Monitoring (AIM) strategy. Our objective was to compare the species composition among reclaimed CBNG well pads, original reclamation seed mixes, and nearby, undisturbed sites. Results include estimates of species diversity, plant cover and vegetation structure for native and invasive plants. Greater Sage-Grouse conservation measures in Wyoming include large revegetation programs to restore landscapes disturbed by energy extraction. If we are to understand the effectiveness of current conservation practices, studies are needed of reclamation seeding outcomes for native plant community diversity and sensitive species habitat.

Session Topics: Species Re/Introductions & Assisted Migration, Forest and Range Management
Format: Poster Presentation
Student Competition: Yes

THE CHICKEN OR THE EGG? THE INTERPLAY OF DISEASE AND CLIMATE CHANGE ON WILDLIFE POPULATIONS

Danielle E Buttke

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Climate change is having broad and multi-faceted impacts on natural resources on every continent. At the same time, human populations are impacting these same resources through land development, introduction of non-native species, over-use of many natural resources, and pollution. Climate change impacts to natural resources are therefore one of multiple stressors on a system, making predictions as to the impacts of a changing climate more difficult than in an isolated system. Warmer temperatures and more variable weather patterns can impact disease organisms, particularly those transmitted by arthropod vectors, in multiple ways. At the same time, vector borne diseases are dramatically influenced by ecological factors strongly altered by human settlement and development. We examine tick-borne, flea-borne, and mosquito-borne diseases that pose risks to National Park resources and visitors, and discuss the multiple factors driving both disease occurrence and impacts. We argue that issues of climate change, loss of connectivity, biodiversity loss, and species introductions, including pathogens, must be examined in concert for the best management outcomes.

Session topic: Climate change
Format: Poster presentation
Student competition: No

INFECTIOUS DISEASE MANAGEMENT IN WILDLIFE IN THE CONTEXT OF ENVIRONMENTAL CHANGE

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Climate and other environmental change has implications for the emergence and spread of many pathogens and alternations to infectious disease processes. These implications pose a dilemma for agencies such as the National Park Service (NPS), which is charged with conserving natural resources while also providing for public enjoyment and protection of human health. The complexity of infectious disease ecology, range of projected environmental changes, and diversity of responses of disease-causing pathogens, vectors, and hosts will make it particularly challenging for managers to accurately predict outbreaks to protect resources and human health. Careful examination of the state of the knowledge and recognition of the knowledge gaps for any given system are integral to selecting an appropriate strategy for disease management. We will cover some of the observed and predicted impacts of climate change on wildlife diseases, and ways in which native disease impacts may be amplified due to climate change and other anthropogenic stressors on native wildlife and ecosystems. Managers are encouraged to address infectious disease from an ecosystem processes standpoint, and evaluate management options from the disease impact perspective rather than based on historic categorization of a specific organism or microbe.

Session topic: Climate change
Format: Oral presentation
Student Competition: No

USING COOPERATIVE AGREEMENTS AND LOCAL RESOURCES TO INCREASE THE SCALE OF CONTROLLED BURNING IN NORTHERN COLORADO

Michael D Caggiano[1]

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This presentation highlights practical applications and lessons learned from several cross-boundary, cooperative prescribed fire projects. These projects facilitated the implementation of prescribed burns using cooperative efforts between land managers and local cooperators including fire districts, tribal entities, and county emergency services. This cooperative burning model provides land management units with additional resources required to increase the scale and complexity of burns, and offers local cooperators the opportunity to gain fire line experience and work on qualifications and task books. This cooperative model also facilitates improved interagency coordination, safe and effective fire response, and helps bridge the gap between fire service and natural resource professionals by integrating local firefighters into ecologically based restoration projects. This program has resulted in the reintroduction of fire into thousands of acres of fire adapted ecosystems, better qualified firefighters, improved interagency relationships, and a resulted in a slow change in fire culture within the communities where the model has been applied. The presentation will described the context in which the program was developed, the institutional arrangements and mechanisms used to administer the initial model, and accomplishments.

Session topic: Wildland Fire as a Management Tool
Format: Oral Presentation
Student Competition: No

COMPARING CHANGES IN SPATIAL PATTERNS BETWEEN RESTORATION TREATMENTS AND WILDFIRES IN THE COLORADO FRONT RANGE

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In the Colorado Front Range, the Collaborative Forest Landscape Restoration Program (CFLRP) has planned or implemented over 8,000 ha of restoration treatments. A key objective of these treatments is to restore elements of complex spatial patterns that historically characterized lower elevation ponderosa pine forests such as a mosaic of gaps, openings and tree groups. Spatial patterns shape many ecological functions such as forest dynamics, understory diversity, and wildlife habitat. Given the high cost of mechanical thinning treatments and constraints to using prescribed fire in the region, interest in utilization of managed ("resource objective") wildfires has recently increased. We supervised classification of satellite imagery and gap delineation algorithms to examine how Front Range CFLRP treatments in ponderosa pine forests alter spatial patterns such as canopy cover and gap size distributions. We compare the outcomes of these treatments to low- to moderate-severity portions of two wildfires in the Front Range. Treatments ranged in size from 50 to 1200 ha and spanned elevations of 2100 to 2900 m. In general, we found that both mechanical treatments and low- to moderate-severity portions of wildfire reduce canopy cover and alter gap size metrics. We discuss (1) important topographic factors related to changes in gap characteristics, (2) the relevance of our findings to ongoing CFLR monitoring of understory plant communities and wildlife species in this landscape, (3) the potential for application of similar analyses across other southwestern CFLRP initiatives, and (4) the implications of our findings for restoration and management of ponderosa pine forests.

Session Topic: Collaborative Restoration
Format: Oral Presentation
Student Competition: No

UNDERSTORY VEGETATION DYNAMICS AND ECOSYSTEM RESILIENCE IN AN EASTERN OREGON PONDEROSA PINE FOREST

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Relatively recent increases in ponderosa pine abundance have generated unprecedented changes to ecosystem structure and function. Efforts to restore ponderosa pine systems are often focused on the manipulation of tree structure and the re-introduction of a more natural fire regime, however successful restoration programs should also consider understory components. The analyses of vegetation, soil, and environmental attributes from an eastern Oregon ponderosa pine forest indicated that increased ponderosa pine occupancy modified the under-canopy environment through alterations in light, nitrogen availability, and soil temperature and was related to reductions in understory diversity and abundance caused by a shift in understory character away from the dominance of perennial bunchgrasses. Light availability appeared to be the most influential driver in understory species distribution. Moreover, the potential for understory recovery from diminished understory conditions may be limited by an evident lack of a persistent soil seedbank for understory species that were dominant in open ponderosa pine stands. Loss of ecosystem resiliency associated with a lengthened fire return interval may initiate additional ecosystem degradation through the loss of the understory component, however restoration practices that reduce pine occupancy should enhance the conditions for perennial bunchgrass growth. Successful restoration will require the re-introduction of desired understory species seeds or other viable plant material when considering stands that have lost the understory component.

Session Topic: Forest management
Format: Oral Presentation
Student Competition: No

AN INTERACTIVE WEB-BASED PLATFORM FOR COMMUNICATING RESTORATION PLANNING AND PROGRESS.

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MPG Ranch is a large conservation property in western Montana, where we are restoring varied habitat types. To develop restoration strategies we consider site conditions, past success and failure, in-house research, literature, and communication with restoration practitioners. Because this information is inherently spatial, we developed an interactive web map to delineate site-specific restoration issues, help communication during planning, and convey management in the context of place. Map users can visualize site conditions with basemap layers including high-resolution imagery, topography, vegetation layers, solar radiation, and other environmental attributes. The map highlights recent on-the-ground restoration activity with site goals, descriptions, and histories. Our goal is to provide a forum for researchers to visualize and discuss site-specific issues. The web map at restorationmap.mpgranch.com will make restoration planning more inclusive and allow transparent access to restoration strategies and progress.

Session Topic: Communicating About Natural Areas Conservation, Technology for Land Management Success
Format: Oral Presentation
Student Competition: No

POST-FIRE CONIFER REGENERATION IN PONDEROSA PINE FORESTS OF THE SOUTHERN ROCKY MOUNTAINS

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Wildfires in ponderosa pine - dominated forests of the southern Rocky Mountains are increasingly burning with a high severity component that is unprecedented in the available historical record. The ability of ponderosa pine and other co-occurring conifers to regenerate in uncharacteristically large and severely burned patches of such fires is unclear, as seeds must disperse from surviving trees. We measured post-fire regenerating conifers in eleven 10+ year-old fires across Colorado, Wyoming, and South Dakota to characterize regeneration in severely burned patches and how regeneration characteristics are governed by abiotic and biotic factors. Our preliminary results indicate that conifers have regenerated post-fire in severely burned areas, but at low densities (~125 stems ha^{-1}); this contrasts with conifer regeneration in unburned and lightly to moderately burned areas, which was more than four times greater. Furthermore, as distance from living trees increased, post-fire conifer regeneration density sharply decreased, suggesting that it will likely be compromised in the interiors of large high severity patches; transects averaged ~170 stems ha^{-1} 25 m from living trees but <10 stems ha^{-1} 250 m from living trees. Meanwhile, regeneration that occurred in severely burned areas was taller than regeneration in unburned and lightly to moderately burned areas, suggesting that regeneration growth was not hampered by more exposed growing conditions. In addition to distance from living trees, conifer regeneration densities were influenced by coarse wood cover, and presence of regenerating conifers was influenced by aspect, solar radiation, and soil productivity and drainage indices.

Session topics: Fire, Restoration
Format: Oral presentation
Student competition: No

COMPARING NATURAL AREAS HERBICIDE MANAGEMENT OPTIONS FOR DOWNY BROME (*BROMUS TECTORUM* L.) CONTROL AND NATIVE SPECIES TOLERANCE

Shannon Clark

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Downy brome (*Bromus tectorum* L.) is a competitive winter annual grass species and is considered one of the most problematic invasive species in open spaces and natural areas in the western US. This invasive grass grows through the winter months, outcompeting native grasses, forbs and shrubs for moisture and nutrients. The currently recommended herbicides (imazapic and glyphosate) for restoration of sites infested with invasive annual grasses have provided inconsistent control or cause injury to desirable perennial species. Indaziflam, a new herbicide alternative for weed management in natural areas and open spaces, has provided long-term downy brome control and other weed seedlings. Field trials were conducted to evaluate the length of control and native species tolerance to indaziflam and other currently recommended herbicides used for downy brome control. For each native species, total counts were conducted across the entire plot area and analyzed as an increase or decrease compared to the non-treated control plots. Total species richness, downy brome control, and perennial grass and forb biomass were also evaluated. Only the plots with indaziflam treatments (44, 73 and 102 g·ai·ha-1) increased native species richness and provided 85-100% downy brome control. A greenhouse study conducted to evaluate biennial and perennial weed seedling control by indaziflam showed control of 8 additional weed species. These results provide critical information about indaziflam as an alternative herbicide treatment available to land natural area managers for restoring open spaces severely impacted by downy brome and other invasive weed species.

Session topic: Invasive species management
Format: Oral presentation
Student competition: no

TOOLS FOR LINKING CLASSIFICATION TO MANAGEMENT

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Ecological classifications embody accumulating knowledge of ecosystem composition, structure, and function; organized into text, tabular, and mapped information. Tools and guidance are needed to ensure that practitioners can fully utilize this knowledge to meet their needs for. Software tools to automate labeling of vegetation sample plots have also been developed to support national mapping efforts by the inter-agency LANDFIRE effort. Methods for automated labeling of sample plots and distinguish these from dichotomous field keys to classification units; which will also be discussed. NatureServe is also developing guide to the USNVC for use by BLM and partners. It includes examples of how the NVC relates to other common ecological classifications, and then illustrate how the UNVC can be applied to vegetation inventory, assessment, stating desired conditions, and monitoring.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries; Communicating About Natural Areas Conservation
Format: Oral Presentation
Student Competition: No

GROUND DWELLING INSECT SPECIES RICHNESS AND ABUNDANCE IN DIFFERENT FOREST RESTORATION TREATMESTS IN WARM, DRY MIXED CONIFER IN SOUTHWEST COLORADO

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Forest health in warm-dry mixed conifer has been affected by fire suppression since the 1800's changing the structure of the forest ecosystem. In this study we will focus on ground dwelling insects because they fill roles such as pollinators, decomposers and seed dispersers which provide valuable insight on how restoration treatments effect forest health. My research objectives are: 1) to observe differences in ground dwelling insects among three forest restoration treatments in warm-dry mixed conifer (thin/burn, burn-only and an untreated control) across the growing season (June to August) in southwest Colorado; and 2) to correlate ground dwelling insects with forest stand structure, forest floor litter/duff and soil physical properties. I hypothesize highest ground dwelling insect abundance in the control treatment and highest species richness in the thin/burn treatment. Litter/duff depth in the controls will be the highest due to no fire providing more habitat for ground dwelling insects. Additionally, I hypothesize the lowest ground dwelling insect species richness and abundance in the burn-only treatment because it will have the highest amount of organic matter removed. The study site consists of four replicated blocks of each restoration treatment. Within each treatment unit, we will sample 5 permanently located 50-m transects and establish 10 pitfall traps along each transect (4 blocks x 3 treatments x 5 transects x 10 traps=600 traps). This study will quantify ground dwelling insect species richness and abundance 13 years post-thinning and 10 years post-fire in hopes to gain understanding on how different restoration treatments effect forest function.

Session Topic: Fire Ecology and Fire Response
Format: Poster session
Student Competition: No

HUMAN-ASSISTED PATHWAYS FOR INVASIVE SPECIES INTRODUCTION AND SPREAD

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It is well known how the increase in global trade has resulted in a concurrent increase in invasive insects, weeds, and disease introductions to the U.S. over time. The USDA Animal and Plant Health Inspection Service (APHIS) has a suite of tools for evaluating the risk of entry for invasive organisms to the U.S. through trade. These risk analyses potentially inform trade policies or other mitigations meant to reduce the risk of invasive species entry through imports. However, we do not have a good understanding for how invasive organisms that escape detection and arrive at the U.S. border move through our domestic transportation infrastructure to arrive in our local communities. These movements may be part of the transportation chain related to imports or an accidental relocation by the public. Efforts to quantify these movements are underway. I will demonstrate an APHIS success story in quantifying domestic movements for European gypsy moth and how the resulting model is currently used to guide early detection surveys. Furthermore, the validation of the human-movement pathway for gypsy moth has motivated APHIS to increase their outreach campaigns to inform the private and public sector of their contribution to this pathway and the regulatory guidelines they must follow when moving from an infested area. This example will illustrate the call for greater data sharing and collaboration across governmental, private, public and NGO sources to create effective management solutions to invasive organisms.

Session topic: Invasive species management
Format: Oral presentation
Student Competition: No

FIRE, SUCCESSION, TYPE CONVERSION, AND ALTERNATE STABLE STATES IN SOUTHWESTERN FORESTS

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Land-use legacies and climate change have altered fire regimes across the southwestern US, including both reduced and expanded wildfire effects. As a consequence, some forest types, exemplified by ponderosa pine and dry mixed conifer, have shifted towards less fire-resistant and resilient configurations, and are increasingly vulnerability to wildfire. Following burning, these systems display a continuum of successional trajectories ranging from relatively short-term recovery to enduring alternate states. Alternate states are typically derived from combinations of common pre-fire understory grasses and/or shrubs--they typically resemble pre-fire communities but with altered abundances and minus dominant tree species. However in some cases, they may include a substantial component of ruderal and non-native species. The magnitude and persistence of differences between pre- and post-fire states may be strengthened or even stabilized by 1) positive internal feedbacks such as reduced regeneration, strong competition, and subsequent fire regimes, and 2) shifts in extrinsic factors, including non-native species and climate change that alter competitive outcomes and subsequent fire regimes. Type conversion refers to any major shift in dominant species composition or physiognomy persisting over time frames relevant to species life spans and management decisions. Type conversions may or may not represent alternate stable states. Mathematical models including differential equations and state-and-transition models can be used to explore the duration of conversions, the potential for forest recovery (resilience) vs. loss (transformation) under varying fire and climate regimes, and also the utility or futility of management interventions for reducing forest losses or promoting their recovery.

Session Topic: Wildland Fire as a Management Tool, Forest and Range Management
Format: Oral Presentation
Student Competition: No

PIPING PLOVER HABITAT LOSS AT THE NATURE CONSERVANCY'S JOHN E. WILLIAMS PRESERVE, CENTRAL NORTH DAKOTA: AN INTERDISCIPLINARY STUDY OF ALKALINE PRAIRIE POTHOLE GLACIAL LAKES, HYDROGEOLOGY AND VEGETATION ENCROACHMENT

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The Great Plains population of the Piping Plover is threatened due to predation and loss of breeding habitat. Plovers nest in open sandy or gravel beaches with little vegetation. The Nature Conservancy's (TNC) John E. Williams Nature Preserve in North Dakota houses a large breeding population of Piping Plovers along alkaline, prairie pothole glacial lakeshores. Over the past eighty years, vegetation has encroached upon the gravel habitat (Root and Ryan, 2004) and been accompanied by a sharp decline in the number of Piping Plover breeding pairs. This region experiences decadal drought-deluge cycles. During 1-2 year droughts, alkaline lakes dry up and gravel habitat expands, both below and above the lakes' high water marks. In rainy years, lake levels rise and nesting areas shrink, including areas above the high water mark. Undergraduate University of St. Thomas Environmental Science majors are studying the hydrogeology, groundwater and lake chemistry, soil chemistry and grain size distribution, lake sedimentation, vegetation patterns and geomorphology of the area to better understand the interplay of processes contributing to encroaching vegetation. We are examining historical land use changes and how global climate change may impact the drought-deluge cycles. Because prairie pothole lakes show disparate responses to annual weather fluctuations as well as drought-deluge cycles (Winter and Rosenberry, 1998), we installed piezometers to characterize each lakes' response to seasonal fluctuations. Drone imagery, in conjunction with field mapping, is being used to delineate vegetation, geomorphology and surface sediment zones. Our goal is to help TNC maintain plover habitat.
KEY WORDS: vegetation encroachment, habitat loss, Piping Plover, climate change, hydrogeology, vegetation mapping

Session Topics: Wilderness and Research Natural Areas Management, Natural Areas Management in Light of Changing Climate, Technology for Land Management Success, Rare Species Management
Format: Poster
Student: Yes

DEVELOPING PROACTIVE STRATEGIES FOR ECOLOGICAL DROUGHT IN THE 21ST CENTURY

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As global temperatures continue to rise, drought is intensifying and increasingly exacerbated by human water use, leading to a wide range of social and ecological impacts. Thus, ecosystems are more vulnerable to drought, and we have seen a rise in drought-driven tree mortality globally and an increased anticipation of ecosystem transformations from one state to another (e.g., forest to a shrubland). More and more, managers are seeking information on proactive preparedness strategies to reduce the vulnerability of natural resources to ecological drought in the face of climate change. But specific strategies for such proactive management are not well developed. We recently formed a Science for Nature and People Partnership (SNAPP) working group to develop a definition and framework for ecological drought, to guide researchers and decision-makers toward more proactive strategies to address the rising risk of drought in the 21st century. The ecological drought framework is organized along two dimensions—the components of vulnerability (exposure, sensitivity, and adaptive capacity) and a continuum from human to natural factors. Using this framework, we can better understand the multiple roles that both people and nature play as drivers of ecological drought impacts, and link that understanding to a suite of on-the-ground strategies for reducing the vulnerability to ecological drought in the future. In the Upper Missouri Headwaters of southwestern Montana, U.S., we are using a distribution modeling approach with retrospective datasets to discover the driver(s) of widespread tree mortality after the early 2000's drought, as a first step toward developing proactive preparedness strategies.

Session Topic: Natural Areas Management in Light of Changing Climate
Format: Oral Presentation
Student Competition: No

COMPLEXITY AS A FRAMEWORK FOR TRANSBOUNDARY CONSERVATION

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Complexity has long been regarded as esoteric theory that is not applicable to practical challenges. However, as conservation seeks to work across boundaries in systems that are frequently not compatible under conventional analysis complexity can provide a conceptual framework for distilling systems down to their bare essence to find common ground. In essence complexity represents a framework to link social and ecological systems, as well as a strategy for working across administrative and geographic boundaries. Based on two decades of research and practical experience I use practical examples from rangelands and other systems to illustrate how complexity represents an effective approach for addressing increasingly large, dynamic, and nuanced conservation challenges. Transboundary conservation represents a challenge to convention strategies and demonstrates the need to re-conceptualize science and policy and I show how a reframing of conservation leads to fundamentally different, and effective strategies for addressing conservation challenges. At the same time building and expanding existing paradigms such as collaborative and community-based approaches to expand the effective scale and scope of conservation.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries.
Format: Poster Presentation
Student Competition; No

PRAIRIE QUEST FARM: WORKING LAND CONSERVATION AND RESTORATION

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Prairie Quest Farm is a 120-acre farm in Northeast Iowa along the bluffs of the upper Mississippi River. The majority of the farm is planted in perennial cool-season grasses and forbs for rotationally grazed pastures and hay fields. Over the past two decades, the farm has been managed for the production of grass-fed beef and dairy cattle as well as habitat for breeding grassland birds. Grassland birds (Bobolink, Eastern Meadowlark) have declined by 75% in the past 50 years due to habitat loss, originally from plowing the prairie and more recently from the conversion of diversified farms with long crop rotations and livestock to intensively managed farms of corn and soybeans. I recently purchased Prairie Quest Farm with the goal of continuing the established management of the farm. With the advice of my farm mentor and renter, I enrolled the majority of the farm in the NRCS Conservation Stewardship Program (CSP) to achieve my dual management goals of producing food and providing wildlife habitat. The CSP was first introduced in the 2002 Farm Bill to financially reward farmers for conservation practices on working farms. In 2015 the CSP offered 119 practices under the broad categories of improving soil and water quality, conserving energy, and planting diverse habitat for wildlife and insects. Within the CSP practices are provisions for maintaining and restoring farmland for plant species diversity and ecosystem function. I will describe how I selected 9 CSP practices to maintain the high quality pasture-grassland and restore farm borders on Prairie Quest Farm.

Session Topic: Value of Ecosystem Services and Working Landscapes
Format: Poster Presentation
Student Competition: No

ROAMING ACROSS BOUNDARIES: COLLABORATIVE MESO-CARNIVORE MONITORING IN THE NORTHERN ROCKIES

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Many rare carnivore species have large home ranges that encompass multiple land management jurisdictions; which makes monitoring and managing these species very challenging for any single management agency. One solution is the adoption of place-based collaborative groups that have emerged across the US in recent years to help provide the venue, relationships, public outreach, and coordination needed for true landscape-scale monitoring. Using seed money from the USFS Collaborative Forest Landscape Restoration Program, the Southwestern Crown Collaborative in Montana has been successful in developing a long-term, rigorous multi-species meso-carnivore monitoring program (focused on Canada lynx, wolverine, and fisher) which is conducted jointly by non-profit partners and agency personnel. The initial effort garnered attention from adjacent land managers which was then leveraged into additional funding and a broader landscape perspective. The project developed and improved upon the innovative use of multiple non-invasive field methods, including track surveys and bait stations as a source of genetic samples. Through five years of work, a clear picture has evolved regarding the abundance and distribution of these species across a large landscape with the information being used by multiple agencies and land managers to develop and adjust management actions. Results are also shared through outreach and education efforts that generate wider community discussions about management of these species. Finally, collaborative partners have organized multiple regional workshops on monitoring and management of meso-carnivores to instigate a more direct discussion among land management agencies in the Rockies.

Session Topics: Forest and Range Management
Format: Oral presentation
Student Competition: No

BIOLOGICAL AND FUNCTIONAL DIVERSITY OF POLLINATORS IN RANGELAND HABITATS OF COLORADO

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Although insect pollinators are keystone species in many terrestrial ecosystems, basic information on their biodiversity and the factors driving pollinator distribution is needed to implement sound conservation practices and maintain ecosystem services. The role of plant traits as regulators of pollinator distribution merits study—in many ecosystems, plant functional traits predict patterns of community assembly and structure, but it is unknown whether this extends to beneficial insect species. However, an understanding of plant-pollinator functional relationships can provide new targets for managers, and provide insights into the specific plant traits relevant for conserving biodiversity and productivity in rangelands. The characterization of functional traits is widely employed in plant community ecology, but this framework has received little application in entomological disciplines. We apply functional trait analysis to pollinator species and provide a comprehensive survey of Hymenopteran pollinators in Colorado rangeland and grassland habitats, evaluating plan-pollinator functional relationships in nondisturbed habitats, as well as those recently disturbed by abiotic (fire) or biotic (cheatgrass invasion) factors. These baselines will be important for assessing change in both pollinator populations and ecosystem services over time.

Session Topics: Pollinators
Format: Oral presentation
Student Competition: No

THE POWER OF DEMOGRAPHIC DATA IN THE RECOVERY OF THREATENED AND ENDANGERED PLANT SPECIES

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Only one percent of species listed under the Endangered Species Act (ESA) have met the recovery criteria required for their delisting. While this has led to debate surrounding the effectiveness of the ESA overall, there is little argument over the utility of quantitative data in monitoring species response to conservation actions. Policy requires the Bureau of Land Management (BLM) to engage in proactive measures to conserve and/or recover listed species and the ecosystems, on which they depend, and to reduce or limit threats to sensitive species in order to minimize the likelihood of their listing and the need for ESA protections. Providing a consistent, integrated, conservation-focused, and scientifically robust approach to assessing a species biological status is critical to achieving this goal. BLM – Colorado has developed and implemented a comprehensive monitoring program in order to understand population trends of ESA listed and candidate plant species at the landscape-level. Demographic monitoring provides objective and measurable information necessary to assess land-use plan effectiveness and inform decisions related to the listing and delisting of plant species of conservation concern. We argue that demographic approaches to monitoring not only provide a baseline understanding of a species status but that is necessary in provide the basis for listing/delisting decisions. We will offer several examples.

Session Topic: Rare Species Management
Format: Oral Presentation
Student Competition: No

BUILDING A DOWNTOWN RIVER PARK: THE HEURISTICS OF PUBLIC PROCESS AND PLANNING

Matt Day

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Building a Downtown River Park: the Heuristics of Public Process and Planning. This presentation will feature Fort Collins' efforts to develop a downtown river park in an extraordinarily difficult location with intense public engagement and interest. The process has included several years of community outreach and master planning, dozens of public meetings, numerous private partnerships, and complications/challenges nearly beyond counting. All of these efforts have involved a process of self-discovery for the participants, many of whom approached the project from a particular perspective without initially understanding its complexity. Today, the park is well into design and permitting. The presentation will provide an overview and insights into the history of the planning and community involvement, key challenges, and the ultimate outcomes.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries.
Format: Oral Presentation
Student Competition; No

SETTING INVASIVE SPECIES MANAGEMENT PRIORITIES WITH STATE PARTNERS

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Invasive species are a constant challenge for natural resource management, and there is a growing need for prioritization tools to help focus limited resources to advance local or regional conservation goals. The New York Natural Heritage Program manages data on rare species, natural communities, and invasive species for the state, and has been working with stakeholders to identify ways to deliver this information to help make strategic invasive species management decisions at many spatial scales. We developed a synthesis map layer for New York to help conservation partners decide where to focus their efforts when surveying and managing for invasive species. The model indicates areas predicted to have high value natural areas prone to new invasive species populations and dispersals by incorporating component models of ecological significance, priority protected areas, and anthropogenic stressors. Stakeholder workgroups helped shape the output and provided valuable use-case examples. This information is further coupled with the state observation data and invasiveness ranks to help determine which projects are likely to be feasible and effective.

Session Topic: Invasive Species Management
Format: Oral Presentation
Student Competition: No

THE EFFECTS OF FIRE RESTORATION TREATMENTS ON LARGE MAMMALS IN SOUTHWESTERN COLORADO, USA

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Euro- American settlement introduced a variety of pressures to warm/dry mixed conifer forests, which altered the fire regime and caused a shift in species abundance. Restoration treatments can be used to restore these forests within their former structure and function, and therefore will alter wildlife habitat. I will quantify the effects of forest restoration treatments on large mammal species in a warm/dry mixed conifer forest in the San Juan Mountains, Colorado in four replication blocks of three restoration treatments (burn only, thin/burn, and an untreated control). I will place a motion activated camera in five permanent plots in each treatment (5 x 12=60 cameras). The objectives of my research are to observe differences in large mammalian richness and abundance across three restoration treatments in 2017 and to compare my findings with data in 2015 and 2016 to quantify temporal differences. I hypothesize that the burn-only and the thin/burn treatments will have the highest large mammal species richness and abundance and that there will be a higher abundance of large mammals in the treatments in 2017 compared to previous years due to increased understory biomass from above average winter precipitation and plant response time since initial treatments (13 years post-thinning and 10 years post-fire). The results of my research will allow managers to have a better understanding of how large mammal species respond to restoration treatments, which will help them manage areas in a way that maintains ecosystem function and conserves biodiversity.

Session Topics: Fire, restoration
Format: Poster presentation
Student Competition: No

PHYSIOCHEMICAL DRIVERS OF VARIATION IF GRASS-INVASION IMPACTS ON SOIL CARBON CYCLING

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Microstegium Vimineum (Japanese Stiltgrass) is an invasive grass species that is currently dominating susceptible ecosystems across the eastern half of the United States. The presence of Japanese Stiltgrass results in decomposition of plant available nitrogen, limiting the variety of species that thrive within habitat that are or were previously invaded. Nitrogen (N) deposition has the ability to influence the composition of plant communities as it can change increase the concentration of nitrogen within the atmosphere and rhizosphere. Similarly, the composition of leaf litter determines available nutrients to understory plants. In this study, we are examining the degree at which nitrogen deposition and leaf litter quality influences the ability for Japanese Stiltgrass to degrade the soil. The study is taking place in the Shawnee National Forest in southern Illinois. 20 pairs of plots consist of 10 low quality litter (pine dominated) plots and 10 high quality litter (5 maple-elm and 5 tulip poplar dominated) plots. Within each pair, three subplots are each receiving one of three nitrogen treatments: 2 g N m^{-2} yr^{-1}, highest total deposition rate currently recorded, 5 g N m^{-2} yr^{-1}, total deposition rate expected in the future, and a control of 0 g N m^{-2} yr^{-1}. A variety of analyses will be performed, root:shoot biomass, soil moisture, pH and temperature, nitrogen concentration, C:N ratio, microbial activity and composition. The presentation will cover introductory material, experimental design, methods, and hypotheses, examine the results provided from these analyses and discuss the significance of the study.

Session Topics: Invasive Species Management and/or Restoration in the Anthropocene and/or Natural Areas Management in Light of Changing Climate
Format: Poster Presentation
Student Competition: Yes

CONSERVATION PLANNING FOR COLORADO'S ALPINE PLANT COMMUNITIES BASED ON HERBARIUM RECORDS: PREDICTING COMMUNITY RESPONSE TO A CHANGING CLIMATE.

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Plant response to a warming climate can help us predict future changes in plant communities and aid in the development of effective management plans. Since 1950, within the alpine regions of Colorado the average annual minimum temperature and annual precipitation increased significantly. Plants can respond to climate change by either shifting their range or phenology to track optimal climatic conditions. Poleward and upslope range shifts are most linked to increasing temperatures. Phenology and range shifts, both important indicators of climate response, can be observed through herbarium collections. Previously we detected an advance in first reproductive day in Colorado's alpine plant community of 8.7 days between 1950 and 2011. Only 12% of 385 alpine and sub-alpine plant species in Colorado had a significant individual advancement in reproductive day. Within this expanded study we analyze shifts in elevation over the same time period and further explore individual species response. Out of 45 species advancing in reproductive day, 6 were collected significantly lower in elevation over time while one species moved significantly upslope. Fifteen species moved significantly lower by nearly 500 meters over 61 years (6 collected significantly earlier, 9 did not move in collection day) and 10 species were collected nearly 300 meters upslope over the study period. To further explain the variation in alpine plant community response to climate change, we examine individual species habitat models, range shifts within Colorado, and the variation in the ability of climate models to describe precipitation over a meaningful scale.

Session Topic: Natural Areas Management in Light of Changing Climate
Format: Oral Presentation
Student Competition: No

USING NATURAL RESOURCE INVENTORIES TO INFORM EXOTIC SPECIES MANAGEMENT

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Since 1992, the National Park Service Inventory & Monitoring program has conducted an effort to complete 12 "basic" natural resource inventories, which were designed to provide park managers with information needed to effectively manage the natural resources. After 25 years, the NPS has nearly completed the planned inventories, providing a baseline that informs scientifically-sound management decisions and serves as a basis of long-term monitoring plans that help ensure the future health of the parks. The NPS I&M Program has completed more than 50 Service-wide scoping sessions to identify new natural resource inventories that will continue to inform current and emerging resource management decisions at the park level. This session will summarize interim findings from park-, I&M network-, regional-, and national-level scoping, with a focus on how planned inventories can be used to inform EDRR activities as well as other aspects of vegetation management.

Session Topics: Early Detection and Rapid Response
Format: Oral presentation
Student Competition: No

MONITORING THE NATURAL QUALITY OF DESIGNATED WILDERNESS

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Five qualities of wilderness are specifically mentioned in the 1964 Wilderness Act: Natural, Untrammeled, Undeveloped, Solitude or Primitive and Unconfined Recreation, and Other Features of Value. Without measuring these qualities, we have no way of knowing whether they are being degraded in designated wilderness areas. As 18% of designated wilderness occurs on national wildlife refuges, the U.S Fish and Wildlife Service, Inventory and Monitoring Program hired and trained Wilderness Fellows to establish wilderness character monitoring on the 65 refuges with wilderness. The monitoring methods come from the interagency publication, *Keeping it Wild 2* which requires measurement of up to 15 specific indicators across the five wilderness qualities. Here we present a summary of those measures selected by specific refuges. While we often associate wilderness areas with wildlife populations or endemic plants, monitoring single species is contentious as a measure of wilderness character. Moreover, maintaining those highly valued populations by removing invasive species and taking other actions can contribute to wilderness degradation through trammeling.

Session Topic: Wilderness and Research Natural Areas Management
Format: Oral Presentation
Student Competition: No

IMPLEMENTING ECOLOGICAL RESTORATION BEYOND OUR BOUNDARY: STRENGTHENING COLLABORATIONS WITH ONLINE LEARNING FOR VOLUNTEER STEWARDS

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Volunteers are increasingly relied upon to improve natural areas. While they require training, which takes time and money to successfully implement, most are looking for easily accessible education that fits into their busy lifestyles. At The Morton Arboretum, we have seen increased volunteer activity and leadership in conducting restoration as a result of implementing a volunteer training program, the Woodland Stewardship Program. In order to expand the program's reach and better serve volunteer needs, we have redeveloped the program in a new blended learning format, which includes both online learning tools and in-person classes. The goal of this effort is to train average citizens who are willing and motivated to improve natural areas within their own communities. This program relies on numerous collaborations to successfully implement so that newly trained volunteers learn about stewardship of different ecosystems and engage with regional conservation organizations. These collaborations with regional stakeholders are essential to the quality and expanded geographic reach of the program, and to making the best use of limited resources to expand best practices in restoration. Learn about successes and challenges of the Arboretum's effort to engage stakeholders who are intently improving their own natural areas, how they participate in this program, and how this program has been engaging partners across local, regional, and international boundaries.

Session Topic: Conservation Across Boundaries
Format: Oral Presentation
Student Competition: No

OCCURRENCE AND CHARACTERISTICS OF GROUNDWATER-DEPENDENT WETLANDS ON NATIONAL FORESTS: FINDINGS FROM RECENT INVENTORIES

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Over the past decade, inventories of groundwater-dependent ecosystems (GDEs), primarily springs and wetlands, have been conducted on National Forests throughout the USA to determine the distribution and characteristics of these critical natural areas. These efforts are frequently collaborative projects among the US Forest Service, state agencies and heritage programs, academic institutions, and non-profit organizations. Inventories have utilized established protocols to evaluate a core set of ecological parameters and management indicators at each site. The consistent collection of on-site field data provides a valuable baseline for effective management, and allows for comparisons of wetland features among different Forest Service units and ecoregions. For wetland GDEs, a primary objective of many inventories is the determination of the occurrence and condition of fens, i.e. those wetlands with a minimum depth of accumulated peat (≥40 cm), which are of high conservation value. Findings from GDE inventories conducted on National Forests in Utah, Wyoming, and Colorado indicate that the distribution of wetland GDEs, as well as the range of peat depths that distinguish fens, is related to elevation, precipitation regime, geomorphic land forms, and past glaciation activity. The continuum of measured peat depths across wetland GDEs, whether within one Forest or across multiple Forests, suggests that the peat depth required for fen designation is ecologically questionable. Wetland GDEs provide valued ecosystem services, including water and carbon storage, and habitat for native biota. Their stewardship is improved through increased understanding of their landscape-level distribution and condition, which is best achieved through collaborative inventories using consistent methods.

Session Topic: Wetlands
Format: Oral Presentation
Student Competition: No

TESTING DEVICES TO REDUCE RAPTOR ELECTROCUTION ON VERTICAL SUBTRANSMISSION POWER POLES

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Electrocution of raptors on power lines is a concern in the United States. Colorado is unique because almost every utility has developed an Avian Protection Plan to address raptor electrocutions. Usually, mitigation strategies focus on reducing electrocution risk on distribution pole, but electrocutions also occurs on subtransmission poles, particularly when vertical configurations place energized wires in proximity to grounded components. We evaluated whether raptors presented with power poles in a flight cage can make simultaneous contact with mock-energized and mock-grounded ends of horizontal post insulators used on distribution and subtransmission poles. Such contact on energized poles would usually lead to mortality. Our goal was to identify whether perch deterrents were effective in preventing simultaneous contact. From March 2016 through March 2017, we exposed 20 raptors (14 Red-tailed Hawks [*Buteo jamaicensis*], 3 Cooper's Hawks [*Accipiter cooperii*], 2 Great-horned Owls [*Bubo virginianus*], and 1 Rough-legged Hawk [*Buteo lagopus*]) to mock power poles. Each of these raptors had been rehabilitated by the Rocky Mountain Raptor Program at their facility in Fort Collins, CO for injuries received in the wild. These raptors were fully flight capable prior to participation in this study and subsequently released afterwards. We used remote cameras to monitor perching day and night. Each time a bird perched on a pole, we recorded a 1-minute video. Initial results from ongoing analyses suggest that in > 60 hours of 1-minute videos, no raptor ever contacted mock-energized and mock-grounded components simultaneously. These perch deterrents may in fact be effective electrocution mitigation tools.

Session Topic: Technology for Land Management Success
Format: Poster
Student Competition: No

ADAPTATION POLICY ANALYSIS: FUEL TREATMENTS AND POST-FIRE RESPONSE IN STAND-REPLACING FIRE REGIMES

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High-severity fire regimes are undergoing change throughout the western US. Climate-driven changes to western forests raise concerns for managers not only regarding changes in fire regime, but also about post-fire decision making. Longer and more frequent dry periods may impede seedling establishment and delay the formation of a new forest canopy. Very large and intense fires may kill most seed trees within burned areas and thus limit seed dispersal and recruitment into interior areas. These large disturbances may also promote native and nonnative shrub and grass invasion and establishment within previously forested areas. This case study examines issues related to stand-replacement fire regimes on the west side of North Cascades National Park. We posed a core question – "Do NPS Management Policies support management to address impacts of human-caused climate change (realized or projected) that involves managing fire-influenced vegetation types under novel fire regimes?" – and asked whether NPS guidance is prescriptive, permissive, contradictory, or lacking. We discuss various approaches to conserving a key process – fire – in the face of climate change, and how to integrate this objective with the maintenance of other resources and values in and outside of parks. We find that NPS Management Policies prescribe resistance to anthropogenic change unless all feasible/possible resistance actions cause unacceptable impacts, allow accommodation of change where resistance is futile, but generally do not support directing change in natural systems towards new conditions even where such conditions are consistent with emerging climatic conditions.

Session Topic: Fire
Format: Oral Presentation
Student Competition: No

IS A COOT A DUCK? AN ANALOGY FOR UNDERSTANDING THE RELATIONSHIP BETWEEN NATIONAL NATURAL LANDMARKS AND THE NATIONAL PARK SYSTEM AND THE CROSS BOUNDARY CONSERVATION OPPORTUNITIES AVAILABLE.

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The notion that "just because it floats doesn't make it a duck," can be similarly applied to National Natural Landmark (NNL) sites; just because they are associated with the National Park Service doesn't make them units of the National Park System. In fact, 96% of the 599 designated NNLs are located on lands not owned by the National Park Service (NPS). Landmark sites are owned by a variety of public and private land stewards and are located in city, county, or state parks, wildlife refuges, national forests, nature preserves, or even in someone's backyard. NNLs are designated by the Secretary of the Interior to formally recognize sites that possess outstanding biological or geological features. The NNL Program, established in 1962, is one of many community assistance programs administered by the NPS that provides opportunities for working beyond the boundaries of park system units. Land acquisition is not a goal of this program and no new land use management requirements or restrictions are imposed. However, in addition to raising awareness about the presence and location of landmarks to aid in well-informed planning efforts, the NPS can provide a variety of conservation assistance to interested site owners and managers. Specific examples will be shared to illustrate how the partnerships formed through this program have offered opportunities for the NPS to work alongside landowners, managers and other partners to encourage and support the protection of these nationally significant sites and engage in and promote landscape conservation.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries
Format: Poster Presentation
Student Competition: No

DETERMINING EFFICACY OF PINYON-JUNIPER THINNING TREATMENTS IN SAGE-GROUSE HABITAT

Cody Ernst-Brock[1], Lee Turner[2], and Elizabeth Leger[3]

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Expansion of Pinyon-Juniper (P-J) woodlands throughout the Intermountain West has led to the loss of critical habitat used by sagebrush-obligate species. This shift has prompted increased interest in determining effective methods for thinning Pinyon-Juniper trees in areas where greater shrub and grass cover are desired. This project is examining the efficacy of recent Pinyon-Juniper thinning projects across Nevada by analyzing vegetation data collected as part of a multi-year monitoring program, the Vegetation/Habitat Assessment program, supported by the Nevada Department of Wildlife in cooperation with the Great Basin Institute. We have been monitoring change over time in multiple measurements including shrub and tree density, canopy gaps between perennial plants, and frequency of forbs and grasses. Our goal is to determine if desired changes in vegetation community composition are beginning to occur in response to tree thinning and removal. Our approach involves the review of data associated with 10 field sites and up to 388 individual monitoring plots, all with varying treatment techniques and time frames. Mixed modeling will be used to perform analyses of vegetation response to treatments at each site, followed by a meta-analysis to ask how effects vary with treatment method, environmental conditions, and other factors. Creating a standardized monitoring and analytical protocol will allow for streamlined analysis of vegetation responses to management in treatment sites throughout Nevada, and reporting our findings to land managers will allow for data-based decision-making in future restoration projects.

Session Topic: Forest and Range Management
Format: Poster Presentation
Student Competition: Yes

NATURE IN THE CITY: ENHANCING HABITAT AND COMMUNITY ACCESS IN THE URBAN REALM

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In the face of rapid growth and urban development, many communities are struggling to protect the natural features that define their unique character and identity. The City of Fort Collins promotes innovative partnerships, policies and projects across the community to not only conserve existing natural resources, but also create new and enhanced habitat features – on both public and private lands. Fort Collins' leading edge conservation program, Nature in the City (NIC), evolves traditional conservation models to address the realities of 21st century urbanization. Typical local government conservation efforts acquire large land parcels in fee title to preserve habitat and provide outdoor recreation. In contrast, NIC is smaller in scale and relies heavily on private-sector and nonprofit partnerships to establish a "ten-minute walk to nature" for every resident and conserve biodiversity and habitat connectivity for wildlife throughout the community's urban core. Recognizing the significant environmental, social and economic benefits offered by high quality natural spaces, NIC extends the reach of protected open space onto developed and soon-to-be developed properties. City planners work collaboratively with the community to enhance existing site conditions, improve access to nature for residents and create new "pockets" of nature on even the most urban of sites. Be it code requirements and policy guidance, educational resources, or on the ground capital projects, a suite of tools allows City staff to reach across conventional boundaries to provide a variety of experiences and functional habitat for people, plants and wildlife in Fort Collins.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries
Format: Oral Presentation
Student Competition: No

REGENERATION OF PLANT COMMUNITIES IN CLEVELAND METROPARKS

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Cleveland Metroparks spans 23,000 acres over 18 reservations that vary in size, shape, and urban influence. The Park District is an important resource for ecosystem services and economic value in Northeast Ohio. Plant communities within the parks are significantly impacted by urbanization, recreation, management, and climate change. To monitor these impacts over time the Park District established a long-term vegetation monitoring project. The aim of the Plant Community Assessment Program (PCAP) is to characterize composition, structure, condition, and restoration potential. Four hundred plots serve as the baseline assessment with repeated sampling events every 5 years.

Using the data collected, community designation has been refined based on species composition and dominance. Results of the project identify forest community composition at various successional stages. Forest covered approximately 73% of the park district in 2010 while tree regeneration is limited in many of the communities due to multiple factors including deer herbivory, invasive plants, and habitat fragmentation. With the introduction of exotic forest pests such as Emerald Ash Borer (EAB), canopy cover has been declining since 2010. The vegetation monitoring data is helping to refine forest management strategies that encourage the development of resilient, diverse forests.

Session Topic: Forest and Range Management
Format: Oral Presentation
Student Competition: No

SOCIO-ECOLOGICAL EFFECTS OF RECURRENT AND PROLONGED DROUGHT IN THE SOUTHERN GREAT PLAINS

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Local and regional resource-use decisions in the Southern Great Plains, particularly in times of sustained drought, impact the resilience of social-ecological systems (SES). SES sustainability may be further exacerbated by public land and water management policies at both the state- and local-level. Indeed, public land and water are life-sustaining commons resources threatened by agricultural overuse and climate change. This research, drawing on land architecture, landscape ecology, and governance theory presents a theoretical framework to better understand SES at both local and community scales by investigating land and water governance issues through the lens of reoccurring, cyclic drought and climate change. We explore this by looking at land and water governance structures operating at various levels (e.g. local/state) and the ecological consequences (in terms of land-use/land-cover change (LULCC)) in a five county/five state region of the Southern Great Plains (CO, NM, TX, OK, KS). First, drawing on archival, secondary, and primary field data collection, we look at the land and water governance policies by state. Next, using a remote sensing LULCC and fragmentation analysis, we compare land and water governance policies to landscape and regional level landscape changes. We conclude that land and water governance policies have direct impacts on both local landscapes and livelihoods, with implications for reducing vulnerability and enhancing resiliency.

Session Topic: Climate change
Format: Poster
Student Competition: Non-Student

DISTRIBUTION MODELLING OF PRE-COLUMBIAN CALIFORNIA GRASSLANDS WITH SOIL PHYTOLITHS: NEW INSIGHTS FOR RESTORATION AND PREHISTORIC GRASSLAND ECOLOGY

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Historical reconstructions of plant communities and their distributions throughout a landscape are useful tools for restoration and conservation planning, however the nature of these insights may depend on the depth of historical information available. For the Central Valley (CV) of California, arguably one of the most altered and invaded terrestrial ecosystems on the planet, this task is particularly difficult given poor historical documentation and sparse relict assemblages of pre-invasion plant species. Coastal and interior prairies were long assumed to have been dominated by perennial bunchgrasses, but this hypothesis has recently been challenged. We evaluated this hypothesis by creating species distribution models (SDMs) using a novel approach based on the abundance of soil phytoliths (microscopic particles of biogenic silica used as a proxy for long-term grass dominance) extracted from soil samples at locations statewide. Phytolith abundance was consistently high along the coast and to a lesser extent, among the higher elevation foothills surrounding the CV. SDMs correctly identified these regions, as well as smaller regions throughout the study area with elevated soil phytolith content likely related to edaphic conditions. Phytolith content, and by extension pre-historic grass distributions, were strongly related to mean temperature, temperature variability, and precipitation variability, with higher predicted abundance in regions with cooler, equable temperatures and moderated rainfall, mirroring the pattern for modern perennial grass distribution across the state. The results of this study strongly suggest that the pre-Columbian Central Valley of California was not dominated by native perennial bunch grasses and highlights a new method for evaluating grass distributions in areas without extensive historical documentation of species' presence and absence.

Session Topic: Restoration in the Anthropocene
Format: Oral Presentation
Student competition: No

HOW THE DEINITION OF NATURAL AREAS HAS SHIFTED OVER TIME AND HOW IT AFFECTS OUR ABILITY TO COMMUNICATE THE VALUE OF SUCH PLACES

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The use of the term “natural areas” has shifted in recent years away from its historical use as a way to describe federal or state areas of biological interest to a broader, more general way of describing places that are natural. This creates a conundrum for those wishing to communicate the value of natural areas. The Natural Areas movement was born from a desire to protect the full range of America’s unique habitats as a way to ensure biological diversity for future generations. The movement spawned state and federal law that called for the protection of such places, and the legal definitions of such natural areas often included language that addressed the high quality of these habitats. The movement also advocated a certain style of management, which sought to ensure the ecological processes that created and sustained such habitats was maintained. However, in recent years, one can trace the use of the term “natural areas” as a way to describe any place that is more natural than human created. It is now synonymous with “nature” and the “outdoors.” This shift in language creates both opportunities and challenges for the professional wishing to communicate the value of natural areas – whether it is through state or federal protections or through community-level conservation action.

Session Topics: Communicating about Natural Areas Conservation
Format: Oral Presentation
Student Competition: No

LARAMIE FOOTHILLS - ENERGY BY DESIGN: A COLLABORATIVE SCIENCE BASED PLAN FOR ENERGY DEVELOPMENT

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In 2011, the Colorado State Land Board (SLB) began seeking a strategy to lease and develop its oil and gas holdings underlying Red Mountain Open Space (owned by Larimer County) and Soapstone Prairie Natural Area and Meadow Springs Ranch (owned by the City of Fort Collins). These properties are highly valued by the public for their vast open space and many sensitive resources and unique values, from rare species to ancient cultural artifacts. The City and County properties are considered “split estate” in that the surface is owned by the City and County, while the vast majority of the underlying mineral estate is owned by separate entities including, but not limited to, the SLB. Not only do the SLB and other mineral owners have the right to develop their mineral estate, but the SLB also is charged with generating revenue from its minerals throughout Colorado, primarily to help fund K-12 education. The City, County, SLB and several NGO and governmental agencies worked with The Nature Conservancy to develop a process to design an oil and gas leasing plan that would allow for reasonable energy development while achieving previously established biological, cultural, scenic and recreational resource conservation goals. This plan, called Energy by Design is a science-based plan that identifies strategies to avoid, minimize, and mitigate the potential impacts of oil and gas development to biological, cultural, and scenic values.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries.
Format: Oral Presentation
Student Competition; No

RESTORATION OF GREENBACK CUTTHROAT TROUT TO RED MOUNTAIN OPEN SPACE, LARIMER COUNTY, CO

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The greenback cutthroat trout, Colorado's state fish, is a federally threatened species. It is currently being reintroduced to Sand Creek within Red Mountain Open Space through a partnership between Colorado Parks and Wildlife and Larimer County Natural Resources. While restoration of greenbacks was highlighted in the 2007 Red Mountain Open Space Management Plan, recent genetic research has punctuated the need to find suitable relocation sites for what is now known to be "true" greenback cutthroat trout. As Sand Creek is a low elevation, spring-fed creek with low density incursion of non-native brook trout, this effort is an experimental stocking to evaluate how the greenbacks perform under these conditions. Management and conservation actions at Red Mountain Open Space including zoning for the variety of other site uses (namely grazing and recreation), securing in-stream flow rights and working with upstream private landowners will be discussed given their importance to ensuring the success of this reintroduction effort.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries.
Format: Oral Presentation
Student Competition; No

INTRODUCTION TO THE U.S. NATIONAL VEGETATION CLASSIFICATION.

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Vegetation classification is important for biological conservation and resource management and for basic scientific research. These activities require that ecological units be defined in a standard system and that their distributions on the landscape be known. The National Vegetation Classification (NVC) is a central organizing framework for this purpose, publically released in 2016. Currently, federal land managers are required to translate (crosswalk) local classifications to the NVC to allow land managers to collaborate across ownership boundaries and manage and identify landscape trends. In addition to the classification system, partners developed a database for vegetation plots (VegBank has over 100,000 plot records) and a peer review system that allows for transparent and evidence-based changes to the NVC. The USNVC has over 6000 concept descriptions at the Association level (www.usnvc.org), the lowest level of an 8-level hierarchy. All levels have written descriptions for all concepts, and completely cover all known vegetation communities in the conterminous United States. The Classification has improved the sharing of vegetation information among agencies for intra- and interagency management. The presence of repeatable and defensible standardized units of classification enables all involved to save time and costs on litigation and on evaluation of habitat value. Projects have successfully used the USNVC for defining states in state-and-transition models of landscape change, a baseline to delineate “novel” or “ruderal” communities resulting from invasions and climate change, and improved mapping efforts. Reliable maps of critical habitat, wildlife corridors, and wetlands can all be standardized and quantitatively evaluated using the USNVC.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries; Communicating About Natural Areas Conservation
Format: Oral Presentation
Student Competition: No

AN EDRR PILOT PROJECT IN WASHINGTON DC

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Invader Detectives (ID) is a citizen science EDRR pilot project initiated by the National Invasive Species Council (NISC) Secretariat. By implementing pilot projects such as ID the NISC Secretariat hopes to increase the likelihood of identifying and eradicating new invasive species or new populations of invasive species. The pilot area is the Washington DC metropolitan area. Because urban areas often contain ports, transportation links, and many human vectors, they are likely points of introduction for invasive species. Stopping a species at the point of introduction protects surrounding natural and agricultural areas. ID considers all taxa and both terrestrial and aquatic environments. The pilot project complements the work of organizations already working on invasive species and/or collecting biological data in the area and takes advantage of existing biological occurrence data reporting processes. Existing training events are being leveraged and augmented to highlight the need for more reporting and to ensure interested participants have the tools and information they need to participate. We have a three-pronged strategy: 1) Target Areas, 2) Alerts, and 3) Watch Lists. There are lots of places to look – we use data to identify target areas and then search them periodically. There are lots of records to look at – we use digital tools to sort through the records and alerts for records of interest. There are lots of species to look for – we craft short watch lists of species for target audiences (e.g. fishermen, hikers) that will increase the likelihood of those species being reported.

Session Topics: Early Detection and Rapid Response
Format: Oral presentation
Student Competition: No

MANAGING FOR RECOVERY OF A PRAIRIE ICON: THE FUTURE OF LESSER PRAIRIE-CHICKEN MANAGEMENT

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The lesser prairie-chicken (*Tympanuchus pallidicinctus*) is an iconic species of the southern Great Plains. However, precipitous population and habitat declines have necessitated conservation actions across the bird's range. Key to managing and conserving the species has been collaborative partnerships. One such partnership between state wildlife management agencies has resulted in a translocation effort of lesser prairie-chickens from the shortgrass prairie of northwestern Kansas to the sand sagebrush ecoregion of southwestern Kansas and southeastern Colorado to augment limited populations in a region that was historically the stronghold for lesser prairie-chicken populations. The process of developing this unique partnership between Colorado Parks and Wildlife and the Kansas Department of Wildlife, Parks and Tourism will be discussed, as well as preliminary results from the first year of the translocation effort. Additionally, the current translocation efforts will be discussed in the political context of the species.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries
Format: Oral Presentation
Student Competition: No

COLLABORATING ACROSS BOUNDARIES TO IMPROVE MANAGEMENT OF NATIVE PRAIRIES: ADAPTIVE MANAGEMENT WITHIN THE US FISH AND WILDLIFE SERVICE ACROSS REFUGE SYSTEM LANDS OF THE PRAIRIE POTHOLE REGION

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Across landscapes, land managers traditionally approach habitat management decisions independently of one another. Linking individual efforts in a structured way allows managers to benefit from shared learning that they acquire, and contributes to collective improvement in conservation delivery across the landscape. We developed an adaptive decision support framework that integrates the efforts of managers to counter invasive grasses within native prairies. It is a collaborative effort among 20 USFWS (Service) Refuge stations scattered across the Prairie Pothole Region, which includes two grass types, two Service regions, and four states. The framework is designed around an iterative decision cycle and is based on a common objective, menu of management actions, set of predictive models, and annual monitoring program that provides information to assess the predictive models, increase understanding of system behavior, and make state-based decisions. To ensure sustainability and institutionalization of this large-scale program within the Service, we engendered strong ownership by making it relevant to their needs and incorporating their preferences and constraints, and we developed an infrastructure that included governance and coordination, database management, and automated analytical tools. The framework delivers annual decision support for individual land units, guided by current conditions on the ground and current understanding about system behavior, and it incorporates learning into future decision guidance. The program made it possible for Refuges to apply the principles of adaptive management as part of a science-based approach to reaching habitat conservation goals. Given its successful implementation within Refuges, the program is now incorporating partners beyond the Service.

Session Topics: Conservation Across Boundaries; Invasive Species Management
Format: Oral Presentation
Student Competition: No

CRUCIAL CONSERVATION CONVERSATIONS: OPTIMIZE EDRR AND PRIORITIZE STRATEGIC INVASIVE SPECIES MANAGEMENT ON NATIONAL WILDLIF REFUGES

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Invasive plant species continue to be a significant threat to the National Wildlife Refuge System conservation targets, biological integrity and landscape partnerships. Operational capacity is extremely limited, while new invaders continue to colonize and existing invasions spread defining an urgent need for a prioritization process that is ecologically and financially sustainable. Ecological assessments and invasion ecology are incorporated into an adaptive invasive species management model. Prioritization frameworks are developed to identify priority invasive species and priority areas, thresholds for impact, triggers for management, cost-effective strategies, and key partners. Tools of prevention and early detection and rapid response are prioritized and implemented to prevent additional management burden. Partnerships are sought at local and landscape level to build trust, increase accountability and transparency, and leverage resources. Messaging accountability and expectations promote a vision of prioritization based on invasiveness, impacts, and feasibility within ecological conditions and social needs of partners.

Session Topics: Early Detection and Rapid Response
Format: Oral presentation
Student Competition: No

USING LONG-TERM CITIZEN SCIENCE MONITORING DATA TO DECREASE EXTINCTION RISK OF RARE PLANTS IN THE CHICAGO REGION

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Rare plant population monitoring can be challenging and time-consuming, but monitoring data are valuable to those managing these often vulnerable populations and their habitats. The citizen science program Plants of Concern (POC) is in its 17th year of collecting and providing monitoring data to over 100 collaborators, including landowners, conservation agencies, and research partners. POC's count-based dataset includes over 1300 populations across 15 counties and three states. A new research partnership uses these data to evaluate the extinction risk to rare plants in this region. Of 36 evaluated species, 20 were found to be at a high risk of extinction within 50 years, and 11 of these high-risk species have no state-wide conservation status in IL. Threats to these species exist at multiple spatial scales, and this research provides specific management recommendations for landowners, who often have limited resources to prioritize their actions toward the greatest threats. For instance, the relative impact of woody encroachment on forked aster (*Eurybia furcata*), a locally rare species in northeastern Illinois, was found to be larger than that of other local (deer browse) and regional (climate change) threats. Therefore, managers should focus efforts on controlling woody invasive species to support populations of this species. Determining priority for management actions requires extensive data on populations and their multiple threats. The long-term monitoring program Plants of Concern is uniquely positioned to provide these data for rare plants in the Chicago region.

Session topics: Rare Species Management, Natural Areas Management in Light of Climate Change
Format: Oral Presentation
Student Competition: No

A MULTISCALAR APPROACH TO RARE PLANT MANAGEMENT: A CASE STUDY OF DEHESA NOLINA (*NOLINA INTERRATA*).

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Given increasing threats to species resilience, effective and efficient rare plant management requires addressing species at multiple spatial and temporal scales, and across jurisdictional boundaries. We present an approach to long-term management of the California state-endangered plant, Dehesa nolina (*Nolina interrata*), an edaphic endemic species restricted to southwestern San Diego County, California. Within San Diego County, Dehesa nolina occurs on Natural Community Conservation Plan (NCCP)-conserved lands owned and managed by federal and state agencies, and non-governmental organizations. Our approach includes (1) assessing species status and threats range-wide, (2) prioritizing occurrences for management based on threats and regional population structure, (3) using models to identify suitable sites for translocation and refugia under current and future climate scenarios, (4) improving our understanding of fine-scale soil requirements to inform site selection for restoration and translocation, (5) developing Best Management Practices via experimentation and promoting the application of those practices to land managers at the preserve-level, and (6) augmenting selected occurrences to improve resilience.

Session Topic: Rare Species Management
Format: Oral Presentation
Student Competition: No

DISTRIBUTIONS AND CONSERVATION PRIORITIES FOR CROP WILD RELATIVES OF THE UNITED STATES

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Our native crop wild relatives have proved useful as genetic resources in breeding more productive, nutritious, and resilient crops. Their utilization is expected only to increase with better information on the species and improving breeding tools, but may well be constrained by their limited representation in seedbanks and the ongoing loss of wild populations due to habitat modification, invasive species, climate change and other impacts. Urgent collecting and habitat conservation efforts for native crop genetic resources are therefore warranted. We present foundational information needed to guide this effort. An inventory of U.S. crop wild relatives has prioritized taxa related to a broad range of important food, forage and feed, medicinal, ornamental, and industrial crops. Utilizing occurrence data gathered from herbaria and genebanks, resulting potential distribution models are enabling the identification of hotspots of taxonomic diversity of wild relatives in the country, and a 'gap analysis' methodology is facilitating efforts to identify those taxa and geographic areas of particular conservation concern. Results indicate that a broad range of wild relative diversity remains to be collected. Numerous populations of high priority taxa could be actively managed in existing conservation areas, although many are distributed in areas without long-term habitat protection. We discuss the value of collaboration across agriculture and natural resources management organizations to better conserve our nation's heritage of crop wild relatives.

Session topic: Conservation Across (Natural/Political/Cultural) Boundaries, Value of Ecosystem Services and Working Landscapes, or Technology for Land Management Success
Format: Poster presentation
Student Competition: No

CLIMATE CHANGE ADAPTATION FOR NATURAL AREAS: EMBRACING THE UNKNOWN

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Despite a widespread appreciation that climate change is having adverse impacts now, many resource managers are still struggling to understand, plan for, and respond to current and projected climate changes. This presentation addresses the process and principles for effective climate adaptation and associated strategies, focusing on experiences and insights from the National Park Service. The NPS Climate Change Program has worked across the system of more than 400 park units and with a very broad community to integrate climate-smart principles into conservation planning. A set of basic climate-smart principles underpin our best practices for climate adaptation. These include managing for continuous change, articulating forward-looking goals, working transparently, and ensuring that adaptation actions are linked to climate impacts. The steps involved in implementing climate adaptation can best be understood within a coherent framework. Steps in adaptation include ensuring goals are climate-informed, identifying key vulnerabilities, identifying and prioritizing actions, and monitoring and revising actions as necessary. While these steps sound familiar, climate change requires a different set of considerations than traditional planning to accommodate uncertainty, the scale of potential changes, and the magnitude of changes. Looking to the future, management goals that have traditionally focused on preserving current conditions need to consider where and when they will manage for resistance, accommodate change, and perhaps facilitate major ecosystem transformation. Other steps in the adaptation process are then designed to achieve conservation goals.

Session Topic: Natural Areas Management in Light of Changing Climate
Format: Oral Presentation
Student Competition: No

CROSS-POLLINATION - FUNDING, TOOLS AND PARTNERSHIPS TO MEET OUR NATIONAL SEED STRATEGY GOALS

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Implementing strategic and geographically relevant National Seed Strategy Goals begins with coordinated efforts from funding to partnerships. Examples of how to leverage already successful programs, expanding the use of financial instrument tools and reaching-out to complimentary efforts such a pollinator partnerships will be presented. Key Nationals Seed Strategy Objective accomplishments that will be discussed include; Goal 1, Objective 1.3 – Increasing the Supply and Reliable Availability of Genetically Appropriate Seed; Goal 3, Objective 3.1 – Develop Training Programs for Practitioners, Producers, and Stakeholders on the Use of Genetically Appropriate Seed for Restoration and Objective 3.2 – Develop Native Seed Source Availability Data and Tools for Accessing the Data.

Session Topic: Restoration
Format: Oral Presentation
Student Competition: No

APPLICATIONS OF SPECIES DISTRIBUTION MODELING TO BIODIVERSITY MANAGEMENT AND CONSERVATION IN AN ERA OF RAPID GLOBAL CHANGE

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Fundamental to understanding how biodiversity may re-distribute, driven by the interacting forces of global change, we need first to determine baseline distributions from which we can measure change. This is particularly relevant to rare or threatened elements of biodiversity, for which accurate distribution information is often lacking. Approaches to determining species distributions include aggregating point locality observations, expert informed broad range maps, and county-based records. When only observations are used, the accuracy of species distribution information depends on intensity of sampling effort, and the occupied area is usually underpredicted. When coarse range maps are used, they are often subjective and difficult to replicate, and the occupied area is often overpredicted. These issues affect downstream spatial analyses of species range shifts, undermining our efforts to understand global change impact on the distribution of biodiversity. For managers of natural areas, reliable information on species distributions influences conservation prioritization efforts, supports climate adaptation actions, and reduces conflict in endangered species management. Using advances in ecological modeling, we describe a proposed initiative to produce a nationally consistent, verifiable, multi-jurisdictional library of species distributions by applying scientifically robust species distribution modeling (SDM) techniques. We demonstrate how SDM offers multiple contributions to the investigation of environmental change and its impacts on biodiversity. These include using SDMs to inform inventory and monitoring efforts, to elucidate the environmental drivers of species distributions, and to support spatially explicit hypotheses of how climate change, fire, invasive species or other factors may affect biodiversity distributions in and around natural areas.

Session Topic: Climate change
Format: Oral Presentation
Student Competition: No

ADAPTING TO WILDLIFE RANGE AND DISTRIBUTION SHIFTS IN RESPONSE TO CLIMATE CHANGE: A CASE STUDY OF A LOW-MOBILITY LISTED SPECIES, THE DESERT TORTOISE

Amanda Hardy, Tanya Shenk[1], Kirsten Leong[2], Mark Sturm[3], Alice Newton[4], Regina Rochefort[5], Christy Brigham[6], Jack Oelfke[7]

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Today's rapidly changing climate challenges traditional assumptions of a relatively stable climate. National Park Service (NPS) Management Policies call on the agency to preserve resources in a natural condition, which is defined as "the condition of resources that would occur in the absence of human dominance over the landscape." The NPS must consider how to fulfill its traditional mandates under a new reality of rapid and continuous climate change that results in novel environmental conditions. We examined NPS policies with respect to changes in wildlife distribution in response to climate change, and focused on the desert tortoise (*Gopherus agassizii*) at Lake Mead National Recreation Area. The purpose of this analysis was to (1) document how existing guidance and policy inform potential management responses to shifts in desert tortoise range and distribution; and (2) highlight gaps or contradictions as a foundation for future guidance or policy development. Our analytical approach provides a framework for analysis of similar situations for other wildlife (e.g. non-listed species, species moving onto park lands), and this case study identified a number of areas that need additional attention: practical analyses for the selection criteria identified for each strategy, how to identify "trigger points" that signal when one strategy may need to be abandoned for another, whether our focus on historical range is appropriate, components of strategies that need further policy analysis and discussion, and the implications of climate change for specific terms that form the foundation of NPS policies (e.g., 'natural').

Session topic: Climate change
Format: Oral Presentation
Competition: No

THE SOUTHWEST JEMEZ MOUNTAINS COLLABORATIVE LANDSCAPE RESTORATION PROJECT: FOSTERING RESILIENCE, PARTNERSHIPS, AND A ROBUST MONITORING PROGRAM

Susan Harrelson and Karl Buermeyer

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The Southwest Jemez Mountains Collaborative Landscape Restoration Project (SWJM CFLRP) is a long-term collaborative effort to restore forest ecosystems at the landscape scale and improve resilience to major disturbances, including fire, insects and disease, and climate change. The CFLRP area consists of 210,000-acres within multiple jurisdictions, including Forest Service, Valles Caldera National Preserve (US Department of the Interior), and the Pueblo of Jemez, in addition to numerous private inholdings, in New Mexico's Jemez Mountains. The area harbors around 3,000 archaeological sites, and two endangered species. Many non-land-holding partners in the project include: US Geological Survey, Forest Guild, New Mexico Forest and Watershed Restoration Institute, New Mexico Forest Industry Association, WildEarth Guardians (WEG), The Nature Conservancy, Trout Unlimited, and New Mexico Trout. Human activities such as logging, grazing, and fire suppression have left the area highly susceptible to intense wildfires, insect outbreaks, and climate change impacts. Restoration activities include thinning of forest stands and prescribed burning to mimic pre-settlement forest structure and create conditions conducive to frequent low-intensity fire, rather than large stand-replacing fires that also threaten life and property. Watershed and riparian conditions are being restored and improved through road decommissioning, riparian plantings, erosion and sedimentation control, and stream channel restoration. Thinning of vegetation in and around archaeological sites protects them from damage from wildfire or prescribed fire. A robust monitoring program coordinated by the Valles Caldera NP, and also involving many partners, rounds out this highly successful collaborative effort.

Session Topics: Forest and Range Management
Format: Oral presentation
Student Competition: No

MONITORING AND ADAPTIVE MANAGEMENT OF PROTECTED RAPTORS WITHIN MULTI-USE OPEN SPACE PARKS

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Jefferson County Open Space (JCOS) owns and manages >50,000 ac. of multi-use land along Colorado's Front Range, encompassing 30 parks and many different ecological communities. Many species of raptors forage, nest, and breed in JCOS parks, including golden eagles (*Aquila chrysaetos*), red-tailed hawks (*Buteo jamaicensis*), Swainson's hawks (*Buteo swainsoni*), peregrine falcons (*Falco peregrinus anatum;* State species of special concern), prairie falcons (*Falco mexicanus*), great horned owls (*Bubo virginianus*), and burrowing owls (*Athene cunicularia;* State threatened). For over 20 years, JCOS has monitored raptor nesting activities to protect inform seasonal trail and climbing route closures, to establish sensitive areas, and to guide land adaptive management. A robust team of experienced volunteers collects most of the monitoring data in a highly-structured framework coordinated by JCOS staff. Seasonal closures are refined throughout the breeding season to account for new nesting locations, nest abandonment, fledging, and other factors. A combination of in-field signage, map updates, website notifications, in-person engagement, and social media are used to keep the millions of annual JCOS park visitors informed about seasonal closures, sensitive areas, and raptor ecology. JCOS is also expanding interagency partnerships with Boulder County Parks & Open Space, Boulder Open Space & Mountain Parks, Colorado Parks & Wildlife, and the U.S. Fish & Wildlife Service to coordinate data-sharing efforts and to consider landscape-scale raptor conservation opportunities.

Session Topic: Rare Species Management OR Urban/Wildland Interface
Format: Oral Presentation
Student Competition: No

ALTERNATE VIEWS OF REALITY: 30 YEARS OF THREATENED SPECIES MONITORING IN DROUGHT, FLOOD AND PESTILENCE

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Oenothera coloradensis (Rydberg) W.L. Wagner & Hock (Colorado butterfly plant) is a threatened riparian species occupying portions of the Platte River watershed in contiguous areas of northeastern Colorado, westernmost Nebraska and southeastern Wyoming. It was a Candidate prior to listing in 2000. One of the largest populations and most diverse of population settings is on F.E. Warren Air Force Base (FEWAFB) near Cheyenne, Wyoming, where the species has been monitored for 30 consecutive years. Population numbers fluctuated almost sixfold in annual census results, increasing overall on two of the three streams and decreasing on the third. Complete census results on FEWAFB are compared during different decades and with a three-year Population Viability Analysis. The hydrological differences on the three confluent streams of occupied habitat on FEWAFB provide a basis for separating cause from effect and document overall population stability, in spite of the interactions between life history and dynamic environmental conditions. Monitoring results on FEWAFB provide a basis for interpreting shorter monitoring results elsewhere in species' distribution on managed landscapes, demonstrating species' capacity for one-time rebounds from a 100-year flood event, a seven-year drought event and a flea beetle outbreak.

Session Topic: Rare Species Management; or other rare plant species sessions
Format: Oral Presentation
Student Competition: No

UNIQUE CONTRIBUTIONS OF THE WYOMING FEN FLORA

Bonnie Heidel[1]

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Fens in Wyoming harbor over 25% of the state wetlands vascular flora. While many wetland plants are widespread and uninterrupted in their distribution, the fen flora includes highly disjunct species, many of which are restricted to fens. Rare fen species were surveyed as a group in Wyoming once it had been established that fen species comprised over 10% of the state plant species of concern. Since then, many of Wyoming's rare fen species have proven more widespread than prior collection records would indicate, now collectively documented across montane to alpine elevations, with basin outliers, in most of the anticlinal mountain ranges of the state and the Yellowstone Plateau. They are not consistently present in fens. The presence of rare fen species concentrations and the most disjunct of fen species in particular relates to fen size, intactness and environmental conditions. The biogeographic and net floristic significance of Wyoming's disjunct fen flora is profiled, and demonstrated in cases of species that are disjunct by 400 km or greater.

Session Topic: Wetlands
Format: Oral Presentation
Student Competition: No

DECADENAL TRENDS OF AN ENDANGERED SAND DUNE SPECIES

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Penstemon haydenii Wats. (blowout penstemon) is an endangered species known from the Nebraska Sandhills and the Ferris Dunes of south-central Wyoming. It was listed as endangered when it was only known in Nebraska, and was not documented in Wyoming until 1999. Surveys for *P. haydenii* ensued in Wyoming, where it is only known from the Ferris Dunes. Annual census cycles were initiated at each dune on public land with high numbers, i.e., those that have ever exceeded 300 plants. Direct comparisons of census results in 2005-2006 with those in 2015-2016 from five dunes document decadenal decline of 75.7%. Results are interpreted in light of the cyclic nature of species' recruitment and the dynamic nature of its sand dune habitat. Annual trends appear to be tempered by the species' capacity for surviving burial. Decadenal *P. haydenii* population trends are offset by sporadic recruitment, as evidenced in major 2015-2016 recruitment events at three of five dunes, whose impact on trends are in early stages of study.

Session Topic: Rare Species Management
Format: Poster Presentation
Student Competition: No

AN ANALYSIS OF THREATS TO WATER RESOURCES IN THE NATIONAL WILDLIFE REFUGE SYSTEM

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Water is often called the lifeblood of the more than 560 wildlife refuges comprising the National Wildlife Refuge System (NWRS). Ensuring reliable supplies of clean water to our nation's National Wildlife Refuges (NWRs) requires extensive knowledge of the current status of these supplies as well as an understanding of the threats to refuge water resources. To centralize this important information, the USFWS has recently developed the Water Resource Inventory and Assessment (WRIA) application, a web-based tool and database with refuge-specific information on water features, water quality, monitoring sites, as well as detailed information on water-related threats and needs. To date, we have at least some threat data for over 360 NWRs in the WRIA database, which allows us to identify common issues and trends. Identified threats include issues of both water quantity and water quality, including altered flow regimes and various types of pollution. Many of the threats to refuges relate to land use conditions outside of refuge boundaries, particularly at refuges within the lower 48 states. Nutrient pollution is one of the most commonly identified threats, with agricultural runoff cited most frequently as the cause. Indeed, agricultural runoff was cited as a cause for a variety of threats, including sedimentation, salinity and altered chemistry, pesticide and other contaminant pollution. Mediating these issues will require a landscape approach working with landowners throughout the watershed for each affected refuge.

Session Topic: Value of Healthy Land in Water Resource Management
Format: Poster presentation
Student competition: No

LOST YOUR COMPASS?...WE CAN RELATE. SCENARIO PLANNING FOR CLIMATE CHANGE ADAPTATION IN THE NATIONAL PARK SERVICE

Cat Hawkins Hoffman[1]

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Since 2007, the National Park Service has explored the use of participatory scenario planning approaches for application to a range of park management issues and planning processes, specifically to assist identification of key uncertainties, examine plausible futures and potential responses, and foster expanded thinking and communication in park management teams regarding climate change. This presentation will relay some of the uses of scenarios and lessons learned in the application of this tool to support planning and climate change adaptation in national parks.

Session Topic: Natural Areas Management in Light of Changing Climate
Format: Oral Presentation
Student Competition: No

NOBODY KNEW (CONSERVATION) COULD BE SO COMPLICATED -- THE CONUNDRUM FOR LONG-STANDING CONSERVATION TENETS OF THE NATIONAL PARK SERVICE

Cat Hawkins Hoffman

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Mandates, policies, and core management principles of the National Park Service (NPS) and other agencies evolved under a stable-climate paradigm in which management goals and planning processes assumed that future ecosystems would reflect those of the past. Yet observed and anticipated environmental and biological responses to today's rapidly changing climate suggest that some existing conservation goals may be ultimately unattainable or potentially inappropriate. Goals described in park management plans often reflect concepts of "natural conditions" that are increasingly difficult to define in a world shaped by an altered climate. Thus, as parks begin to experience climates outside their historical ranges of variability, it is challenging for managers to know how to proceed in their work to conserve park resources. This presentation will describe the background for a scoping effort conducted with national park managers to discover specific issues confronting parks in the context of ongoing and projected climate change impacts to natural resources. The resulting input from parks continues to support development of concepts for the evolution of management policies for the NPS.

Session Topic: Natural Areas Management in Light of Changing Climate
Format: Oral Presentation
Student Competition: No

A COMPARISON OF LANDCOVER DATASETS FOR EFFICACY IN THE ANALYSIS OF RARE SPECIES DISTRIBUTION

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Conservation scientists are challenged by the need for comprehensive occurrence data for rare species, but often lack the funds, time, and personnel to develop such datasets. Species Distribution Modeling has provided a means to focus inventory efforts and potential overcome these shortcomings. Like many states, Oklahoma has not been systematically inventoried for rare taxa, and until recently lacked reliable land use/land cover dataset for modeling purposes. For decades, the most effective Potential Vegetation map has been the Duck & Fletcher Game Type Map of Oklahoma, released in 1943, because the original state GAP Analysis map is unreliable for modeling applications. The recent completion of the Oklahoma Ecological Systems map promises a remedy for this situation. Our objective is to evaluate efficacy of this new data source for modeling rare species in the state. We analyzed the distribution of eight tracked species, four plants and four animals: *Penstemon oklahomansis, Valerianella nuttalli*, *Calopogon oklahomaensis,* and *Cypripedium kentuckiense* (plants) and *Phrynosoma cornutum, Vireo atricapilla, Gryllotalpa major,* and *Somatochlora ozarkensis* (animals). The results were compared with analyses using the Duck & Fletcher and Gap maps. We found the scale of the Duck & Fletcher map tended to overpredict distribution, which we attribute to resolution of mapped vegetation types. Conversely, the Ecological Systems map accurately captured the distribution of most of the modeled species, demonstrating its applicability and promise as a valuable tool for conservation.

Session Topic: Rare Species
Format: Poster
Student Competition: Non-Student

INCORPORATING LARGE SCALE CONSERVATION PRIORITIES, PLANS AND TOOLS INTO LOCAL LAND ACQUISITION PROPOSALS

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The California Department of Fish and Wildlife (CDFW) and the California Wildlife Conservation Board (WCB) work with public and private partners to identify and evaluate lands that may warrant protection through the acquisition of fee-title or other interest in real property. Although the former template used by CDFW for these proposals did address climate change, the questions tended to prompt boilerplate responses that did not meaningfully contribute to prioritizing proposals. Additionally, this template did not adequately address ecosystem services and the California State Wildlife Action Plan. The proposal template was revised in format and content, in part, to address these deficiencies. Identification of appropriate, objective information and information resources that can be used efficiently by proposal authors was a major challenge. People from a wide variety of backgrounds prepare land acquisition proposals. They are often unfamiliar with the myriad of models and other tools used in the large-scale environmental analyses that the State has used to set habitat conservation priorities. The revision of the land acquisition proposal includes a greater number of questions, but the questions are more specific; it incorporates a few easy-to-use online information resources developed for California in the last few years, and shifts more of the analysis of information from the applicants to the reviewers. It is too early in the implementation of this new format to determine whether it will consistently result in the development and approval of local land acquisition proposals that reflect state-level conservation priorities.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries
Format: Poster Presentation
Student Competition: No

RESEARCH NATURAL AREAS IN US FOREST SERVICE ROCKY MOUNTAIN REGION

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Research Natural Areas (RNAs) in US Forest Service Rocky Mountain Region include ecosystems from the shortgrass steppe to alpine tundra. We present an overview of the RNAs, highlight research and management activities conducted in them, and discuss the effects of disturbance and climate change on these special places. From a wildfire at Narraguinep RNA in southern Colorado to prescribed fire in ponderosa pine at Hot Creek RNA, from spruce beetle mortality in Engelmann spruce at Snowy Range RNA to white pine blister rust in limber pine at Dave's Draw on the Colorado prairie, our Research Natural Areas are experiencing disturbances and climate change. RNAs in Region 2 present a unique opportunity to study the effects of climate change, especially at high elevations, but are presently an underused resource for research and monitoring.

Session Topic: Research Natural Areas
Format: Oral Presentation
Student Competition: No

USING BOTANICAL COLLECTIONS TO INFORM CONSERVATION AND RESTORATION OF THREATENED PLANT COMMUNITIES

Kristina M. Hufford[1] and Lawrence O. Schmidt[2]

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Biological collections such as the nearly one million specimens available through the Rocky Mountain Herbarium (RM) provide a historical reference for contemporary ecological restoration. Each specimen represents a snapshot of the plant species that occur at a particular location on a specific date. Recognition of the value of these specimens not only for plant identification and taxonomy, but also for ecological and biogeographical studies is growing. Using online search tools available through herbaria databases, we will describe the potential for use of herbarium databases to evaluate floristic change in restoration. In a case study using specimens from the RM and other relevant databases for the region, we will compare the number of plant species, their origin (native or introduced), and the proportion representing functional groups such as grasses, forbs and shrubs between common seed mixes used in land reclamation efforts in Wyoming and historical plant collections at those sites. In this manner, comparative studies using biological collections begin to answer the question of whether we are restoring historical species diversity, and may highlight problems with revegetation programs. Now and well into the future, the conservation of native plant diversity and the management of threatened and endangered species will depend on active restoration of degraded landscapes. In a transformation similar to that of zoos that once displayed animals solely for public enjoyment and now conduct captive breeding programs, biological collections such as herbaria have assumed new roles with active databases to document environmental change and assist with restoration planning.

Session Topics: Role of Native Plant Materials in Restoration & Rehabilitation
Species Re/Introductions & Assisted Migration
Format: Oral Presentation
Student Competition: No

ECOLOGICAL STEWARDSHIP: RESTORATION AT DENVER BOTANIC GARDENS CHATFIELD FARMS

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In 2015, we initiated a riparian restoration project at Denver Botanic Gardens Chatfield Farms. As part of this project we installed three in-stream diversions in Deer Creek to help improve hydrology and riparian vegetation. We established permanent transects to monitor water quality and plant diversity. We measured plant cover, water quality, and aquatic macroinvertebrate diversity. We incorporated planting of native species along the riparian area, including willows and cottonwoods. For many of the understory riparian species we are planning to add in subsequent years, we initiated an annual seed collection program from the restoration site and nearby properties. Additional project components contribute to outreach and educational activities, including two trap cameras, a time-lapse camera, an interpretive trail, and a riparian demonstration garden. This long-term monitoring will provide a baseline assessment on the condition of the riparian area along Deer Creek prior to current and future riparian or stream restoration efforts. We will provide results of our first year of monitoring, issues that arose with the maintenance of the in-stream diversions, and discuss our long-term plans for the management of this project.

Session Topics: Restoration in the Anthropocene, Urban/Wildland Interface, Role of Native Plant Materials in Restoration & Rehabilitation
Format: Poster presentation
Student Competition: No

AN OVERVIEW OF BLACK-FOOTED FERRET RECOVERY EFFORTS IN THE GREAT PLAINS AND INTERMOUNTAIN WEST

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Despite a successful captive propagation and reintroduction program, the black-footed ferret (*Mustela nigripes*) remains one the most endangered mammals in North America due to widespread lethal control of prairie dogs (*Cynomys spp.*), diseases such as sylvatic plague, and conversion of rangeland to row crop agriculture. Black-footed ferrets have been reintroduced at 28 separate sites throughout the Great Plains and Intermountain West, primarily on federal lands. Non-federal rangelands throughout the Great Plains, the historic core of black-footed ferret range, represent a unique opportunity to recover the species, provided that regulatory concerns, financial incentives, disease management, and prairie dog management issues can be addressed to the satisfaction of private landowners, tribal interests, agricultural producer groups, state wildlife agencies, and local governments. This presentation will provide an update on the implementation of the Black-footed Ferret Programmatic Safe Harbor Agreement and other regulatory assurance mechanisms, their potential future use, and an update on ongoing challenges to black-footed ferret recovery range wide.

Session Topic: Conservation Across – Natural/Political/Cultural
Format: Oral Presentation for Symposia
Student Competition: No

EVALUATING ALTERNATIVE MANAGEMENT SCENARIOS TO INFORM INVASIVE SPECIES MANAGEMENT ACTIONS

Catherine Jarnevich[1], Catherine Cullinane-Thomas[1], Nicholas Young[2], and Sarah Cline[3]

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African buffelgrass (*Pennisetum ciliare* syn. *Cenchrus ciliaris*) is an invasive grass spreading rapidly in the Sonoran Desert of southern Arizona and the Chihuahua Desert of West Texas, potentially impacting six parks in the Intermountain Region. One of these sites, Saguaro National Park (SNP) is surrounded by Tucson and other public lands, including Coronado National Forest and Ironwood Forest National Monument. Buffelgrass has spread throughout Tucson's natural and urban areas below 5,000 feet. Prioritizing where to control buffelgrass, predicting where buffelgrass will spread and understanding the role climate change will have in buffelgrass spread are challenges for park managers. The goal of this project is to provide decision support for park managers dealing with buffelgrass management, under a range of scenarios and considering the uncertainty introduced with a changing climate. The analysis integrates habitat suitability models with a spatially explicit state and transition simulation model and combines them with economic data to develop a decision support system. First, we spatially determine the suitable habitat for buffelgrass establishment within SNP. Then we evaluate how habitat suitability within SNP may change with changing climate to determine if buffelgrass may become more or less of a problem in the future. We simulate the baseline (i.e. no treatment) spread of buffelgrass over a 30-year horizon. Given a variety of management goals, we estimate the resources needed to meet these goals. We use relevant economic data to estimate the required funding-levels and treatment duration needed to reduce or eliminate buffelgrass within SNP or in priority areas within the park. We have been developing a paper describing a framework to integrate models and socioeconomic decision tools for invasive species control. We will consider a follow-up note that evaluates utility of the framework or modifications in light of the discussion. It will hopefully be useful for all participants in making invasive species research better translate to informed management decisions.

Session topics: Invasive species management
Format: Oral presentation
Student competition: No

LANDSCAPE-SCALE RESTORATION OF SHORTLEAF PINE-OAK WOODLAND IN THE MISSOURI OZARKS: AN ECOLOGICAL-ECONOMIC TRADE-OFF ANALYSIS

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The nation-wide Collaborative Forest Landscape Restoration Program (CFLRP) has selected part of the Missouri Ozarks to restore current densified forests to the once extensive shortleaf pine-oak woodland given its ecological significance. Prescribed burning and harvesting are commonly used in woodland restoration; however, it is a challenging task to balance conflicts over cost of prescribed burning, revenue from harvest, and desired forest conditions (basal area, tree density). We evaluated trade-offs among projected forest conditions, cost of prescribed burning, and revenue from harvest in a 100-year restoration (divided into two stages: restoring current forests to woodlands, and maintenance of woodland condition) on the CFLRP landscapes. An integrated research approach incorporating field study, forest landscape modeling, and economic analysis was employed to evaluate 9 combination scenarios of burn intervals (every 4, 8, and 16 years) and harvesting intervals (stand basal area thinned from 16 to 7 m^2/ha every 8, 16, and 32 years) in each of the two stages. In scenarios that can restore current forests to woodlands, we chose three scenarios with highest economic benefits to continue into maintenance stage. More frequent burnings with shorter harvesting intervals can restore current forests to woodland condition and maintain the woodland condition. With more frequent burns, both average basal area and tree densities were lower, burning cost was higher and harvest revenue was lower compared to those under scenarios with less burns. With more frequent harvests, average basal area were lower, harvest revenue was higher.

Session Topic: Restoration in the Anthropocene
Format: Oral Presentation
Student Competition: No

BURNING WITHOUT BORDERS: THE NORTHERN COLORADO FIRESHED COOPERATIVE

Bryan Karchut[1] and Paul Cerda[2]

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This presentation provides perspectives from land managers and fire practitioners on the current initiatives occurring on the Arapahoe Roosevelt National Forest and in the Poudre River watershed. These initiatives are designed to increase the use of wildland fire as a management tool and increase the scale of prescribed fire planning and implementation. With the help of local partners this effort has taken a cooperative approach to engage local fire districts and other cooperators in both the planning and implementation of prescribed fire. We have begun to leverage interagency coordination and advanced spatial models to help prioritize and plan for burns, as well as cooperative agreements to help encourage participation for increasing the scale of prescribed burning multiple jurisdictions in the watershed.

Session topic: Wildland Fire as a Management Tool
Format: Oral Presentation
Student Competition: No

RESTORATION AND MANAGEMENT OF PRAIRIE HABITATS TO SUPPORT POLLINATING INSECTS

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Insects are important pollinators of many plants, from agriculturally significant species to plants in natural areas. Pollinators and plants depend on one another for completion of their life cycles and together they serve significant ecosystem functions. Restoration and management of prairie habitat in the Pacific Northwest provides an opportunity to improve conditions for many pollinators, and land managers can provide better conditions for these insects by providing for basic life-history needs of major insect groups, especially through providing a diversity of plants that provide nectar and pollen as food, as well as nesting habitats. Research on habitat restoration in this region at multiple upland and wetland sites shows that flowering plant diversity can be increased by combinations of management treatments that include seeding with native plants after burning and herbicide applications. Although these treatments can improve conditions for food plants of insects, they can also harm or kill them, so it may be important to apply such treatments over portions of managed landscapes rather than all at once across managed sites. Strategies that combine improvements in plant diversity and overlapping bloom periods throughout the growing season with habitat features such as bare ground, availability of dead hollow or pithy stems of woody plants, and leafy materials, can optimize food and nesting conditions for multiple species of pollinating insects while achieving many other restoration goals.

Session topic: Restoration, Pollination
Format: Oral Presentation
Student Competition: No

THE VALUE OF A STANDARD VEGETATION CLASSIFICATION FOR MAPPING AND CONSERVATION: A STATE'S PERSPECTIVE

Todd Keeler-Wolf

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Vegetation mapping is one of the principle uses of the US National Vegetation Classification (USNVC) in California. The USNVC and the California vegetation classification began a collaborative data-driven, defensible trajectory in the early 1990's. Early adoption of the USNVC and coincident development of the California Classification has led to constructive and mutually beneficial products over the past 25 years. State legislated mandates on conservation of "natural communities" required detailed mapping of the many unique and restricted types of vegetation in California. To accomplish this we first needed accurate description and definition of types, inspired by work at the National level through USNVC. Accurate, detailed mapping of vegetation for modeling habitat of special status species and ecosystems required efficient sampling and analysis techniques to define and describe all vegetation within project boundaries. The maps use sample plots as the descriptive basis, followed by reconnaissance points, and validation or accuracy assessment sampling. All mapping has inherent interpretive constraints imposed by type and quality of the imagery used. Thus, mapping requires a thorough understanding of rules of the field-based classification and must use the NVCS hierarchy at the proper resolution to translate field-defined units into mapping units. Overall, this has been a fruitful marriage of state and federal objectives. Starting from scratch California now has 58% of its land base mapped to these standards with a number of new projects begun. I discuss some mapping uses and techniques we have learned, which have improved efficiency.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries; Communicating About Natural Areas Conservation
Format: Oral Presentation
Student Competition: No

A MULTI-AGENCY COLLABORATION TO DEVELOP SEED TRANSFER GUIDELINES FOR SEVEN NATIVE FORBS IN THE WESTERN UNITED STATES

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Native forb species are critical for the restoration of habitat after fire and other disturbances, particularly in the sagebrush steppe of the western United States where wildlife such as the greater sage grouse are experiencing population declines. However, very little is known about the adaptive genetic variation of forb species in this ecosystem. In some cases, forb species are highly adapted to local environmental conditions and their use in successful restoration projects may be dependent on taking this adaptive variation into account. Seed transfer guidelines and seed zones, developed through common garden studies, are an excellent tool to help managers make decisions on what plant varieties or populations are the most genetically appropriate for the area being restored. This talk will describe a multi-agency effort to develop seed transfer guidelines for seven forb species, through a coordinated seed collection effort and the use of a common garden network to test adaptive genetic variation. The project is in its early stages. Seed collection began in the summer of 2017 with participants from the USDA Forest Service, USDOI Bureau of Land Management, USDOI Fish and Wildlife Service, and the Chicago Botanic Gardens. The first common gardens will be installed in the spring of 2018. This talk will focus on the theories behind the use and development of seed transfer guidelines, and the practical logistics of developing seed transfer guidelines efficiently for many species at a regional scale.

Session Topic: Native Plant Materials in Restoration & Rehabilitation
Format: Poster Presentation
Student Competition: No

SUSTAINABLE HARVEST OF OSHA, LIGUSTICUM PORTERI, AN IMPORTANT MEDICINAL PLANT OF THE SOUTHWEST U.S.

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Oshá is an important medicinal plant to Native Americans and Hispanics in the Southwest and Mexico. There are concerns about its over-harvest, as the roots are used for medicine (respiratory tract infections, digestive issues and other health problems), it is regionally popular, and this plant only occurs in moist, high elevation habitats in the Rocky and Sierra Madre Mountains (primarily from 7,500 to 11,000 ft.). Our research has simulated harvest of two populations in Colorado and we conducted detailed plot sampling to estimate populations and understand its response to harvest in the Rio Grande National Forest (for the last 5 years) and the San Juan National Forest (for the last 3 years). We have found substantial populations, many thousands of plants and have situated our plots in dense stands. Our data also indicate that forest and meadow sites differ in population sizes and root production, and that over 65% of holes from harvested roots produced re-sprouts. Low levels of harvest (33% or lower) or mature class-sized plants (those either flowering or large enough to flower) conducted once every 10 years appear to produce stable populations of oshá, at least over the short term. We continue to work toward our goal of providing guidance on the sustainability of harvest of oshá and are working to developing criteria and guidance to share with the US Forest Service.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries
Format: Oral Presentation
Student Competition: No

WOODLAND GROUND FLORA CHANGES IN RELATION TO OVERSTORY STRUCTURE IN THE OZARK HIGHLANDS

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Oak woodlands in the Ozark Highlands region are being reintroduced to fire to prevent or reverse trends toward fire-intolerant vegetation mixtures. We investigated fire, thinning, and combination (thin+burn) as methods for achieving woodland species composition and overstory structure, after pretreatment sampling of oak-hickory stands in 2001. This study evaluates the interactions between canopy openness and ground flora dynamics after commercial thinning from below in 2002 reduced stocking to approximately 40%, and two prescribed burns in the springs of 2003 and 2006. By 2012, the thin+burn led all other treatments in understory richness, evenness, and diversity, despite having the lowest values for each in 2003. Thin+burn plots also contained the greatest percent coverage of forbs, graminoids, shrubs, and vines when compared to burn-only, thin-only, and control. Within these physiognomic groups, certain species were selected as "woodland indicators" and analyzed by treatment and aspect (north, ridge, and south). Woodland indicator species responded almost equally to thin-only and burn-only treatments, however, the response of woodland indicators in thin plots did not persist compared to burn plots by 2011. Aspect did have a significant effect ($P=<0.001$) on the cover of woodland indicators, which were most abundant on south slopes. Basal sprouts in thinned stands substantially limited light transmission to the understory (1m above the forest floor). Results suggest that mechanical thinning is effective for improving understory composition, however, prescribed burns will be necessary to maintain the advantages of canopy removals, especially where woody regrowth is a concern.

Session Topic: Forest management
Format: Oral Presentation
Student Competition: No

GETTING TO THE ROOT OF LAND MANAGEMENT SUCCESS: DATA MANAGEMENT IS KEY

Brian Knowles

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At the root of any successful land management program is a well-thought-out and clearly-defined data management strategy. To ensure an optimal plan with widespread, durable adoption the strategy must be organized around the people in your organization and how systems can best support their critical work. When done correctly, you will enjoy improved operational efficiencies, be able to track performance against defined goals, and turn field data into actionable intelligence.

Brian Knowles, founder and managing partner of Sitka Technology Group, will share data management best practices gained from over 9 years of working with leading organizations, such as the US Bureau of Reclamation, Oregon Metro, Weyerhaeuser, and the National Forest Foundation.

Session Topic: Technology for Land Management Success
Format: Oral Presentation
Student Competition: No

AN UPDATED FRAMEWORK FOR ROCK CLIMBING MANAGEMENT IN FRONT RANGE PARKLANDS

Eric Krause[1], Christine Hartman[2], Eric Holzman[3], Eric Fields[4], Dave Davenport[5], and Mary Ann Bonnell[6]

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Located along the Front Range of Colorado where the plains and cities meet the mountains, the >50,000 ac. of Jefferson County Open Space (JCOS) parklands have been a national destination for rock climbers for decades. The guiding mission of JCOS is to preserve open lands, to protect natural and park resources, and to provide for healthy nature-based experiences. With the rapidly increasing population in the Denver metropolitan area, and increasing pressure from the climbing community for more access and new routes, JCOS recently revised its climbing management guidelines to ensure that this mission can be met now and in the future. The JCOS Climbing Committee reviewed data on past and present climbing access and restrictions, analyzed the climbing management strategies of other land management agencies, and redeveloped our fixed hardware installation guidelines to ensure visitor safety and to protect natural and cultural resources in the face of increasing rock climbing pressure. We provide an overview of these processes, lessons learned, and a new decision-making framework, the "New Crag Assessment Matrix" that was developed to facilitate data-driven assessments of whether undeveloped areas are suitable for new climbing routes and increased climbing access.

Session Topic: Urban/Wildland Interface
Format: Oral Presentation
Student Competition: No

CHECKLIST OF BEES (APOIDEA) FROM A PRIVATE CONSERVATION PROPERTY IN WESTERN MONTANA

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We present a comprehensive bee species list from the first three years of a long-term bee survey conducted at a 3,840-ha private conservation property in the northern Sapphire Mountains and Bitterroot River Valley, and a pilot study at an associated 80-ha property in the Swan River Valley, Missoula County, Montana, USA. The survey includes hand-net, bowl-trap,and blue-vane trap collections. The resulting checklist comprises 229 bee species and morphospecies within 5 families, 38 genera and 91 subgenera. Of the total species in the list, 34 of them represent first state records Montana. This survey expands the number of bee species recorded in Montana to 366. Included in these species is *Megachile* (Eutricharaea) *apicalis* Spinola, showing a range expansion for this introduced bee.

Session Topic: Role of Natural Areas in Pollinator and Invertebrate Conservation
Format: Poster Presentation
Student Competition: No

12,000 YEARS IN THE LARAMIE FOOTHILLS: THE IMPORTANCE OF CULTURAL RESOURCE IDENTIFICATION AND PROTECTION

Jason LaBelle

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Humans have lived within the Laramie Foothills for over 12,000 years. Cultural uses varied, ranging from ancient bison hunters at the Lindenmeier Folsom site (a National Historic Landmark), to short-term tipi encampments dating to the last millennia, and then to shepherds and early homesteaders of the last century. While a small part of this history is known from books and other records, the vast majority has been discovered through archaeological survey and excavation. This presentation describes the process of inventory, interpretation, and protection of these cultural resources and advocates for gathering the many stories of human history as a critical component in the management of natural areas.

Session Topic: Conservation Across Boundaries
Format: Oral Presentation
Student Competition: No

USING THE ASSESSMENT, INVENTORY, AND MONITORING STRATEGY TO MEASURE TREATMENT EFFECTIVENESS IN THE TAOS FIELD OFFICE

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As the relevance of public renewable resources becomes more apparent, the need to accurately document changes and patterns in these resources is growing. In particular, it is important to understand how different management actions may affect different landscapes. In response to this increasing demand and due to a lack of standardized monitoring, the Bureau of Land Management (BLM) developed the Assessment, Inventory and Monitoring (AIM) strategy. The AIM approach is based on five key elements: 1) a standardized set of core and contingent indicators, 2) a statistically valid sampling design, 3) a structured implementation process, 4) electronic data capture, and 5) integration with remote sensing. This strategy can help to more efficiently meet national, regional and local resource information needs. The Taos Field Office (TFO) has used the AIM protocol for three successive years in order to monitor vegetation treatment effectiveness and inventory wildlife habitat. Here we discuss the implementation of AIM protocols and use AIM data to describe five Pinon Pine (*Pinus edulis*) and Juniper (*Juniperus monosperma*) thinning areas in Taos, New Mexico. Indicators relevant to wildlife habitat such as vegetation composition, soil stability and tree density were compiled from these treatment areas and compared to non-treated areas within the same Ecological Sites. The use of AIM data shows us the complex consequences of these management actions and illustrates the advantages of ongoing monitoring at the field office level.

Session Topic: Forest and Range Management
Format: Poster Presentation
Student Competition: No

AQUATIC INVASIVE SPECIES RANGE EXPANSIONS IN RESPONSE TO A CHANGING CLIMATE

David J. Lawrence

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Smallmouth bass (*Micropterus dolomieu*) are a popular game fish that has been widely introduced outside of their native range, and in many cases have caused dramatic reductions in native fish populations. In the Pacific Northwest, bass populations have greatly expanded from their initial introduction sites and there is increasing concern that climate-induced stream warming will enable upstream range expansions of predatory bass into the rearing grounds of endangered salmon. In this study I combined correlative and mechanistic models to examine the contemporary controls on bass distribution and project the range expansion of bass in streams of the Pacific Northwest. Using a series of linked models I investigated how the thermal regime of the John Day River (Oregon) is likely to change as a result of anticipated climate change, which in turn allows bass to occupy an increasingly large portion of salmon rearing habitat in the future. Although study results suggest large gains in bass range while salmon habitat contracts, I also found that riparian vegetation restoration could both reduce bass abundance while maintaining thermally suitable habitat for rearing salmon in the face of climate change. Finally, I employed a bioenergetic model to mechanistically examine how stream temperature influences bass distribution. Model results suggest bass upstream extent is determined by temperature-constrained growth of their earliest life history stage. By knowing which life-history stage determines bass distribution in temperate streams managers can target strategies to diminish the growth performance of that stage to reduce the overall expansion of bass into salmon habitat.

Session topic: Climate change
Format: Oral presentation
Student Competition: No

THE COASTAL PLAIN SAND COMMUNITIES OF SOUTHEAST MISSOURI

Mike Leahy and Andrew P. Braun

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The southeastern corner of Missouri makes up the northern extent of the North American coastal plain. The Mississippi Alluvial Plain is often thought of as consisting of wetlands, but xeric, sand-based prairies, savannas, and woodlands also developed and contributed to the floral and faunal diversity of this region. These sand communities, though widely degraded, continue to harbor many edge-of-range populations, as well as globally rare species, like pondberry (*Lindera melissifolia)*, Hall's bulrush (*Schoenoplectiella hallii)*, and the Illinois chorus frog (*Pseudacris illinoensis*). The Missouri Department of Conservation has collaborated with private landowners to manage these areas with prescribed fire, invasive species control, and midstory canopy thinning, as well as inventory and monitoring of the flora, pollinators, and herpetofauna of these unique communities.

Session Topic: Wilderness and Research Natural Areas Management; Restoration in the Anthropocene; Rare Species Management; Role of Natural Areas in Pollinator and Invertebrate Conservation
Format: Poster Presentation
Student Competition: No

NATURAL AREAS AS REPOSITORIES OF INVERTEBRATE DIVERSITY

Mike Leahy and Steven Buback

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Natural areas can serve as critical population sources for species that are not management targets, or for cryptic species not even known to exist in a state. For example, rattlesnake-master borer moth (*Papaipema eryngii)* is a candidate for listing under the Endangered Species Act. This species was not known from Missouri prior to 2015 despite intensive surveys by qualified lepidopterists, and known populations in adjacent States. In 2015, the Missouri Department of Conservation contracted surveys for this species, and we now have 17 known sites, 6 of these on designated Missouri Natural Areas, with some populations numbering into the thousands. *P. eryngii* thus serves a great example of the role that natural area preservation, management, and inventory can play in protecting rare and declining species, even when the target species are unknown. Other more easily identified invertebrate species, such as the regal fritillary (*Speyeria idalia),* have more often been the focus of conservation attention, and they may act as an umbrella species for a whole suite of fire-sensitive invertebrates. Natural areas, by conserving remnant natural communities, such as tallgrass prairies, are well known for abundant populations of characteristic and remnant-dependent plant species. These same sites likely serve an important role in invertebrate conservation of which we are just beginning to learn the depths.

Session Topic: Role of Natural Areas in Pollinator and Invertebrate Conservation
Format: Oral Presentation
Student Competition: No

APPLICATION OF THE U.S. NVC TO WETLAND RESTORATION: USING CLASSIFICATION TO ESTABLISH APPROPRIATE THRESHOLD FOR WETLAND CONDITION ASSESSMENT

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Ecosystem monitoring and assessment programs are critical for resource management. NatureServe and member Natural Heritage Programs have worked with the U.S. Environmental Protection Agency (EPA) to develop a standard set of criteria for wetland ecological integrity assessments. Conceptual models highlight ecological attributes for which indicators of integrity are most needed and they delineate linkages between key ecosystem attributes and known stressors. The presentation will provide an overview of the Natural Heritage Network's Ecological Integrity Assessment (EIA) framework for wetlands, including a) selection of indicators that assess major ecological attributes and measure potential degradation, b) the role of classification in establishing thresholds bound by the range of natural variability, c) the benefits of multiple levels of assessment (remote, rapid, intensive), and d) scoring and integrating the indicators in an index of ecological integrity through a scorecard. The presentation will discuss both the general metric threshold guidance provided by NatureServe, which is based on the Formation level of the National Vegetation Classification System (NVC) and more specific metric threshold guidance for Colorado, which is based on the finer Ecological Systems classification. Colorado is one of the states most involved with EIA development and application. To date, the Colorado Natural Heritage Program has used this method to assess over 500 wetlands and riparian areas through multiple large-scale wetland assessment projects, and has developed training materials specific to the use of the EIA framework for Colorado wetlands.

Session Topics: Conservation Across (Natural/Political/Cultural) Boundaries; Communicating About Natural Areas Conservation
Format: Oral presentation in a symposium
Student Competition: No

ENHANCING COLLABORATION BETWEEN UNIVERSITY, NON-GOVERNMENTAL ORGANIZATIONS, AND GOVERNMENT AGENCIES TO ADDRESS THE INVASION RISK OF NON-NATIVE BIOMASS PLANTING IN FLORIDA

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Biological invasions simultaneously threaten agricultural production and the ecosystem functions and biodiversity of natural areas. Decimation of commercial crops (e.g. citrus and avocado) by pests and disease threatens Florida's $100 billion per year agriculture sector and has growers turning to alternatives, including biomass planting for fiber and biofuels. Unfortunately, biomass species such as *Eucalyptus grandis* and *Millettia pinnata* share many common biological traits with invasive plants (e.g. high establishment rates, tolerating low resource environments). Protecting Florida's natural areas and maintaining the substantial contribution of agriculture to Florida's economy requires bringing stakeholders together to achieve a common understanding of the invasion potential of biomass species, current regulatory tools, and strategies that minimize invasion risk. The University of Florida/IFAS Assessment and the National Wildlife Federation co-organized a roundtable with stakeholders including UF researchers, non-governmental organizations, and government regulators. The discussion was constructive in identifying of areas for concern, and several actionable items to prevent future invasions (e.g. opening a dialogue with companies promoting high risk species, drafting a position letter to state government regulators, and identifying new research opportunities). Bringing together a diverse array of stakeholders to address the risks posed by biomass planting resulted in insights that would likely have been otherwise overlooked. This event provides a tangible example of stakeholder involvement in ecological advocacy that could be replicated in other states.

Session Topic: Invasive Species Management, Conservation Across Natural/Political/Cultural Boundaries
Format: Oral Presentation
Student Competition: No

GREAT PLAINS PLANT COMMUNITY CHANGES ASSOCIATED WITH JUNIPER ENCROACHMENT

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Woody plant encroachment in natural grasslands is a widely documented global phenomenon that alters ecosystem dynamics by altering vegetation composition and suppressing herbaceous productivity. We selected 16 50x50 sites with juniper (*Juniperus virginiana* L.) canopy cover ranging from zero to approximately 75% in tallgrass prairie in Oklahoma. Juniper trees were removed from 7 of the sites along the gradient of juniper canopy cover. Canopy cover of plant species and herbaceous plant productivity were estimated at each site 1 year before and 1, 2, and 5 years after tree removal. Herbaceous species richness declined as a function of increased canopy cover of eastern redcedar and subsequent loss of open space, but decrease in species richness closely followed a species–area model. Composition of C3 and C4 grasses and forbs did not change with increasing canopy cover. Herbaceous biomass, which declined with increasing canopy cover, varied most within those plots with intermediate canopy cover. The first year after juniper removal, species richness increased on all removal sites compared to intact sites and productivity on removal sites increased two years after removal. Plant community dissimilarity between reference sites and juniper removal sites remained relatively high (30–60%) the first two years after tree removal on all removal sites, but dissimilarity was about 22% 5 years after juniper removal. Within 5 years, removal sites were comparable to reference plant communities. In our study, juniper associated succession limitations were not apparent, and complete autogenic restoration was achieved within 5 years without seeding or species manipulation.

Session Topic: Forest and Range Mangement
Format: Oral Presentation
Student Competition: No

ENDEMIC PLANTS OF THE CENTRAL GRASSLAND OF NORTH AMERICA: DISTRIBUTION, ECOLOGY, AND CONSERVATION STATUS

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Establishing conservation priorities for the Central Grassland of North America requires sound knowledge of the distribution and ecology of endemic and at-risk plants. A growing body of floristic and ecological research provides data for the first full enumeration of the endemic plants of the region. A total of 382 plant taxa are identified as endemic to the Central Grassland, which encompasses the full extent of the tallgrass, mixed-grass, and shortgrass prairies plus floristically related ecological systems that adjoin and/or interdigitate with these grasslands including savanna-open woodland systems, shrub-steppe, and rock outcrop communities. Nine regional concentrations of endemic taxa are identified as centers of endemism for the Central Grassland: Arkansas Valley Barrens, Edwards Plateau, Llano Estacado Escarpments, Llano Uplift, Mescalero-Monahans Dunes, Niobrara-Platte Tablelands, Raton Tablelands, Red Bed Plains, and Reverchon Rocklands. Most of the endemics (299 taxa or 78%) are habitat specialists, associated with rock outcrop, sand, hydric, or riparian habitats. Fifty-nine percent of Central Grassland endemics (225 taxa) are rock outcrop specialists, with most of these associated with carbonate rock types. Of Central Grassland endemics, 124 (33%) are of conservation concern (G1/T1-G3/T3) and 78 (63%) of these at-risk taxa are primarily associated with one of the centers of endemism. Insular ecosystems such as rock outcrop communities, sandhills, and playa wetlands support the greatest concentrations of endemic and at-risk plants in the Central Grassland.

Session Topic: Rare Species Management
Format: Oral Presentation
Student Competition: No

EFFECTS OF SOIL AND WATER CONSERVATION ON VEGETATION COVER: AREMOTE SENSING BASED STUDY IN THE MIDDLE SILLUH VALLEY, NORTHERN ETHIOPIA.

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Soil and water conservation (SWC) has been implemented in the Tigray region of Ethiopia since 1985. This has led to noticeable gains in vegetation cover. The objective of this study was to quantify vegetation cover as the effects of SWC activities by analyzing associations between Soil Adjusted Vegetation Index (SAVI), Land Surface Temperature (LST) and rainfall between 1985 and 2015. Multi-temporal remote sensing data of Landsat imagery were used for estimating the Soil Adjusted Vegetation Index (SAVI) and Land Surface Temperature (LST) for the years 1985, 2000 and 2015. Long term station based daily precipitation from 1973 was aggregated to annual average into three sections to correspond with the image data and then converted into raster format using the Inverse Distance Weight (IDW) technique. Vegetation cover dynamics was quantified by correlations of SAVI with LST, and SAVI with precipitation. The results show that there was a statistically significant inverse relationship between SAVI and LST in all the study periods. The correlations between annual average precipitation and SAVI pixel-by-pixel were r = -0 14 in 2015 and r=0.06, r=0.25 for 2000 and 1985, respectively. In 1985, the total area with SAVI ≥ 0.2 was 23.57 km^2. After fifteen years (in 2000), the total area with SAVI ≥ 0.2 increased to 64.94 km^2. In 2015, the total area of SAVI with values ≥ 0.2 reached 67.11 km^2, which is a 3.3% increment from year 2000. These vegetation cover changes are attributable to the implementation of integrated SWC techniques.

Session Topic: Wilderness and Research Natural Areas Management
Format: Poster Presentation
Student competition: No

MODELING SOIL TEMPERATURES DURING FIRES REQUIRES MODELING UNRESOLVED ASPECTS OF SOIL MOISTURE AND WATER VAPOR DYNAMICS

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The increasing use of prescribed fire by land managers and increasing likelihood of wildfires due to climate change requires an improved modeling capability of extreme heating of soils during fires. But this is a very demanding task not only because soil heating during wildfires and prescribed burns lacks a detailed observational data base and the few data sets that exist suggest that the modeling the surface heating rate (forcing function, or equivalently the upper boundary condition) is extremely variable in both time and space, but also because evaporation of soil moisture and the subsequent transport of soil water vapor can significantly influence the soil temperatures during a heating event. Here we compare the performance of two models with very different soil moisture dynamics on their ability to simulate both soil temperatures and soil moisture during a fire.

Session Topic: Fire Management
Format: Oral Presentation
Student Competition: No

MANAGEMENT OF *PSIDIUM CATTLEIANUM* ON OAHU, HAWAII: A COLLABORATIVE BIOCONTROL RELEASE

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The Oahu Native Ecosystem Protection and Management Program (NEPM) is working in conjunction with multiple organizations on the island of Oahu to introduce a biocontrol agent used to combat strawberry guava (*Psidium cattleianum).* Strawberry guava is one of the state's most destructive alien species. Native to the forests Brazil*,* it has dramatically decreased biodiversity and watershed value while promoting the spread of alien invaders, erosion and agricultural pests. Manual removal and chemical management has proven to be unfeasible on a landscape scale. The Hawaiian Islands have no natural predator for this species, which forms dense monotypic stands that rapidly encroach into forests and other natural areas. *Tectococcus ovatus,* also native to Brazil, is a gall forming insect that thrives on the new growth of strawberry guava. *T. ovatus* is highly host specific and should reduce the vigor and fruiting of strawberry guava. The newly hatched nymphs of *T. ovatus* can survive for 3-5 days without food; this "crawler" phase coupled with windborne eggs are the species primary modes of dispersal. Multiple factors including the insect's short life span, lack of food availability and poor dispersal make mass laboratory releases unlikely to be successful. With numerous landowners and stakeholders across two mountain ranges a multi-agency collaborative effort is required to facilitate and implement the process of introduction including propagation, site preparation, inoculation and monitoring. The NEPM program on Oahu serves as the hub of this collaboration endeavoring to slow the spread of this pest into our unique ecosystems.

Session Topic: Invasive Species Management
Format: Poster Presentation
Student Competition: No

RESTORATION ASSESSMENT AND MONITORING PROGRAM FOR THE SOUTHWEST (RAMPS)

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The southwestern U.S. has been degraded by invasive species, wildfire, overgrazing, agricultural conversion, energy development, recreational activity, and urban growth. These disturbances and others are accelerated by one of the fastest growing human populations in the country and a pressing background of decreasing water availability due to drought and elevated temperatures that are projected to become more pronounced. The potential reduction and loss of ecosystem productivity can have large socioeconomic and environmental costs. Restoration practices are needed to promote recovery from disturbance, improve ecosystem health and integrity, and ensure the long-term sustainability of ecosystem services. Despite the demand for restoration, little information is available to help managers effectively reestablish perennial vegetation and stabilize soils in regions strongly constrained by water availability, and even less information is available to help managers structure restoration efforts to be successful in the context of changing climate and disturbance regimes. The Restoration Assessment and Monitoring Program for the Southwest (RAMPS) is a new initiative that is working to strengthen restoration strategies and outcomes in drylands by providing science and guidance on effective restoration practices to agencies within the Department of Interior and other partners. RAMPS is coordinated at the U.S. Geological Survey - Southwest Biological Science Center in Flagstaff, AZ and composed of a consortium of scientists, managers, and practitioners with restoration expertise. Our presentation will review how our collaborative approach responds to dryland restoration needs in a changing world.

Session Topics: Conservation Across (Natural/Political/Cultural) Boundaries, Natural Areas Management in Light of Changing Climate, Role of Native Plant Materials in Restoration & Rehabilitation
Format: Oral Presentation
Student Competition: No

USING INTERACTIVE MODELS TO INCREASE HYDROLOGY LITERACY

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The purpose of this research is to assess what sixth grade students in the Fort Collins, Colorado area know regarding hydrology and climate change in the Rocky Mountains. Also being examined is how interactive tools like Google Earth can help increase scientific literacy in the students. A narrated tour through Google Earth was created to represent scientifically defined snow zones and talk about the features of each, as well as mention how climate change will affect these zones in the future. A pre-test and post-test were given to evaluate the knowledge gained from the lesson. I expect the results and conclusions to show that the students better understand the hydrologic cycle and the vulnerability of certain snow zones as climate change persists in areas surrounding their home town. I expect the conclusions to also show that interactive models are more effective tools for teaching as opposed to textbooks, and help to engage the student's interests.

Conservation Topic: Communicating About Natural Areas Conservation
Format: Poster Presentation
Student Competition: Yes

THE FOREST HEALTH INDEX: AN INTERATIVE PLATFORM TO COMMUNICATE AND VISUALIZE CHANGES IMPACTING NATURAL AREAS

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The rapid increase in availability and diversity of environmental data has outstripped our ability to successfully communicate changes and trends along with their implications for conservation and management. Data products including remote sensing and in situ measurements, when effectively communicated, can increase understanding and acceptance of management solutions. In particular management of forested landscapes invites diverse opinions and contention. Lack of effective communication between management agencies and the public can lead to opposition, delay or a curtailment of funding for specific initiatives. In 2013 the Aspen Center for Environmental Studies with the assistance of the Aspen Global Change Institute developed the Forest Health Index (FHI) as an interactive platform to share locally relevant data and analyses.

The FHI presents climatic, ecological and socioeconomic data through the multiple lens of ecological integrity, public health & safety, ecosystem services, and sustainable management. Along with visualizing raw data indicators are indexed on a scale of 1 – 100 in proportion to their deviation from baseline conditions. Indicators are combined based on weighting informed by local input to produce a readily interpretable score used to assess how well local priorities are being met. Educators, local governments, and NGOs have leveraged the FHI to depict shifting environmental conditions. The FHI primarily utilizes nationally available data making it an easily replicable and effective model for any for other natural areas.

Session Topic: Communicating About Natural Areas Conservation, Technology for Land Management Success
Format: Oral Presentation
Student Competition: No

COLLABORATING FOR SUCCESS: LESSONS LEARNED FROM COLLABORATIVE FOREST MANAGEMENT AND PLANNING

Adam D. McCurdy[1], Will Roush[2]

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Land management and restoration has become increasingly contentious and underfunded. Combined these issues have curtailed the ability of land managers to conduct necessary work. Collaboration with local constituents has proven to be a valuable tool in overcoming these barriers. In Pitkin County a group of government agencies, NGOs, and residents identified the Hunter Smuggler recreation area as a priority for restoration and management. This area posed a unique challenge as it encompasses land managed by the USFS, Pitkin County and the City of Aspen. A collaborative was formed to address forest health, wildlife habitat, and wildfire risk in the heavily recreated WUI area. The collaborative, formed in 2012 spans multiple levels of government and several local NGOs with diverse priorities.

Since its formation, the collaborative has successfully conducted a prescribed fire less than three miles from downtown Aspen, mechanical vegetation treatments, trail construction, and noxious weed treatment on a combination of federal, county and city land. Utilizing the flexibility of a bottom up approach has allowed the group to address conflicts prior to proposing management solutions. Furthermore, collaborative members have leveraged the resources of their constituents to fund many of the projects. Finally, by working through a collaborative of diverse organizations we have increased the scope and effectiveness of public outreach, evidenced by broad understanding, awareness and acceptance of treatments, including prescribed fire, prior to implementation. Here we present on the implementation of a forest management collaborative along with legislative hurdles and tools, as well as successes and lessons learned.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries, Urban/Wildland Interface, Communicating About Natural Areas Conservation
Format: Oral Presentation
Student Competition: No

COLLABORATIVE GOVERNANCE AND PUBLIC LANDS: OUTCOMES, SUCCESSES, AND CHALLENGES UNDER THE CFLRP

Kathleen McIntyre and Courtney Schultz

Colorado State University

The Collaborative Forest Landscape Restoration Program (CFLRP) was authorized in 2009 by Congress to address large landscape restoration projects on national forest lands. The program competitively funds 10-year restoration projects greater than 50,000 acres that are developed and implemented collaboratively through partnerships between stakeholder groups and the US Forest Service. The CFLRP is the newest policy attempt to provide support for collaboration on National Forest projects. The CFLRP legislation will be considered for reauthorization in 2019; therefore, developing a better understanding of outcomes, successes, and barriers is pertinent. The Forest Service-Washington Office invited us to conduct a third-party evaluation of its restoration authorities including the CFLRP. We conducted approximately 90 interviews with stakeholders across all 23 current CFLR projects regarding success, challenges, and future next steps. I will present on the reported value added under the CFLRP, specifically, the successes and outcomes participants feel they have garnered in collaborative forest landscape restoration projects funded by this new policy system. Potential outcomes to be discussed include better trust, stronger relationships, increased monitoring, and larger landscape planning. While stakeholders are reporting various successes and outcomes, they also reported multiple barriers they continue to face within this policy context including capacity issues, infrastructure needs, and challenges related to prescribed fire. These findings are an important component of our broader review of additional restoration authorities across the United States.

Session Topic: Forest management, Restoration, Conservation Across Boundaries
Format: Oral Presentation
Student Competition: Yes

ENVISIONING A RIVER'S NEW FUTURE: A STORY OF COLLABORATION AFTER ADVERSITY

Jana McKenzie

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Flooding, while a natural and necessary ecological event, comes with consequences when homes, businesses, and public lands notched in a river canyon receives 10 inches of rainfall over four days. The September 2013 floods in central Colorado reached record levels causing major infrastructure damage, destruction of riparian and aquatic habitat, and loss of life. However, with this event came the opportunity to re-envision a more naturalized and resilient river corridor. This session will focus on how the adversity experienced has spawned opportunities to collectively chart a new path for the future of the Big Thompson River and its environs. This session highlights river restoration master planning, recreational master planning, mountain park reconstructions, and partnerships between city, county, state, and federal agencies. These efforts also required sensitive but necessary discussions with private landowners. The Bigger Vision for the Big T identified conservation and recreation lands for future hazard mitigation. The Viestenz-Smith Mountain Park Redesign was a cohesive design and engineering effort integrating park amenities with flood control measures. And now the county is creating a mountain resiliency land use plan to reduce the losses from floods and wildfires. For the long-term economic vitality of the communities that depend on this corridor and the future of a healthy river system, collaboration was critical to building (or the lack of building) back better than before.

Session Topic: Urban/Wildland Interface, Communicating About Natural Areas Conservation, Conservation Across (Natural/Political/Cultural) Boundaries
Format: Oral Presentation
Student Competition: No

RESTORATION AND PRESERVATION OF NATURAL DARK SKIES ACROSS LAND MANAGEMENT AGENCIES AND COMMUNITIES

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Dark night skies are rapidly becoming a rare resource across the globe as populations increase and the accompanying development of formerly rural lands, and the associated outdoor lighting, encroaches into former natural areas. Many cities and smaller communities across the United States have begun to address the topic of light pollution and its effect upon residents and wildlife in their area. The National Park Service began inventorying night sky conditions in units across the country in 2002. These photometric assessments provide a baseline condition from which managers can learn where to focus their efforts in restoration and/or preservation. The all-sky measurements identify sources of sky glow, such as light domes from nearby and distant cities, as well as local glare and light trespass sources.

In recent years, the National Park Service has begun to work collaboratively with the City of Fort Collins Utilities and the Natural Areas Department to help identify sources of light pollution and to develop mitigation solutions. Currently, the city manages 46 Natural Areas encompassing over 36,000 acres. Night sky quality measurements have been made in five of these areas, with future assessments planned in Natural Areas along the east boundary of the city. The city is in the midst of a planning effort for retrofitting all street lights to modern LED technology and is working with the NPS Night Skies Program to implement a lighting design that helps protect its natural areas and other surrounding lands, including Rocky Mountain NP.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries
Format: Oral Presentation
Student Competition: No

SOMETIMES THE BEST RELATIONSHIP IS A LONG-DISTANCE RELATIONSHIP: A COMMUNICATION CAMPAIGN TO INFLUENCE HUMAN BEHAVIOR AROUND WILDLIFE

Sara Melena

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"I just wanted to get a picture of that squirrel/wild horse/deer/elk/bison." People getting too close to wild animals is a constant issue for parks and protected areas. Some people may be unaware of the danger posed by approaching wildlife. In other instances, the draw to be close to wildlife overwhelms the sense of risk. Or, it could be that everyone else is doing it, so I will too. How do we manage this constant challenge and protect visitors and wildlife? Colorado State University and the National Park Service collected observational information about human behavior in parks and analyzed communication studies to develop and evaluate communication strategies to address these behaviors. The communication campaign was implemented in four parks in the summer of 2017. Preliminary results from the study and recommendations for implementing a human-wildlife interactions campaign will be shared.

Session Topic: Communicating About Natural Areas Conservation
Format: Oral Presentation
Student Competition: No

MORE FORAGE AND IMPROVED MANAGEMENT FLEXIBILITY ARE EXPECTED OUTCOMES RESULTING FROM A NEW HERBICIDE FOR INVASIVE WINTER ANNUAL GRASS CONTROL ON RANGELAND

Paul Mieman, Colorado State University and Steve Sauer, Boulder County Weed Manager

Rangeland livestock production in the western United States involves ruminant herbivores that are ideally suited to diets dominated by perennial graminoids (grasses, sedges and rushes) with smaller amounts of higher quality, forbs and shrubs. Perennial graminoids make up the bulk of the diet, while forbs are considered the quality components. Annual grasses comprise a very minor component of native rangeland plant communities. Most invasive annual grasses contribute very little available forage for rangeland herbivores. A few invasive annual grasses have the potential to provide a forage source, but taking advantage of it is quite difficult for managers because the biomass is attractive to herbivores for only a short time period. As exotic annual grass invasions progress, diverse perennial native rangeland plant communities which provide a diverse forage resource are replaced by plant communities and forage resources that are much less diverse. Rangeland herbivores (wild and domestic, alike) are better able to meet their nutritional requirements when selecting their diets from a diverse forage resource, and land or animal managers have much more flexibility with grazing management when this is the case. Management flexibility drastically improves the ability of managers to successfully meet multiple objectives simultaneously. Recent research on a new herbicide for invasive winter annual grass control suggests that substantial increases in perennial grass and forb biomass production are possible following effective reduction of invasive annual grasses with no detectable reduction of species richness. The increased quantity of forage is an obvious benefit. Less obvious, but as important is the increased management flexibility that results from shifting plant species composition back to dominance by perennial grasses and forbs while maintaining or improving species richness.

Session topic: Invasive species management
Format: Oral presentation
Student Competition: No

CONSERVING GENETIC RESOURCES: USDA-ARS NATIONAL LABORATORY FOR GENETIC RESOURCES PRESERVATION

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Fort Collins is home to globally important living collections of plant and animal genetic resources that comprise the backbone of three critical Federal programs: the National Plant Germplasm System, the National Animal Germplasm Program and the National Culture Collections Network. The National Laboratory for Genetic Resources Preservation (NLGRP) has been located on the CSU campus since 1958 and provides long term backup storage for important living biological collections. Taken together, NLGRP houses the single largest and most diverse collection of agriculturally-relevant germplasm in the world. Plant genetic resources are stored as seed, buds, spores, and pollen, while animal resources are stored as semen, eggs, oocytes and other propagules. Our microbial collection contains bacteria, yeast, fungi and viruses. This wealth of diversity represents a reservoir that can be drawn on to develop crops and livestock that can withstand a multitude of challenges. Secured ex situ, these collections are an insurance policy, protecting biodiversity from genetic erosion and extinction. Importantly, these resources are available to support restoration and reintroduction efforts. Our four story state-of the art vault provides storage at -18° C, -80° C, and -196° C. NLGRP is more than a vault; active research and conservation efforts ensure that we are securing a broad range of living materials, making them freely available to breeders and researchers for generations to come.

Session topic: Conservation Across (Natural/Political/Cultural) Boundaries, Role of Native Plant Materials in Restoration & Rehabilitation, Communicating About Natural Areas Conservation
Format: Poster presentation
Student Competition: No

RECREATIONAL PRESSURES ON URBAN OPEN SPACE PRESERVES

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As urban centers expand in density and extent, the demand for recreational opportunities creates tension with conservation goals. The City of San Diego is tasked with managing and monitoring 27,000 acres of urban open space conserved for the protection of 85 rare and endangered species, along with 178 trailheads and over 225 miles of trails. Such recreational pressure associated with population expansion was not anticipated during initial creation of the Multiple Species Conservation Program, a region-wide Habitat Conservation Plan/Natural Communities Conservation Planning Program, in 1995. A recent collaborative study by the City of San Diego and San Diego State University revealed that use of trails is highly variable, with a handful of popular trails receiving the majority of use. One 1.5 mile trail, for example, accommodates more annual visits than the local major league baseball team's home games. In addition, City Park Rangers have reported abrupt increases in usage of trails popularized via social media. Which begs the question: How should implementers respond? The City of San Diego is utilizing a multi-pronged approach including development of site specific management and trail plans based on a long-term rare species monitoring dataset, creative programs to balance use across preserves, and a strong commitment to its Park Ranger program. We will discuss the importance of monitoring both sensitive species and use in open space, compare and contrast urban users with traditional park users, and explore access control issues for heavily used trails and parks.

Session Topics: Urban/Wildland Interface
Format: Oral presentation
Student Competition: No

EMBRACING COMPLEXITY AND UNCERTAINTY: MERGING SIMULATION MODELING AND SCENARIO PLANNING TO INFORM NATURAL AREAS MANAGEMENT UNDER CLIMATE CHANGE

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Managing natural areas in this era of anthropogenic climate change is fraught with uncertainties. Scenario planning is gaining traction as a valuable tool for addressing this challenge. At the same time, quantitative simulation models have proven useful as virtual laboratories for exploring how complex natural systems might respond to different climate change trajectories and management approaches. Despite the complementary strengths of these approaches, application of these tools in combination has been limited. Here, we describe a process of researchers, resource managers, and climate adaptation specialists co-producing a simulation model in conjunction with a scenario planning effort to inform natural resource management in southwest South Dakota. Scenario planning for a wide range of resources facilitated open-minded thinking about a set of divergent and challenging, yet relevant and plausible, climate scenarios and management alternatives that could be implemented in the simulation. With stakeholder input, we built a simulation of key vegetation types, grazing, exotic plants, fire, and the effects of climate and management on rangeland productivity and composition. By simulating multiple land management jurisdictions, climate scenarios, and management alternatives, the model highlighted important tradeoffs between herd sizes and vegetation composition, and between the short- versus long-term costs of invasive species management. It also pointed to impactful uncertainties related to the effects of fire and grazing on vegetation. This integrative approach led to the discovery of counter-intuitive and surprising findings, and resulted in a more tractable set of possible futures to plan for.

Session Topic: Natural Areas Management in Light of Changing Climate
Format: Oral Presentation
Student Competition: No

GEOSPATIAL TOOLS TO COORDINATE THE MANAGEMENT OF INVASIVE MUSSELS IN THE WEST

Jeff Morisette, Jamie Reaser

Invasive species pose one of the greatest threats to our Nation's natural areas. Early detection and rapid response (EDRR) actions can reduce the long-term costs and economic burden that invasive species have on communities. In February 2016, the Federal government released *Safeguarding America's Lands and Waters from Invasive Species: A National Framework for Early Detection and Rapid Response*. That Framework served as an initial step in the development and implementation of a national program for the early detection of and rapid response to potentially invasive species that affect priority landscapes and waters.

The National Invasive Species Council (NISC) provides high-level interdepartmental coordination of federal invasive species actions and works with other federal and non-federal groups to address invasive species issues at the national level. The National Invasive Species Council (NISC) 2016-2018 Management Plan emphasizes advancing the EDRR framework.

This talk will present work that utilizes geospatial technologies to promote regional coordination and more effect management of invasive mussels in the West. It is an example of the type of collaborative EDRR decision making tools we need for horizon scanning, prioritization of limited resources, and maintaining two-way communication between research and management. The example demonstrates:

1. Working across agencies and other institutions to pool/share information resources

2. Setting priorities on an eco-regional scale rather than within jurisdictional borders and

3. Filling data gaps by reaching out across jurisdictions and organizations; thus enabling collaboration across boundaries to better inform nature area management.

Session Topics: Early Detection and Rapid Response
Format: Oral presentation
Student Competition: No

A PROPOSED NATURAL AREAS CLIMATE-CHANGE MONITORING NETWORK FOR THE SOUTHWEST UNITED STATES BASED ON A CLIMATE CHANGE VULNERABILITY INDEX

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As designated federal lands established to protect biological values and conduct research, Research Natural Areas (RNAs) and many Areas of Critical Environmental Concern (ACECs) offer an ideal opportunity to detect signals of climate-driven ecological change with limited human-disturbance interactions. Key to using these natural areas effectively is to design a well-distributed regional network of sites that will be sensitive to ecological change and also representative of the major ecological communities of interest. Accordingly, we compiled a geo-spatial database of 171 RNAs (58) and ACECs (112) across Arizona and New Mexico and categorized them into 29 broadly defined ecosystem types referred to as Ecological Response Units (ERUs), based on their mapped distribution across the region. Using a Climate Change Vulnerability Index (CCVI) surface which we had developed for the ERUs, we scored each natural area for climate change vulnerability. CCVI values ranged from 0.05 to 19.7 where higher CCVI scores reflect greater exposure and imply greater ecological sensitivity to climate change. Across all ERUs, the average CCVI value was 4.04 and the average range was 4.47. For most ERUs, this range of values allowed us to select a subset of potential sites within ERUs that are potentially sensitive to climate-change impacts. Next steps are to evaluate these areas operationally as monitoring sites (ease of access, permissions, historical data, etc.), and to devise monitoring protocols that can be efficiently and effectively implemented across a wide-ranging network. We are particularity interested in designing ERU-specific protocols which can be adopted within a citizen-science framework.

Session Topics: Climate change
Format: Oral presentation
Student Competition: No

PRE-ESTABLISHED PLANT INFLUENCES ON ANTELOPE BITTERBRUSH (*PURSHIA TRIDENTATA* PURSH) SEEDLING RECRUITMENT AND GROWTH: ANALYSIS OF SPECIES AND POSITIONAL EFFECTS

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We evaluated the influence of pre-established plant species distance, direction and identity on antelope bitterbrush (*Purshia tridentata* Pursh) seedling establishment and biomass production. Antelope bitterbrush seeds were planted 10 and 20 cm away from the base of three pre-established plant species. We monitored seedling establishment and growth during and after two growing seasons. Sowing antelope bitterbrush seeds 20 cm away from pre-established plant bases yielded 1.59 times greater seedling establishment than seeds sown 10 cm away, suggesting that established plants interfere with bitterbrush recruitment. Antelope bitterbrush seedling survival after two years growth was greater than 96% for all treatments, suggesting that early growth phases were the primary bottlenecks to establishment. Antelope bitterbrush forage production decreased with proximity to pre-established plants. After two years growth, antelope bitterbrush biomass was almost 3 times greater for plants grown without pre-established plant neighbors or with a pre-established grass (*Elymus elymoides*) than with pre-established forb species (*Dalea candida* or *Gaillardia aristata*). Inoculating pre-established plants with soil from native sites or arbuscular mycorrhizal fungi did not influence antelope bitterbrush establishment or growth. We suggest that plant trait complementarity and spatial relationships can be used to design seeding strategies to increase antelope bitterbrush establishment and forage production.

Session Topic: Role of Native Plant Materials in Restoration& Rehabilitation
Format: Oral Presentation
Student Competition: No

GONE TO THE DOGS: CLOSURE AND RESTORATION OF THE 107 AC. ELK MEADOW PARK OFF-LEASH DOG AREA

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Jefferson County Open Space (JCOS) manages >50,000 ac. of multi-use land along Colorado's Front Range. The Dog Off-Leash Area (DOLA) was a 107-ac. portion of the 1,660 ac. Elk Meadow Park located near the town of Evergreen. The DOLA began in 2001 as a 1-ac. fenced area, but expanded over time to encompass a larger area with a small stream and several miles of developed trails. Unfortunately, the level of use greatly exceeded capacity in terms of dog conflicts, vegetation loss, soil erosion, water quality impacts, safety, and the lack of visitor compliance regarding cleaning up dog waste. After substantial public engagement in early 2017, JCOS made the difficult decision to close the park and initiate long-term restoration. Conceptual restoration plans developed by JCOS included soil stabilization, stream repair, and revegetation of upland and riparian areas using a diverse palette of native species. The DOLA was formally closed in April 2017, and JCOS staff began implementing erosion control measures, volunteer clean-ups, vegetation assessments, wildlife monitoring, removal of old infrastructure, and regular water quality monitoring. Contractors will begin formal restoration work in Fall 2017. The project will take at least three years, with many volunteer opportunities. While park closures are never a desirable outcome for a land management agency, valuable lessons have been learned regarding the challenges of operating a large off-leash dog park in a natural setting. These lessons are being shared with other agencies, revising the framework required for successful dog park operation along Colorado's wildland-urban interface.

Session Topic: Restoration in the Anthropocene, Value of Healthy Land in Water Resource Management, Urban/Wildland Interface
Format: Oral Presentation
Student Competition: No

ECOLOGICAL RESTORATION OF A SUPERFUND SITE (ROCKY FLATS SITE, COLORADO)

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The Rocky Flats Site (RFS) is a Comprehensive Environmental Response, Compensation, and Liability Act Superfund site near Golden, Colorado, managed by the U.S. Department of Energy, Office of Legacy Management. Cleanup and closure of RFS was completed in October 2005, and ecological restoration is progressing on approximately 650 acres that were disturbed as part of the closure activities at this U.S. Department of Energy facility. The 12-year transformation from an industrial complex that once produced nuclear weapons components to a thriving natural ecosystem has been challenging and educational. Primary objectives were to stabilize the soil, minimize erosion, and establish native plant communities. Establishment of sustainable native grasslands, wetlands, and riparian habitats has involved setting realistic goals, selecting native, adapted plants, using appropriate seedbed preparation techniques, balancing weed control with species diversity objectives, creating forb nurseries to promote the establishment and spread of native forbs, using effective erosion control practices, and managing restoration areas proactively. Unavoidable impacts to wetlands and the habitat of the Preble's meadow jumping mouse (a native species listed as threatened under the Endangered Species Act) were addressed through consultation with regulators and mitigation. Success of the ecosystem restoration work performed at Rocky Flats is validated by monitoring results, successfully meeting mitigation requirements for reestablishment of wetlands and Preble's mouse habitat, and increased use by numerous native wildlife species. This presentation will discuss the challenges, lessons learned, and restoration techniques used at the Rocky Flats Site.

Session Topic: Restoration in the Anthropocene, Role of Native Plant Materials in Restoration & Rehabilitation, or Forest and Range Management
Format: Oral Presentation
Student Competition: No

WITHIN-STAND TREE SPATIAL PATTERNS IN SIERRA NEVADA MIXED-CONIFER FORESTS: MANAGEMENT BY TOPOGRAPHY IN FREQUENT-FIRE SYSTEMS

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In California's Sierra Nevada, managing for forest health and sustainability in the context of frequent fire is a critical endeavor. Not only are fires a biological necessity for many local species, but they impact air quality in a heavily regulated state. In addition, humans rely on these fire-prone montane forests for their homes, livelihoods, and water supply. Currently, interactions between climate and human activities are predicted to increase severe fire damage to these forests on unprecedented scales. Managing for forest survivorship requires (among other things) clear targets for management plans, metrics by which to evaluate progress, and ecological data to inform both of those items. Our study focuses on heterogeneity in tree spatial patterns: an important ecological characteristic that has been associated with resilience to fire and drought. In 2014-15, we mapped a series of 2 ha plots in forests with multiple recent burns, including burns at lower/mixed-severities during the 2013 Rim Fire. Using structural metrics based on the pattern of Individuals, Clumps, and Openings (ICO), we are currently analyzing tree spatial patterns across three topographic categories (ridges, mid-slopes, and valleys). Initial results suggest differences in tree densities (highest in valleys), tree clump sizes (lowest on ridges), gap sizes (largest on ridges) and species composition (higher percentage of fire-tolerant stems on ridges). By quantifying variable stand structure across slope positions, we will provide general guidelines for marking prescriptions that may increase treated forest resilience to increasing fire severity.

Session Topics: Wildland fire as a management tool; Forest and range management; Wilderness and research natural areas management
Format: Oral Presentation
Student Competition: Yes

NEW DIRECTIONS IN MODELING AND COMMUNICATING NOISE IMPACTS IN NATIONAL PARKS

Kathryn Nuessly[1]

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Noise in national parks negatively affects both visitors and wildlife by interfering with solitude and communication. One of the main sources of this noise is transportation. To reduce or eliminate the impacts of noise through mitigation, the spread of noise in parks must first be quantified. Noise propagation modeling provides a quick, cost-effective, and accurate method to estimate and compare noise scenarios in national parks. Theodore Roosevelt National Park's North Unit, south of Watford City, ND, is bordered to the east by US Highway 85. The highway has experienced a ten-fold increase in truck traffic due to expanding oil infrastructure. A noise model was used to simulate the propagation of highway road noise into the park under two different traffic scenarios: 424 trucks per 24-hour day in year 2006 and 4,379 trucks per 24-hour day in 2014. The increase in traffic from year 2006 to year 2014 resulted in a predicted increase in road noise spreading into the park. At the park visitor center, the predicted average road noise increased by 10 decibels (A-weighted) and the amount of time noise was audible increased by 20%. Additionally, the amount of time wildlife would be affected by the noise near the visitor center was predicted to increase by 44%. As evidenced above, noise models generate complex results that include multiple metrics, making it difficult to directly apply to land management actions. In order effectively communicate the important results relevant to management alternatives, a visual representation of data called an infographic, was created.

Session Topic: Technology for Land Management Success
Format: Oral Presentation
Student competition: Yes

THE NORTH AMERICAN BAT MONITORING PROGRAM: COLLABORATING ACROSS A CONTINENT TO MONITOR AND CONSERVE BATS

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The North American Bat Monitoring Program (NABat) was developed through the cooperation of multiple federal and state agencies and other partners to produce scientifically credible information about the distribution, status, and trends of bat populations across North America. This collaborative project is designing a continental sampling framework, databases, survey protocols, and data analysis tools to be able to inventory, monitor, and ultimately conserve the native bats that occur across all of North America. The poster provides details on the partners, goals, continental sampling design, tools (e.g., protocols, databases, websites), timeline, progress, and the expected data analysis, products and outcomes of this international collaborative project.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries
Format: Poster presentation
Student Competition: No

PROTECTING WATER QUALITY THROUGH COLLABORATIVE RESTORATION IN THE UPPER POUDRE RIVER WATERSHED

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Protecting water quality through collaborative restoration in the Upper Poudre River watershed. This talk will describe the objectives and monitoring activities of the Upper Cache la Poudre collaborative monitoring programs and the new focus on landscape and stream restoration following the 2012 wildfires and the 2013 floods as means to protect the City's water supplies. The City's recent commitment to watershed protection will be highlighted, as well as how we are working with community partners, including the Coalition for the Poudre River to address restoration needs and future threats to the Poudre River. In addition, an overview will be provided of how work performed high in the Poudre Watershed supports the health of the river downstream.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries
Format: Oral presentation
Student Competition: No

GENECOLOGY AND SEED ZONE MAPPING FOR BOTTLEBRUSH SQUIRRELTAIL

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Bottlebrush squirreltail (*Elymus elymoides*) is a short-lived perennial bunchgrass of semi-arid regions of western North America. It is used in post-fire rangeland restoration because it can rapidly colonize disturbed sites, is relatively fire-tolerant, and is a potential competitor with problematic invasive annuals, such as cheatgrass (*Bromus tectorum*). Previous studies indicate that there is strong ecotypic divergence in squirreltail, but few studies have evaluated how genetic variation is related to climate across the Great Basin. This study aims to determine how adaptive traits are related to climatic variation in order to ensure that the proper germplasm is chosen for revegetation and restoration and use that information to develop seed transfer guidelines and seed zones. Seed was collected from two maternal families from 101 populations from five western states, primarily from the northern and central Great Basin. Common garden studies were established at three contrasting sites in Reno Nevada, Powell Butte Oregon, and Central Ferry Washington. A variety of traits were measured to assess plant growth, morphology, phenology, and fecundity in 2012 and 2013. We found high trait variation between common garden sites and years, suggesting that trait expression in bottlebrush squirreltail is highly plastic, but we also found significant relationships between traits and climates of population source locations, suggesting local climatic adaptation. Using a multivariate regression tree modeling approach, we identified seed zones differentiated by climatic variables including temperature differential, precipitation as snow, annual heat-moisture index and mean coldest month temperature. Seed zone modeling results were mapped through a process that highlighted the spatial distribution of model limitations and uncertainties, enhancing the value of the map for restoration practitioners.

Session Topic: Role of Native Plant Materials in Restoration & Rehabilitation
Format: Poster Presentation
Student Competition: No

SLASH PILE IMPACTS ON SURFACE AND BELOWGROUND STANDARD SUBSTRATE DECOMPOSITION RATES

Deborah S. Page-Dumroese[1], Martin F. Jurgensen, and Joanne M. Tirocke

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Many forest stands in the western United States are in need of restoration for a variety of attributes (e.g, fire regime, watershed health, insect and disease resilience) after 100 years of fire suppression or lack of harvesting activities. Precommercial and commercial thinnings along with biomass-to-energy harvests contribute to large amounts of slash material, which is commonly disposed of by piling and burning. Belowground soil impacts from slash pile burns can be highly variable because of differences in soil texture, fuel type and loading, and soil moisture during burning. We investigated changes in soil microbial processes from pile burning by using a standard wood stake that is well suited for examining fire impacts on multiple sites. Many decomposition studies use native organic matter, but differences among sites are difficult to determine. Our results indicate that, in general, spring pile burning has less impact on belowground processes as compared to fall burning. In addition, coarse-textured soils show higher decomposition rates than fine-textured soils after burning.

Session Topic: Forest Management
Format: Oral presentation
Student Competition: No

ADAPTIVE MANAGEMENT EXPERIMENTS FOR RESTORATION OF OAK ECOSYSTEMS: EFFECTS OF CANOPY THINNING ON SEEDLING REGENERATION AND GROUND LAYER PLANT COMMUNITIES

Jillian R. Pastick[1] and Robert T. Fahey[2]

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Oak ecosystems throughout eastern North America have experienced shifts in composition, dynamics, and structure as a result of land management and human influences on landscape disturbance regimes. Formerly oak-dominated forests and woodlands throughout the region have experienced an increase in dominance by shade-tolerant, mesophytic species, as well as a shift towards dense canopy structure, with little to no oak regeneration or recruitment to the overstory. Land managers face the challenge of implementing management strategies to restore oak ecosystems and promote oak regeneration in exurban and suburban natural areas, where high intensity Silvicultural treatments are often not feasible. To investigate management alternatives, the Southern Des Plaines Adaptive Management Experiment was implemented in Lake County, Illinois, in which five canopy thinning treatments of variable intensity, timing, and spatial pattern were replicated across three study areas. We monitored survival, growth, and morphology of planted oak seedlings, observed changes in groundlayer plant communities, and characterized the subcanopy environment. Through this research, we aim to better understand how experimental management treatments influence oak regeneration and groundlayer plant communities. Results will guide in evaluating the efficacy of different canopy thinning treatments that could be utilized for oak woodland management projects in natural areas throughout midwestern and eastern United States.

Session Topic: Restoration in the Anthropocene, Forest and Range Management
Format: Oral Presentation
Student Competition: Yes

MEETING MULTIPLE MANAGEMENT PRIORITIES WITH LIMITED RESOURCES WHEN MAKING POST-FIRE MANAGEMENT DECISIONS IN THE INTERMOUNTAIN WEST

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Fire regimes throughout the Intermountain West have been altered by invasive species, causing significant structural changes in the region's plant communities. Since the 1990s, there has been a dramatic increase in the amount of land burned by fire. Invasive annual species are among the first species to become established after fire events, outcompeting native perennial plants. This positive feedback loop has dramatic, negative effects for the ecology of impacted western ecosystems. Managers have many potential tools at their disposal to help slow this feedback loop and mitigate or minimize the negative impacts of fires on critical biotic, abiotic, and social resources. However, it is not always clear which management tools are most effective at meeting multiple priorities with limited resources, particularly given different policy and regulatory frameworks. The goal of this review is to synthesize how different post-fire management techniques that aim to break the invasive species-fire feedback loop support the delivery of different management priorities. We discuss common techniques (e.g., ground cover additions, broadcast seeding, prescribed burns, and post-fire lumber salvage), as well as more novel approaches (carbon addition, microbial pathogens). No management technique is able to deliver on all resource priorities, but some are better than others. Additional research on the true costs and benefits of these techniques, as well as their relative costs, will help policy makers and land managers make increasingly informed decisions about the most appropriate and effective management practices to meet their resource priorities while working to interrupt the invasive-species fire feedback loop.

Session Topic: Invasive Species Management
Format: Poster Presentation
Student Competition: Yes

HOW DO PLANT INVASIONS IMPACT INSECT FOOD WEBS

Ian Pearse

U.S. Geological Survey Fort Collins Science Center

Predictive models of invasive species distributions have proven useful to managers that wish to identify places where invasive species can establish. An additional goal is to anticipate the impact of particular plant invasions on ecosystems and food webs such that the management of invasions can be better prioritized. Predictive models of invasive plant impact have proven challenging; but some aspects of invasive plant impacts are highly predictable. I illustrate this by showing that new links in plant-herbivore food webs following a plant invasions can be anticipated based on the plant traits and phylogenetic relationships that determine herbivore host breadth. Thus, it is possible to predict which introduced plants native herbivores will consume based on their placement within native food webs. This same logic holds true for predicting the new potential hosts of invasive insects and biocontrol agents. Predictive methods that extend beyond anticipating the new range of invasive species will be of great use when trying to understand and anticipate the impacts of invasive species on food webs and ecosystems.

Session Topic: Invasive species management
Format: Oral presentation
Student Competition: No

MOJAVE DESERT NATIVE PLANT PROGRAM: IMPLEMENTING THE NATIONAL SEED STRATEGY IN THE MOJAVE DESERT ECOREGION

Judy Perkins[1], Lesley A. DeFalco[2], Dan Shryock[2], Loraine Washburn[3], Sarah DeGroot[3], and Heather Dial[4].

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Increasing large-scale wildfires, interacting with invasive species such as red brome, cheatgrass, and Sahara mustard, along with expanding renewable energy development, continue to negatively impact large acreages across the Mojave Desert Ecoregion. Through implementation of the National Seed Strategy for Rehabilitation and Restoration 2015-2020, the Mojave Desert Native Plant Program (MDNPP) is coordinating interagency efforts to prioritize restoration species, increase availability of Mojave Desert native plant materials, and improve success of restoration projects. Multi-faceted research supporting native plant restoration is underway to: 1) develop empiric seed transfer zones based on genetic analysis and common garden tests, 2) develop restoration decision-making tools for land managers, 3) develop seeding strategies to circumvent granivory on restoration sites, 4) develop Mojave Desert germplasm releases and species-specific growing techniques of use to commercial growers, and 5) support increased container stock production capability for the Mojave Desert Ecoregion. A major emphasis of the MDNPP is restoration of habitat for the Federally threatened Mojave desert tortoise (*Gopherus agassizii*). Desert tortoise habitat has been heavily impacted by wildfires and subsequent annual brome infestations. Priority restoration species include those important for desert tortoise forage and cover, as well as species of value for pollinators.

Session Topic: Restoration
Format: Oral Presentation
Student Competition: No

SCENIC VIEWS NEED MORE THAN APPRECIATION: A NATIONAL PARK SERVICE APPROACH

Melanie V. Peters, Mark Meyer, Ksienya Taylor

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Scenic views inspire future generations, are windows to the natural world, and foster connections with history and culture. As landscapes change with increasing speed, agencies need to actively engage in management of views within and beyond boundaries. In 2013, the National Park Service launched a visual resource inventory method designed specifically to meet NPS needs. Capturing visual experiences accurately and consistently across diverse landscapes is a key goal. In the inventory process, each view is mapped and described from the viewers' perspective. Views are also evaluated to capture both scenic quality and importance to the visitor experience. This approach allows the NPS to assess and value visual resources in a holistic way. Inventory data can be used in spatial analysis to quickly show where views overlap, which portions of the landscape are truly visible from a given view point, and what the composite value of all intersecting views is. Robust inventory information allows managers to integrate visual resource considerations into park planning and management. This is especially important when working with partners beyond our boundaries to affect project proposals and target critical areas for visual resource protection. The NPS visual resource inventory method has already proven effective in diverse park landscapes and is gaining more traction. Embracing our role in preserving and protecting scenic views is critical to the continued viability of NPS areas as places of national significance into the future.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries
Format: Oral Presentation
Student Competition: No

INCREASING THE USE OF RESTORATIVE PRESCRIBED FIRE THROUGH COLLABORATION: BURNING THROUGH BARRIERS

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The ecological and cultural importance of fire in the southern Sierra Nevada Mountains of California is not contained within artificially-derived management boundaries. Diverse members of the Dinkey Collaborative Forest Landscape Restoration Project (CFLRP) have been working together since the formation of the collaborative entity in 2010 to reduce the barriers of using frequent, prescribed burning and controlled wildfire for resource benefit as management tools on the Sierra National Forest. Efforts to increase the use of fire on the landscape have required establishing and creating relationships that are outside the Dinkey CFLRP boundary. This has included reaching out to air quality control regulators, medical entities, and the public on the importance of frequent prescribed fire to reduce the impacts of fire-related emissions in comparison to those from severe wildfires. Increasing capacity and fire-related networks through training and education that bring together diverse interest groups, tribal partners, and public agencies have been a priority. These coordinated efforts are beginning to have an impact not only within the Dinkey CFLRP but also in the surrounding landscape. This presentation will highlight some of the successes and continued challenges of increasing the use of fire in the southern Sierra Nevada.

Session topic: Wildland Fire as a Management Tool
Formal: Poster Presentation
Student Competition: No

UNDERSTANDING ASPEN POPULATION DYNAMICS AS A RESULT OF COMPOUND DISTURBANCE IN COLORADO

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Recent and projected 20th century decline in Quaking aspen (*Populus tremuloides*) extent has prompted many land managers in Colorado to categorize aspen as unworthy of management resources. However, the spatial models that predict this significant aspen decline focus on climate change and aspen's climate requirements, and do not incorporate many bottom-up variables (for example, topographic complexity) or ecological disturbances. Ecological disturbances play a large role in aspen regeneration. However, disturbance regimes are changing; insect outbreaks and wildfire are projected to increase in frequency and severity. Therefore, there is increased probability that an ecosystem will experience compounded disturbances that can alter ecosystem trajectory in currently poorly- understood ways. To quantify the success of aspen regeneration after compounded disturbance in the variable climates of the Colorado Rocky Mountains, we ask: have recent (since 2000), extensive, high-severity wildfires preceded by recent, high-severity beetle outbreak caused aspen to regenerate in landscapes where they were not previously observed? If aspen has regenerated after compounded disturbance, how do aspect and elevation affect the success of this regeneration? During the summer of 2017, we will randomly establish 144 transects throughout landscapes that have experienced this compounded disturbance in Colorado to answer our questions. We expect to find that aspen are regenerating in these post-disturbance landscapes and are particularly thriving in cold refugia. Our results will directly apply to forest management plans in these areas of study and potentially to other sub-alpine forested ecosystems throughout the Rocky Mountains.

Session topics: Forest management, climate change
Format: Poster Presentation
Student Competition: Yes

CONTROL OF AN INVASIVE GRASS UNDER PROJECTED CLIMATE CHANGE CONDITIONS FOR THE STATE OF FLORIDA.

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Wetland plant communities throughout North America are being replaced by monocultures of *Phragmites australis* (common reed). This species is divided into haplotypes, with native and exotic haplotypes present in the United States. Two haplotypes present management concerns in Florida: Haplotype M (an aggressive Eurasian type) was first identified in the state in 2013, and haplotype I (which has unclear origins) has recently become aggressive in disturbed freshwater wetlands. Increases in atmospheric CO_2 concentrations and temperature can impact the growth and physiology of C_3 species such as *P. australis*, potentially altering their herbicide tolerance. We examined this relationship in a greenhouse experiment. Haplotypes I and M were grown under elevated (700 ppm, 22/34 ^oC) or ambient (390 ppm CO_2, 18/30 ^oC) climate conditions for six weeks, before being treated with glyphosate (0.5 lb.-a.i. per acre). Morphological and photosynthetic characteristics were measured prior to herbicide application. Visual injury, height, stem number, and aboveground biomass were measured 30 days after treatment. Plants regrew for another 30 days before height, stem number, and biomass were measured. Haplotype I showed fewer stress responses to glyphosate treatment under the elevated climate conditions. This is likely due to the reduced leaf area exhibited by this haplotype under increased CO_2 concentrations and temperature, which may have resulted in reduced herbicide uptake by the plants. The response of haplotype M to glyphosate was unaffected by climate treatment.

Session Topic: Natural Areas Management in Light of Changing Climate; Invasive Species Management
Format: Poster presentation
Student Competition: Yes

20 YEARS OF COLLABORATIVE RIPARIAN RESTORATION: LONG-TERM RECOVERY OF CACHE CREEK AFTER CURTAILMENT OF IN-CHANNEL GRAVEL MINING

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Cache Creek in Yolo County, CA was intensively mined for high-quality aggregate since the early 20th century, causing substantial environmental degradation. In 1996, in-channel mining was curtailed and the innovative Cache Creek Area Plan (CCAP) was implemented by Yolo County to facilitate long-term restoration. The County has since partnered with numerous public and private stakeholders to implement the multifaceted CCAP, the 10-year update of which was completed in 2017 in conjunction with a Parkway Plan that creates a vision for an open space network. The updated CCAP and Parkway Plan directly inform climate-smart adaptive management by incorporating 20 years of monitoring data on geomorphological, hydraulic, and biological features of the creek and the riparian corridor. We present a) an overview of this unique planning framework, b) a summary of changes in biological resources from 1996–2016, and c) a summary of past, present, and future habitat enhancement and restoration projects. Riparian habitat has generally increased since 1996 in conjunction with intensive control of invasive arundo and tamarisk, passive recovery of vegetation on formerly mined areas, and active restoration projects. Utilizing a multi-benefit approach, funding for additional large-scale restoration projects is now being sought. Recent large-scale surveys of nonnative invasive plants and special-status native plants are also being used to inform adaptive management efforts; e.g., prioritizing additional invasive species for treatment including perennial pepperweed, Ravennagrass, and Himalayan blackberry. A trajectory of long-term restoration of Cache Creek has now been established, due in large part to collaboration between diverse stakeholders.

Session Topic: Restoration in the Anthropocene (preferred) OR Natural Areas Management in Light of Changing Climate, Invasive Species Management
Format: Oral Presentation
Student Competition: No

SOIL DATA AVAILABILITY FOR MANAGEMENT OF NATURAL AREAS

Carla Rebernak

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Soils information is readily available for more than 95 percent of the nation's counties and can be used in many forms to make more science based land use decisions. USDA Natural Resources Conservation Service (NRCS) maintains a database of natural resource information, the largest of its kind in the world. Commonly sought data elements include Unified classifications, hydrologic soil group, hydric soils, and ecological site descriptions. Examples of how soil properties and ratings are used on the Caribou-Targhee and Bridger-Teton National Forests of Idaho and Wyoming include planning and project management for climate sensitivity, travel, livestock grazing, fuels and fire, native species selection, and resource mapping. Data can be accessed in real-time through an interactive map for most of the U.S. with smartphones, tablets, and desktop computers. Spatial and tabular data can also be viewed or downloaded, at no cost, for modeling and spatial applications.

Session Topic: Wilderness and Research Natural Areas Management, Technology for Land Management Success, Forest and Range management
Format: Oral Presentation
Student Competition: No

CLIMATE AND LANDSCAPE PHYSIOGRAPHY INTERACT TO CONTROL TREE GROWTH IN SEMI-ARID AND SUBALPINE ECOSYSTEMS OF THE ROCKY MOUNTAINS

Miranda D. Redmond[1], Katharine C. Kelsey[2], Alexandra K. Urza[3], Jason C. Neff[4], and Nichole N. Barger[4]

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The growth response of forests and woodlands to increasing temperatures and altered precipitation regimes will play a key role in mitigating or accelerating the pace of climate change. Growth responses to climate will not only vary across ecosystems due to stark differences in resource availability and species physiology, but also within ecosystems due to local physiographic factors such as elevation, aspect, and soil type, which alter local water and energy balance. We investigated how recent climate warming has impacted tree growth among three tree species in two Rocky Mountain ecosystems: pinyon pine, a widely distributed species of semi-arid woodlands, and Engelmann spruce and subalpine fir, two widely distributed species of subalpine forests. We investigated the growth trend of individual trees through time, determined the climate variables most important for driving growth, and quantified the interactions between climate and landscape physiography that are influencing the long-term growth trends. Growth declines were observed in subalpine fir and pinyon pine over the past century while Engelmann spruce growth increased during this time period. Pinyon pine and subalpine fir growth was negatively affected by summer temperatures and positively affected by seasonal precipitation. The magnitude of growth responses to these climate variables varied across the landscape due to topographic effects on water and energy balance and soil available water capacity. In contrast, Engelmann spruce was uniformly unresponsive to climate. In addition to highlighting the importance of species-level differences in growth response to climate, our results suggest that local landscape physiography can mediate climate related stress in forest and woodland ecosystems.

Session Topic: Natural Areas Management in Light of Changing Climate
Format: Oral Presentation
Student Competition: No

TRACING ELEVATED STREAM NUTRIENT EXPORT BACK TO WILDFIRE

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Bare landscapes and elevated stream and soil nutrient concentrations remain commonplace in watersheds burned by the 2002 Hayman Fire. They serve as stark reminders that these systems were fundamentally altered by severe fire 15 years ago. Data collected from this area in 2015 and 2016 show that watersheds with high burn extent (>50%) have significantly higher stream nutrient concentrations. While upland and soil processes partially explain long-term nutrient export, the in-stream mechanisms are still unknown. This study uses a series of tracer injections and long-term monitoring to investigate the impact of landscape-scale disturbances on in-stream nutrient processing and transport. The use of conservative and non-conservative (biologically active) tracers differentiate physical and biological controls on nutrient processing. Experimental results demonstrate strong hydrologic control on dissolved inorganic nitrogen transport, presumably a result of large surface-groundwater exchange in burned watersheds. While hydrologic exchange generally promotes biological uptake, the lack of nutrient uptake suggest potential for shifting controls after fire. The process-based understanding gained here will provide insight into the mechanisms regulating long-term water quality recovery following severe wildfire.

Session Topic: Value of Healthy Land in Water Resource Management
Format: Oral Presentation
Student competition: Yes

MARKET-BASED CONSERVATION: LESSONS LEARNED IN PROGRAM DESIGN

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Market-based programs are innovative approaches that provide revenue to landowners for conservation and improved land management. These programs can be instrumental in bringing new sources of capital to conservation efforts and in engaging private landowners in natural resource management. Market-based approaches are sprouting up across the country and hold great potential; however, many of these programs have failed to become operational, even after several years of stakeholder collaboration and the development of tools and processes. This presentation will address recurring challenges and share lessons learned from three case studies of market-based programs that the presenter has played a role in designing. The first case study is on a forest carbon crediting program in the Santa Cruz Mountains of California, and the second and third case studies are both based in Colorado, one focused on water quality and the other on sage-grouse habitat. The recommendations for overcoming challenges will touch on technical assessments, regulatory frameworks, stakeholder engagement and planning tools. The presenter will also introduce a specific planning approach: the theory of change and results chains. Attendees will come away with a sense of the building blocks for designing a successful market-based program, knowledge of which common traps to avoid, and some tools for taking a program from concept to an on-the-ground functioning operation that provides conservation benefits and revenues for landowners.

Session Topics: Value of Ecosystem Services in Working Landscapes
Format: Oral Presentation
Student Competition: No

SUDDEN ASPEN DECLINE IMPACTS ACROSS VARYING FOREST RESTORATION TREATMENT TYPES IN WARM DRY MIXED CONIFER, SOUTHWEST COLORADO

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Sudden Aspen Decline (SAD) is the sudden mortality of aspen stands. Since the 2000s, SAD in southwest Colorado has been observed to cause mortality of aspen stands within 3-6 years, much faster than natural die back. SAD is influenced by three factors: climate, topography and insect pathogens. I will quantify insects and pathogens associated with aspen within four blocks of three replicated treatments (control, thin/burn and burn-only). Additionally, I will predict future SAD impacts in the San Juan National Forest using a GIS site suitability model. I will identify a minimum of 10 aspen stands within each block (4 blocks x 3 treatments x 10 aspen stands= 120 plots). In each plot, I will randomly choose 20 aspen trees and quantify insects and pathogens, tree DBH and tree health status. I will incorporate my findings into a site suitability model comparing abiotic layers such as slope, aspect, elevation and slope position (ridge, valley, mid-slope) and biotic layers such as tree species composition and stand density. I hypothesize that the control treatment blocks will have the highest SAD mortality and pathogen presence because of higher stand density and increased stress from competition. Quantifying differences in SAD for the three forest restoration treatments will provide insight on which forest stand structure is most resistant to SAD and will assist in providing management options for SAD stands in southwestern Colorado.

Session Topic: Forest and Range Management
Format: Poster Presentation
Student Competition: No

TWO DECADES OF INTENSIVE FOREST STEWARDSHIP IMPROVE STAND INTEGRITY BUT NOT RESILIENCY

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In 1993, the Pennypack Ecological Restoration Trust inventoried trees in a 1.5-ha mixed hardwood forest called Overlook Woods—a stand typical of the larger 330-ha Pennypack Preserve natural area in the suburbanized northern Piedmont of the eastern United States. The inventory served as a baseline against which to measure progress in reversing degradation caused by historic selective harvesting and cattle grazing as well as the more recent effects of invasive plants and white-tailed deer. Following completion of the inventory, the Trust worked aggressively to control invasive plants, reforest canopy gaps, and reintroduce extirpated shrubs. Twenty years later, in 2013, the Trust repeated the tree inventory, which demonstrated that two decades of stewardship and restoration had reduced the impact of some invasive plants, modified forest structure (especially species importance, tree age distribution, and total stand basal area), and increased shrub richness. Nevertheless, despite 20 years' intensive efforts, continued stewardship will be required to sustain the progress achieved to date because of conditions inherent in the woods (e.g., the presence of aggressive shade-adapted invasive plants and canopy trees nearing the end of their lifespans) in addition to external threats (e.g., invasive species recolonizing edges, newly introduced pests and diseases, and hurricane windthrow).

Session Topics: Restoration in the Anthropocene; Wilderness and Research Natural Areas Management; Forest and Range Management
Format: Oral Presentation
Student Competition: No

TAKING THE PROACTIVE APPROACH TO NATURAL AREAS PROTECTION THROUGH OUTREACH - A CASE STUDY AT BUFFALO NATIONAL RIVER, ARKANSAS

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Management of environmental degradation within natural areas is too frequently reactive instead of proactive and often lacks preventive measures. Reactive management actions might seem futile inside of natural areas when impacts from activities outside of jurisdictional boundaries are chronic. Created in 1972, Buffalo National River is known as a "shoe string" river park where only the corridor is managed as a natural ecosystem, while over half of the river's watershed is privately owned. Most catchments for tributaries of the Buffalo River are outside of the park's boundary, and decades of research have consistently shown them to be impacted by non-point source pollution, making several tributaries candidates for impaired-waterbody status. Historical controversies about the manner in which the park was created and perceptions that the park continues to impact the cultural fabric of people living within the watershed have led to conflicts between private land use developments and the National Park Service's need for unimpaired water quality. This social discord has made working with landowners to improve water quality within the park difficult. During this session, you will discover how interdisciplinary teamwork at Buffalo National River is unveiling unique community outreach opportunities and partnerships, such as through the creation of STEM Research Learning Centers, in order to overcome these political and cultural boundaries. Through instilling a sense of value for America's first National River in the hearts of its stewards, the staff at Buffalo National River is proactively protecting the water quality and other natural resources within the park.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries
Format: Oral Presentation
Student Competition: No

MODELING THE INFLUENCE OF CLIMATE AND LOCAL SITE FACTORS ON POST-FIRE REGENERATION IN THE SOUTHERN ROCKY MOUNTAINS ECOREGION

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Over the last several decades, the area burned in large wildfires in the western United States has steadily increased. Anthropogenic climate change (ACC) is now recognized as an important contributor to this trend because it lengthens fire seasons and increases fuel aridity. Indeed, ACC may account for 50 percent or more of the recent increase in area burned in large wildfires. Unless fuel availability becomes especially limiting, fire activity is expected to continue to increase in the future, and the Rocky Mountain region is especially susceptible to these increases. Given the increase in area burned, an understanding of post-fire ecosystem dynamics is paramount to both managers and scientists. While increased temperatures and drought stress influence wildfire activity directly, they can also negatively influence post-fire recovery, compounding the initial impacts of these disturbances. Our research focuses on ponderosa pine, pine-oak, and dry mixed-conifer forest ecosystem responses to wildfire in the Southern Rocky Mountain Ecoregion (SRME; EPA Level III Ecoregion 21), and we seek to understand the relative influences of climate, topography, competition, and distance to seed source in influencing post-fire conifer establishment across ca. 20 recent wildfires. Initial findings suggest that there is notable spatial variability in the presence and abundance of post-fire conifer establishment across each of these fires and across the region. An understanding of this variability may improve our understanding of the climatic constraints on post-fire establishment, and help to prioritize areas in which post-fire planting is likely to be successful.

Session topic: Climate change, fire, forest management
Format: Oral Presentation
Student Competition: Yes

EFFECTS OF SHRUBLAND TECHNIQUES ON INSECT POLLINATORS AND COMMUNITIES

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Restoring sagebrush shrublands is a conservation priority on public rangelands. In 2012, herbicide and seeding treatments were applied to four invaded experimental blocks within a national conservation area in southwestern Idaho. Each block consisted of 16 1-ha plots, with treatments distributed in a fully factorial design. The design assessed the effectiveness of commonly applied vegetation treatments in invaded and disturbed sagebrush-steppe habitats. We measured the influence of the treatments on insect communities. The goal of our study was to determine if insect pollinators or pests were affected by the vegetation treatments. We sampled insects twice each summer in 2012 and 2013 on a subset of the plots within the blocks. We sampled two herbicide plots and two drill seeded plots within each block and two reference plots (with intact sagebrush overstories) outside of the blocks. All insects were identified to family and analyzed according to three guilds: communities, herbivores, and nectarivores, the group including pollinators. We captured and identified 21,085 insects, 5,994 of which were nectarivores and 7,866 of which were herbivores. Preliminary results indicate that richness and diversity of insect communities were higher at plots treated with herbicide than at control plots in 2012 and 2014, and abundance was higher at herbicide plots than control plots in 2014. Abundance of herbivores was higher at herbicide plots than control plots in 2014, but richness and diversity were not different among treatments. We found no evidence that nectarivores responded to shrubland restoration treatments, possibly because of low forb abundance.

Session Topic: Role of Natural Areas in Pollinator and Invertebrate Conservation
Format: Oral Presentation
Student Competition: Yes

TREE CUTTING AND GOAT BROWSING IN A SAVANNA RESTORATION: EFFECTS ON MICROCLIMATES AND VEGETATION

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Restoration of oak savanna was studied from 2006 to 2011 at Chichaqua Bottoms Greenbelt in Polk County, Iowa. Vegetation data were collected in 2006, 2008 and 2011 on control plots, plots with only tree cutting, and plots with tree cutting followed by 3 seasons of goat browsing. The microclimates of study plots were measured with dataloggers and sensors for light at the soil surface, air temperature, relative humidity, wind speed, soil and surface temperatures and soil moisture. Data were analyzed for 63 vegetation variables representing the richness, species composition and structure of herbaceous, shrub, sapling and tree layers. Cutting alone resulted in decreases in sapling and tree density, tree basal area and the abundance of European buckthorn (*Rhamnus cathartica*). Cutting alone also caused an increase in the frequency of violets (*Viola* sp.), in the richness of sedge (*Carex* sp.), forbs and native herbaceous plants, in the relative frequency of exotic herbs, and in the abundance of herbaceous seedling/juvenal plants. The addition of goat browsing provided increases in total herbaceous abundance, in graminoid and sedge frequency, while effecting decreases in the abundance of jumpseed (*Persicaria virginiana*), in tree density, and in shrub and tree richness. Microclimates were more savanna-like environment on plots that were cut and browsed by goats compared to both cut only and control plots. Higher light, temperatures and wind speeds, and lower relative humidities, were observed on browsed plots. Goat browsing was effective in creating a favorable herbaceous layer while reducing shrub richness.

Session Topic: Invasive Species Management
Format: Oral Presentation
Student Competition: No

EFFECTS OF SPRING SURFACE FIRE ON MICROCLIMATES AND PLANT COMMUNITY COMPOSITION IN CENTRAL IOWA OAK FOREST

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Habitat loss, alteration and disturbance over the last 200 years has greatly diminished the occurrence of natural woodland and forest fires in Iowa and the Midwest. Ecosystem structure and species composition of woodlands have changed from the pre-settlement landscape. This study investigated the effect of prescribed spring fire in the restoration of woodland and forest ecosystems. Three sites in central Iowa were studied to compare paired burned and control plots. Burns took place between 15 March and 30 April 2016, while field data were collected from June through September 2016. Variables compared include 40 variables for species abundance, 8 variables for structure and vegetation quality, and 2 variables for understory light levels. Microclimate data (temperature, wind, light, relative humidity) were collected on three dates over 3-day periods with Campbell dataloggers and sensors. Most herbaceous species were not affected by the burn; 2 forbs decreased on the burn plots relative to the control. More significant changes were seen in the removal of woody vegetation under 2 meters tall. Light levels in the shrub layer were higher on the burn plot compared to the control. Ordination of the plots shows a very similar shift in species composition due to the burn at two of three sites.

Session Topic: Wildland Fire as a Management Tool
Format: Oral Presentation
Student Competition: No

USING TREE SPECIES DOMINANCE AS AN INDICATOR OF DEGRADED SHIFTS IN POPULATION STRUCTURE AND DIVERSITY

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Oligarchy in tree species importance ranking is a characteristic that is evident in sample populations of forest stands. Changes in the degree of oligarchy, especially in the dominant species, over time may indicate changes in population structure caused either by natural events or anthropogenic influences. I used USDA Forest Service, Forest Inventory and Analysis (FIA) data from three southern states to monitor changes in tree species dominance over two successive surveys. Alabama, Georgia, and Mississippi were chosen because of the fairly high occurrence of forest management practices. There are 27,171,283 ha of forest land in these three states. Data from the most recent surveys show 16,215,596 ha of forest where ≥50 percent of stand basal area is in one species, 60 percent of all forest land in these three states. Noteworthy is that this is a 2.7 percent increase in these types of stands over the last 5 to 7 years. The degree of dominance (≥50 percent) is arbitrary but any level decided upon provides a measure of the degree of stand evenness across landscape scales. Determining meaningful levels of dominance depends upon succession levels and ecotypes. High dominance in one particular species does not always mean system degradation. Deciding how much forest land should be dominated strongly by one species in a respective state could be difficult. These inventory and monitoring efforts are essential in establishing baseline data for defining policy to address difficult issues in managing resources.

Session Topic: Forest Management
Format: Oral Presentation
Student Competition: No

NATIVE BEES AND LARGE MAMMALS: VERTEBRATE-INVERTEBRATE INTERACTIONS IN RIPARIAN NATURAL AREAS

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Land managers have increased efforts to better understand how natural areas can be managed to enhance native pollinators; however, pollinator management must be balanced with other uses such as livestock grazing and wildlife habitat. Yet little attention has focused on how grazing mammals, especially native ungulates, interact with pollinators. As part of a larger, collaborative project evaluating ungulate grazing management and riparian restoration at the Starkey Experimental Forest and Range (Starkey) in northeast Oregon, we examined how large mammals may influence native bees through dietary overlap. We sampled native bees and floral resources from spring to fall in 2014-2016 along a 14-km reach of Meadow Creek within Starkey to 1) document which flowering species are most commonly visited by native bees, and 2) quantify how herbivory by deer and elk influences flowering plant communities. Half of the 12 sampling sites were excluded from grazing. We recorded >150 species of flowering forbs and shrubs and >900 bee visitors of >80 species. Flowering stems were generally more abundant in ungrazed vs. grazed sites; however, patterns were highly variable in time and space and across species. For some plants frequently visited by bees and also in elk diets (e.g., *Potentilla gracilis*), we found higher flower abundance in ungrazed sites. We discuss management implications relative to seasonal habitat use and dietary preferences of ungulates and variation in bee phenology, and conclude with guidance about timing and intensity of ungulate grazing when managing for multiple conservation objectives in grazed sites, especially in riparian areas.

Session Topic: Pollinator management
Format: Oral Presentation
Student Competition: No

FIRE AND RESEARCH NATURAL AREAS IN CALIFORNIA: RESTORING A KEY ECOLOGICAL PROCESS TO REFERENCE LANDSCAPES

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Research Natural Areas (RNAs) are often selected to exemplify minimally disturbed ecosystems where ecological processes can proceed unencumbered with minimal human intervention. Ideally, such areas serve as properly functioning reference landscapes for land managers. However, most RNAs have been modified to varying degrees by past and ongoing actions, most notably fire management. These factors, in combination with a changing climate, compromise the usefulness of the RNA system as a reference network and underline the importance of considering natural disturbance in RNA stewardship. We examined 64 RNAs on National Forest System lands in California to assess departure from their natural (pre-Euroamerican settlement) fire regime in terms of fire frequency and severity. We found that more than two thirds of the area encompassed by RNAs in California exhibit moderate to high departure. Of these, 87% are burning much less frequently than they would have under their presettlement fire regime and 13% are burning much more frequently. Seventeen RNAs in erstwhile frequent-fire ecosystems have not had a fire recorded within their boundary since prior to 1908 and 50% of the area has not burned in at least 109 years. We present case studies that demonstrate where recent wildfire has had positive and negative effects on the target element in RNAs, as well as areas where fire management actions, if implemented in the near future, could effectively maintain the conditions for which the RNA was set aside. We suggest that a re-examination of the strictly hands-off approach that has characterized RNA management is required.

Session topics: Fire
Format: Oral presentation
Student competition: No

PREDATION ON EARLY RECRUITMENT IN MEDITERRANEAN FORESTS AFTER PRESCRIBED FIRES

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Wildfires play a significant role in many different elements of Mediterranean forest ecosystems. In recent years, prescribed fires have started being used more often as a fuel reduction tool, and also as silvicultural treatment to help the regeneration and health improvement of stands. Apart from the fact that fire may alter microsite conditions, very little is known about the impact of prescribed burning on natural regeneration or plant species renewal in Mediterranean pine forests. Likewise, knowledge about the influence of seedling predators on post-fire regeneration is still scarce. In this study, we aimed to compare the effects of seedling predation on recruitment in earlier stages after prescribed burnings in three pine stands in Central Spain: a pure stand of *Pinus nigra*; a mixed stand of *Pinus halepensis* and *Pinus pinaster* and a mixed stand *P. nigra* with *P. pinaster*. In situ we superficially sowed seeds from two different species. In the sowing experiment, we tested two different seed provenances (drier and more humid spanish regions) for each species. In all, 60 plots (30 burned, 30 unburned) per site, with 10 seeding units per plot and more than 20,000 seeds, were used in the whole study. Seedling predation was evaluated by replicating the seeding units inside and outside a wire cage as protection for rodents and birds. Our results showed that prescribed fires alter initial seedling predation intensity: predation was significantly higher in the seedlings grown in the plots affected by prescribed fire. The individuals sown before the fire passed showed slightly more predation than those sown after fire passage. Provenances did not appear as an important predation drive. Understanding the role of the predation associated with these treatments can help improve Mediterranean pine forest management.

Session Topic: Fire Ecology and Fire Response
Format: Poster session
Student Competition: No

DECLINING CHANNEL MIGATION RATES ON A FREE-FLOWING RIVER SUGGEST FUTURE RIPARIAN HABITAT LOSS

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Dynamic interactions between river flows and floodplains create and sustain riparian ecosystems. Flooding flows provide a disturbance that floodplain ecosystems have evolved in conjunction with, but flow management and bank stabilization commonly impede this relationship today. Channel migration is the primary mechanism of floodplain turnover in meandering rivers and is essential to the maintenance of floodplain ecosystems. We investigated channel migration on the free-flowing Powder River in Montana to see how river processes are occurring in a relatively natural setting. A rich body of fluvial geomorphic research has come from this river from studies beginning in 1975, but it was unknown how representative documented conditions are compared to those that occurred before agricultural expansion, incremental water development, and climate change. We calculated channel migration rates from topographic cross-sections that had been collected between 1975-2014. We then extended the spatiotemporal perspective of channel migration by delineating the river channel in air photos (1939-2013) and by aging cottonwood trees on transects (1829-2014). All lines of evidence suggest that channel migration and floodplain turnover have decreased in recent decades, and the recent intensively studied period is not representative of past fluvial geomorphic processes. Corresponding to the decreased channel migration rates are a decrease in channel width, increase in sinuosity, decrease in flood peaks, and an exotic shrub invasion. We conclude that even a modest degree of land development, flow management, and climate change in the watershed has caused channel migration to decrease, threatening the native floodplain ecosystem that depends on dynamic fluvial processes.

Session Topic: Value of healthy land in water resources management
Format: Oral Presentation
Student Competition: No

TALLYING THE IMPLICATIONS OF PILE BURNING FOR MULTIPLE RESOURCE MANAGEMENT IN FUEL REDUCTION AND FOREST HEALTH PROJECTS IN THE ROCKY MOUNTAIN REGION

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Pile burning has played a key role in the forest management toolbox for the past century. Current efforts to reduce hazardous fuel levels, restore historic forest structure, and respond to forest health challenges have greatly increased the number of slash piles in forests. In this talk we tally and describe pile burning activities by forest and project type on federal land in the Rocky Mountain Region. We will summarize the main botany, soils, watershed, wildlife and air resource issues that arise where pile burning is used on federal land, outline efforts to mitigate and reverse damage, and review common public responses to pile burning. We will discuss silvicultural and fuel management alternatives for retaining logging residue within harvest units as well as factors that influence the current patterns of pile burning on federal lands. Finally, we will review regional economic alternatives to pile burning, including utilization of woody biomass as a bioenergy feedstock.

Session Topic: Forest Management
Format: Oral Presentation
Student Competition: No

‘RESILIENCE’ – IT’S EVERYWHERE, BUT WHAT DOES IT MEAN IN A CLIMATE CHANGE ADAPTATION CONTEXT?

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Climate change adaptation is a rapidly evolving field in conservation and includes strategies from resisting to actively directing change on the landscape. The term ‘climate change resilience,’ frequently used to characterize adaptation strategies, deserves closer scrutiny because it is ambiguous, often misunderstood, and difficult to apply consistently across disciplines and spatial and temporal scales. Current definitions of resilience encompass all aspects of adaptation from resisting and absorbing change to reorganizing and transforming in response to climate change. Climate change adaptation practitioners, funders, and stakeholders require clear terminology to articulate and understand management strategies and the inherent tradeoffs involved in adaptation. Language that distinguishes among strategies that seek to resist change, accommodate change, and direct change (i.e., persistence, autonomous change, and directed change) is prerequisite to clear communication about climate change adaptation goals and management intentions in conservation areas. This presentation illustrates the challenges, explains why a term with a longstanding and clear meaning in ecology lacks such clarity in the climate change adaptation realm, and presents alternative frameworks and terminology that better support collaboration among diverse partners.

Session Topic: Natural Areas Management in Light of Changing Climate
Format: Oral Presentation
Student Competition: No

ADAPTATION ACROSS THE NATION: SHIFTING THE PARADIGM OF NATIONAL PARK MANAGEMENT

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Climate change challenges not only traditional natural resource conservation goals, but also the management paradigms that guide goal setting. Careful examination of national parks' most 'gnarly' climate change-related management questions shows that many National Park Service (NPS) managers readily reexamine management goals in the context of ongoing climate change. In contrast, NPS Management Policies (2006) are largely silent regarding climate change, and thus provide little guidance for the challenges of climate change adaptation, and in fact preclude or strongly constrain certain plausible, climate-informed goals. This presents a dilemma for park managers, given a fundamental assumption in NPS *Management Policies*: that we can know what the condition of a natural resource or process would be in the absence of human domination – either by referring to a contemporary un-impacted analog or to historical information – and manage for those conditions today. Climate change of course renders this assumption increasingly unrealistic. The ubiquity of climate change generally precludes the existence of un-impacted contemporary reference sites, and the departure of modern climate from historical ranges will increasingly challenge efforts to restore or maintain historical ecological conditions and processes in the long term. Examination of parks' adaptation-related questions grounds our thinking, and helps advance policy evolution to better address climate change. For example, a forward-looking conception of 'ecological integrity,' untethered from historical ranges of variability, may be a better guide for resource management than the longstanding concept of 'naturalness', which is frequently part of conservation management policies but increasingly difficult to define.

Session Topic: Natural Areas Management in Light of Changing Climate
Format: Oral Presentation
Student Competition: No

USING STRUCTURAL EQUATION MODELING TO LINK HUMAN ACTIVITIES TO WETLAND ECOLOGICAL INTEGRITY IN THE PROTECTED LANDSCAPE OF ROCKY MOUNTAIN NATIONAL PARK

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Wetlands in Rocky Mountain National Park are threatened by a complex history of human disturbance (HD) including alteration of hydrologic regimes; elimination of elk, wolves, and grizzly bears; reintroduction of elk; and the extirpation of beaver. More recently, nonnative moose were introduced to the region and have expanded into the park. Bioassessment suggests that up to half of the park's wetlands are not in reference condition, but provides little information about how altered conditions connect to community response. We develop a structural equation model (SEM) to evaluate how human alterations influence wetland integrity. SEM analyses suggest several ways human activities have impacted wetland integrity. First, HD is highest where the combined effects of all types of direct human disturbance have been the greatest (i.e., there is a general, overall effect). Second, specific sources of HD appear to create a "mixed-bag" of complex indirect effects, including reduced invasion and increased conservatism, but also reduced native forb cover. Some of these effects are associated with alterations to hydrologic regimes, while others are associated with altered shrub production. Third, landscape features created by historical beaver activity continue to influence wetland integrity years after beavers have abandoned sites via persistent landforms and reduced biomass of tall shrubs. Our model provides a system-level perspective on integrity and provides a context for future evaluations and investigations. It also suggests scientifically supported natural resource management strategies that can assist in the National Park Service mission of maintaining or, when indicated, restoring ecological integrity "unimpaired for future generations."

Session Topic: Value of Ecosystem Services and Working Landscapes
Format: Oral presentation
Student Competition: No

BURNING DOWN BARRIERS TO URBAN NATURAL AREA MANAGEMENT

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In 2016, the City of Greeley successfully implemented a prescribed fire program with two primary goals: to manage fuel loads and to begin restoration work in urban natural areas. Prescribed fire is the controlled application of fire by a team of trained firefighters under specified weather conditions that helps restore health to the fire-adapted environment. These burns are used to encourage the growth of native vegetation, while safely reducing excessive amounts of non-native grasses, brush, and trees, thereby maintaining the habitats on which wildlife depend. Many of Greeley's natural areas abut developed housing areas with residents often voicing concerns about fire potential. Facing the challenges of limited staff and budget resources, the program's success is attributable to working across internal and external political boundaries to provide on-the-ground wildland fire training to multiple agencies throughout the region. Over two burn seasons, fall 2016 and spring 2017, more than 400 acres of designated natural areas were burned; 12 fire agencies and natural area management entities participated including the Aims Community College Fire Academy, along with support from multiple city departments. Greeley Fire Department is believed to be the only municipal fire agency in Colorado to effectively implement a prescribed fire program. As a result of this effort, it is anticipated that Greeley will develop a Community Wildfire Protection Plan (CWPP). Three other agencies have asked to be included in the CWPP, including Weld County, one of the few Colorado counties that does not have a CWPP.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries
Format: Poster Presentation
Student Competition: No

THE RESEARCH NATURAL AREAS OF ALABAMA: HISTORY, NEED, USES, AND FUTURE OPPORTUNITIES

Andy Scott[1, 2], Arvind A.R. Bhuta[2], Cynthia Ragland[2], Justin L. Hart[3]

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The Forest Service Research Natural Areas (RNAs) represent a unique opportunity to provide the public with areas that serve as conduits for scientific inquiry through research and education while also sustaining biodiversity. Two established RNAs are highlighted from the National Forests in Alabama, the Reed Brake (598 acres, established 1975) and the Bee Branch (128 acres, established 1962). These two RNAs have been used by academic and USFS researchers and the Natural Forests in Alabama to gain a better understanding of the natural conditions of these RNAs while also serving as a baseline or reference area for other sites which are undergoing restoration across the National Forests in Alabama. Past and current work a with academia (The University of Alabama, and Alabama A&M) and land managers will be discussed along with the development of long-term monitoring work that is being conducted around and within the Reed Brake RNA with the National Ecological Observatory Network. We will discuss the need for future opportunities and needs so that we can maximize further use and a better understanding of the ecosystems and communities that are found within and around both of these RNAs, while developing educational opportunities that could help to better inform the public about Alabama's RNAs and their importance on the landscape.

Session Topic: Research Natural Areas
Format: Oral Presentation
Student Competition: No

EVALUATING A LONG-TERM CONTROL STRATEGY FOR MANAGING INVASIVE WINTER ANNUAL GRASSES - THE TIME TO ACT IS NOW

Derek Sebastian

Bayer VM Stewardship and Development Team

Invasive winter annual grasses such as downy brome (*Bromus tectorum*) are a threat to native ecosystems throughout the US. Downy brome out-competes native vegetation with devastating consequences including more frequent and more intense wildfires, degraded wildlife and pollinator habitat, loss of diversity, and inferior recreation experiences. For decades, land managers have been attempting to recover downy brome dominated sites; however, there are currently limited management options that work consistently, provide multiple years of control, and do not injure desirable plant communities. While glyphosate, imazapic, and rimsulfuron are herbicides commonly recommended to control invasive annual grasses, short-term control results in rapid re-establishment of treated areas via the soil seed bank. Indaziflam (Esplanade®, Bayer) is a cellulose biosynthesis inhibiting (CBI) herbicide that is a unique mode of action winter annual grass management. Multiple studies at Colorado State University have shown indaziflam provides long-term (3+ years) downy brome control with a single application. In field studies, downy brome control ranged from 83-100% for indaziflam, while control following imazapic treatments was 10-32%. In addition, indaziflam promoted the re-establishment of the co-occurring plant community by increasing perennial grass (36-fold) and forb biomass (5-fold), and plant diversity (richness) over time. In a greenhouse study, indaziflam applied pre-emergence was on average 12 times more active than imazapic on six invasive annual grasses including downy brome, medusahead (*Taeniatherum caput-medusae*), and ventenata (*Ventenata dubia*). Indaziflam could potentially be used to eliminate the soil seed bank of these invasive grasses, decrease fine fuel accumulation, and ultimately increase the sustainability of perennial co-occuring species.

Session topic: Invasive Species Management
Format: Oral Presentation
Competition: No

LARGE SCALE CONTROL OF INVASIVE WEEDS AND RESPONSE OF NATIVE SPECIES TO INDAZIFLAM TANK MIXES

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Invasive species management on non-crop and rangeland remains a constant challenge throughout many regions of the United States. While there are over 300 rangeland weeds, downy brome (*Bromus tectorum* L.), Dalmatian toadflax (*Linaria dalmatica*), musk thistle (*Carduus nutans*), Scotch thistle (*Onopordum acanthium*), diffuse knapweed (*Centaurea* diffusa), and moth mullein (*Verbascum blattaria*) have emerged as some of the most invasive and problematic on Boulder County Open Space properties. Indaziflam (Esplanade™, Bayer CropScience) has been adopted by many land managers throughout Colorado with a new open space and natural areas label. Field studies at CSU have demonstrated that indaziflam has excellent long-term downy brome control (3+ years) with minimal injury to native perennial species. Because indaziflam is a root inhibiting herbicide this allows for increased safety on desirable perennial plants that have roots below the layer where the herbicide is active. Multiple large-scale experiments were initiated in 2016 in collaboration with CSU to evaluate the efficacy of currently recommended herbicides alone and in combination with indaziflam for restoring open space properties infested with invasive grass and broadleaf weeds. Aminocyclopyrachlor and picloram were applied alone and in combination with indaziflam to determine if indaziflam tank-mixes extend the duration of annual, biennial, and perennial invasive weed control by eliminating re-establishment from the soil seed bank. All treatments including indaziflam resulted in 100% downy brome control and significantly increased perennial grass biomass for this first growing season after treatment. In 2017, visual and biomass evaluations will provide further evidence for the utility of indaziflam for long-term invasive weed control on Boulder County Open Space properties.

Session topic: Invasive Species Management
Format: Poster Presentation
Competition: No

INCREASED SEEDED NATIVE SPECIES ESTABLISHMENT IN RESTORED SLASH PILE BURN SCARS AT LILY LAKE, ROCKY MOUNTAIN NATIONAL PARK

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The mountain pine beetle (*Dendroctonus ponderosae*) epidemic has created the need to thin dead trees from forests of National Parks in the Mountain West for the safety of park visitors. Dead trees are thinned to reduce tree-fall and fire risks and stacked into piles for winter burning. It is necessary to restore scars left behind after the piles are burned because the intensity of the fire reduces the seedbank and changes the physical and biological properties of the soil, which can reduce recruitment of plant species. After burning in late winter 2013, 8 meter (26 ft) wide pile burn scars were monitored at Lily Lake, Rocky Mountain National Park in mid July 2014, 2015, and 2016. Before restoration, we observed 0.2 species/m2 in the center and 1.3 species/m2 outside of the visible scar. The scar edge had three times the species richness of scar centers. After restoration, plant growth in restored and unrestored scars depended on location within the scars. In 2016, restored scar centers had the highest native plant cover of 28.8%. Unrestored scar centers had only 7% native plant cover. We found the highest non-native forb cover of 6.4% in unrestored scar edges compared to 1.1% in restored scar edges. While this difference was not statistically significant, it is an important trend to continue observing. These results indicate the important effects of restoration of pile burn scars. Continued monitoring will provide valuable insight into the effectiveness of restoration for minimizing invasion by non-natives.

Session topic: Forest Management
Format: Poster Presentation
Competition: No

LAND MANAGEMENT: DATA DRIVEN DECISION MAKING

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In a time when monetary budgets and staff availability are decreasing while the need for restoration is increasing, making land management and restoration decisions can often be difficult and overwhelming. Where should we focus our efforts? How can we be efficient and effective? How do we know our management is enhancing the natural ecosystem and benefiting native flora and fauna? Utilizing available tools and technology, land managers can easily make data-driven, intentional and impactful management decisions. Learn how Mt. Cuba Center's Natural Lands staff prioritize, monitor, collect, and analyze data using ArcGIS to inform and guide future habitat restoration and management actions on 535 acres of preserved land in Delaware.

Session Topic: Technology for Land Management Success
Format: Oral Presentation
Student Competition: No

RESEARCH NATURAL AREAS IN THE U.S. FOREST SERVICE: 90 YEARS OF PROGRESS, AND A LOOK TOWARD THE FUTURE

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The Research Natural Area (RNA) program is one of the oldest formal programs in the U.S. Forest Service (USFS). Since 1927, RNAs have been systematically established to represent a wide range of habitats as part of a national network of reference sites protected in perpetuity for research, education, and the conservation of biological diversity. To date, 533 RNAs have been designated across all nine USFS regions, protecting approximately 600,000 acres. The development of the RNA network has been a collaborative endeavor involving many agency and non-governmental partner organizations. As the RNA program has evolved, many issues have arisen related to stewardship of the areas and representation of ecological sites. Historically, RNAs were viewed as 'hands off' reserves intended to protect natural features in a strictly unmanaged state. However, as the ecological effects of fire suppression, invasive species and other altered conditions have increased, a philosophical shift has been taking place regarding the management of RNAs, and stewardship management is now more commonplace. While the RNA network has historically aimed to represent current and potential vegetation types, changing climate patterns and other broad-scale influences suggest that future additions to the network should also include a range of geophysical settings. Research in RNAs has been modest, but there is outstanding potential for studies regarding climate change and ecological restoration. Studies utilizing RNAs in the USFS Northern Region are examining the effects of increased atmospheric carbon dioxide (CO2) on tree growth and the efficacy of restoration treatments in old growth forests

Session topic: Research Natural Areas
Format: Oral Presentation
Competition: No

SCALING STAND-SCALE MEASUREMENTS TO LANDSCAPE-SCALE PREDICTIONS OF FOREST REGENERATION AFTER DISTURBANCE: THE IMPORTANCE SPATIAL PATTERN

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Understanding the relationship between the spatial patterns of disturbance and regeneration processes across the landscape is critical in the face of changing fire regimes. Shifts in the spatial patterns of severity could have significant effects on post-fire forest regeneration if the scale of the disturbance no longer matches the regeneration traits of the dominant species. In forests of the western US that that lack serotiny, post-fire regeneration depends on proximity to remnant tree seed sources, but anthropogenically-driven changes in the fire regime are increasing high severity patch sizes to scales (>1,000 ha) that are outside the historic range of variability (~200 ha). To scale plot-level observations of regeneration to the landscape-scale, we created a spatially-explicit predictive model of the probability of post-fire conifer regeneration, using data from 24 wildfires across California. To estimate the neighborhood effect of remnant trees we used a kernel smoothing technique on post-fire forested areas to act as a proxy for seed source, examining a range of neighborhood scales. Topographic and climatic variables were important in building predictions, but burn severity and the kernel-based seed proxies at 150m neighborhoods were the most important predictors of regeneration. The proxies were not as good of a predictor as field-recorded distance to seed trees, but dramatically improved the prediction model over Euclidian distance to lesser-burned edge. By forecasting post-fire regeneration patterns at the landscape-scale using publicly available data, this method provides both land managers and scientists a tool to predict potential changes in ecosystems under changing disturbance regimes.

Session topic: Forest management
Format: Oral Presentation
Competition: No

MAPPING FEN WETLANDS ON NATIONAL FOREST LAND THROUGH AERIAL PHOTO INTERPRETATION

Gabrielle Smith and Joanna Lemly

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Fens are as groundwater-fed wetlands with organic soils that typically support sedges and low stature shrubs. In the mountain west, organic soil formation can take thousands of years and long-term maintenance of fens requires protection of both the hydrology and the plant communities that enable fen formation. Given the sensitivity of fens, the U.S. Forest Service (USFS) has determined that all fens should be managed for conservation and restoration. However, few National Forests have a complete inventory of fen wetlands. To fill this data gap, Colorado Natural Heritage Program (CNHP) began mapping fen wetlands on USFS lands in 2011 through a series of contracts with USFS Regional 2 and 4. To date, fen wetlands have been mapped in four National Forests, with work underway in six additional Forests. For each project, potential fens are identified from digital aerial photography and topographic maps. Each potential fen polygon is hand-drawn in ArcGIS based on the best estimation of fen boundaries and attributed with a confidence value of 1 (low confidence), 3 (possible fen) or 5 (likely fen). CNHP photo interpreters rely on multiple image sources, as well as ancillary data such as topographic maps and general wetland mapping form the National Wetlands Inventory. Fen density is highly variable among Forests mapped and is strongly related to elevation and landforms. For most Forests, fens are concentrated between 9,000–12,000 feet in elevation in the subalpine zone. Fens form at the base of slopes, on valley margins, and in old kettle ponds. The geospatial data on fen locations will help USFS avoid potential impacts and target rare plant surveys in these important wetland habitats.

Session topic: Wetlands
Format: Oral Presentation
Competition: No

ASSISTED MIGRATION OF THE CRITICALLY IMPERILED ROCKY MOUNTAIN MONKEYFLOWER, *MIMULUS GEMMIPARUS*: A COOPERATIVE CONSERVATION PROJECT

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The Rocky Mountain monkeyflower, *Mimulus gemmiparus* W.A. Weber, is a rare and critically imperiled plant endemic to Colorado. In 2015, only seven extant populations were known, each consisting of several very small (typically < 2 m^2) patches of plants rooted in water seeps on shelves on granite cliffs. It is an annual plant that survives the non-growing season via vegetative propagules (bulbils) that are produced in the leaf axils. Small population sizes, restrictive habitat needs, and a unique life history combine to make the species especially vulnerable to extirpation from stochastic events and changing climate. It has been petitioned for federal listing under the Endangered Species Act, with a positive 90-day finding in 2012. Assisted migration was proposed to reduce the threat of extinction. Propagation of asexual bulbils has proven simple and inexpensive, and establishment of supplementary populations successful. In a 2012 pilot project on State lands, 16 new patches were planted, with six (37.5%) expanding after two growing seasons and still occupied after five seasons. Efforts were extended as a cooperative multi-agency project, and in 2016 we used a stock of approximately 100,000 bulbils from four separate parent populations to plant several dozen new patches. If these patches are successful, they would establish three new populations and augment four existing ones. Long-term monitoring is underway to track all known native and established populations and to evaluate the effectiveness of assisted migration.

Session Topics: Assisted Migration
Format: Oral Presentation
Student Competition: No

THE POUDRE RUNS THROUGH IT: FIVE YEARS OF SOCIOLOGICAL BRIDGE BUILDING

MaryLou Smith

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The Poudre Runs Through It: Five Years of Sociological Bridge Building. Building a wooden or steel bridge over a river is easy. Building bridges between groups of stakeholders with divergent interests in that river, much harder. Research shows that people form and keep opinions based on the facts they believe, and all the fact sharing in the world is unlikely to change their beliefs. So how can we bring together for collaboration, those whose opinions are based on their own (often polarized) set of beliefs and values? Relationship building. The Poudre Runs Through It Study/Action Work Group has for five years provided a safe setting for agricultural, urban, and environmental stakeholders to learn from one another about their various interests in the Poudre River. This mutual learning has led to several collaborative actions that would have earlier been impossible. Lessons learned and challenges remaining will be shared, to encourage others to take on similar sociological bridge building.

Session topic: Conservation Across (Natural/Political/Cultural) Boundaries
Format: Oral Presentation
Competition: No

RIPARIAN RESTORATION, PATHS AND FISHING ACCESS – BUT WHERE'S THE WATER?

Zach Smith

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Riparian Restoration, Paths and Fishing Access – But Where's the Water? In Colorado, rivers have no inherent legal right to flowing water. Fort Collins' local river, the Cache La Poudre River, provides water for farms, showers, and beer, but those withdrawals result in several seasonal dry-up spots. This presentation will explain the basics: why rivers run out of water, and what programs exist in Colorado to put water back in rivers. Finally, the presentation will touch on a collaborative approach to this challenge on the Poudre.

Session topic: Conservation Across (Natural/Political/Cultural) Boundaries
Format: Oral Presentation
Competition: No

MODELING ECOLOGICAL RESPONSES TO CLIMATE: WHAT ARE THE CHALLENGES AND OPPORTUNITIES?

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Understanding and predicting the responses of ecological systems to ongoing climate change underlies our ability to develop efficient and forward-looking management plans. A major challenge for researchers is to produce credible and actionable science given the available information and resources. Here, we provide three examples of how models can be designed to integrate key ecological processes and how model assessment can target management-relevant metrics. First, we describe a modeling framework for assessing climate change impacts for the many ecological systems sensitive to climate extremes. Climate models often project different rates of change for climate means versus climate extremes, and we illustrate the implications for ecological modeling. Second, vulnerability assessments based on species distribution models often summarize the projected magnitude of range expansion and contraction. We show that even models with excellent discrimination performance may struggle to predict changes in occupancy – meaning that the summaries of model output that are most relevant to decision-making can be unreliable. Third, we discuss applications of species distribution models intended to guide subsequent search efforts, which can increase efficiency for early detection of invasive species and for inventory of rare species. Collectively, our results emphasize how models can be developed and assessed based on their intended applications, providing more realistic assessments of uncertainty for decision-making.

Session topic: Climate change
Format: Oral Presentation
Competition: No

DO HAZARDOUS FUELS TREATMENTS AMELIORATE EFFECTS OF HIGH-INTENSITY WILDFIRE ON WARM-DRY MIXED-CONIFER FOREST PLANT COMMUNITIES?

Judith D. Springer[1], Michael T. Stoddard[2], David W. Huffman[3], Andrew Sanchez Meador[4], and Amy E. M. Waltz[5]

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Few studies have examined the effectiveness of fuel treatments on plant community composition and resilience in mixed-conifer forests. Resilience at the plant community level is measured by such metrics as species richness, species diversity, and native and non-native cover following a disturbance. In the early 2000s, a landscape scale stewardship project was implemented in warm-dry mixed-conifer forests in the White Mountains of eastern Arizona to reduce hazardous fuels across the wildland urban interface. The Wallow Fire of 2011 burned over much of this area and set the stage for an opportunistic experiment to examine the effectiveness of these treatments on the post-fire plant community. We collected species cover and presence-absence data in nine paired treated-untreated blocks in 2012 and 2016, one and five years after the fire. In 2012, average total and native species cover were significantly higher in treated vs. untreated units, but by 2016, these differences had attenuated. Neither non-native cover nor richness was significantly different between treated and untreated units in either year. In the untreated units, we found a negative correlation between species cover and tree basal area and a positive correlation between tree mortality and species cover. In the treated units we also observed a negative correlation between tree basal area and cover. We found negative correlations between insolation, elevation and topographic position index and species richness and diversity in both treated and untreated units. By 2016 the community composition had diverged from the immediate post-fire community toward one dominated by grasses and wind-dispersed species.

Session Topic: Urban/Wildland Interface, Fire
Format: Oral Presentation
Student Competition: No

EVALUATING POTENTIAL TRADE-OFFS AMONG FUEL TREATMENT STRATEGIES IN MIXED-CONIFER FORESTS OF THE SIERRA NEVADA

Jens T. Stevens [1, 2], Brandon M. Collins [3, 4], Jonathan Long [4], Malcolm P. North [1, 4], Susan Prichard [5], Leland W. Tarnay [4], and Angela M. White [4]

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The objectives for fuel treatments in mixed-conifer forests can range from improving fire suppression efforts and protecting infrastructure, to facilitating reintroduction of lower-severity fire, to restoring and maintaining variable forest structure and wildlife habitat. In designing a fuel treatment, managers can alter the treatment's prescription, placement and extent (collectively the "treatment strategy") to optimally meet one objective. We evaluated whether five different mechanical fuel treatment strategies have tradeoffs in achieving different objectives related to fire severity, smoke production, forest heterogeneity and avian wildlife habitat. We used a cross-platform modeling approach based on spatially-explicit modifications of forest structure data for a 7820-ha landscape in the Lake Tahoe Basin, California. Our simulations indicated that when approximately 13% of the landscape was treated, the proportion of the landscape vulnerable to high-severity fire decreased by 13-44% depending on the treatment strategy. Increasing the extent of treatments to 30% of the landscape did little to further reduce the area vulnerable to high-severity fire, with additional reductions of 4-7% depending on the treatment strategy. However, increasing the extent of treatments reduced the extent of harmful downwind smoke impacts, primarily by reducing rate of fire spread. Slight increases in predicted avian species richness that followed all treatment strategies were not closely linked to increases in canopy variability. Our analysis illustrated that tradeoffs are not necessarily inherent to general outcomes of fuels treatments. Results are currently being used to design treatment strategies in the Lake Tahoe Basin through a collaborative process involving researchers, managers, and stakeholders.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries, Forest management
Format: Oral Presentation
Student Competition: No

UNDERSTORY THERMOPHILIZATION FOLLOWING THE 2002 HAYMAN FIRE

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Forest fire can lead to major shifts in understory plant diversity and community composition, due to mortality of existing vegetation and open niche space for new species to establish. Shifts in community composition can be driven by fire-mediated changes in understory microclimate, with increasing fire severity leading to increased temperatures and water stress in the understory. Prior work has shown more severe fire may favor understory species with biogeographic affinity to warmer drier regions. Here we test that hypothesis using a unique time series dataset of pre- and post-fire vegetation from the Hayman Fire, which burned in dry mixed-conifer forest of central Colorado in 2002. We used paleobotanical evidence to assign species to either a north temperate or southern xeric biogeographical affinity. The proportion of north temperate species decreased most strongly following fire in plots that burned at high-severity. North temperate species in moderate-severity plots also decreased over time, while remaining steady in low-severity plots. This trend in high-severity plots was driven by a combination of increased colonization by southern xeric species for three years after the fire, and increased extinction of north temperate species in the first year following fire. More north temperate species went locally extinct for the 10-year duration of the study from high-severity plots than from low- or moderate-severity plots, while very few southern xeric species went locally extinct. Collectively this evidence suggests that high-severity fire may simultaneously select for warmer climate species and select against cooler climate species during the first decade following fire.

Session topics: Forest management, Fire
Format: Oral Presentation
Student Competition: No

WILDFIRES AND CLIMATE FACILITATE ECOSYSTEM TRANSITIONS

Camille S. Stevens-Rumann[1], Kerry B. Kemp, Philip E. Higuera, Brian J. Harvey, Monica T. Rother, Daniel C. Donato, Penelope Morgan, Thomas T. Veblen, Forest and Rangeland Stewardship, Colorado State University, 1472 Campus Delivery, Fort Collins, CO 80523-1472, C.Stevens-Rumann@colostate.edu, 602-509-5077

Forest resilience to climate change is of escalating concern globally, given the potential for forest loss due to heightened disturbance activity and major shifts in forest composition due to a lack of post-fire regeneration. We used a large, multi-regional dataset to document post-fire tree regeneration in the U.S. Rocky Mountains to ask if and how changing climate over the last several decades has impacted the rate and density of post-fire tree regeneration. We analyzed data from 1485 sites, including field measurements on > 62,000 tree seedlings across 52 wildfires that burned between 1988-2011. Recruitment failures, defined based on seedling density needed to exceed site-specific regeneration thresholds, were more common in recent wildfires, especially for fires that burned since 2000. Our results highlight that both the proportion of sites meeting recruitment thresholds fell on more recent fires and the drivers of tree regeneration varied prior to 2000 compared to after 2000. Many more site characteristics such as seed availability, post-fire climate, and solar radiation were important before 2000, while only 30-yr climatology and seed availability were predictive of post-fire regeneration for sites burned since 2000. Sites with the least resilience to wildfires – low or no regeneration -- were located in the warmest and driest forests, at low elevations and at lower latitudes. Our results demonstrate reduced post-fire recruitment and recruitment failure following 21st-century wildfires, suggesting the initiation of a major climate-induced reduction in forests especially in low-elevation forest density and extent.

Session topics: Forest management, Fire, Climate change
Format: Oral Presentation
Student Competition: No

ALTERATIONS IN FIRE BEHAVIOR AND FIRE EFFECTS AS A RESULT OF PRE-FIRE MASTICATION

Camille Stevens-Rumann, Penelope Morgan, Anjeleeca Tomayko, Zachary Lyons, Robert Keefe

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Mastication, in which trees and shrubs are chipped by machine, is increasingly used before and during fires. The resulting compact beds of shreds and chips burn less intensely, but can smolder leading to soil heating that can alter vegetation response. We performed replicated lab and prescribed fire experiments following two different treatments in three thinned ponderosa pine stands to understand how mastication alters fire behavior as well as post-fire effects on soil and vegetation response. Fire behavior (flame length and rate of spread) was low and variable in masticated fuels. We expect understory plant diversity and abundance to differ where masticated and burned relative to masticated only, and relative to controls (not thinned and masticated). As more and larger areas are treated through mastication and mowing of trees and shrubs, more of them will likely burn given the increased area treated. In many locations, mastication is done to either reduce fuels in place of a broadcast burn or enable prescribed burning for fuels management as it is expected to reduce fire intensity. As such it is critical to predict how these compact beds of wood shreds and chips will burn and the long-term implications for ecological effects

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Session topics: Forest and Range Management, Urban/Wildland Interface
Format: Poster Presentation
Student Competition: No

LONG-TERM CHANGES IN SOIL MICROBIAL DIVERSITY AFTER SLASH PILE BURNING

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Forest restoration efforts require thinning operations to reduce tree density, wildfire risk, or insect and disease conditions to improve ecosystem processes and function. However, one issue with the thinned stands is to dispose of the residues. Slash pile burning is currently used on many forest sites as a preferred method for residue disposal because they can be burned at various times of the year and are usually more controlled than broadcast burns. In some cases, fire can be beneficial to site conditions and soil properties, but often large slash piles, with a concentration of a large amount of wood, needles, forest floor, and sometimes mineral soil, can do irreversible damage. On the Flathead National Forest in northwestern Montana there are many areas where slash piles were dozer piled and burned in the 1960s. We selected 3 replicate 50 year-old burn areas with limited vegetative regrowth as targets for determining total soil bacterial and fungal microbial diversity. Soils were collected and measurements of soils properties were analyzed. Further, total DNA was extracted using a MolBio Soil DNA extraction kit. Samples were then amplified at the 16s rDNA V4 region (bacterial diversity) and ITS1 rDNA region (fungal diversity) and sequenced on an Illumina MiSeq platform. Reads for each rDNA region were clustered based on 97% similarity to estimate total numbers of Operational Taxonomic Units (OTUs). Representative reads for each OTU were compared to the Silva Database to determine species identify. Preliminary data suggests that total numbers of fungal OTU clusters were similar in each soil sample, ranging from 561-723, which was similar in the bacterial samples. This presentation will highlight microbial diversity found along a transect from the center of the pile to the surrounding regenerating forest.

Session topic: Forest Management
Format: Oral Presentation
Competition: No

LARAMIE FOOTHILLS LAND CONSERVATION PLANNING AND CONSERVATION

John Stokes

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This presentation will describe the history of land planning and acquisition in the Laramie Foothills Mountains to Plains project. It will detail The Nature Conservancy's initial eco-regional plan and TNC's efforts to stitch together a protected landscape. Out of these early efforts grew a more comprehensive and ambitious effort by a variety of agencies to conserve a number of large properties. The presentation will detail the land conservation efforts of the City of Fort Collins, Larimer County, the State of Colorado, TNC, the City of Cheyenne (Wyoming), and others which, in the end, resulted in an over 100,000-acre array of public and privately conserved land. The backstory on these efforts includes a bit of high drama, as well as an instructive allegory for how the stage is set for an ambitious conservation vision and its implementation.

Session Topic: Conservation Across (Natural/Political/Cultural) Boundaries
Format: Oral Presentation
Student Competition: No

IT TAKES A VILLAGE: AUGMENTING AN ENDANGERED BUTTERFLY METAPOPULATION IN SAN DIEGO, CALIFORNIA

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Abstract:
In the 1970s, the Quino checkerspot butterfly (*Euphydryas editha quino*) was one of the most abundant butterfly species in southern California. Two decades later, due to habitat loss, fragmentation, and competitive exclusion of host plants by non-native weeds, the species was listed as federally endangered. The United States Fish and Wildlife Service has partnered with a diverse group of collaborators from seven different organizations possessing differing areas of expertise to develop a captive rearing and reintroduction protocol for the Quino checkerspot. Last winter, 1400 larvae were released on part of the San Diego National Wildlife Refuge where the butterfly had been absent for almost a decade. Emergence of Quino checkerspot adults this spring demonstrates a proof of concept for rearing and reintroducing the species, which may become necessary in the future. Coupled with future habitat management and additional reintroductions, this project will increase the number of Quino checkerspots and promote connectivity within the metapopulation on the refuge. A successful protocol provides the ability for future reintroductions and paves the way for collaborative efforts to alleviate the impacts of habitat loss and other anthropogenic pressures on the Quino checkerspot.

Session Topics: Species Re/Introductions & Assisted Migration, Rare Species Management
Format: Poster presentation
Student Competition: No

MAPPING FUTURE FIRE-CLIMATE SUITABILITY THRESHOLDS FOR THREE SOUTH CENTRAL U.S. WOODY ECOSYSTEMS

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Climate affects wildfire frequency, and together can be primary drivers of plant species distributions. Long-term management of south-central woody ecosystems requires information on projected changes in climate and fire frequencies, and how these changes might affect plant communities. We used historic (1900-1929) and projected climate data for 2040-2069 and 2070-2099 from three global climate models (GFDL, CGCM, and HadCM3) to estimate fire probabilities using a physical chemistry fire frequency model. We then used the fire probability data with additional climate parameters in Maxent software to construct fire-climate suitability envelopes for three important south-central ecosystem types: an oak type (dominated by *Quercus stellata* and *Q. marilandica*), a mesquite type (dominated by *Prosopis glandulosa* and *P. velutina*), and a pinyon-juniper type (dominated by *Pinus edulis* and *Juniperus osteosperma*). We mapped future fire-climate suitability scores and indicated locations in which conditions projected by all three global climate models exceeded suitability thresholds for each ecosystem type. Results show changes in the spatial locations of conditions under which these ecosystems have been historically dominant and/or managed. Suitability threshold maps show projected future northward and eastward shifts in suitable conditions for dry oak woodlands, a reduction in suitable area for mesquite communities, and constriction of suitable conditions for pinyon-juniper communities toward higher elevations. The inclusion of projected future fire probabilities is an important new addition to climate envelope modeling for south-central woody ecosystems.

Session Topic: Natural Areas Management in Light of Changing Climate
Format: Oral Presentation
Student Competition: No

RARE PLANTS AND PLANT COMMUNITIES AT SOAPSTONE PRAIRIE

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Regulations for plant protection are limited. The City of Fort Collins is collaborating with multiple agencies to help gain species knowledge and strengthen protection on areas like Soapstone Prairie. Soapstone Prairie Natural Area is located on 22,498 acres along the Colorado and Wyoming State border. This is an amazing landscape with over 500 species of plants, 22 rare plants and 15 rare plant communities. Threats from fragmentation, noxious weeds, improper grazing, recreation and oil and gas development are major concerns for protecting and conserving these unique resources. Collaboration with outside entities like Larimer County, Denver Botanic Gardens, Missouri Botanical Garden, US Fish and Wildlife Service, The Nature Conservancy, State Land Board and Folsom Grazing Association help ensure that these rare species and communities are protected.

Session Topic: Conservation Across – Natural/Political/Cultural
Format: Oral Presentation
Student Competition: No

EXPLORING EDGE EFFECT AND THE IMPACT OF INVASIVE VEGETATION ON SNOWY PLOVER NESTING SUCCESS

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Habitat fragmentation and invasive species may alter the distribution, abundance, and behavior of organisms and are considered among the greatest threats to biodiversity. Many studies have documented negative edge effects and impacts from species invasion, but little is known about the interaction of these threats on species of concern. We assessed the combined effect of habitat edge and plant species invasion on nesting success in the declining snowy plover (*Charadrius nivosus*) at the Salt Plains National Wildlife Refuge (SPNWR), in Oklahoma. We expect reduced nesting success with proximity to edge, and to see an increased negative effect from edges dominated by invasive saltcedar (*Tamarix* spp.) compared to nests near native vegetation. We are currently testing these predictions, but preliminary analysis indicates that increased temperature has a negative effect on nesting success, depredation occurs most often with nests associated with bare ground, and nest success is higher in the beginning of the breeding season. Results of this study will aid in understanding the effects of edge and invasive vegetation on Snowy Plover nesting success, and assist further development of predator management strategies at the SPNWR.

Session Topic: Invasive Species Management or Rare Species Management
Format: Oral Presentation
Student Competition: Yes

AFFIRMATION OF THE SHALE BARREN ENDEMIC PACKERA MANCOSANA (ASTERACEAE: SENECIONEAE) OF SOUTHWEST COLORADO AS A DISTINCT SPECIES USING MOLECULAR PHYLOGENETIC AND PHYLOGEOGRAPHIC METHODS

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Packera mancosana, an endemic represented by roughly 400 plants, grows alongside other rare plants on the unique Mancos Shale barrens of the southern portion of Lone Mesa State Park. *P. mancosana* was first described in 2011 but has had variable acceptance due to the difficult taxonomy and inherent variability present within the genus *Packera*. It was recognized in Weber and Wittmann's "Colorado Flora- Western Slope" 4th edition (2012); however, it has been placed within the variable *P. werneriifolia* in other floral books. In this study, I will investigate the level of distinctness between *P. werneriifolia* and *P. mancosana* using chloroplast genes (rpl32-trnL, ndhf-rpl32 and ndhC-trnV) along with a nuclear gene (WAXY) isolated from 8-10 different populations. Haplotypes will be summarized from DNA sequences, haplotype maps will be constructed using TCS and geographical distributions will be mapped using ARCGIS. I will compare 20 different vegetative and floral characteristics to develop a data matrix which will be analyzed using various univariate and multivariate techniques. Working through taxonomic complexities found in *Packera* is critical for identifying rare organisms that need conservation. Within *Packera* the geographic and taxonomic distribution patterns of hybridization and the occurrence of species growing in harsh environments aids in our ability to assess the effects of climate and historical events on evolution. It is imperative that proper management is included to protect the livelihood of rare and endemic species given that current livestock grazing along with plans for recreational and/ or energy development are underway at Lone Mesa State Park.

Session Topic: Rare species management
Format: Poster presentation
Student Competition: no

RESPONDING TO NEW INVASIVE ANNUAL GRASS THREATS WITH AN INTERAGENCY WORKING GROUP

Dan Tekiela

University Wyoming

Ventenata (*Ventenata* dubia) and medusahead (*Taeniatherum caput-medusae*) are two invasive winter annual grasses that are spreading across the western US at an alarming rate. Similar to downy brome (*Bromus tectorum*), both species offer poor wildlife habitat, poor forage, and increase fire risk and intensity. As of 2016, both species were identified for the first time in Wyoming in the north central region of the state. Alarmingly, this is the first report of either species establishing within the greater plains ecoregion, suggesting both species may be able to establish beyond the Rocky Mountain divide. A taskforce, the North East Wyoming Invasive Grass Working Group (NEWIGWG) was quickly formed to respond to this new invasion. This group, composed of private, local, state, and federal entities has the objective of working at a landscape scale across land ownership boundaries to quickly and effectively respond to this nascent challenge with the goal of eradication at the state level. The group intends to utilize an early detection rapid response (EDRR) framework for this threat to identify both invaders current statewide extent while also developing a research program to better understand the biology, demography, spread, and impact of both invaders.

Session Topic: Invasive species management
Format: Oral presentation
Student Competition: no

FIRES DON'T KNOW OWNERSHIP BOUNDARIES, NEITHER DO CONTROL OPPORTUNITIES; LET'S PLAN WITH THAT IN MIND

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Land ownership and jurisdiction can exert a major influence on wildland fire management strategies, in both incident response and controlled burning environments. This is especially true where there is potential for conflict over factors like policy, land and resource objectives, and responsibility. As a result managers often attempt to demarcate fire boundaries to align with ownership boundaries, despite the knowledge that fires don't recognize these artificial boundaries. In the worst case, this could lead to unnecessary exposure of fire personnel to hazards in locations with few control options. In other words, like fires, opportunities for safe and effective control of fire don't necessarily align with ownership boundaries. In this presentation we will highlight emerging research mapping potential fire control locations, and illustrate its potential application to cross-boundary planning of controlled burning treatments. A key aim of this research is to develop transparent, repeatable methods for developing potential control line maps that are objective and quantifiable. The basic spatial analysis is built from the intersection of historical fire perimeters with measured landscape features such as topography, fuels, and roads, along with compound fire indices such as fire rate of spread, resistance to control, and suppression difficulty indices. By leveraging these products with information on management objectives and treatment priority, we hope to find synergistic opportunities for safe and effective cross-boundary implementation of controlled burning.

Session Topic: Wildland Fire as a Management Tool
Format: Oral Presentation
Student Competition: No

EXAMINING THE U.S. FOREST SERVICE'S CLIMATE CHANGE VULNERABILITY ASSESSMENTS: THEMES AND OPPORTUNITIES

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Land managers and scientists have been collaborating to develop climate change vulnerability assessments that support adaptation planning. While there has been diversity in the scale and focus of vulnerability assessments, all have the collective goal of supporting improved land management decisions in light of predicted, yet uncertain, impacts from climate change. This research seeks to better understand the current state of vulnerability assessments conducted by the U.S. Forest Service and potential opportunities for improving the practice. We conducted a series of qualitative interviews with scientists to inform criteria for a systematic content analysis of existing vulnerability assessment efforts. We then analyzed around 40 vulnerability assessment documents. This presentation highlights findings on the collaborative processes used to develop these assessments. It also discusses the scope of these vulnerability assessments, including the geographic scale and timeframe at which impacts are considered, and the specific resources covered by the assessment. Some assessments focus on individual administrative units, while others cover larger geographic areas. These assessments tend to use a framework that considers vulnerability in terms of exposure, sensitivity, and adaptive capacity for a range of resources, including specific vegetation types, watersheds, and human uses, such as recreational activities. I discuss the implications of these findings for future collaboration between scientists and managers to produce useful and relevant scientific information that supports adaptation planning. Planned follow-up research includes a series of interviews with vulnerability assessment authors and targeted end-users investigating how information in vulnerability assessments has been used to inform management actions and planning.

Session topic: Natural areas management in light of a changing climate
Format: Oral presentation
Student competition:

ON THE BRINK: RARE PLANT POPULATION DYNAMICS IN KĪPAHULU VALLEY, HALEAKALĀ NATIONAL PARK, MAUI

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Scientific research nested in natural resources management is one of the most effective routes of advancing ecosystem protection practices. Kīpahulu Valley, Maui is a highly biodiverse montane and lowland wet forest valley managed by Haleakalā National Park. Native biodiversity in Kīpahulu Valley is threatened by invasive alien plant and animal species, and management priorities for intensive resource protection have shifted to less-impacted upper-elevation areas. To fill this knowledge gap about mid-elevation rare species, we are collecting and analyzing demographic data on populations of nine species of rare plants in areas of Kīpahulu Valley where native species habitat has become degraded.

Integral population modeling (IPM) is a type of structured demographic model that uses a continuous variable such as growth, survival, and fecundity to predict population change over time with relatively small amounts of data. Environmental covariates can also be evaluated for effects on population change. This has direct implications for managers who may be able to alter environmental conditions to effect more positive demographic outcomes.

Using IPM, we will project survival and evaluate environmental drivers for each population. We hypothesize that most populations are in imminent danger of extinction, but some may be more stable than others, and managers will be able to use these projections to prioritize populations for immediate restoration and conservation action. Additionally, environmental covariates, such as cooler microhabitat temperatures and northeast facing slopes, will predict survival, while the early presence of ecosystem-altering invasive plants will drive extinction.

Session topics: Wilderness and Research Natural Areas Management, Restoration in the Anthropocene, Species Re/Introductions and Assisted Migration, Rare Species Management
Format: Poster presentation
Student Competition: Yes

A NEW EMERGING INVASIVE THREAT TO NORTHEASTERN RICH MESIC FORESTS: MANAGING THE HARDY KIWI VINE (*ACTINIDIA ARGUTA*)

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A new emerging invasive threat to the diverse forests of Western Massachusetts is the Hardy Kiwi vine. Hardy Kiwi vine (*Actinidia arguta*) is one of the newest species to be reviewed by the Massachusetts Invasive Plant Advisory Group and listed as Likely Invasive but is still being sold primarily through catalogue sales. Hardy Kiwi vine poses a threat to rich, mesic forests by growing over 20-35 feet/year and forming dense mats of intertwining vines that can overwhelm other vegetation, including trees. The weight of the vines during the growing season in addition to snow and ice loading on the vines breaks down the tree canopy, creating "amphitheaters" of only kiwi vine.

One of the largest known infestations in New England is found on two adjacent properties, Kennedy Park (owned and managed by the Town of Lenox, MA) and Pleasant Valley Wildlife Sanctuary (owned and managed by MassAudubon). In 2015, a large-scale control project was initiated through partnership of the Town of Lenox, MassAudubon and the Mass Wildlife focusing treatment of 100 acres of patches of kiwi vine in 2016 and 78 acres in 2017. Native Habitat Restoration was hired as the contractor for the control efforts. Initial results from the treatment efforts will be presented as well as considerations for future survey and management for this species.

Session Topic: Invasive Species Management
Format: Poster Presentation
Student Competition: No

PLAGUE MITIGATION PREVENTS PLAGUE-ASSOCIATED PRAIRIE DOG COLONY COLLAPSE

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We compared the effectiveness of insecticide or oral vaccination in combating plague in prairie dogs by tracking their survival and burrow activity on treated and placebo plots. Plague caused sharp declines in burrow activity and prairie dog density in placebo plots. The timing of treatment relative to plague outbreaks influenced effectiveness, but both treatments did enhance prairie dog survival. We concluded that applying insecticide or vaccine well before a plague epidemic can blunt losses and prevent colony collapse even though some plague may still occur. Successful plague control will likely require using insecticides and oral vaccination within large colony complexes.

Session Topic: Conservation Across – Natural/Political/Cultural
Format: Oral Presentation
Student Competition: No

INTEGRATING RECREATION AND RESTORATION IN A POST-INDUSTRIAL LANDSCAPE ON CHICAGO'S SOUTH SIDE

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Heavy industrial activity in Chicago's far southeast side played a vital role in the development of one of the largest cities in the United States and left the landscape severely impacted. An old industrial property, 278-acre Big Marsh is the region's largest inland wetland. Despite extensive slag and fly dumping, altered hydrology, and invasive species dominance, the ecological potential of the site is substantial. In recent years, the Chicago Park District has begun to redevelop the site into a safe, open, and inviting park space for Chicago residents, visitors, while supporting local biological diversity, including rare flora and fauna. Approximately 45 acres of the site was developed with specialized bicycle features integrated into a native landscape. The remainder of the site is in the process of being restored to a mosaic of hemi-marsh, emergent marsh, sedge meadow, wet prairie, prairie, savanna, and woodland ecosystems. This presentation will highlight the history and industrial legacy at Big Marsh, and how this influenced the integration of active recreation and ecological restoration into the largest natural area in the Chicago Park District's nearly 1,700 acre system. Unique plant community assemblages associated with the landscape and the initial plant and animal responses to restoration activities be presented as well as potential future research collaborations exploring soil amendments and seed mixtures for this and other post-industrial landscapes. The recent work at Big Marsh will be presented as a case study demonstrating the challenges and opportunities associated with integrating ecological restoration and recreation in a post-industrial, highly urban area.

Session Topic: Restoration
Format: Oral Presentation
Student Competition: No

CHALLENGES OF UTILIZING MUNICIPAL COMPOST AS AN AMENDMENT IN BOREAL FOREST RECLAMATION ON NUTRIENT POOR SITES

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Reconstructed subsoils of low fertility and organic carbon are common when trees are planted on forest reclamation sites following open pit mining. Co-composted municipal compost (urban kitchen and backyard waste) and biosolids (treated sewage sludge) is known to enhance soil properties by increasing organic matter, decreasing bulk density, and increasing water holding capacity. These improved soil conditions are often accompanied by competing invasive and agronomic species that reduce tree establishment. In this study, we explored the use of co-compost as an amendment to poor subsoils for boreal forest reclamation at a large open-pit coal mine near Edmonton, Alberta, Canada. This project utilizes a novel application (layered) technique in which co-compost incorporated into subsoil (25 cm layer) is covered with a poor mineral subsoil (20 cm) cap. This gives tree roots access to co-compost while remaining concealed from competing species. In 2015, a six hectare site was constructed and in 2016, 5,000 stems/ha of *Populus tremuloides*, *Picea glauca*, and *Pinus contorta* were planted. In 2016, the entire site experienced the establishment of a soil salinity tolerant, invasive annual (*Kochia scoparia)*. This species dominated and heavily competed with trees in plots with co-compost. There was a relationship between mineral soil cap thickness and *Kochia* performance indicating that a cap of 40-50 cm is likely more effective. High electrical conductivity (EC) and sodium adsorption ratio (SAR) values in the co-compost layer suggest that co-compost is salt-affected and may limit tree growth. Tree mensuration will occur before bud flush in April of 2017 and August.

Session Topic: Restoration in the Anthropocene
Format: Oral Presentation
Student Competition: Yes

DIFFERENTIAL EFFECTS OF INVASIVE SPECIES ON SANDBERG'S BLUEGRASS COMPETITIVE ABILITY AND TOLERANCE

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Competition from invasive plants exerts a strong selective pressure on native plant communities. The same selective pressures may also act within a species, potentially selecting for genotypes able to coexist with invaders. We evaluate whether invasions select for increased tolerance and/or competitive ability in Sandberg's bluegrass (*Poa secunda*). We hypothesized that (1) *Poa* on invaded sites develops increased ability to tolerate and compete with cheatgrass, (2) competitive ability and tolerance varies by site, and (3) a specific suite of traits are associated with enhanced competitive ability and tolerance. We collected *Poa* from paired cheatgrass or spotted knapweed invaded and uninvaded sites then moved them to a common garden. After two years growth to eliminate potential maternal effects, we collected seeds. We grew seeds from 140 maternal plants alone and in competition with cheatgrass and analyzed each for the ability to tolerate and compete at four life stages: germination, seedling, juvenile and adult. Although we did not find consistent support for our first hypothesis for juveniles or adults, smaller plants had greater tolerance and a specific suite of root traits were associated with cheatgrass tolerance and competitive ability. Seeds from invaded sites were larger, suggesting selection for a trait that confers greater ability to establish. Competitive ability, tolerance, and seed mass varied by site, indicating an invasion resistance biogeography. Our results potentially provide target traits for invasion-resistant plant materials development.

Session Topic: Role of Native Plant Materials in Restoration and Rehabilitation
Format: Oral Presentation
Student Competition: No

UNDERSTANDING THE SOCIO-ECONOMIC IMPACTS OF FOREST AND ON-FARM TREE CONSERVATION AND MANAGEMENT

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In southern Illinois, private landowners control much of the forestland in the area. These forested lands provide a habitat for native flora and fauna, protect vulnerable waterways, provide environmentally important carbon sequestration, and serve as a source of aesthetic and recreational enjoyment. A well-managed forest with a written management plan is essential to these services, but can be hard to establish on private land. Recent studies have shown that less than thirty percent of landowners in the southern Illinois region have a written forest management plan. However, recent efforts to increase landowner participation in managed forestry have been put into effect, including cost-share measures for landowners who wish to improve their forestland, tax breaks for landowners with well-managed forests, and other financial incentives. In this study, we focus on identifying key programs in the area that support landowners who wish to actively manage their forestland and investigating their ecological and socio-economic impacts on communities in southernmost Illinois. Here I present the results of interviews with officials from the Illinois Department of Natural Resources, U.S. Forest Service, Natural Resources Conservation Service, and similar groups involved with the implementation of forest management on private lands. Additionally, interviews with private landowners who practice managed forestry on their land were utilized to gain understanding of their experiences with active forest management. Results indicate that managed forestry provides both environmental and economic benefits, both to the landowners that own managed land and to the broader southern Illinois region.

Session Topic: Value of Ecosystem Services, Natural Areas Management in Light of a Changing Climate
Format: Poster Presentation
Student Competition: Yes

FOREST DISTURBANCE TRENDS FROM 1985 TO 2014 IN THE CASCADE MOUNTAIN RANGE, WASHINGTON

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Forests in Washington State generate substantial economic revenue from commercial timber harvesting, which occurs largely on the conifer-dominated, low-elevation private lands west of the Cascade Mountains. Researchers from the USGS are using a new generation of annual land-use/land-cover (LULC) products to investigate the rates, causes, and spatial and temporal patterns of forest harvest on private tracts throughout this region. LULC maps are created from the application of the Continuous Change Detection and Classification (CCDC) algorithm to Landsat satellite imagery collected from 1985 to 2014, resulting in 9 general categories of land cover at a 30-m resolution. In this study we focused on pixels that converted from forest to disturbed land cover during 1985 – 2014. We calculated annual metrics of individual patch size, total area, and distance between patches for forest and disturbed areas to assess trends in logging patterns and forest shape complexity. Random samples from groups of either persistent forest or disturbed pixels were associated with a suite of spatially explicit biophysical and geographical variables using multiple logistic regression. Results show a significant reduction and fragmentation of private forestland from 1985 to 2014. Patch dynamics suggest that logging trends are marked by four distinct eras: higher harvest rates for 1985 – 1992 and 1997 – 2007, and lower harvest rates for 1993 – 1996 and 2008 – 2012. Key explanatory variables indicate that logging site selection is more discriminating during times of weaker timber demand. The results demonstrate the utility of annual LULC data for temporally precise identification and attribution of landscape trends.

Session Topic: Forest and Range Management
Format: Poster Presentation
Student competition: No

RESTORED FIRE REGIMES REDUCE SUBSEQUENT WILDFIRE-MEDIATED CONVERSION FROM FOREST TO NON-FOREST VEGETATION TYPES

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Extensive high-severity wildfires have driven major losses of ponderosa pine and mixed-conifer forests in the southwestern U.S., catalyzing enduring conversions to non-forested vegetation types. Management interventions to reduce stand-replacing wildfire have included prescribed fire and resource-benefit wildfire, but also continues to include aggressive, direct fire suppression. The 2011 Las Conchas fire in northern New Mexico burned over forested areas not exposed to fire for >100 years as well as several prescribed fire units and prior (1977-2000) wildfire perimeters, where together resemble pre-settlement-type fire regimes. We analyzed remotely sensed burn severity grids (dNBR), pre- and post-fire field vegetation samples, and pre- and post-fire measures of surface fuels, to assess the interaction and effects of prescribed fire and prior wildfire on subsequent burn severity and patterns of post-fire forest retention vs. conversion. Prescribed fire units showed significant reductions in Las Conchas burn severity and increases in tree survival relative to stands that had not been subject to prescribed fire. Where prescribed fire units overlapped with pre-Las Conchas wildfire burn perimeters, effects were even stronger. Forests lacking recent fire were overwhelming converted to non-forested vegetation types. Forest retention was strongly associated with reduced surface fuel loads and stand density in areas exposed to prescribed fire and prior wildfire. Our results support the utility of prescribed fire, resource benefit wildfire, and their combination, in conserving forest types vulnerable to wildfire-mediated type conversion. These findings are especially relevant given projected climate changes influences on wildfire and forest dynamics.

Session Topic: Wildland Fire as a Management Tool, Restoration in the Anthropocene
Format: Oral presentation
Student Competition: No

PRIORITIZING CONTROLLED BURNS FOR HEADWATER PROTECTION

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Controlled burn helps lower fire intensity, prevent crown fire activity, and create safer suppression opportunities given the occurrence of a large catastrophic fire. Controlled burning can also help decrease sediment delivery into water facilities including lakes, reservoirs and water intakes following major fire and storm events. In this study, we first delineate the Cache la Poudre and Big Thompson Watersheds into Potential wildland fire Operation Delineations (PODs) using National Hydrography Dataset Plus Version 2 (NHDPlus2) and major roads. We systematically simulate one controlled burn starting from each POD and allow that fire to burn into its adjacent PODs. The optimal confined area of each controlled burn is determined by an optimization model under predefined weather conditions and suppression resource availability constraints. By looping through all possible starting locations and expanding patterns of controlled burns within the watersheds, we can inform managers of efficient opportunities for locating and confining the boundaries of prescribed fires.

Session Topic: Wildland Fire as a Management Tool
Format: Oral Presentation
Student Competition: No

SEASONAL WATER BALANCE DRIVES THE DISTRIBUTION OF PLANT FUNCTIONAL GROUPS IN A SEMI-ARID REGION

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Prediction of vegetation response to climate change is commonly conducted for individual species. Such species-specific predictions are limited by use of presence/absence data and the lack of information on interspecific interactions within communities. These limitations can be obviated by aggregating species data to higher organizational levels such as plant functional groups. We explored vegetation-climate relationships for six plant functional groups that occur in the semi-arid Great Basin and that differ in life cycle (perennial, annual), stature (forb, grass, shrub, tree), and growth form (woody, herbaceous). We used quantile regression GLMs to model relationships between variables describing the seasonal site water balance, and field-estimated functional group abundances. The most predictive climate variables were proxies for water deficit, AET, water storage in snowpack, soil water holding capacity, and late-season moisture. Critical thresholds were observed where trees did not occur beyond an upper limit of climatic water deficit. Models were extrapolated geographically; the spatial comparison of climatically-derived potential distributions with observed, contemporary distributions revealed the importance of land-use, exotic plant invasions, and drought-related mortality. Areas of under-predicted tree cover include woodland margins that likely expanded downwards since the late 1800s, but have recently experienced drought-related dieback. Areas of over-predicted tree cover include regions beyond the biogeographic limits of pinyon pine, and also high valleys with potential for future expansion. Comparison of annual grass models with observed *Bromus tectorum* (cheatgrass) distributions provides insight into future invasion potential. Across functional groups, results revealed fundamental climate-vegetation relationships that can be further investigated for other arid regions.

Session Topic: Natural Areas Management in Light of Changing Climate
Format: Oral Presentation
Student Competition: No

PLANT SPECIES COMPOSITION AND ABUNDANCE IN RELATION TO SOIL CHEMISTRY, THICKNESS OF PEAT, AND LIVESTOCK USE IN FENS IN THE SIERRA NEVADA, CA, USA

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Fens are peat-accumulating wetlands that form at low points in the landscape or near slopes where ground water intercepts the soil surface. Compared to other habitats, fens in the Sierra Nevada support a disproportionately large number of rare vascular and nonvascular plant species underscoring the importance of these habitats for regional biodiversity. Further, determining effects of livestock grazing on fens in the Sierra Nevada is of importance for land managers. In this study, we examined 36 fens on the Tahoe National Forest, California, to study effects of livestock grazing on these ecosystems. Fens differed in plant community composition, soil chemistry including pH, soil Carbon content and also peat thickness. Relationships between plant species occurrence, environmental variables, and livestock use will be presented and implications for managers will be discussed.

Session Topics: Wetlands
Format: Oral presentation
Student competition: No

COLORADO NATURAL AREAS PROGRAM: A CONSERVATION MODEL USING VOLUNTARY AGREEMENTS

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The Colorado Natural Areas Program (CNAP), within Colorado Parks and Wildlife, was created through state legislature 40 years ago with the mission to identify, designate, and aid in the protection of Colorado's most special natural places. The program's conservation model is unique compared to most other states' natural areas programs. CNAP attains conservation through voluntary conservation agreements and collaboration with numerous partners. CNAP currently has 112 voluntary agreements with over 30 different partners including federal, state, city, county, and private landowners. The program has a small staff but a large cadre of knowledgeable volunteer stewards. CNAP does not own or manage any of its 93 designated natural areas; however, program staff and volunteers conduct monitoring on each property and report to land managers. CNAP is the only Colorado state government program with an emphasis on rare plant conservation. Much of the program's monitoring is botanical, which fills a valuable niche for partners. Colorado recently added a rare plant addendum to its revised State Wildlife Action Plan. CNAP uses this overarching conservation strategy as a guide to implement the State's conservation efforts in coordination with other agencies on behalf of rare plant species.

Session Topic: Conservation Across Boundaries
Format: Oral Presentation
Student Competition: No

EMPLOYING MULTI-DATE REMOTE SENSING FOR MONITORING INVASIVE SPECIES DISTRIBUTION IN NATURAL AREAS

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Invasive species such as *Bromus tectorum* (cheatgrass) have been observed to rapidly spread in post-burn landscapes of the Intermountain West. Accurate maps of cheatgrass cover are necessary for targeted management, especially in topographically heterogeneous landscapes. These maps can be produced using species distribution models (SDMs) fit with field data and remotely sensed imagery. In this research, we developed an open source SDM methodology to predict the distribution of cheatgrass in a post-burn landscape that is replicable over time and can be used to forecast distribution across space. When tested with an independent dataset, the statistical accuracy of these SDMs was improved by employing an iterative approach in which a threshold for cover was established. We also quantified the area at highest risk for invasion in future seasons given 2014 distribution, topographic covariates, and seed dispersal limitations. Our research demonstrates the effectiveness of using multi-date spectral indices to monitor cheatgrass invasion in post-burn landscapes, the importance of selecting thresholds for cover in SDMs, and the applicability of Landsat 8 satellite imagery and the Software for Assisted Habitat Modeling for targeted invasive species management in natural areas.

Session Topic: Invasive species management
Format: Oral Presentation
Student Competition: No

FUNCTIONAL DIVERSITY BUFFERS NEGATIVE EFFECTS OF DROUGHT IN XERIC TALLGRASS PRAIRIE: IMPLICATIONS FOR RESOURCE MANAGEMENT

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Droughts are one of the most devastating natural hazards faced by the United States today. A key challenge in managing agro-ecosystems in the face of climatic extremes such as drought is the unpredictable nature of such events. Using a long-term dataset, we explore how grassland vegetation resilience to drought is influenced by functional group diversity and precipitation legacies. Our results show that drought effects are largely negative, as expected, but the strongest sensitivities were in forbs. We also show that legacies from previous-year precipitation play an important role in explaining current-year production responses. These results suggest that management that either ensures the presence of many types of functional groups prior to a drought or reduces legacy effects following a drought year by reducing residual dry matter may reduce drought severity and increase the rate of grassland recovery.

Session Topic: Range management, climate change
Format: Poster Presentation
Student Competition: Yes

EFFECTS OF CLIMATE CHANGE ON MAST-SEEDING IN A SEMI-ARID CONFIER: PINYON PINE (*PINUS EDULIS*)

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Mast-seeding, or the synchronous and episodic production of perennial seed crops, is a reproductive strategy utilized by several semi-arid conifers, including the widely-distributed pinyon pine (*Pinus edulis*). Seed crops of *P. edulis* constitute a significant food resource in semi-arid ecosystems, and the harvest and sale of these crops provide economic and cultural opportunities to local communities. Increases in global temperature have the potential to disrupt these socioecological functions through climate effects on seed production. Previous research has found late summer temperatures to be negatively correlated with seed production in *P. edulis*, suggesting that predicted increases in temperatures will adversely affect seed production. Yet the effects of changing climate on seed production are unlikely to be uniform across a region: the direction and magnitude of seed production responses to climate may vary due to local climatic and edaphic conditions. Using the cone abscission scar method to obtain historic (last 15 year) estimates of seed cone production across numerous sites that span a range of environmental conditions across the US Southwest, our research examines the relationship between annual fluctuation in climate and seed production and quantifies how these cone-climate relationships vary across spatial gradients of environmental stress. We also quantify how the degree of masting and total reproductive output varies across the region. Preliminary results suggest that local climatic and edaphic conditions can strongly influence the effects of climate variability on seed production for this semi-arid mast-seeding conifer.

Topic: Natural Areas Management in Light of Changing Climate
Format: Poster Presentation
Student Poster Competition: Yes

INTEGRATING CLIMATE CHANGE INTO PLANNING FOR NATURAL AREAS: AN NPS PLANNER'S PERSPECTIVE AND EXPERIENCE

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Climate change affects all aspects of national park management, from natural and cultural resources to facilities, operations, and the visitor experience. Management of the diversity of park resources and activities is guided by more than 50 types of planning documents – plans for vegetation, invasive species, fire, cultural resources, visitor management, transportation, etc. The NPS Planning Division works with parks to produce and update these plans. The planning process is the foundation for the direction and implementation of activities in parks, and is where change is often first incorporated into practices. To integrate climate considerations into routine operations and planning, the NPS Climate Change Response Program has worked closely with the Planning Division and the National Wildlife Federation to produce guidance based on the Climate-Smart Conservation guide, but with content specifically tailored for NPS and for planning professionals. Planning professionals require concise, efficient, readily accessible approaches in a form that can act as a reference document. Because climate adaptation is a complex topic, the challenge was to identify core topics and ways to very efficiently communicate the essence to planners without a background in ecology or climate sciences. The presentation discusses our approach to distilling the broad field of climate adaptation into a concise guide. This information and our "lessons learned" may assist other natural area managers to help them prepare for a continuously changing future.

Session Topic: Natural Areas Management in Light of Changing Climate
Format: Oral Presentation
Student Competition: No

COMPETITION AND INTERACTIONS BETWEEN MANAGED HONEY BEES AND NATIVE BEES IN NORTH AMERICA

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Balancing the need to support the health of managed honey bees and the conservation of native bees has created conflict over concerns that honey bees negatively impact the survival of native bees through competition for resources. A review of studies on how honey bees may impact native bee populations is crucial for informing honey bee management decisions in order to support the need for providing honey bees with forage while minimizing impacts to native bees. We compiled and review experimental studies on competition between managed honey bees and wild bees. The most consistent negative impacts of managed honey bees were reported on bumble bees. Understanding carrying capacities for bees (managed and native) is crucial to understand whether honey bees potentially compete with native bees for limited resources, yet no studies have examined landscape carrying capacity. Because there is a severe lack of literature, yet potential that honey bee presence could negatively impact native bees, we advocate for further research on competition between managed and native pollinators and guidance for landscape situations where they interact.

Session Topic: Pollination, Species management
Format: Oral Presentation
Student Competition: No

RESTORING SOUTHERN BLUE RIDGE MAFIC FENS AND WOODLANDS IN VIRGINIA: TWO DECADES OF ACTIVE MANAGEMENT AT BIG SPRING BOG AND GRAYSON GLADES STATE NATURAL AREA PRESERVES

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Located in the Southern Blue Ridge physiographic province within Grayson County, Virginia, The Glades conservation site supports a globally rare ecological community and numerous state and globally rare plant and animal species. Since the early 20th century, much of The Glades has been fragmented by residential development and altered hydrologically by agriculture and mining. In 1991, the Virginia Department of Conservation and Recreation (DCR) began acquiring land in The Glades. As of 2017, 103 acres has been dedicated within two State Natural Area Preserves: Big Spring Bog and Grayson Glades. For the past 18 years, DCR's Division of Natural Heritage has worked to restore these natural areas with a combination of on-going invasive species control and mechanical thinning, plus repeated applications of prescribed fire. We evaluated plant community monitoring data, rare plant population monitoring data and photo series to chronicle the effects of this active management. Our results suggest that the current management strategy is both (1) increasing native herbaceous species richness and abundance and (2) beneficial to the site's high-value conservation species. Similar results may be possible within other portions of The Glades conservation site and at similar sites in the Southern Blue Ridge of Virginia and North Carolina.

Session topics: Rare Species Management; Wildland Fire as a Management Tool; Invasive Species Management
Format: Oral presentation
Student competition: no

PREDICTIVE PROVENANCING: CAN SOUTHERN-SOURCED SEEDS BE USED IN MIDWEST RESTORATION EFFORTS?

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Due to climate change of an unprecedented rate, planning restoration populations to be adaptive and resilient is of critical importance. Managers and researchers have conventionally recommended using locally sourced seed for restoration due to local adaptation. Because of the rapid rate of change, some have suggested a predictive approach of using seed from plants adapted to the conditions that the restoration site will soon face. However, without empirical testing, this strategy risks that the resultant seedlings will be maladapted to the conditions of the restoration site. The emergence, establishment, survival, and fitness of these seedlings will depend on their suitability to the environment and timing of germination and flowering. We use two species (*Chamaecrista fasiculata* and *Rudbeckia hirta*) to examine if southern-sourced seeds are appropriate. We seeded them in a common garden to compare the phenology, survival, and fitness of seeds and seedlings from three potential sources for the Chicago area that differed by latitude. Under lab conditions, seeds from local and southern sources had higher germination compared to the northern source while in the field we found much lower establishment in the seedlings from the local and southern sources in *C. fasiculata*. In both species, we found individuals from southern regions to flower later. In *C. fasiculata*, we found higher seed set in the southern source while in *R. hirta* we found higher seed set in the local source. We use Aster modeling to present a more accurate comparison of lifetime fitness and make recommendations on predictive seed sourcing.

Session Topic: Restoration in the Anthropocene
Format: Oral Presentation
Student Competition: Yes

PROJECTED EFFECTS OF CLIMATE CHANGE ON AVIAN COMMUNITIES IN US NATIONAL PARKS

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Climate change is projected to drastically shift or reduce ranges of nearly half of North America's bird species. We used survey data from the Breeding Bird Survey and Christmas Bird Counts and 17 bioclimatic variables to construct species distribution models for 360 species in summer and 396 species in winter. We then projected climatic suitability in 2011-2040 and 2041-2070 across 274 US national parks. For each species and season, we performed a linear regression of climate suitability over time to analyze change, and found that if bird communities in national parks respond to climate change as anticipated then they are likely to see drastic changes in the next several decades. Looking at the high greenhouse-gas emissions scenario (8.5 W/m^2) that is consistent with current trends, avian communities in parks may experience an average turnover of 0.27 ± 0.09 in the summer and 0.25 ± 0.11 in the winter. Gains in climate suitability in winter outpace losses across all parks; an average of 50 ± 13 species could gain suitability in the winter. Half of national parks are projected to lose climate suitability for 25% or more of their current birds in summer by mid-century, although 60% are projected to gain suitability for 25% or more species. The changes (additions and losses) would be more drastic at higher latitudes, and less drastic under a low emissions scenario (2.6 W/m^2). National parks, although already protected from the threat of habitat modification, are nevertheless prone to significant climate-driven changes in avian communities.

Session Topic: Climate change
Format: Oral Presentation
Student Competition: No

ARCADE CREEK: SACRAMENTO'S GREATEST OPPORTUNITY

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Arcade Creek in Sacramento, California is a secret wonderland of oak woodlands, remnant prairie, and archaeological resources. Located just one mile north of the central city, the creek serves as a laboratory for students, a haven for fish and wildlife, and provides open space and recreation to urban residents. Remaining natural resources within the watershed, both protected and vulnerable, present great opportunities for increasing ecological services including mitigating urban heat island effects, retaining and filtering stormwater, and reconnecting pathways for people and wildlife. Serious threats to the creek include invasive non-native plants, creek channel erosion due to the post-1940s stormwater system, and ongoing intrusion of illegal campers who bring solid waste, camp fires, and IV drug use into designated Natural Areas. Collaboration between local government; land managers including the Sacramento Horseman's Association, Morton Golf LLC; nonprofit organizations, regional businesses, local schools, and energized community activists have led to numerous efforts to protect, restore, and advocate for care of this public resource. Recent efforts include reforestation of oak woodland and riparian forests with locally harvested materials, water quality assessment by students, Creek Week cleanups, clearing of illegal campsites, soil and water conservation projects, and increased vigilance by volunteer park stewards and city staff. Diverse stakeholders are combining their skills, insights, and muscle to conserve and restore the natural and recreational resources of Arcade Creek, boost the ecological functions of the waterway, and bring Nature to within reach of people who dwell in neighborhoods that are increasingly diverse, both ethnically and economically.

Session topic: Urban/Wildland Interface
Format: Oral Presentation
Student Competition: No

THE URBAN PRAIRIES PROJECT: PARTNERSHIPS FOR OPEN SPACE RESTORATION

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Collaboration is key when it comes to restoring urban and suburban open spaces for pollinators and people. In 2016, The Urban Prairies Project brought public and private partners together to devise restoration work plans, educate the community about open space issues and create a corps of Restoration Master Volunteers. These knowledgeable, committed volunteers expand capacity by assisting with revegetation efforts, weed management, pollinator monitoring, bioblitzes and public programs in order to ensure more successful restoration efforts. Each year, Butterfly Pavilion, the City of Westminster and City and County of Broomfield identify 25 additional acres to add to the program and create comprehensive scopes of work for each new site. Data collected at each site is then used to evaluate success and adapt work plans to constantly changing conditions. Over the next five years, the Urban Prairies Project will restore over 120 acres of pollinator habitat throughout Broomfield and Westminster, CO and serve as a model of habitat restoration and community engagement in the region.

Session Topic: Role of Natural Areas in Pollinator and Invertebrate Conservation
Format: Oral Presentation
Student Competition: No

MONITORING THE EFFECT OF SYLVATIC PLAGUE IN BLACK-TAILED PRAIRIE DOGS ON DENSITY AND TRENDS OF GRASSLAND BIRDS IN THE MOUNTAINS TO PLAINS AREA OF NORTHERN COLORADO

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In an ongoing effort to aid conservation and management of a biological corridor containing some of the last high quality shortgrass prairie along northern Colorado's Front Range, Bird Conservancy of the Rockies has partnered with the City of Fort Collins to monitor grassland birds on 45,000 acres of city-owned properties annually since 2006. This annual monitoring has contributed to a better understanding of the Natural Area's bird community population dynamics and how adaptive land management can affect bird abundance and distribution, especially in light of recent outbreaks of sylvatic plague that have significantly decreased the Black-tailed prairie dog (*Cynomys ludovicianus*) population. Long-term annual bird monitoring has documented a concurrent decline in prairie dog-associated bird species and provided a basis for grassland bird management. Management in these areas strives to conserve and augment prairie dog populations, maintain and restore native shortgrass prairie, minimize disturbance from natural resource development and recreation, and closely monitor grassland bird populations. Bird Conservancy's partnership with the City of Fort Collins' Natural Areas has also helped leverage significant support for grassland bird habitat management and conservation science in northern Mexico, where many of the species breeding on city-owned natural areas spend the winter, thereby helping to protect investments made by the City of Fort Collins. This dual-focus conservation effort provides a model for full-annual cycle stewardship and conservation of migratory birds and helps bridge the gap between science and conservation.

Session Topic: Conservation Across – Natural/Political/Cultural
Format: Symposia Oral Presentation
Student Competition: No

THINKING OUTSIDE THE BOX WHEN PRODUCING MATERIALS TO RESTORE LOCALLY RARE PLANT SPECIES: MICROPROPAGATION OF *CIRSIUM HILLII* IN THE CHICAGO REGION

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Attaining sufficient seed for the restoration of some plant species can be limited by low population sizes, low seed production, and low seed viability. Tissue culture (or in vitro propagation) may be used as an alternative method of producing propagules for ex situ and in situ conservation. The controlled environment and rapid multiplication possible with tissue culture increases efficiency and likelihood of success when dealing with limited amounts of materials. One species that could benefit from the use of tissue culture as a conservation technique is Hill's thistle (Cirsium hillii), a perennial thistle listed as threatened in Wisconsin and Illinois and endangered in Indiana. Populations of Hill's thistle in the Chicago Region have been shown to have low seed set and viability, associated with a limited number of mates, making conservation through more traditional methods difficult. Here, I describe a project underway at the Chicago Botanic Garden aimed at establishing and multiplying numerous lines of Hill's thistle in tissue culture. The ultimate goal of the project is to produce plant material in vitro that can be acclimatized to field conditions and used in seed beds to increase production or re-introduced to new or existing populations. In this talk, I will cover some of the challenges and opportunities presented by in vitro propagation of Hill's thistle and the possible applications of this work in the conservation of other seed limited and/or threatened plant species in the Chicago region.

Session topics: Rare Species Management, Role of Native Plant Materials in Restoration & Rehabilitation, Species Re/introduction
Format: Oral Presentation
Student Competition: Yes

TREE REGENERATION PATTERNS FOLLOWING ATYPICAL STAND-REPLACEMENT FIRE: INFLUENCE OF TOPOGRAPHY AND NEIGHBORS

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Past disturbances modify spatial patterns of forest structure influencing future forest dynamics. In *Pinus ponderosa* forests, the role of historic fire regimes on spatial patterning is well understood. Conditions following large extents of high-severity fire however, challenge our understanding of how such fires modify patterns of forest structure. In this study, we mapped regenerating trees after a decade of establishment following high-severity fires in Colorado and South Dakota. We explored spatial patterns of tree locations and heights using point pattern analyses. We tested whether patterns were influenced by tree interactions or topographic influences using point process modelling. Tree regeneration was sparse, averaging 43 trees ha^{-1}. All species were spatially aggregated. Interspecific species associations with, and without, *P. ponderosa* revealed attraction and independence, respectively. Accounting for abundance decreasing with distance from residual forest canopy, we found more *P. ponderosa* in exposed areas like southwesterly aspects, whereas other conifers were abundant in sheltered areas, and *Populus tremuloides* was common in swales. Trees occurred in conspecific size hierarchies. Proximity to heterospecifics modified tree heights, specific to species-pairs. Observed patterns reflect the contribution of tree interactions and topography on tree establishment and growth. Results suggest both topography and facilitation drive establishment patterns. Although topography did not explain tree heights, positive tree interactions were influential. These patterns, mainly of a facilitative origin, establish future enhanced competitive processes, including *P. tremuloides* exclusion. Forest managers should consider such patterns of tree regeneration when contemplating near-term post-fire actions or anticipating long-term forest dynamics.

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