CASRI: Partnerships for Connectivity

Canaan Valley Resort & Conference Center

13-14 November 2018

CASRI's "Partnerships for Connectivity" conference celebrates decades of success restoring the red spruce-northern hardwood ecosystem in Central Appalachia. Long-term partnerships have been invaluable to continued success in receiving funds for restoration at scale as well as moving forward with novel restoration methods and tools.

This conference gathers managers, practitioners, scientists, and leaders in the field to discuss the latest research findings, problem-solve common management challenges, and network to advance new and emerging partnerships. Strong partnerships will enable the network to continue to advance landscape resilience and connectivity of red spruce forests across the region. We, the CASRI conference committee, are excited to host you at the Canaan Valley Resort & Conference Center in gorgeous Davis, WV November 13th & 14th.

Please submit your questions and feedback to kathryn.barlow@tnc.org.

This CASRI conference is made possible by generous donations from the West Virginia Highlands Conservancy and The Nature Conservancy's Central Appalachians program.

Program Overview

Tuesday, 13th November 2018

8:00 am – 8:45 am	Registration and Networking Time – *Aspen Hospitality Area*
General Sessions ***Spruce Meeting Room***	
8:45 am – 9:00 am	Welcome with Ron Hollis Project Leader of the Canaan Valley National Wildlife Refuge
9:00 am – 9:10 am	Conference Overview with Katy Barlow Restoration and Public Lands Manager for the Central Appalachians Program The Nature Conservancy

9:10 am – 10:10 am 10:10 am – 10:30 am	Opening Remarks: *Partnerships Leverage Connectivity for Conservation* Clyde Thompson, Forest Supervisor of the Monongahela National Forest Thomas Minney, State Director of The Nature Conservancy in West Virginia John Schmidt, Field Supervisor of the West Virginia Field Office of the U.S. Fish and Wildlife Service Presentations from each panelist Panel discussion
10:30 am – 10:45 am	BREAK
	SOILS SESSION Facilitator: Pabodha Galgamuwe, Forest Science Project Manager, TNC-MD
10:45 am – 11:15 am	*Soils, Ecological Sites, and Forest Restoration in the Central Appalachians* Speaker: James A. Thompson, Professor of Soils and Land Use, WVU
11:15 am – 11:45 am	*Soil Carbon Estimation on the Monongahela National Forest: What Role Can Soil Carbon Have in Forest Management?* Speaker: Steffany Mellor, Forest Soil Scientist
11:45 am – 12:15 pm	*Exploring the Influence of Microclimate Data on Red Spruce* (Picea rubens) *Presence Prediction* Speaker: Adrienne Nottingham, Assistant Forest Soil Scientist
12:15 pm – 1:15 pm	LUNCH – *Maple Meeting Room* Mingle by table topic: Soils, Wildlife, Vegetation, Climate Adaptation
	WILDLIFE SESSION Facilitator: Amy Coleman, South Zone Ecologist, Monongahela National Forest
1:15 pm – 1:45 pm	*Partnering for Spruce and Birds: Opportunities for Greater Collaboration Between the Appalachian Mountains Joint Venture and CASRI* Speaker: Todd Fearer, Coordinator for the Appalachian Mountains Joint Venture
1:45 pm – 2:15 pm	*Wildlife and Ecological Restoration: Habitat Conditions, Treatment Responses, and Adaptive Management* Speaker: Corinne Diggins, Postdoctoral Researcher, VA Tech

2:15 pm – 2:45 pm	*S to the Fourth Power: Spruce, Spodosols, Squirrels, and Saprophytes, aka Using ESDs to Describe and Manage the Habitat of WV Northern Flying Squirrel (*Glaucomys sabrinus fuscus*) in WV* Speakers: Shane Jones, Wildlife Biologist, MNF; Jason Teets, Soil Scientist, USDA
2:45 pm – 3:15 pm	COFFEE BREAK Wildlife speakers available for questions
VEGETATION SESSION Facilitator: Douglas Manning, North Zone Ecologist, Monongahela National Forest	
3:15 pm – 3:45 pm	*Relative Abundance of Habitats and Species in Greatest Conservation Need in the High Alleghenies Conservation Focus Area* Speaker: Jim Vanderhorst, Natural Heritage Program Ecologist, WV DNR
3:45 pm – 4:15 pm	*Red spruce recovery in the Central Appalachian Mountains* Speaker: Justin M. Mathias, Ruby Doctoral Fellow, WVU
4:15 pm – 4:45 pm	*Outcome-Based Restoration Monitoring* Speaker: Ben Rhodes, Ecological Restoration Coordinator, TNC
4:45 pm – 5:15 pm	*Forest Ecosystem Restoration for Climate Resilience in the Central Appalachians* Speaker: Campbell Moore, Director of the Central Appalachians Whole System program, TNC
5:15 pm – 7:00 pm	BREAK and POSTER SESSION Vegetation Session speakers available for questions Posters presenters available for questions – *Aspen Hospitality Area*
7:00 pm – 9:00 pm	DINNER – *Maple Meeting Room* *Shades of Death: How temporal and spatial landscape connectivity enabled our spruce ecosystem to survive insects, fire, drought, ax, acid rain, and climate change* Dinner Speaker: Rodney Bartgis

Wednesday, 14th November 2018

8:00 am – 8:30 am	Registration and Networking Time – *Aspen Hospitality Area*
General Sessions ***Spruce Meeting Room***	
8:30 am – 9:00 am	Opening Remarks on Partnership: *Implementing the Forestry Reclamation though Partnerships* Speaker: Scott D. Eggerud, Forester, OSMRE
9:00 am – 9:50 am	PLENARY *Combining experiments, spatial models, and the paleorecord to explore climate adaptation in forest trees* Speaker: Matt Fitzpatrick, Assistant Professor, UM
PRACTITIONERS' PERSPECTIVES	
9:50 am – 10:20 am	*Introduction of Ecosystem Services Incorporation into Land Management and Restoration on the Monongahela National Forest* Speaker: Stephanie J. Connolly, Forest Soil Scientist, MNF
10:20 am – 10:40 am	BREAK Morning session speakers available for questions
10: 40 am – 12:00 pm	*Panel Discussion: Spruce Release Science and Implementation* Facilitator: Ben Rhodes, Ecological Restoration Coordinator, TNC Panelists: Dr. James Rentch, WVU; Dr. Melissa Thomas-Van Gundy, USFS; Ben Rhodes, TNC-WV; Travis Miller, WVDOF
12:00 pm – 1:15 pm	LUNCH – *Maple Meeting Room* CASRI Trivia Game – Facilitated by Hannah Worton, Appalachian Forest Heritage Area Americorps for the Monongahela National Forest
1:15 pm – 5:00 pm	FIELD TRIPS *10 Years of Public and Private Spruce Ecosystem Restoration in Canaan Valley* Guides: Dawn Washington, Wildlife Biologist, CVNWR; Mike Powell, Director of Lands, TNC-WV **Carpooling is encouraged. High clearance, all-wheel drive vehicles are required.**

Abstracts - Tuesday, 13th November 2018

Opening Remarks on Partnership	*Facilitator – Katy Barlow, Restoration and Public Lands Manager, TNC-Central Apps*	9:10 am – 10:30 am

Partnerships Leverage Connectivity for Conservation

PANELISTS
Clyde Thompson, Forest Supervisor of the Monongahela National Forest
Thomas Minney, State Director of The Nature Conservancy in West Virginia
John Schmidt, Field Supervisor of the West Virginia Field Office of the U.S. Fish and Wildlife Service

CASRI partners - public agencies, non-profits, and dedicated citizen volunteers – have made red spruce ecosystem restoration throughout its historic footprint in the Central Appalachians a reality. 'Partnership' is more than a 'buzz' word for the committed individuals and teams in the CASRI network who believe that to drive forward a shared vision on a landscape scale it takes genuine listening and sharing across viewpoints, and collaborative planning. Our panelists are leaders in their organizations who have facilitated the CASRI partnership that enables and leverages connectivity of ecosystems and partners for conservation. From the perspective of their organization each panelist will speak to meeting the challenges and opportunities that a successful multi-stakeholder partnership contributes to landscape resilience in the Central Appalachians.

Soils Session	*Facilitator – Pabodha Galgamuwe, Forest Science Project Manager, TNC-MD*	10:45 am – 12:15 pm

Soils, Ecological Sites, and Forest Restoration in the Central Appalachians
Speaker: James A. Thompson, Professor of Soils and Land Use
Authors: James A. Thompson[1] and Stephanie J. Connolly[2]
[1]Division of Plant and Soil Sciences, West Virginia University
[2]USDA Forest Service, Monongahela National Forest

Soil surveys have provided baseline data for land use planning in the United States since the early 20th century. Ecological Site Descriptions (ESD) are complementary land management tools that integrate historic and local knowledge of ecosystems paired with field data to describe ecological dynamics. Often, USDA-NRCS soil surveys are used as the foundation for many ESD. Recent work by NRCS and USFS staff identified significant acreage of previously unrepresented Spodosols in areas associated with historic and current red spruce forests on the Monongahela National Forest (MNF) and surrounding privately held lands. Since 2010 several MLRA Soil Survey projects have been conducted in Pendleton, Pocahontas, and Randolph Counties, WV, resulting in over 300 soil profiles descriptions which focused on identifying spodic morphology. As a result, one new soil series (Wildell, a Haplorthod) was developed and one existing soil series (Mandy) was reclassified as a Spodic Dystrudept. Consequently large tracts of land in WV were remapped to reflect these changes. This remapping effort also supported the development of ESD in this region. This presentation discusses the development of two ESD in historic red spruce habitat in West Virginia, and how those ESD were used to inform land management decisions. The development of these ESD was and continues to be essential for land management planning to support red spruce restoration, soil carbon management, and expansion of Cheat Mountain Salamander (*Plethodon nettingi*) and Virginia Northern Flying

Squirrel (*Glaucomys sabrinus fuscus*) habitat while simultaneously allowing for targeted profitable timber management.

Soil Carbon Estimation on the Monongahela National Forest: What Role Can Soil Carbon Have in Forest Management?

Speakers: Steffany Mellor, Forest Soil Scientist
Authors: Steffany Mellor[1], Frederica Wood[2], Adrienne Nottingham[1], Stephanie J. Connolly[1], and Pamela J. Edwards[2]
[1]USDA Forest Service, Monongahela National Forest
[2]USDA Forest Service, Northern Research Station

Current land management initiatives on the Monongahela National Forest (MNF) include interdisciplinary red spruce restoration projects that will help to restore soil carbon, improve habitat for threatened species, and protect important ecosystem services. Toward that end, the MNF soil resource staff has built a soil chemistry database over the past 20 years, which is now being used to develop a Forest-wide spatial soil carbon layer in GIS. Source data include descriptions and soil chemistry results from samples collected by MNF staff, Natural Resource Conservation Service (NRCS), and cooperating academic institutions. All data were collected by horizon from soil pedons following NRCS standards. Pedons primarily were located in project areas to provide data for environmental analyses, with the earliest sampling focused on characterizing soils for their sensitivity to acidification by atmospheric deposition. More recent sampling locations have been included to target questions centered on red spruce restoration and carbon sequestration. MNF data along with historic NRCS data collected within the MNF are being used in geographically-weighted regression (GWR) analyses to estimate and map carbon stores. Initial data analyses compared mineral carbon stores by source (MNF vs. NRCS), geologic formation, forest type, and soil order. No differences were found by data source, so all data were included in subsequent analyses. Data also were not different by geologic formation. Preliminary GWR results indicate that topographic variables and vegetation indices are the most important environmental covariates for predicting mineral soil carbon on the MNF, with coefficient of determination (R^2) values ranging from 0.34 to 0.47 (mean = 0.39). Unexpectedly, pedons associated with conifer forests and Spodosols or Spodic complexes, respectively, had significantly lower carbon stores than other forest types or soil orders. Explanations for these results include decreases in mineral carbon from soil disturbances by exploitative clearcutting and wildfires that occurred early in the 20th century. Our results show that soils associated with hardwood forest types, often ignored for carbon management, have potential to sequester substantial amounts of carbon. In addition, with time, restoration of red spruce forests and underlying Spodosols may regain their potential to sequester much larger carbon reserves that are thought to have existed 100 to 150 years ago.

Exploring the Influence of Microclimate Data on Red Spruce (Picea rubens) *Presence Prediction*

Speaker: Adrienne Nottingham, Assistant Forest Soil Scientist
USDA Forest Service, Monongahela National Forest

Models predicting red spruce (*Picea rubens*) presence are used to guide forest restoration efforts; however, previous efforts have not utilized site-specific microclimate data. In this study, local air temperature, soil temperature, and soil moisture data were collected at 20 randomly-located plots in a small (5.4 km^2), high-elevation watershed (781-1424 m). Measured microclimate data were aggregated into variables thought to be associated with red spruce physiological requirements, extrapolated across the watershed, and combined with topographic attributes as inputs for a commonly-used species distribution model, Maximum Entropy. Area under the receiver operating characteristic curve (AUC) values for models using only topographic, air temperature, soil temperature, or soil moisture variables were 0.80, 0.79, 0.78 and 0.69 respectively. The most

important topographic and microclimatic variables from these runs were combined in a final model that yielded an AUC value only slightly better than preliminary run with only topographic variables. Highest relative occurrence rates of red spruce for both the topographic-only model and the final model were predicted within cold air drainage ways rather than on higher elevation ridgetops. Therefore, focusing restoration efforts in coves adjacent to ridgetops and shoulders could improve ecosystem connectivity, which is especially important for species endemic to red spruce ecosystems.

Wildlife Session	*Facilitator – Amy Coleman, South Zone Ecologist, Monongahela National Forest*	1:15 pm – 2:45 pm

Partnering for Spruce and Birds: Opportunities for Greater Collaboration Between the Appalachian Mountains Joint Venture and CASRI

Speaker: Todd Fearer, Coordinator for the Appalachian Mountains Joint Venture
Appalachian Mountains Joint Venture

The Appalachian Mountains Joint Venture (AMJV) is one of 21 U.S. Fish and Wildlife Service Migratory Bird Joint Ventures. The mission of the AMJV is to restore and sustain viable populations of native birds and their habitats in the Appalachian Mountains Joint Venture region through effective, collaborative partnerships. The AMJV is a self-directed partnership with a 22-member management board consisting of state agencies, federal agencies, and several NGOs involved in conservation in the Appalachians. Conservation and restoration of high elevation spruce stands throughout the Appalachians has been of the AMJV's priorities since its inception in 2008, and many of our partners are actively engaged in both the Central and Southern Appalachia Spruce Restoration Initiatives. The AMJV recently completed a new 5-year strategic plan that included increased collaboration with other conservation partnerships in the Appalachians as a high priority. This presentation will provide an overview of the AMJV's work in the Appalachians and our new strategic plan, focusing on collaborative opportunities to work with CASRI that will provide mutual benefits to both partnerships.

Wildlife and Ecological Restoration: Habitat Conditions, Treatment Responses, and Adaptive Management

Speaker: Corinne Diggins, Postdoctoral Researcher
Department of Fish and Wildlife Conservation, Virginia Tech

Appalachian spruce-fir forests host a variety of rare species that are either endemic to the region or are disjunct populations of northern latitude species at their most southern distribution. Due to past industrial logging, acid precipitation, introduced pests, and climate change, the extent and quality of these forests were greatly reduced. As a result, many of the species associated with Appalachian spruce-fir forests are rare and of conservation concern on the state and/or federal level. Therefore, rare, sensitive, or endangered wildlife tend to be a main management driver to conserve existing spruce forests or to recover the extent of this forest type. Successful conservation and ecological restoration require an understanding of wildlife responses across a gradient of structural, temporal, and spatial scales. Ecological restoration uses reference conditions to guide restoration treatments and post-restoration management. However, for wildlife, reference conditions do not typically exist. I will focus this talk on how understanding wildlife habitat needs, monitoring wildlife responses to treatment, and designing restoration in adaptive management framework are important to ensuring restoration enhances habitat for rare and endangered wildlife.

*S to the Fourth Power: Spruce, Spodosols, Squirrels, and Saprophytes, aka Using ESDs to Describe and Manage the Habitat of WV Northern Flying Squirrel (*Glaucomys sabrinus fuscus*) in WV*

Speakers: Shane Jones[1], Wildlife Biologist; Jason Teets[2], Soil Scientist
[1]USDA Forest Service, Monongahela National Forest
[2]USDA Natural Resources Conservation Services

Ecological Site Descriptions (ESDs) are reports that describe the biophysical properties of ecological sites, vegetation and surface soil properties of reference conditions that represent pre-European vegetation and historical range of variability. The descriptions include a state-and-transition model and text, and a description of ecosystem services provided by the ecological site. Ecological sites are linked to one or more map unit components of one or more soil map units. The West Virginia Natural Resources Conservation Service and Monongahela National Forest have partnered to create ESDs on soil map unit components derived from high elevation Devonian shale and sandstone materials. Soil Scientists have recently acknowledged the evidence of podzolization within these materials that historically was not documented in published soil surveys. These "podzolized" soils provide clues to the historic range of red spruce and red spruce-hardwood forests. The exploitative logging and subsequent slash fires during and following the industrial logging period from 1880-1920 severely degraded soils and reduced the extent of red spruce on the landscape. Fortunately, some fragmented patches of red spruce and red spruce-hardwood forest (reference communities) with the accompanying 'old soils' that contain folistic epipedons escaped disturbance in areas difficult to access or slash fire was absent. Refugia for rare species such as WV Northern Flying Squirrel (NFS) exist as fragments across its historic range. Two ESDs have been approved and correlated. The Spodic Shale Upland Conifer Forest consists of a red spruce-eastern hemlock/intermediate woodfern species assemblage. The Spodic Intergrade Shale Upland Hardwood and Conifer Forest consists of a red maple-red spruce/intermediate woodfern species assemblage. These sites are associated with new map unit components that recognize the influence of podzolization across the landscape; the soil components are classified as Spodosols and Spodic Dystrudepts. Using these ESDs conservationists are informed about appropriate locations for spruce planting and release of red spruce for restoration of NFS habitat. Land managers and practitioners can use these ESDs to target restoration efforts and set trajectories for NFS habitat composition and structure.

Vegetation Session	*Facilitator – Douglas Manning, North Zone Ecologist, Monongahela National Forest*	3:15 pm – 5:15 pm

Relative Abundance of Habitats and Species in Greatest Conservation Need in the High Alleghenies Conservation Focus Area

Speaker: Jim Vanderhorst, Natural Heritage Program Ecologist
West Virginia Division of Natural Resources Wildlife Section

Three key elements identified in State Wildlife Action Plans (SWAPs) are habitats, Species in Greatest Conservation Need (SGCN), and Conservation Focus Areas (CFAs). West Virginia's SWAP was submitted to and accepted by the U. S. Fish and Wildlife Service in 2015 and we are now developing conservation plans for each of 21 CFAs. To inform this process I conducted a spatial analysis of habitats and SGCN that occur in CFAs. Relative abundance of a SGCN in a CFA is calculated as the number of occurrences of the SGCN in that CFA divided by the total number of occurrences in the

state. This metric helps identify which species are most important for conservation in each CFA. I conducted a similar analysis for habitats. Results will be presented for the High Alleghenies CFA.

Red spruce recovery in the Central Appalachian Mountains

Speaker: Justin M. Mathias, Ruby Doctoral Fellow
Authors: Justin M. Mathias[1] and Richard B. Thomas[2]
[1]Department of Biology, West Virginia University
[2]Professor and Chair of The Department of Biology, West Virginia University

In the 45 years after legislation of the Clean Air Act, there has been tremendous progress in reducing acidic air pollutants in the eastern United States, yet limited evidence exists that cleaner air has improved forest health. We investigated the influence of recent environmental changes on the growth and physiology of red spruce (*Picea rubens* Sarg.) trees, a key indicator species of forest health, spanning three locations along a 100 km transect in the Central Appalachian Mountains. We incorporated a multiproxy approach using 75-year tree ring chronologies of basal tree growth, carbon isotope discrimination ($\Delta^{13}C$, a proxy for leaf gas exchange), and $\delta^{15}N$ (a proxy for ecosystem N status) to examine tree and ecosystem level responses to environmental change. Results reveal the two most important factors driving increased tree growth since *ca*. 1989 are reductions in acidic sulfur pollution and increases in atmospheric CO_2, while reductions in pollutant emissions of NO_x and warmer springs played smaller, but significant roles. Tree ring $\Delta^{13}C$ signatures increased significantly since 1989, concurrently with significant declines in tree ring $\delta^{15}N$ signatures. These isotope chronologies provide strong evidence that simultaneous changes in C and N cycling, including greater photosynthesis and stomatal conductance of trees and increases in ecosystem N retention, were related to recent increases in red spruce tree growth and are consequential to ecosystem recovery from acidic pollution. This study documents the complex environmental interactions that have contributed to the recovery of red spruce forest ecosystems from pervasive acidic air pollution beginning in 1989, about 15 years after acidic pollutants started to decline in the United States.

Outcome-Based Restoration Monitoring

Speaker: Ben Rhodes, Ecological Restoration Coordinator
The Nature Conservancy, West Virginia Chapter

Over the past decade, CASRI has implemented several different monitoring protocols to gauge the efficacy of its red spruce restoration projects. Those monitoring efforts have had mixed results, as practitioners and researchers have attempted to balance the need for meaningful quantitative data against practical concerns like staff availability and funding. Despite these difficulties, CASRI has gained valuable insights from its monitoring programs. This presentation will discuss those findings, the pros and cons of each major monitoring protocol, and potential steps towards establishing a set of protocols that benefits researchers and practitioners alike.

Forest Ecosystem Restoration for Climate Resilience in the Central Appalachians

Speaker: Campbell Moore, Director of the Central Appalachians Whole System program
The Nature Conservancy

West Virginia's high elevation red spruce forests are part of a much larger conservation landscape that spans the Appalachians and connects the southern blue ridge nearly to the boreal forest. This presentation will help put CASRI's important work in this larger landscape context. Over 80 scientists, led by The Nature Conservancy (TNC), have invested a decade of research into identifying the landscapes in North America where natural systems have the greatest ability to adapt to climate change. This presentation will provide a brief overview of that science and how TNC implements and uses that science to guide our work, including CASRI's role in advancing these larger conservation visions.

Poster Session	5:15 pm – 7:00 pm

Rock-Eating Fungi Trace Fossils in US Spodosols and Possible Implications for Red Spruce Restoration in West Virginia

Presenter: James E. Leonard
Authors: James E. Leonard[1], James A. Thompson[1], Kathleen C. Benison[2]
[1]Division of Plant and Soil Sciences, West Virginia University, Morgantown, WV
[2]Department of Geology and Geography, West Virginia University, Morgantown, WV

The existing habitat of red spruce (*Picea rubens*) within the high-elevation forests of West Virginia has been significantly reduced due to intensive logging in the late 19th and early 20th century, followed by wildfires, disease, and soil erosion that reduced spruce regeneration. Efforts are now being made to restore spruce habitat within its historic extent. It is known that red spruce and other gymnosperms form symbiotic relationships with ectomycorrhizal fungus (EcM) species, enabling greater access to nutrients for the host plant. It has also been documented that EcM can tunnel into sand- and silt-sized grains of feldspar, contributing to the overall weathering process and nutrient acquisition in a nutrient limited environment—while leaving behind distinctive micropores within the mineral grains. We looked for the presence of fungal tunnels in the high-elevation Spodosols of WV and archived USDA-NRCS samples from across the US. Thin sections from eluvial horizons, representing Spodosols from WV and seven other states were examined with optical petrography to identify distinctive EcM fungi tunnels in feldspar mineral grains. Images depicting tunneled minerals were taken from each thin section, and the intensity of weathering and frequency of tunneling were compared with soil and site characteristics of the sample locations to better understand possible relationships. Out of 18 total NRCS samples, eight pedons were found to exhibit EcM tunneling with various degrees of hyphal weathering, while four of the five samples from WV also contained these same fungal trace fossils. All pedons containing hyphal weathering were associated with coniferous and/or ericaceous vegetation, including red spruce. These trace fossils of past EcM tunneling may be useful as an indicator to identify and delineate historic red spruce habitat and, therefore, potential restoration sites.

Continued Research on the Federally Threatened Cheat Mountain Salamander: Movement and Genetics

Author and Presenter: Dawn Washington, Wildlife Biologist
Canaan Valley National Wildlife Refuge

In 2016, a wildlife underpass was constructed on a Canaan Valley National Wildlife Refuge ski trail. From December to April, this trail is heavily traversed by skiers of White Grass Ski Touring Center. The trail travels through red spruce forest, habitat to the federally threated Cheat Mountain Salamander (CMS). CMS are endemic to only 5 counties in West Virginia and rely on cool, moist habitat to breathe through their skin. To assess whether the trail is causing fragmentation in the CMS population, in 2017 habitat assessments and mark-recapture surveys began around the underpass. Every CMS found was marked with a unique fluorescent elastomer for future identification to investigate the movement of CMS. This year, the project has been expanded to include genetic sampling at the underpass site along with two other sites within the refuge. Tail clips from each site were taken and sent to West Virginia University for analysis to determine the similarities and differences between these three isolated populations. Currently, 44 CMS have been marked and 93 genetic samples have been collected.

The Monongahela National Forest's high elevation spruce & spruce-northern hardwood habitats and the species that rely on them – conservation challenges and opportunities

Author and Presenter: Catherine M. Johnson, Wildlife Program Manager
USDA Forest Service, Monongahela National Forest

Mineland restoration of red spruce in the Monongahela National Forest

Authors: Jenna Happach and Hannah Wroton, Appalachian Forest Heritage Area AmeriCorps
USDA Forest Service, Monongahela National Forest

Mower Tract and Sharp Knob areas of the Monongahela National Forest comprise over 40,300 acres of historic red spruce habitat that has been damaged by almost a century of logging and mining. The USFS has created a long-term restoration initiative to restore these historic red spruce-hardwood habitats, beginning with the Mower Tract in 2011 and continuing with Sharp Knob in 2018. Post-mining reclamation laws mandated that the areas be replanted and recontoured to prevent erosion, but the heavy equipment caused the soil to become deeply impacted which prevents many plants from effectively seeding. Additionally, non-native plant species were introduced, causing the land to become locked in arrested-succession where few native species can grow. The loss of native species affected local watersheds, carbon sequestration, and the habitats of over 135 species of concern. To combat mineland degradation, intensive restoration processes are necessary. Deep ripping to decompact the soils, the creation of wetlands, increasing red spruce habitat connectivity, and intensive planting of locally adapted native plants are ways that the USFS is restoring these historic areas.

Abstracts - Wednesday, 14th November 2018

Opening Remarks on Partnerships	8:30 am – 9:00 am
Implementing the Forestry Reclamation though Partnerships Speaker: Scott D. Eggerud, Forester Office of Surface Mining Reclamation and Enforcement, West Virginia	
Overview of ARRI and the FRA.	

Plenary: Climate Adaptation	9:00 am – 9:50 am
Combining experiments, spatial models, and the paleorecord to explore climate adaptation in forest trees Speaker: Matt Fitzpatrick, Assistant Professor Authors: Matt Fitzpatrick[1], Stephen Keller[2] [1]Appalachian Lab, University of Maryland Center for Environmental Science [2]Department of Plant Biology, University of Vermont	
High elevation coniferous forests dominated by the foundational species red spruce (*Picea rubens* Sarg.) are biodiversity hotspots in the Central Appalachians, representative of boreal forest ecosystems typically restricted to eastern Canada and New England. Understanding how global change may impact red spruce is important for planning purposes, but presents a number of challenges. A prevailing paradigm is that forest trees will respond to climate change by migrating, adapting, or going extinct. However, local adaptation is a central feature of most tree species occupying heterogeneous environments, and therefore the ability of populations to adapt or migrate in response to climate change is likely to vary across the range of the species. Most forecasts models of species responses to climate change ignore this population-level variability, and a lack of long time series of how tree species respond to rapid climate change hinders our ability to develop and test these predictive models. In this talk, I will discuss ongoing efforts to tackle some of these issues, including a new project that combines insights from the paleorecord, population genomics, spatial modeling, and common garden experiments to improve our understanding of the past, present, and future of red spruce populations throughout the Appalachians.	

Practitioners' Perspectives	9:50 am – 12:00 pm
Introduction of Ecosystem Services Incorporation into Land Management and Restoration on the Monongahela National Forest Speaker: Stephanie J. Connolly, Forest Soil Scientist USDA Forest Service, Monongahela National Forest	
The Central Appalachians are comprised of intermediate- to high-elevations, which include the headwaters for millions in the eastern US. The highest mountain ranges are topped with red spruce forests and coves filled with hardwoods that provide the foundations for this region's biological diversity. Despite the water values and rich ecology, legacy impacts, especially from resource extraction during the 20th century, remain evident across both public and private lands throughout the region. Cross-boundary restoration in this regional landscape can enhance the quality of life of local communities by sustaining the ecosystem services that support clean air and water, quality recreation opportunities, and wildlife habitat, while also protecting important forest types, such as red spruce and oak-hickory forests. Healthy forests and watersheds can help buffer the adverse effects of air, soil, and water pollutants. Afforestation projects, sustainable forest management, and watershed restoration practices also can reduce pollutants and sequester carbon above- and	

below-ground. Red spruce forests have an exceptional capacity to store carbon and regulate the release of water to streams from precipitation and snowmelt events, while also providing critical habitat for a variety of threatened, endangered, and sensitive species.

Every national forest has a responsibility to sustainably manage natural resources and a fundamental responsibility to ensure that support of local communities, businesses, and individuals is a central consideration during forest and watershed management and restoration activities. Within West Virginia, the Monongahela National Forest understands that land management actions taken to ensure healthy forests and streams can be a direct means for supporting local economies. Environmental protection and improvement are quite compatible with protecting and improving local economic health; indeed, environmental improvements can serve as a nexus for the provision of local economic health and ecosystem services.

Panel Discussion: Spruce Release Science and Implementation
Facilitator: Ben Rhodes, Ecological Restoration Coordinator
The Nature Conservancy, West Virginia Chapter

This panel will cover CASRI's groundbreaking efforts to release red spruce from hardwood competition on a landscape scale. Spruce release research began in 2010, and implementation based on that research began in 2014. CASRI's spruce release projects have been a stellar example of how sound research and adaptable implementation can produce positive results on the ground. Panel participants will cover past research (Dr. James Rentch, WVU), ongoing research (Dr. Melissa Thomas-Van Gundy, USFS), non-commercial implementation (Ben Rhodes, TNC), and commercial implementation (Travis Miller, WVDOF). Audience members will be given several opportunities to ask questions during the panel discussion.

Field Trips | 1:15 pm – 5:00 pm

10 Years of Public and Private Spruce Ecosystem Restoration in Canaan Valley
Guides: Dawn Washington[1], Wildlife Biologist; Mike Powell[2], Director of Lands
[1]Canaan Valley National Wildlife Refuge, West Virginia
[2]The Nature Conservancy, West Virginia Chapter

Powell: We will hike the Middle Ridge property which is a 1100 acre private in holding surrounded by CVNWR. Spruce forest restoration began on this tract in 2006 through a grant to fund tree planting, building exclosures and cattail management. We will look at multiple planting areas with varying levels of success, areas where deer have been excluded for over 10 years, and wetland cattail control. The discussion will include lessons learned, need for additional management, and long term vision of success.

Washington: This trip will explore the remaining high elevation spruce forests on Canaan Valley NWR which are home to the Federally threatened Cheat Mountain salamander. In addition, we will explore a native Canaan fir forest and talk about impacts affecting both fir and spruce management and restoration. We will visit a soil pit that shows the soil forming process podzolization and will classify as a Spodosol according to Soil Taxonomy (2014). This soil type and soil forming process supports the planting of red spruce to restore the site to canopy dominance of spruce.