Abstracts accepted for presentation at the 10th Northeast Alpine Stewardship Gathering, Hulbert Outdoor Center, Fairlee, Vermont. April 27-29, 2018

The following abstracts are of talks or posters presented on April 28, 2018
* Presenting
^ Poster

***Alpine snowbank communities, rare, diverse ecosystems**

Kevin Berend
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Alpine snowbank communities are rare, diverse ecosystems found in the Northeast only in sheltered sites above treeline. My work focuses on how the duration of snowpack, temperature, soil moisture, and light affects plant community composition and phenology at snowbank sites on Mt. Washington, NH. Results presented will consist of snowmelt, species richness, phenology, and plant traits among study sites, ordinations of plant community composition, and relationships to environmental variables (e.g., soil moisture, temperature, light). Ordinations showed a consistent turnover in community composition across the snowmelt gradient, including an inverse relationship in both diversity and richness between vascular plants and lichens; no transition in these variables was evident in bryophytes. Second, I will present results of a common garden experiment in which seeds of two snowbank herbs, *Chamaepericlymenum canadense* (Bunchberry Dogwood) and *Clintonia borealis* (Bluebead Lily), were collected from both high- and low-elevation sources, and grown under uniform conditions. Variation in plant traits or phenology between populations may provide evidence for genetic differentiation and/or alpine-adapted ecotypes.

Alpine areas worldwide have been shown to be disproportionately affected by climate change, and increased temperatures will likely lead to decreased snowpack. Little is known about how snowbank communities in the Northeast will be affected by climatic change, though, as mountains in the region are unique in environmental conditions and weather patterns. Increased precipitation may in fact lead to longer snow cover, protecting or expanding snowbank sites at the expense of "true" arctic-alpine species. Alternatively, warmer temperatures may melt snowbank sites earlier, leading to habitat and diversity loss. Alpine snowbank communities have the potential to be used as sensitive indicators of change in the Northeast.

***Baseline data on alpine snowbed and rill communities, including their bryophyte and lichen constituents**

Robert S. Capers
Department of Ecology and Evolutionary Biology, University of Connecticut
Nancy G. Slack,
Biology Department, The Sage Colleges

Snowbeds, areas above treeline where the snow melts latest in the season, have long attracted the attention of botanists. Those on Mount Washington have been studied for nearly 100 years. Still, we lack good quantitative data on snowbed communities, and we need that information to know if they are changing over time because of warming climate, nitrogen

deposition, or changes in the amount or timing of precipitation. We surveyed five snowbeds and four rill communities, recording the presence and abundance of vascular plants, which had been studied previously, as well as bryophytes and lichens, which had been incompletely documented in snowbeds and rills. We found 54 vascular plant species, 42 bryophytes and 13 lichens. Although vascular plants were most abundant, bryophytes and lichens were important in terms of species richness (as many as eight bryophytes and four lichens in 1 m^2 quadrats) and were occasionally abundant, particularly bryophytes in rills. Our surveys provide baseline information on snowbeds and rill communities so future studies can determine how they respond to changes in environmental conditions.

***Tree seedling recruitment, growth and survival above treeline on Mount Moosilauke: Seven years of surveys**

Robert S. Capers
Department of Ecology and Evolutionary Biology, University of Connecticut

Little is known about how trees recruit to the tree-free area we know as the alpine. How many tree seedlings establish, how quickly do they grow, how long do they survive? What we really want to know is whether trees are surviving longer and growing faster now than they did in the past, but the data we would need to answer those questions are lacking. The best we can do now is get the baseline information so someone can come back in 30 or 40 years and determine if the seedlings are doing better or worse. Only then will know whether the trees will be able to survive where they can't now, creating a forest on what is the tree-free alpine and eliminating the alpine plants that can't survive under a closed canopy. I report here on seven years of surveys on tree seedling recruitment, growth and survival on Mount Moosilauke. I can't answer the questions we care most about, but I can provide the baseline information so those questions can be answered in the future.

***Forty years of hiker damage, trail management, and rehabilitation on Franconia Ridge**

Charlie Cogbill

The Franconia Ridge Trail (a segment of the Appalachian Trail) has been the site of the most intense and comprehensive studies of trail management and hiker impact of any alpine trail in the world. Informal photographs since the 1860s have documented the results of expansion of the trail from only ascending the summit of Mount Lafayette to then traversing the entire ridge south to Little Haystack. In 1975 the AMC surveyed the trail, photographed 62 trail segments, established 32 cross trail transects, and planned for reconstruction of the trail. The trail was reconstructed and well defined in 1977 using scree walls, stone steps, waterbars, cairns, blazing, and grading the treadway. From 1977 to 1980 Peter Marchand established 12 sites to test the effects of transplanting, seeding, natural revegetation, fertilization, terracing, and gardening along the abandoned trail. These revegetation efforts were renewed in 1988-1991 by the USFS using alien seeding and mechanical cover of the most degraded sites. In 1989 Joe Doucette of the AMC followed up resampling 13 of the 1975 cross-trail transects and retaking 50 to the trail segment photographs. Charles Cogbill working under a USFS contract in 1993 sampled the previous experimental sites and established 11 semi-permanent vegetation transects. Last summer (2017) Cogbill, working under a USFS contract with Beyond Ktaadn, re-photographed all 62 1975 trail segments; resampled Marchand revegetation plots; resampled and marked 9 of the 1993 vegetation transects; and resampled 10 of Doucette's cross-trail transects. Collation,

archiving, and analyses of these data and creation of a photographic portfolio are reported in this paper. These tools allow for following the impact of hikers on the trail and the effect of human and trail management through 42 years. Overall, the trail was unmanaged in 1975 and was an undefined and broad trampled swath in many places. Some of the most disturbed sites were already barren gravel or exposed bedrock. Trail management of the less disturbed sections resulted in moderate recovery through 1993, but many sections (such as the old trail around the east side of Mount Truman) have degraded since then. The highly degraded sections in 1975 have not recovered despite efforts of revegetation, active protection, and limiting traffic. It is clear that the some of the Franconia Ridge trail is stable (such as over bare rock or where passing through krummholz), but much continues to degrade due to heavy and unrestricted hiker traffic.

***Defining the Habitat Characteristics of Three Rare Alpine Plant Species in the Presidential Mountain Range, New Hampshire USA**

Jenifer Dickinson
Antioch University New England

The alpine plant communities of the Presidential Range in the White Mountains of New Hampshire, USA are fragile systems that support a wide diversity of plant species including several rare and endemic species. Due to the fragility of these systems, defining the current ecology of the environments in which these rare plants exist is the baseline information required to inform conservation strategies in the face of climate changes. I have studied three different rare alpine plant species: alpine-bearberry (*Arctous alpine*, Nied.), snowbed willow (*Salix herbacea*, L.), and mountain avens (*Geum peckii*, Pursh) across the high peaks of northern NH, defining the ecology and habitats of each species. At each location where these species are found data was collected on: 1) topographic variables including aspect, slope position, and elevation, 2) soil characteristics including pH, and depth and 3) plant communities: the number of individuals of each species, the percent cover of surrounding plants, and the type of habitat and plant community. These known locations were photo-documented for future monitoring to help determine if the population size of each species is changing over time. Data is being analyzed to determine if there are any patterns in plant location or if there are any habitat associations for each individual species. Working with rare species is challenging due to the vagueness of written site locations, unclear historic records, and inaccurate GPS locations. Rare species also present challenges when answering statistical questions, usually due to the low number of. A better understanding of the ecology and habitats with which these rare plants live and any population change over time is what will lead to the best land management policies to preserve these rare species.

***Long-term monitoring of vegetation composition on Adirondack Alpine summits.**

Monica Dore, SUNY Oneonta
Sean C. Robinson, SUNY Oneonta

Eleven permanent 30-meter transects were established by Edwin H. Ketchledge in 1984 above timberline on the summits of Wright, Algonquin, Boundary, and Iroquois peaks in the Adirondack High Peaks Region of New York State. Eight of these eleven transects were resampled during the months of July and August 2017. Three of the eleven transects were not sampled due to the loss of one or both bolts marking the ends of each transect. Comparisons to data collected along these transects in 1984, 1994, 2002, and 2007 show only minor changes in overall frequency of vegetation. Compositional shifts, however, show a pattern of replacement of

bare substrate by pioneer species and bryophytes by vascular plants, with graminoids showing the most significant increase in frequency. Additional methods were added to the sampling protocols for each of the eight transects sampled, including line-intercept and percent cover estimates within $1m^2$ quadrats. Data from these additional sampling methods are presented as a baseline for future vegetation comparisons.

***Monitoring plant populations in the Adirondack Alpine**

Julia Goren, Adirondack Mountain Club
Tim Howard, New York Natural Heritage Program

Alpine ecosystems, and alpine plants in particular, are experiencing rapid climatological changes yet the vegetative and population level responses to these changes are uncertain. In the Adirondack Mountains the potential for a negative response seems especially likely because of the very small total area of the alpine zone and the close proximity of this alpine zone to lower-elevation krummholz and forest. Our goal of this project is to monitor plant populations in the alpine zone through repeated, stratified random sampling. We report on findings from our first two sampling bouts separated by six years: 2006-2007 and 2013. In 2006-07, we sampled 376 plots on 17 summits; in 2013, we sampled 384 plots on the same 17 summits. Each plot was placed using a spatially-balanced randomization procedure in GIS. Field crews located these points using GPS and printouts of paper maps. Within each 5 m X 5 m plot, we counted the number of individuals (clumps) of *Diapensia lapponica* (pincushion plant). Because many plots lacked individuals (e.g. counts of zero), parametric estimates of population size violate statistical rules regarding a normal distribution. Thus, we modeled plant species densities based on slope curvature, elevation, western exposure, flow length, and solar radiation. The best fit model utilized all variables and included the separate sampling bouts as factors, indicating that densities changed over the six-year interval. We discuss the decrease in population density detected over these two sampling efforts and the importance of sampling again in 2018 or 2019 to better evaluate the presence of a trend in population size. Additional factors may be playing a role in influencing alpine plant populations in the Adirondacks, particularly the effective management actions taken by the Summit Steward Program. Indeed, reduced hiker trampling is positively affecting vegetation growth overall, which might have varying effects on specific alpine plant species, depending on their habitat requirements. We discuss our plans for better understanding this interplay of management success under our changing climate. Finally, we discuss the success of the project as a collaboration with the New York Natural Heritage Program and the Adirondack Summit Steward Program and the benefits of integrating botanical summit stewards into the Summit Steward Program.

***Experimental germination and growth of alpine *Nabalus* (Syn: *Prenanthes*) taxa: Implications for climate change response and conservation.**

Kristen Haynes
PhD Candidate, Lab of Donald J. Leopold SUNY-ESF

Although climate change is widely recognized as a threat to alpine areas, little is known about response mechanisms available to northeast alpine plants. For species to survive environmental change, they must move to suitable habitat, adapt to change, or tolerate the change through phenotypic plasticity (acclimation). In the short term, phenotypic plasticity is the only option for

individuals encountering climate mismatch or stress. The capacity for phenotypic plasticity varies among individuals, species, and populations. Using a reciprocal transplant experiment at the summit and base of Whiteface Mountain (Wilmington, NY), I investigated the ability of *Nabalus boottii* (Boott's rattlesnake-root) and *Nabalus trifoliolatus* var. *nanus* (alpine rattlesnake-root) to respond to climatic changes via phenotypic plasticity. Seed of each taxon was germinated at low elevation and transplanted into raised beds on Whiteface. High-elevation transplants exhibited a strong plastic response to climate by replacing their first true leaf with a much smaller, more typically alpine leaf. Low-elevation transplants did not lose their first true leaf and produced taller and larger leaves than their high-elevation counterparts. These results suggest that alpine *Nabalus* populations may have the capacity to respond to climate change through phenotypic plasticity, increasing their odds of survival.

However, species do not respond to climate change in a vacuum. Perhaps more important than any temperature or precipitation changes experienced by organisms will be the biotic changes they experience—especially species invasions from historically warmer habitats and regions. For alpine areas, considering the possible invasion of lower-elevation taxa is critical when evaluating species' climate change vulnerability. Such low-elevation taxa could negatively impact alpine species by outcompeting them or by altering local conditions; such competition is especially likely among closely related taxa. In a second experiment, I investigated the germination and establishment of non-alpine *Nabalus trifoliolatus* at three elevations on Whiteface Mountain to investigate its potential for competition with the alpine *Nabalus* taxa. For low-elevation *N. trifoliolatus* and both alpine *Nabalus* taxa, germination and establishment was highest at the summit location and declined at lower elevations. These findings suggest that low-elevation *Nabalus trifoliolatus* seed can readily establish at high elevation given the opportunity, and could potentially compete with the alpine taxa, especially if subsequent analyses reveal low and high-elevation *Nabalus trifoliolatus* to be distinct. Additionally, our results suggest that higher temperatures may negatively affect the germination and survival of alpine *Nabalus* taxa, indicating a possible vulnerability to climate change as global temperatures continue to rise.

^Mountain Birdwatch: Bicknell's Thrush Populations & Tools for Landowners and Managers

Jason M. Hill (Vermont Center for Ecostudies, Norwich, VT)
John D. Lloyd (Vermont Center for Ecostudies, Norwich, VT)

Bicknell's Thrush (*Catharus bicknelli*) is one of the most range-restricted bird species in North America. In the United States (U.S.), it occurs only in the disturbed montane forests of fir (*Abies balsamea*) and spruce (Picea spp.) in the northeastern states of New York, Vermont, New Hampshire, and Maine. Climate change is expected to substantially diminish this vegetation community (>50% extinction from current range) by 2300. Despite the increasingly tenuous conservation status of the species, fundamental demographic parameters remain unknown and overall population size is uncertain. We used N-mixture models in a hierarchical Bayesian framework to predict population size and to elucidate spatial and temporal patterns of Bicknell's Thrush abundance in the northeastern United States. From 2011 to 2016, as part of Mountain Birdwatch, citizen-scientists conducted 14,552 five-minute point counts at 747 sampling locations along hiking trails. Observers detected Bicknell's Thrush at 49.4% of points and tallied 1079 observations of the species. Bicknell's Thrush abundance was parsimoniously modeled as a

complex function of elevation, forest canopy cover, and latitude. Using our model results, and the estimated U.S. range of the Bicknell's Thrush, we produced the first fine-scale (<1.0 ha resolution) abundance estimate and map of Bicknell's Thrush density across their U.S. range. We predicted the U.S. Bicknell's Thrush population in 2016 as 71,318 (95% credible interval: 56,080–89,748), and 95% of that population occurred above 805 m. Combining our results with existing estimates of population size in Canada suggests a global population size of <120,000; Bicknell's Thrush likely have one of the smallest population sizes of regularly occurring bird species within the contiguous United States and Canada. By cross-referencing the U.S. Geological Survey Protected Areas Database, we estimated that 76.6% of Bicknell's Thrush habitat occurred on conserved lands across the United States and that this habitat supported 84.6% of the predicted population. The White Mountain National Forest (New Hampshire and Maine) is the largest conservator of Bicknell's Thrush habitat in the United States and supports ~31% of the predicted U.S. population. Our model provides a testable framework for assessing the success of future conservation and management actions on Bicknell's Thrush populations throughout their U.S. range.

^Alpine Plant Communities of Mount Moosilauke in the White Mountains of New Hampshire: A 22 Year Cross-Data Analysis of Composition and Structure.

Timbo Maddalena-Lucey
MS student Conservation Biology Antioch University New England

Alpine plant communities are fragile complex systems that may be threatened by our changing climate. Is there evidence that alpine plant communities are changing in the northeast? In 2015, on Mount Moosilauke, the southernmost peak in the White Mountain National Forest, I resampled 71 meter squared plots initially established in 1993 to assess any evidence of change in species composition and community structure. In each plot both vascular and nonvascular plant species richness, percent cover, and relative abundance were assessed. Throughout all categories in species richness results: vascular plants, non-vascular bryophytes, lichenous vegetation, and all plants, the East snowbank and Southeast heath plant communities shown the most increase between 1993 and 2015 surveys. As a whole, the differences in species richness values for all transects in the all plants category shown the most significant differences between the two surveys wherein there was an average increase of seven species per community in 2015. All five plant communities shown the most increase in species diversity values from 1993 to 2015 in both the lichenous vegetation and non-vascular bryophytes categories except in the East snowbank community. Additionally, the most significant differences in species richness values between the two surveys were recorded in two out of five community types in the non-vascular bryophytes category. Some of these increases can be attributed to the difference in number of species recorded in the 2015 survey as compared to the 1993 survey. However, the most statistically significant increases in species richness values between 1993 and 2015 surveys were found as a whole in all transects in 3 out of 4 categories which does indicate a strong presence of change in plant community composition and structure in the alpine plant communities of Mount Moosilauke. Additional factors to be taken into account regarding these changes in composition and structure include human disturbance and distribution. Do the views regarding the success of plant species faced with climate change (ie. resilience versus resistance) play a role in the future success of the alpine plant communities in the White Mountains of New Hampshire? Further

research is needed to quantify and assess these roles and the part they play in the future of Mount Moosilauke.

***Shaping the Reason to Hike – An Additional Tool for Alpine Stewardship**

Vin Maresco
Adirondack High Peaks Summit Stewardship Program

As a volunteer with the Adirondack High Peaks Summit Stewardship Program and the Adirondack Mountain Club's Hiker Information Host Program, I performed duties for both programs in consecutive days during August 2017. The summit was Algonquin Peak, NY's second highest mountain, while the information host assignment was at the ADK's High Peaks Information Center located at the Adirondack Loj trailhead. While on the mountain I interacted with 130 hikers using the "Authority of the Resource" approach, encouraging all to stay on rock surfaces while in the alpine zone. Of those I interacted with, I estimate that approximately 30 to 50% participated with me in meaningful stewardship discussions. Nevertheless, I felt my mission had been accomplished because there were no trampling alpine plants by person or dog on my watch. While on Algonquin I took photos of alpine goldenrod and mountain sandwort in flower. My goal in taking the photos was personal enjoyment. The following day as information host the first rotation consisted of directing cars parking at the trail head. Unless I had a line of 3 or more cars I used the "captive" situation of the cars entering to discuss hike plans. For those headed into the alpine zone I engaged about the importance of staying on the rock and off the plants. However, if I detected even the slightest interest I asked them to come back to me for more information. In that second session, I tried an experiment. I tried to make the fragile alpine zone the star of the show. I gave my short "elevator" speech about the rare and endangered nature of the plants and the limited acreage that was home to alpine species in NY. I attempted to get them to be on the lookout for what was in flower with help from my photos. I made seeing the flowering alpine plants part of the goal for the hike. For many this resonated and thus I had a new tool in the toolbox of alpine stewardship! The hiking public is out hiking for every reason but if we can cause some of them to make seeing the alpine plants one of the reasons then they will become a stakeholder in alpine preservation and conservation. Rather than the plants being something to be cautious of, they become part of the reason for hiking and therefore as important to protect as the mountain itself.

***Mountains Without Handrails: Carrying Capacity in the Alpine Zone**

Dr. Jeffrey L. Marion
U.S. Geological Survey Recreation Ecologist, Virginia Tech Field Station.

Joseph Sax, in his book "Mountains Without Handrails" proposes that protected area managers and preservationists should seek to provide and encourage "contemplative and reflective recreation." He would encourage us to extract people from their vehicles so they can truly experience nature on its own terms, emphasizing intensiveness of experience in place of intensiveness of consumption and impact. Benefits that accrue to society include improved physical and mental health and increased political support for protected natural areas. If we agree, then we stewards of the alpine zone need to develop our knowledge and expertise in applying carrying capacity, the process of sustainably managing visitor use to protect sensitive natural environments while ensuring high quality visitor experiences.

This presentation will review the art and science of sustainable visitor use management in the context of visitation to high elevation mountain environments. We will examine the new interagency Visitor Use Management (VUM) framework and its adaptive management decision-making process. We will examine the carrying capacity "toolbox," including site management, educational, and regulatory options to increase the sustainability of visitor use. Specifically, we will examine the latest findings from research to design and maintain sustainable trails, effective site management and educational practices to persuade hikers to remain on formal trails, options to model and redistribute visitor use in time and space, and when necessary, regulations to reduce resource and experiential impacts and restrict access. And to keep it fun, I'll include a number of alpine zone backpacking photos from across the U.S.!

***American Pipit Population Survey in the Presidential Range and Franconia Ridge**

Christian J. Martin, NH Audubon
Hector Galbraith

American Pipits (*Anthus rubescens*) add to the unique natural character of the Northeast's highest alpine summits with their captivating flight displays, delicate "pip-pip" calls, and a penchant for perching on boulders and trail signs. Sparrow-sized migratory birds that nest on the ground, but *only* in arctic and alpine habitat, pipits nest commonly in Canadian high latitudes and in western U.S. mountains, but in only three isolated areas east of the Rockies – Quebec's Chic-Chocs, Maine's Mount Katahdin, and New Hampshire's Mount Washington (MW). MW is the southernmost breeding site in the eastern North America. They are state-listed as "Special Concern" species in New Hampshire due to an extremely limited breeding distribution, and the 2015 *NH Wildlife Action Plan* lists them among "Species of Greatest Conservation Need."

New Hampshire Audubon conducted pipit surveys in the Presidential Range from 1992 to 1998. In 1997, we surveyed 20 alpine trail miles, but detected no pipit breeding activity *except* on MW. Intensive fieldwork in 1998 located 11 territories, 9 nests, and 27 fledged young, all between 5200 to 5800 feet on MW. We wanted to know if pipits had expanded breeding in the alpine zone during the past 20 years to areas beyond MW. In 2017, we delineated areas in the White Mountains above 5000 feet, used existing hiking trails and roads as transects, and conducted a visual and auditory survey for pipit presence.

Pipits favor alpine meadows dominated by sedge and cushion tussock vegetation, and there are about 425 acres of this habitat in the White Mountains. Roughly 98% is located in the Presidentials and on nearby Franconia Ridge. In June and July 2017, we surveyed 13.7 transect miles, including Franconia Ridge and parts of Madison, Adams, Jefferson, Clay, and MW. We detected a total of 14 pipits (11 adults, 3 fledglings) and, as in 1998, all detections occurred on MW.

Our 2017 survey is a first step in updating pipit status information for this isolated breeding population. We have received funding to support more intensive fieldwork in 2018. Improving our understanding of this alpine-obligate bird could lead to better-informed land management decisions, including those related to recreational activity and development within the alpine zone.

***Proposing A Survey of Conservation Mandates and Policies for Alpine and Subalpine Vegetation in Maine**

Caitlin McDonough MacKenzie

David H. Smith Postdoctoral Research Fellow
Climate Change Institute University of Maine

The mountain habitats of Northern New England are threatened by climate change. Alpine and subalpine plant species here are isolated by topography, ecology, and management in Maine. Islands of habitat above treeline are scattered across mountains that are owned and managed by several federal and state agencies and non-government organizations with varying conservation mandates and resources. As a David H. Smith Postdoctoral Research Fellow, I'm engaged in a project that aims to compile a comprehensive list of government agencies, conservation organizations, and land trusts engaged in the conservation and management of land above treeline in Maine. I will analyze how the origin acts and conservation mandates of each agency or organization inform their conservation policies and planning for climate change. Gathering a list of the agencies and organizations working in alpine and subalpine habitats is an especially challenging undertaking in Maine, where the Appalachian National Scenic Trail traverses much of the land above treeline, but off-trail the majority of mountain lands are owned and managed by other organizations, each of which may be subject to different conservation mandates, policies, and procedures. The 2017 Northeast Alpine Stewardship Gathering will bring together representatives from many of these agencies and organizations; it seems like a perfect opportunity to launch this project. At the Gathering, I'd like to outline the background for this project and begin compiling the list of Maine's alpine and subalpine conservation practitioners. I can also place this project in a broader context: my postdoctoral research is mainly focused on paleoecology. I am collecting and analyzing sediment cores from two subalpine lakes in Maine to reconstruct vegetation changes from pollen and plant fossils over the past 12,000 years. This paleoecological perspective on the persistence or transience of alpine and subalpine vegetation on Maine's mountains will inform climate change vulnerability assessments for the agencies and organizations involved in managing land above treeline in Maine.

After the 2017 Gathering, I will craft a survey for conservation practitioners to gather information about approaches to conservation above treeline including mandates, current projects, resources and funding sources, and the role of science in management. Ultimately this work hopes to bring together conservation practitioners and researchers to collaborate on the current challenges to conservation and identify research questions with the potential to best inform conservation management.

^Why YOU Should NOT Stack Stones

Peter Palmiotto, Director of Environmental Studies
Dianne DuBois
Alyssa Milo
MERE Project
Antioch University New England

Across the northeast stacks of stones above the treeline, known as cairns, are being disturbed or destroyed. Meanwhile other stacks, sometimes on the edge of cliffs, are being built. Why is this behavior a problem and why shouldn't you stack stones? Cairns are official trail markers, built to withstand the harsh high elevation environment. They are intended to keep hikers safe and also protect the alpine vegetation. They guide hikers safely along trails and off the mountain during times of poor visibility such as cloudy weather or snow storms. The alteration of cairns removes that safety net for hikers leading them into potentially dangerous

situation or areas with sensitive alpine vegetation. In addition, taking stones directly form the soil to build new cairns or tamper with existing ones often leads to soil erosion and the death of alpine plants. In an effort to address the stacking stone problem on Mount Monadnock in southwest New Hampshire, the Monadnock Ecology Research and Education Project (MERE) based in the Environmental Studies (ES) Department of Antioch University New England partnered with Monadnock State Park to develop signs to elevate hikers' awareness of cairns. Sign were placed just below treeline on each that leads to the summit. A second sign was placed on all kiosks at the base of the mountain asking the question, "Why shouldn't you stack stones?" Below the question are key reasons why you shouldn't, as mentioned above, and that it is illegal in NH. Surveys conducted by MERE graduate students before signs were placed on the mountain indicated that 49% of the hikers knew what cairns were, but 82% were not aware of the impact of destroying or building cairns or that it was illegal. Preliminary results of post sign installation surveys suggest a significant increase in awareness of cairns with hikers commenting that they now knew the reasons why they should not stack stones. Many survey participants made comments indicating that they had noticed the cairns before but never realized what they were for. We do need to educate hikers to reduce the alteration and building of cairns as a means to protect the alpine zone and for hikers' safety. There really are good reasons why we should not stack stones.

***New Discoveries in the Vermont Alpine: Natural or Introduced?**

Bob Popp
State of Vermont, Department of Fish and Wildlife

Vermont's alpine area comprises only a little more than 100 acres. Of that approximately six acres exist on the summit of Camel's Hump. Unsurprisingly the mountain has been extremely well botanized with a number of records dating back to the 1870s. With the creation of the VT Natural Heritage Program there was a more recent surge of plant inventory work beginning in the late 1970s. Despite this abundant inventory work, however, populations of previously undocumented, exceedingly rare plants are still being discovered.

In 2014 Bob Zaino, State Lands Ecologist, reported four patches of diapensia (*Diapensia lapponica*) on the North Summit of Camel's Hump. Investigating further we found that it had been observed in 2007 by his predecessor who was unaware of its significance as a new population disjunct by approximately 20 miles from its only known station in VT on Mt. Mansfield. On that summit it is scattered in a few localized, small patches on the Chin and West Chin. Nowhere in VT does it exist as the locally abundant groundcover as it does in N.H. and ME. This discovery was even further confounded by the subsequent discovery of a number of stems of Lapland rosebay (*Rhododendron lapponicum*) growing within two of the Diapensia mats. Lapland rosebay had previously been unknown from the Vermont flora.

We initially speculated that the plants had to be introduced because of the unlikely coincidence of two previously unknown, very rare plants growing in close proximity to one another in a well botanized location. The size of at least one of the Diapensia mats would indicate that it has been onsite for a long time or more likely, transplanted. But much of the evidence would preclude the latter scenario. It is widely accepted that mature Diapensia plants are very difficult, if not impossible to transplant because of their extensive tap root. Bryophytes collected adjacent to Diapensia clumps indicated no species indigenous to other areas or widely

disjunct. In addition, soil samples collected from beneath Diapensia clumps vs. elsewhere on Camel's Hump showed no evidence of introduced material.

^Bryophytes of the Alpine and Subalpine Zones of the Adirondack High Peaks Region.

Sean C. Robinson
Associate Professor of Biology SUNY-Oneonta
Lorinda Leonardi
Collections Manager New York State Museum

In an effort to monitor possible changes in bryophyte distributions in the Adirondack alpine zone, this project aims to produce baseline species lists for each of the Adirondack alpine summits. Using herbarium specimens accessioned at the New York State Museum, a preliminary list of 225 species occurring above 4,000 ft., with 219 of those species occurring above timberline, has been produced. Over the next year, we hope to expand this species list using herbarium records from other institutions, followed by field surveys that will be conducted during the summer of 2018.

^Practical Anthropology for Recreation Management: Using Anthropological Methods For Rapid Assessment (RAP) of Hiking Behavior and Environmental Impact On Franconia Ridge.

Nat Scrimshaw
West End Trail Tenders (WETT)
World Trails Network-Hub for the Americas

The Franconia Ridge Trail is experiencing crowding and significant damage to the adjacent alpine ecology. Professional managers and volunteers are struggling to identify strategies to address what is a deteriorating biophysical and social environment. In support of an Appalachian Mountain Club (AMC)/Waterman Fund research project—*An Assessment of Hiker Use Patterns and Relationship to Current Scree Wall Efficacy and Alpine Trail Treadway Standards on Franconia Ridge-40 Years Later*—the AMC Franconia Ridge Trail Adopter spent 33 days over a period 15 weeks on Franconia Ridge, directly observing more than 3,000 hikers. In addition to administering an observational hiker survey developed by the AMC research department, the trail adopter used the anthropological methods of observation, participant observation, informal interviews and focus group discussions (informally in small groups at Greenleaf Hut) to better understand hiking behavior. By combining information collected using these qualitative anthropological methods with the quantitative survey results, it is possible to triangulate these data, helping to validate conclusions. Anthropological methods are also designed to get an "insider perspective," providing insight into the contribution of culture to behavior. This can be particularly helpful in designing educational programs. Traditional anthropology can require years of field work, but rapid assessment procedures (RAP) for applied anthropology can be used by field staff in a single season (2-3 months) or even in a single field session.

While use of anthropological methods on Franconia Ridge was *ad hoc* in 2017, it shows great potential. This poster outlines some of the ways the quantitative and qualitative data from Franconia Ridge in 2017 can be triangulated. It also presents some unique insights from observations during the 2017 field season. This includes identifying patterns of trail impact

across the ridge as well as associated patterns of hiking behavior. These examples serve as a first step in developing a RAP manual for alpine area management which could be used by volunteers and field staff in 2018.

***Cryptogam Studies in Snowbed and other Communities on Mount Washington**

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Studies of alpine snowbed (snowbank) and rill (streamside) communities on Mount Washington by Nancy Slack, Bob Capers, Kate Storms, Allison Bell and associates and volunteers since 2012 on Mt. Washington have been funded by the Waterman Fund. This research has had a number of interesting results (Capers and Slack, 2016). One of these was the diversity and importance of cryptogams, bryophytes and lichens, in these communities. A great many community analyses have been carried out in these and other alpine communities on Mount Washington since 1963, the studies of Sperduto and Kimball, 2011, noted that bryophyte diversity of bryophytes can be quite high in these two communities, even when their abundance was low. That was not the case in some of our sites. None of the previous studies included all the bryophytes and lichens present.

A surprising result in our snowbed studies was the fact that the number of bryophyte (moss and liverwort) and lichen species present in these communities at all the sites studied is essentially equal to the number of vascular plants, 54 vascular plant species to 55 species of bryophytes and lichens. 42 moss and liverwort species and 13 lichens were found. The largest number of moss species in the family Polytrichaceae, which is well-adapted to alpine conditions. *Cladonia* was the lichen genus containing the most species. Many of the members of this genus, as well as other lichen genera on Mount Washington are essentially Arctic species.

Both bryophytes and lichens have important ecosystem functions including water-holding capacity, nutrient cycling, and as substrates for vascular plant seed germination (Slack, 1988). On the other hand, the fact that the snow cover lasts longest in snowbed communities enables many bryophytes as well as the boreal vascular plants to survive and often thrive in this species-rich community.

Another part of our original Waterman grant was to locate rare species of bryophytes and lichens on Mount Washington. We followed 5 lichen species that are common in the Arctic, but rare in much of the Northeastern Alpine, particularly in the Adirondack high peaks. These included worm, coral, and snow lichens. (*Thamnolia*, *Sphaerophorus*, and *Flavocetraria species*). We monitored these species, with interesting results, and explored for other unusual lichen species.

There is a moss list for Mount Washington; and one rare Arctic moss, *Aulacomniium turgidum*, was studied quantitatively in both our snowbed and rill communities. There is no liverwort list for the mountain. Jeff Duckett, a liverwort expert from the London Natural History Museum was with us the first year of our grant and found a very rare liverwort in Tuckerman's Ravine, one with symbiotic fungi. That find appeared on the cover of *Evansia.* Subsequently another liverwort expert joined us for several seasons, and we are working on a list for the mountain.

Dandelions were discovered by Allison Bell in snowbed communities in the upper cone of Mount Washington in 2014, subsequently also in the *Carex bigelowii* community. This invasion is happening in alpine communities all over the world; the common dandelion *Taraxacum officinale* is surprisingly adaptable in the alpine. The important work of removal to date will be discussed by the next speaker.

***Decline of *Sibbaldia procumbens* L. on Mount Washington, New Hampshire**

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Sibbaldia procumbens (Rosaceae) is a widespread circumboreal plant of alpine and subalpine habitats in the Northern Hemisphere, thriving in areas where late-lying snow persists into summer. Despite its widespread distribution and local abundance, *Sibbaldia* is one of the rarest plants in New England, USA, occurring only in Tuckerman Ravine on Mount Washington, New Hampshire. The New Hampshire population has apparently been declining for several decades, possibly the result of a combination of interspecific competition, over-collection, and changes in environmental conditions. We assessed historical trends, current status, and potential causes of decline of the New Hampshire population through evaluation of herbarium and historical records, field surveys, and comparison of photographs. Our examination of collections at seven New England herbaria revealed 236 plants with roots, including many large adult plants, on 65 herbarium sheets. Most of these plants were collected between 1846 and 1908, representing trophy collection activity characteristic of some novel species during that period, and which may have had a lasting impact on the reproductive capacity of this long-lived perennial. Contemporary surveys (within the last 40 years) establish a continuous decline in abundance over time. During timed surveys at two previously documented stations within Tuckerman Ravine and adjacent appropriate habitat, we found no evidence of the species. We observed encroachment of the local snowbank habitat by mountain alder (*Alnus viridis* ssp. *crispa*) and possibly other species. Our observations support the hypothesis that a combination of over-collection, competition from robust vegetation, and local disturbance may have contributed to its decline and possible extirpation. If extirpated, *Sibbaldia* would be the first documented alpine vascular plant to be extirpated from New England. Because the decline of this species may have been anthropogenically facilitated, we recommend that the feasibility of re-establishment (from Mount Washington source material) be evaluated.

Invasive common dandelion (*Taraxacum officinale*) Removal Effort on Mt. Washington, New Hampshire

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Common dandelion (*Taraxicum officinale*) was first observed around the Summit House on Mt. Washington in 1895. This raised no concern until 2014 when Alison Bell (Capers and Slack snowbed research team member) discovered a large infestation in a natural meadow below Ball Crag on the White Mountain National Forest (WMNF). This was troubling, because dandelion infestations have been reported from other alpine and Arctic sites around the world. WMNF Botanist Dan Sperduto initiated planning to remove dandelions through National Environmental Policy Act (NEPA) requirements. The NEPA analysis was complicated by the novelty of the situation; sensitivity of the alpine environment and rare species involved; the presence of four management zones on the WMNF and five landowners, each with different management direction and permitting requirements; and coordination with other partners and groups. Dandelion removals were approved and initiated in 2015 by the WMNF on federal and state land, with digging and monitoring help from the Slack-Capers group (via Waterman Fund support), and other partners. In 2016 and 2017, NH Natural Heritage Bureau and Division of Parks organized additional volunteer crews, and the AMC removed dandelions at two huts. Dig crews involved dozens of volunteers including students, and other members of the public. Species composition and cover, number of dandelions, and dandelion biomass removal weights are being monitored along two permanent transects in natural alpine meadows, and dandelion removal weights from all other locations are also being recorded. From 2015-2017, dandelions were dug with hand weed diggers, totaling more than 150 person-days. Results from monitoring transects, and dandelion weights elsewhere, indicate substantial progress in diminishing dandelion vigor and biomass over the three year period, with minimal change detected in the cover of native alpine species. Dandelions occur primarily in lee positions of summit infrastructure features and along upper sections of the Auto Road on mineral soil; disturbed soils at two AMC Huts near treeline; as well as in four locations on organic soil in natural alpine communities, including herbaceous-shrub snowbank or Bigelow sedge meadows above Great Gulf, east of Ball Crag, on the south facing summit cone of Mt. Washington. Numerous locations of rare plants have been discovered growing near or with dandelions, including *Saxifraga rivularis*, *Salix herbacea*, *Poa pratensis* ssp. *alpigena*, *Nabalus boottii*, and *Rhinanthus minor* ssp. *groenlandicus*. Dandelions occur within 100 feet of the Great Gulf Wilderness, and a few hundred feet from the Alpine Garden RNA.

***Rapid shift in composition, extent, and resilience in Alpine natural communities**

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Ecosystem Management Consultants (EMC)

Alpine natural communities and the species they support are experiencing a relatively rapid shift in composition, extent, and resilience on account of changing global climatic conditions. This is particularly true in the Northeastern United States where the extent of alpine

vegetation is limited to isolated mountain tops that are fairly small in size. Using the north slope of the largest of the alpine zones in New England, the Presidential Range, the author has observed some of the salient changes in alpine vegetation among six permanent plots that were established on Mount Adams in 1991. Plots were placed in four of the most common alpine natural communities near the subalpine edge in order to test the effects of changing wind, snow depth, exposure, and vegetation on these plant communities. This presentation summarizes some of the changes observed during four replicates between 1992 and 2005. Besides noted shifts in plant species composition, analyses are presented on the effects of foot traffic along a well-used hiking trail, as well as subsequent species shifts due to inadvertent damage to alpine vegetation by student researchers.

***An Assessment of Hiker Use Patterns and Relationship to Current Scree Wall Efficacy on Franconia Ridge - 40 Years Later**

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West End Trail Tenders and World Trail Network: Hub for the Americas
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Franconia Ridge in the White Mountains of New Hampshire is one of the most frequently hiked alpine areas in the region, with peak daily use approaching 2,000 hikers. Because of this level of use and the associated impacts, the Ridge has long been an area of stewardship focus, including the construction of scree walls 40 years ago, establishment of an alpine stewardship and trail-adopter program, and outreach to hikers through the nearby Greenleaf Hut and other avenues. Although these efforts have largely been successful in limiting impacts to the alpine vegetation, increasing trends in trail use are starting to reverse some of that progress. We present preliminary results of an ongoing study that aims to assess current trail conditions, identify and prioritize site-specific trail issues, and develop solutions to address problems along Franconia Ridge.

The study is a partnership between AMC Research and Trails Departments, the Franconia Ridge Alpine Stewards and Trail Adopter, and the White Mountain National Forest (WMNF), among others. It is one component of a larger Visitor Use Management Framework process (VUMF) to provide useful information to the White Mountain National Forest (WMNF) in their decision making. More specifically, the study will help provide baseline information for the VUMF goal of using, "…monitoring data [to] help refine the understanding about which actions are necessary to maintain and/or achieve desired conditions and improve the understanding and use of indicators and thresholds".

We will present a summary of our insights into hiker use patterns, based on hiker observations made during the study. We will also discuss our effort to identify specific trail locations that need to be addressed, and integrate the observation data to inform how hiker use patterns contribute to these issues. We will also discuss how the ecological survey work is used identify areas of intersection between trail issues and rare plant populations, and ensure that proposed solutions will reduce and not adversely impact rare alpine vegetation. Based on these data, we are developing site-specific solutions to existing trail conditions, which incorporate on-the-ground hiker use patterns and preserve ecological resources. We will also present

additional stewardship actions that could help to address the increasing use of this well-travelled alpine area.

^Keep the Whites Wild

Michael Wejchert
Board Member, Keep the Whites Wild

During the ten-minute poster session, I will discuss the efforts of a new nonprofit, Keep the Whites Wild, to counter building development in the alpine zone, particularly the Cog Railway's plan to construct a luxury hotel above the Great Gulf wilderness. KTWW has partnered with the Waterman Fund to combat this and other attempts at development in a fragile, disappearing landscape.

The Cog's proposal, to build a hotel on the east coast's most storied mountain, is a step towards a mountain developed specifically for tourism with little regard for the increasingly rare portion of terrain it operates in. The hotel would create a middling number of jobs while adding untold stress to a threatened environment: New Hampshire's alpine zone.

Keep the Whites Wild's mission is to preserve and protect the diverse biology, natural aesthetic, and intrinsic value of New England's White Mountain region.

During the brief presentation, I'd like to outline specific ecological threats the Cog's proposed hotel presents. I'll also talk about individual strategies we've found useful in countering the proposal, and where KTWW stands as it continues to push back. Most importantly, I'll outline ways in which other conservation organizations can help in partnership with KTWW to protect a resource that is important for everyone.

We have had success at gatherings and functions with short oral presentations and we feel this would be the best format for the Alpine stewardship gathering as well.

^Cairn Tampering in the Adirondack High Peaks

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Adirondack Mountain Club Adirondack High Peaks Summit Stewardship Program

Cairn tampering has been studied in other parts of the Northeast but not in the Adirondack High Peaks although it remains a rampant problem. The only educational contact hikers have regarding cairns is if Summit Stewards catch hikers in the act of tampering with cairns. Constructed as a solid structure at heights of 2- 5 feet, cairns are meant to last forever if left undisturbed. The negative impacts for cairn tampering include resource impacts such as damage to alpine and subalpine vegetation, soil erosion, as well as hiker safety impacts. Furthermore, Summit Stewards spend ample amounts of time un-decorating rocks from cairns and rebuilding unstable cairns. The focus of this educational cairn effort will be on Cascade Mountain, the busiest of the High Peaks with the largest amount of novice hikers, as well as the High Peaks Information Center on the Adirondack Mountain Club's (ADK) Heart Lake Property.

During the 2017 Summit Steward season, stewards and volunteers will be collecting data on the persistence of cairn tampering on Cascade Mountain before and after a cairn educational sign kiosk is built at the Cascade trailhead and signs are placed on the summit. We hope to see cairn tampering decreasing significantly on Cascade after signs are put up. The Waterman Fund

has given ADK a grant to build these signs. All of the signage will be focused on protecting alpine vegetation, fragile summit soil, and preventing cairn tampering.

***Collaboratively Working Toward Visitor Use Management Solutions for the Alpine Zone of Franconia Ridge**

Hawk Metheny, New England Regional Director Appalachian Trail Conservancy
John Marunowski
Nathaniel Scrimshaw
Kim Votta
Jason Zink

Franconia Ridge in the White Mountains of New Hampshire has long been a destination for outdoor recreation. In recent years, visitor use of the Ridge has grown considerably; on summer and fall weekends, several hundred people per day have been observed within the alpine zone. Protecting the ecological integrity of alpine areas of the Ridge has been a goal of stewards and land managers for several decades. Traditional approaches to visitor use management on the Ridge (e.g., scree walls, trail treadway hardening, education) provide considerable benefit, but may have diminished effectiveness as visitation to the Ridge continues to increase.

In 2016, a diverse group began meeting to address this challenge. Partners include: White Mountain National Forest, New Hampshire Division of Parks and Recreation, Appalachian Mountain Club, Appalachian Trail Conservancy, The Waterman Fund, and others. The group has followed the newly released Interagency Visitor Use Management Council (IVUMC) framework, which has been adopted as a visitor use planning process by many Federal agencies and the Appalachian Trail Conservancy. This framework goes beyond the traditional carrying capacity approach to visitor use management, by incorporating considerations of resource protection and visitor experience in addition to capacity. The framework delineates 14 steps, which generally fall into the broader categories of: understanding the challenges and background; defining desired conditions; identifying management actions; then implementation, monitoring, and adaptive management.

In recent months, multiple partner meetings have occurred, which build from the already rich history of data collection, monitoring, and lessons learned from managing visitors on Franconia Ridge. The group has worked through the IVUMC framework to the point of identifying possible strategies for managing use. These potential strategies include multiple tactics, generally within the categories of education, trail hardening, parking improvements, policy, enforcement, and administrative controls. Evaluation and prioritization of potential actions is ongoing, with the goal of developing and implementing a visitor use management plan that protects the ecological integrity of Franconia Ridge while providing for appropriate recreation opportunities. This methodology may be applicable to other Alpine Areas in the Northeast experiencing similar visitor use management challenges.