

PROCEEDINGS OF THE ACADIA NATIONAL PARK SCIENCE SYMPOSIUM

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Summary

The 2019 Acadia National Park Science Symposium, held at the Schoodic Institute at Acadia National Park in Winter Harbor, brought together over 100 researchers, students, and park staff to discuss science taking place in and beyond park boundaries. The symposium featured three sessions with multiple speakers as well as 26 posters describing results and plans for research in a range of disciplines, including natural sciences, social sciences, and humanities.

The speakers at the event were:

State of science in Acadia

Rebecca Cole-Will, Chief of Resource Management, NPS, Acadia National Park

Abraham Miller-Rushing, Science Coordinator, NPS, Acadia National Park

Adapting to the future

Kate Miller, Plant Ecologist, NPS, Northeast Temperate Inventory and Monitoring Network

Linda Welch, Biologist, Maine Coastal Islands Wildlife Refuge

Nancy Sferra, Director of Stewardship and Ecological Management, The Nature Conservancy Maine

Integrating social and natural science research

Dave Pettebone, Applied Research Coordinator, NPS, Environmental Quality Division

Adam Gibson, Social Scientist, NPS, Acadia National Park

Katharine Ruskin, Lecturer and Undergraduate Coordinator, University of Maine and Second Century Stewardship Fellow

Allison Gardner, Assistant Professor, University of Maine; Second Century Stewardship Fellow

For more information on Schoodic Institute and research in Acadia National Park and surrounding areas, please see:

<http://www.schoodicinstitute.org/>

Session Abstracts

State of Science in Acadia

Rebecca Cole-Will and Abraham Miller-Rushing

NPS, Acadia National Park

Adapting to the future

Kate Miller¹, Linda Welch², and Nancy Sferra³

1 NPS, Northeast Temperate Inventory and Monitoring Network

2 Maine Coastal Islands Wildlife Refuge

3 The Nature Conservancy Maine

Integrating social and natural science research

Dave Pettebone¹, Adam Gibson², Katharine Ruskin³, and Allison Gardner³

1 NPS, Environmental Quality Division

2 NPS, Acadia National Park

3 University of Maine and Second Century Stewardship Fellow

Social science has been an important area of research in Acadia National Park for well over 40 years. However, it is still considered an emerging area of research in the broader field of natural resource management. One reason social science may not be a more prominent area of research could be lack of knowledge related to the integration of social and natural or biological science. To increase understanding of the role social science can play, this session reviewed the history and current state of social science research in the National Park Service, summarized the use of social science research in Acadia National Park, and explored in depth two examples that successfully integrated social and biological research methods.

Poster abstracts

An Artist's Look at Changes in Colors in the Landscape Based on Projected Climate Change

Patricia Tewes

The poster is an artistic representation of how colors in Maine will change based on projected vegetation changes with +2 degrees of warming.

Long Forgotten Invasive Plants Become New Targets

Jesse Wheeler, James Burka, Nicholas Stevenson, and Alexander Fetgatter

National Park Service, Acadia National Park

Botanists and Resource Managers inventoried Invasive plant locations throughout Acadia National Park in the early 2000's. Acadia's Invasive Plant Management Team (IPMT) investigated these reports in 2018 and 2019, only to find a whole range of outcomes. Many invasive observations from 15 years ago have stayed small and isolated, though some are now large populations that have gone unchecked. Will the IPMT succeed in managing them all?

Invasive species trends in eastern national park forests

Camilla E. Seirup, Kate M. Miller, and Aaron S. Weed

National Park Service, Northeast Temperate Network Inventory and Monitoring Program

The National Park Service Inventory and Monitoring Program (NPS I&M) monitors forest health in a network of permanent plots in 39 eastern national parks. The parks included in this study vary widely in size, land use history, and designation, but all are impacted by invasive exotic plant species and the threat of further expansion and new invasion.

Here we present preliminary findings regarding trends in invasive plants in eastern national parks over the last 12 years of monitoring. We used mixed effects models to determine how invasive plant abundance is changing over time. We modeled trends in each park individually, and assessed multiple scales and metrics of invasion, including proportion of plots invaded, frequency of 1m² quadrats invaded, and average percent cover of invasives. We assessed trends in invasive plants overall, by species, and by the following guilds: trees, shrubs/vines, graminoids, and herbs.

Parks vary considerably in their degree of invasion: Acadia National Park is the least invaded park (4.6% of plots invaded) while the most invaded parks are in the mid-Atlantic states (9 parks with 100% plots invaded). Increasing trends in invasive species abundance far outnumbered decreasing trends, and only two parks in our study showed an overall decline in invasive plant abundance over time:

Marsh-Billings-Rockefeller National Historic Park (VT), and Prince William Forest Park (VA). Where detected, significant declines of invasive herbaceous or graminoid species tended to coincide with roughly equivalent increases in invasive shrub abundance.

Japanese stiltgrass (*Microstegium vimineum*) emerged as the most aggressive invasive species and is a high management priority, particularly in northern parks where its range is still limited. Invasive shrubs also increased over time in many parks across the region and should be a high management priority because of their impacts to natural forest processes, biodiversity, and because their presence may be linked to increased risk from tick borne diseases. Invasive plants are a growing challenge for many parks in the northeast and this study will help parks prioritize species for management. Our findings suggest that natural resources in parks suffer from deferred management, particularly of invasive species, just as park infrastructure suffers from deferred maintenance.

Reversing the widespread increase of invasive plants we have documented will require a long-term commitment from the NPS similar to the commitment being made to address the costs of deferred maintenance.

Research permits at Acadia National Park: The numbers

Emma Albee¹ and Abraham Miller-Rushing²

1 Schoodic Institute at Acadia National Park

2 National Park Service, Acadia National Park

A breakdown of Acadia National Park's research permits from 2001 through 2019: number of research permits each year, where research takes place, and topics of research.

Scientific publications related to Acadia National Park in 2018 and 2019

Abe Miller-Rushing¹ and Emma Albee²

1 National Park Service, Acadia National Park

2 Schoodic Institute at Acadia National Park

This poster provides a list of the scientific papers and reports related to Acadia National Park published in 2018 and 2019. It gives a measure of the amount and breadth of scientific output from research happening in Acadia National Park.

New Drone-based Aerial Outcrop Photography at Schoodic Point, Acadia National Park

Mark T. Swanson

University of Southern Maine

First-ever quadcopter drone flights over Schoodic Point and adjacent coastal bedrock have generated new spectacular hi-resolution imagery of the outcrop surface in seamless and continuous orthomosaics. Our DJI Phantom 4 Pro quadcopter with 20 mpx camera was flown for ~2 hours on a single day (April 18, 2019) at 100 feet/30 meters above ground level. 858 overlapping nadir photos were taken covering about 4000 ft/1300 meters of shoreline outcrop in two sections; the east half and flank of Schoodic Point (303 photos for 400 meters of shoreline) and west of Schoodic Point to Pond Cove (557 photos for 900 meters of shoreline). Photo sets for these two sections were processed using the photogrammetry software Agisoft PhotoScan to align photos with ~150,000 matching tie points, create a dense point cloud of ~30 million points, generate a mesh with ~ 2 million faces and added textures to produce accurate detailed 3D models and hi-resolution orthomosaics. Processing time for each photo set for medium level of accuracy/quality was ~ 7 hours including 2.5 hrs for aligning photos and 4 hours for depth mapping and point cloud generation. The final resolution for the orthomosaic images has been refined down to ~1 cm (9.2 mm) ground distance pixel sizes compared with Google imagery at ~10 cm ground distance pixel sizes but the final .tif or .jpeg image files are large-sized, ranging from 500 mb .jpeg to 3 Gb .tif files. This new hi-resolution view will enable detailed mapping and visualization of the many dike intrusions and fault zone features found and previously surveyed throughout the Schoodic Peninsula. In particular, this new view will allow the mapping and compilation of small-scale brittle

horsetail-terminated strike-slip faults that have never before been imaged or mapped. Planned photographic quadcopter surveys for the Fall 2019 off-season include shoreline outcrops of the west half of Schoodic Point, as well as Pond Island and Little Moose Island. Any flight planning requires low wind, no precipitation and 3 mile visibility to be able to fly, overcast skies for best photography with no shadows and no park visitors on the outcrop per FAA Part 107 regulations.

Acadia Scholars 2019: A multifaceted approach to bat conservation in Acadia National Park

Molly Donlan

College of the Atlantic

The Acadia Scholars program is a partnership between the College of the Atlantic and Acadia National Park. This program provides students with internships in the park to gain real-world experience, skills in their chosen field, and make connections in the local community and with professionals. This summer was the third year of the Acadia Scholars program, after two successful summers of students working within the Interpretation and Resource Management divisions. As the 2019 Acadia Scholar, I worked alongside the Wildlife Department of Resource Management as an intern. My work was primarily to assist in the department's study on bat populations within the park. The goal of this study is to better understand how White Nose Syndrome (WNS) has affected local populations, especially of the *Myotis* bats which have experienced the most dramatic population decrease since WNS was observed on Mount Desert Island in 2011.

Seeing Smelt: Citizen Science to Inform Sea Run Fish Monitoring

Molly Payne Wynne¹, Sarah Kirn², Sarah Madronal³, and Danielle Frechette⁴

1 The Nature Conservancy

2 Gulf of Maine Research Institute

3 Downeast Salmon Federation

4 Maine Department of Marine Resources

Maine is home to 12 species of native, sea-run (diadromous), fish with significant ecological, economic, and cultural value. Scientists and resource managers need more complete coast-wide information on these fish to sustainably manage them now and in

the future. To help fill information gaps and re-engage citizens' connection to these incredible natural resources, The Nature Conservancy, Gulf of Maine Research Institute (GMRI), Downeast Salmon Federation (DSF), and the Maine Department of Marine Resources (DMR) are collaborating on a project to enable interested volunteers to contribute vital information about the spawning of rainbow smelt, a species that has been in decline since the mid to late twentieth century. This project will be part of GMRI's new Ecosystem Investigation Network, an online platform that connects and supports a community of partner organizations and citizen scientists of all ages who are investigating how climate change is impacting the species, communities, and habitats in the Gulf of Maine watershed. The partners hope to replicate the rainbow smelt project to support observation and data collection on other diadromous species (e.g. tomcod, American eel) to inform their management and restoration. Building on the impressive volunteer-based fisheries monitoring by DSF and in coordination with DMR, the project is being beta-tested in the Downeast region with anticipated roll-out to volunteers this winter! This poster will present particulars regarding the tool, data quality and management. Project collaborators will be on hand to demonstrate and discuss the project, platform, and/or future directions.

High resolution water monitoring at Acadia National Park

William Gawley¹, Shannon Wiggin¹, Jake VanGorder¹, Rachel Fowler², and Jasmine Saros²

1 National Park Service, Acadia National Park

2 Climate Change Institute, University of Maine

Seven seasons of near-continuous monitoring in Jordan Pond has provided our project team a more comprehensive and accurate understanding of temporal and seasonal trends in the lake's water quality and physical properties than was possible with traditional monthly monitoring visits. We have documented considerable variation in how conditions in this oligotrophic lake respond to changes in weather and climate. Future goals include expanding the use of high resolution monitoring techniques to investigate whether similar or divergent response patterns exist in lakes with different morphometry and trophic states; and to track daily water quality conditions in streams.

Applying regional resilience data to parcel-level priorities for land protection in the Schoodic to Schoodic region

Bob DeForrest and Jeremy Gabrielson

Maine Coast Heritage Trust

The Schoodic to Schoodic region in eastern Maine is characterized by high levels of terrestrial habitat connectivity as compared with other coastal area in the eastern United States. Relatively large, unfragmented habitat blocks, anchored by conserved land in Acadia National Park and in the Tunk Lake /Donnell Pond area, support populations of wide-ranging mammals along the Schoodic Peninsula; and contribute to both species' diversity and habitat resilience in the region.

In 2015, Maine Coast Heritage Trust (MCHT) worked with partners to develop a landscape-scale land protection strategy designed to protect connectivity in the Schoodic to Schoodic region, while also allowing for traditional uses of the landscape, such as forestry, hunting and outdoor recreation. The plan that we developed identified parcel-level priorities for outreach to landowners. Our planning effort relied on conversations with wildlife biologists and researchers to supplement lower resolution resilience mapping products available at the time.

In 2019, MCHT and our partners made use of new, higher resolutions spatial datasets to review and revise our priorities for land owner outreach. Results of the new analysis largely align with our prior assessment; however, the new analysis also identified new priorities for outreach near existing blocks of conserved land; and helped us refine priorities for land owners outreach around critical pinch-points. This poster describes our methods for applying ecoregion-level resilience data to inform parcel outreach priorities as a local scale; and provides a summary of our results.

Research Briefs through Interpreters' Eyes

Martha Merson, Alyssa Parker-Geisman, Louise Allen, Nickolay Hristov

Research Briefs through Interpreters' Eyes. How do interpretive park rangers regard research briefs? This audience interacts with tens of thousands of visitors annually and often feel left out of the most up-to-date information on park-based research. Quotes from interviews with interpreters and principles for inclusive science communication suggest slight shifts in form and content that would make research briefs a powerful resource for interpreters.

Greater Connection

Alexis Brunnert, Nickolay Hristov, Louise Allen, and Martha Merson

iSWOOP

Greater Connection is a five-minute film that tells the story of the community members, researchers, and rangers who have been part of the alewife recovery effort on Mount Desert Island. The film raises questions about how stories like this one get into the public's awareness, how films like this one can move conservation efforts forward and change the narratives surrounding government-funded projects.

Second Century Stewardship: Science for America's National Parks

Catherine Schmitt¹, Abe Miller-Rushing², Nick Fisichelli¹, and Rebecca Cole-Will²

1 Schoodic Institute at Acadia National Park

2 National Park Service, Acadia National Park

Second Century Stewardship began in 2016 as an initiative to advance science and inspire audiences of all ages. The goals of the initiative are to: (1) support stewardship of park resources through advancing conservation and ecosystem science, (2) strengthen public understanding of the importance of science for parks and society, (3) increase public engagement with science, and (4) pursue solutions to critical conservation challenges. The project partners achieve these goals by providing research fellowships and communication training, by enhancing park education activities and school curricula, and by convening leaders to pursue solutions to critical challenges. Second Century Stewardship has achieved early successes and promises to continue to grow its impact in Acadia National Park and throughout the National Park Service.

WHITHER SCHOODIC? Monitoring Visitor Numbers and Activities in a Time of Change

Rebecca Stanley

Friends of Acadia

Proceedings of the Acadia National Park Science Symposium - October 24, 2019

The development of the Schoodic Woods campground and visitor center in 2015 resulted in significant changes for visitation in the Schoodic Peninsula. The new infrastructure included a 100 car parking lot, a 97 site campground, 7 miles of bike paths, and 5 miles of hiking trails to park facilities. Since the construction of these sites, vehicle and bicycle traffic data has been collected to better gauge visitor use patterns and volumes. Visitation trends from 2015-2019 will be discussed, as well as possible trends over the next 5 years.

Hydrologic Mapping at Little Long Pond Preserve, Seal Harbor, Maine

Sahra Gibson¹ and Tate Bushell²

1 College of the Atlantic

2 Mt. Desert Land & Garden Preserve

We used Arc GIS data and field reconnaissance to map natural and engineered waterways in the Little Long Pond Watershed. Most notable was a cluster of deep ditches of unknown origin. We speculate that the ditches formed during a period of deforestation and severe erosion.

Measuring Human and Dog Visitation at Little Long Pond Preserve, Seal Harbor, Maine

Sahra Gibson¹ and Tate Bushell²

1 College of the Atlantic

2 Mt. Desert Land & Garden Preserve

We measured human and dog visitation rates by deploying three infrared pedestrian counters at two preserve entrances and a commonly used trail (April - September total ~38,000 human visits, ~21,000 dog visits). We conducted visual counts to determine the percentage of parties entering Little Long Pond Preserve with at least one dog (~56%).

Health-Climate Linkages in Maine: Timeline of Extreme Events and Impact of Winter Warming on Deer Tick Expansion

Charlotte Rhodes, Julia Simonson, Susan Elias, and Sean Birkel

There is increasing need to document linkages between climate and health in Maine as extreme weather events associated with climate change are becoming more frequent and severe. In order to address this need, we 1) created a timeline of recent high-impact extreme weather events, and 2) developed a case study to test the hypothesis that wintertime warming associated with the 1997-98 mega El Niño was a factor that contributed to the spread of Lyme disease in Maine by producing favorable conditions for survival of the vector deer tick (*I. scapularis*). The latter is known to have important connection to wintertime survival of the white-tailed deer. The results from our analysis suggest that winter has an indirect affect on tick populations through their influence on deer populations. Future studies should further examine this correlation considering more environmental variables.

Acadia Visitor Health and Risk Perceptions of Ticks

Nathaniel Burke

Acadia National park has seen a large increase of tick borne disease (especially Lyme) in the last decade and increased risk of exposure to vector borne diseases was identified as one the top concerns by visitors in recent University of Maine research. This poster will display data from an ongoing study at the University of Maine which examines ANP visitor health risk perceptions and behavioral responses related to tick and tick borne disease.

Determining the relationship between trail proximity and tick abundance in Acadia National Park

Shayla Miller, Sara McBride and Allison Gardner

University of Maine

Tick abundance has been steadily increasing throughout the northeastern and midwestern U.S. over the past 50 years. Maine has been heavily affected by this increasing prevalence of ticks, including the blacklegged tick, *Ixodes scapularis*. This tick is responsible for the transmission of the Lyme Disease-causing bacteria, *Borrelia burgdorferi*. Acadia National Park, located in Midcoast Maine, and has seen a sharp increase in tick abundance in recent years. This raises concerns about the possible exposure of staff and visitors to ticks and the increased chances of contracting Lyme Disease. Little is known about how proximity to trails can impact tick abundance. In this study, we explored the effect of trail proximity on tick abundance. We hypothesized that as proximity to trail increases tick abundance will decrease. We tested this hypothesis by flagging for ticks along trails that are considered high use (e.g., Cadillac Mountain), medium use (e.g., Great Head), and low use (e.g., Gorham Mountain). We found that as the distance from trail increases so will tick abundance. This research is important to bring awareness to staff and visitors of the park of the exposure to ticks they experience while in Acadia.

Ranges of *Peromyscus* in Acadia and Maine: disease potential and a model for the future

Molly Bennett, Danielle Levesque, Sara McBride, Allison Gardner

University of Maine

Two mouse species in Maine (*Peromyscus maniculatus* and *Peromyscus leucopus*) are currently undergoing a range shifts, potentially because of climate change. The objective of my project is to determine the historical and current range of each species within the state of Maine. I will take two approaches: 1) identify to species samples obtained from the Acadia and Orono areas and 2) a literature review of previous research and trapping within the state. I will use ear biopsies collected this summer in Acadia National Park and throughout the state to genotype the mice as either *P. maniculatus* or *P. leucopus*. Additionally, I will summarize research that denotes where the two species were historically present around the state. These species are functionally impossible to tell apart in the field, and projects that use small mammal trapping often simply choose one of the two species to identify all uncertain mice. However, understanding the ranges of the two species could yield information as to how the two species might differ as reservoirs for tick-borne disease or hantavirus and how they might act as a model for mammalian range shift.

25 Years of Cadillac Mountain Hawk Watch Data

Seth Benz, Angi King-Johnston, and Carol Thompson

Schoodic Institute at Acadia National Park

A compilation of general hawk count numbers for the past 25 years, including species trends. Will submit later.

Anecdata: A Versatile Platform For Crowdsourcing Data

Cait Bailey, Anna Farrell, Ashley Taylor, and Jane Disney

MDI Biological Laboratory

Anecdata.org is a free online platform and mobile app developed by the Community Lab at the MDI Biological Laboratory. Anecdata is used by over 140 projects worldwide to host citizen science projects and collect, manage, and share observations of our changing environment. While other platforms have been created for citizen scientists to share their observations, these have typically been limited to biodiversity surveys or bird counts; projects that required more versatile data collection capability have had to use paper datasheets or costly custom-made online data collection systems. Anecdata is designed to help projects like these avoid having to create their own data collection solution by offering ease of use and a far broader scope of data collection.

Cost-effective data-collection systems for for citizen science

Sudarshan S. Chawathe

University of Maine

Citizen science efforts often include data collection by volunteers. Computerizing such data collection provides several benefits, including improved data consistency, shorter time from collection to use, and immediate feedback to the data collectors. Implementing such a computerized data collection system is often challenging because it is difficult to accurately estimate the level of participation and, therefore, the required load-handling

capacity. Overestimating the capacity results in unnecessary infrastructure costs while underestimating it leads to sluggish or failed systems. The so-called serverless or cloud based systems are attractive in this context because they permit the apparent (paid) infrastructure to scale with load. Determining cost profiles of different designs in this environment and, therefore, selecting a suitable one are challenging tasks that are addressed by this work.

Variation of benthic consumer communities in the Gulf of Maine rocky intertidal across latitude and wave exposure

Danielle Whalen¹, James Corbett¹, Catherine Matassa², Suzannah Trainer¹, and Geoffrey Trussell¹

1 Northeastern University

2 University of Connecticut

Understanding how large scale processes modify local-level processes to shape the distribution and organization of ecological communities is one of the central goals of ecology. These processes are driven by a variety of both biotic and abiotic factors which in turn influence the dynamics of rocky intertidal communities throughout the Gulf of Maine (GoM). Particularly, wave exposure (exposed, sheltered) and latitudinal gradients have been shown to have a strong effect on community assemblages within this region. Deciphering the relative impact of consumers across the broad latitudinal extent of the GoM is challenging due to the natural variation in consumer communities, density, and per capita impact. In order to do so, we conducted standardized surveys of benthic consumer communities at 10 pairs of exposed and sheltered sites from Nahant, MA in the southern GoM to Lubec, ME in the northern GoM. On sheltered shores, total consumer density was highest at mid-latitude sites while on exposed shores, total consumer density was highest at low-latitude sites. Although aggregate consumer density had a relatively simple relationships with latitude, patterns for individual species were more heterogeneous. Thus, characterizing the functional roles of individual consumer species may be necessary to understand how top-down processes shape community dynamics at local scales and compare the magnitude of consumer impacts across larger spatial scales. Moreover, because we also found evidence for large inter-annual variation at some of our sites, we suggest that long-term, large scale studies are necessary to understand the relative importance of top-down and bottom-up processes throughout the Gulf of Maine rocky intertidal.

Connecting Communities, Schools, and Science

Bill Zoellick and Sarah Hooper

Schoodic Institute at Acadia National Park

We summarize the work that Schoodic Institute has been doing to increase the capacity within rural communities to make evidence-based decisions as they respond to change. We posit that there are assets within communities that could contribute to such capacity but are underutilized because they are disconnected. In particular, we see the public school system as such a resource. We review our work to date with Gouldsboro and RSU 24 as a case study that has helped us refine this conjecture, and we outline plans for scaling up the investigation. We present the poster with the hope that it will stimulate conversations about translating research into local practice. We seek critical feedback to shape our work.
