

PROCEEDINGS OF THE ACADIA NATIONAL PARK SCIENCE SYMPOSIUM

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Summary

Note: The Acadia National Park Science Symposium originally set for October of 2013 had to be postponed, due to the government shutdown, until April 16th, 2014.

The April 2014 Acadia National Park Science Symposium, held at the Schoodic Education and Research Center (SERC), brought together over 100 researchers, students, and park staff to discuss science taking place in and beyond park boundaries. The symposium featured five invited speakers and 45 posters describing results and plans for research in a range of disciplines, including natural sciences, social sciences, and humanities. This symposium highlighted the process of connecting science with people.

The speakers at the event were:

Science Is People, Then and Now - Catherine Schmitt, Maine Sea Grant

Art Is the Natural Science - Catherine Clinger, College of the Atlantic

Ecological Citizenship: Reflection, Reverence, Restoration, and Resilience - Seth Benz, Schoodic Institute

Dragonfly Larvae as Sentinels of Mercury Contamination in Acadia and Beyond: Engaging Citizen

Scientists in National-scale Research - Sarah Nelson, University of Maine

Leveraging Citizen Science with Groups - Mark Chandler, Earthwatch Institute

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

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

Emma Albee, Science Information and Communications Manager, Schoodic Institute

Abraham Miller-Rushing, Science Coordinator, Acadia National Park

Poster abstracts

Increasing the accessibility of research conducted in Acadia National Park through digitization

Emma Albee¹, Abe Miller-Rushing², Robyn King², Rebecca Cole-Will², Katherine Pontbriand², and Maxwell Swann²

1 Schoodic Institute, Winter Harbor, Maine

2 National Park Service, Acadia National Park, Bar Harbor, Maine

For the past few summers, Acadia National Park has been working to digitize their bibliography of all research that has been done in the park. These documents include journal articles, letters, and park reports about research that was conducted in and around Acadia National Park since the park was formed. Information, such as title and author, and a digital copy of the documents were then uploaded to a database called the Integrated Resource Management Application, or IRMA (irma.nps.gov), so they could be accessed by scientists in the future.

Exotic Plant Management at Acadia National Park

Frank Archuletta and Anthony Tocci

National Park Service, Acadia National Park, Bar Harbor, Maine

This program gives a brief overview of Exotic Plant Management in Acadia National Park. It includes basic information on non-native plant species currently being managed, and explains treatment methods used by Acadia's EPMT (Exotic Plant Management Team.)

A citizen science approach to mapping eelgrass (*Zostera marina* L.) loss in Maine

Duncan Bailey, Jordan Bailey, George Kidder and Jane Disney

MDI Biological Laboratory P.O. Box 35 Salisbury Cove, ME

In Maine, eelgrass (*Zostera marina*) emerges each spring from rhizomes in the sub-tidal sediment. It propagates by vegetative and sexual means throughout the summer, and usually dies back to the rhizome in fall or early winter. In fall 2012 eelgrass died back by late August in upper Frenchman Bay

and did not emerge from rhizomes in spring 2013, nor did it germinate from seeds. This was determined by underwater videography and direct observation from kayaks at low tide. In order to understand the extent of the eelgrass loss, we developed a new database-driven web application that invites the public to report locations where eelgrass is and is not growing (www.eelgrassinmaine.org). We used a variety of approaches to distribute information about the site, including e-mails to groups, media coverage, and personal contacts. Numerous individuals, kayak tour participants, and students at summer camps used the site to report their observations. In total, fifty-nine observations were reported from locations in Maine. These reported observations showed that although other bays such as Maquoit Bay in southern Maine experienced similar expansive declines in eelgrass coverage, the decline was not uniform statewide. The presence of eelgrass was reported for 46 locations; eelgrass loss was reported for 13 locations, most of them in Frenchman Bay. Our experience demonstrates there is potential for crowd-sourced technological solutions in gathering data on emerging environmental problems. Anecdotal information can play a role in revealing broad patterns and pointing scientists toward new studies. We are building on our experience by creating a new online data portal for community observations which will function as a collaborative naturalist's notebook at www.anecdata.org.

Impact of the invasive European fire ant, *Myrmica rubra* L. (Hymenoptera:Formicidae) and their control treatments on non-target arthropods within Acadia National Park

Elissa Ballman and Eleanor Groden

School of Biology and Ecology, University of Maine, Orono, ME

The European fire ant is a widespread invasive stinging pest in Acadia National Park. During 2011 and 2012, multiple pesticide treatments were deployed against the fire ant across several sites on Mount Desert Island. In 2012, insect surveys were undertaken to determine the impacts of fire ants, and fire ant treatments on native arthropods. Pan traps, pitfalls, and specific host surveys were conducted to measure insect populations at three site types: 1) uninfested and untreated, 2) infested and untreated, and 3) infested and treated. Abundance and diversity of arthropods were recorded and compared among site type. Our results indicate fire ants have a negative impact on certain non-target specimens, whereas the pesticide treatments had no detectable detrimental effects on non-target organisms.

Year three update of site-specific integrated pest management of the invasive European fire ant, *Myrmica rubra* L. (Hymenoptera: Formicidae), within Acadia National Park

Elissa Ballman and Eleanor Groden

School of Biology and Ecology, University of Maine, Orono, ME

The European fire ant is an invasive pest that is negatively impacting native fauna in Acadia National Park. In 2011 and 2012, a site specific integrated pest management plan was implemented on Mount Desert Island across eight infested sites in an attempt to manage this serious threat. A combination of different pesticide treatments was deployed and populations of ants were simultaneously monitored throughout the two field seasons. Ant sampling revealed reduced fire ant populations for all sites in 2011 and 2012. Our results indicate that eradication, even in small populations, is unlikely. Management can best be attained by using a site specific strategy based on the use of the area and size of the infestation.

Microplastics Pollution Monitoring Project

Abigail Barrows¹, Jessica Whelpley¹, Kaela Wuesthoff^{1,3}, Meggan Dwyer^{1,2}, Ane Braga¹ and Jennifer Fortier¹,

1 Marine Environmental Research Institute, 55 Main Street Blue Hill, Maine 04614

2 Department of Marine Resources, 22 Coaling Station Lane, Lamoine, ME 04605;

3 Children's Maritime Foundation, 4676 Lakeview Ave Suite 211, Yorba Linda, CA 92886

This study piloted different sampling techniques to determine the best procedure for understanding microplastic distribution and density in Blue Hill and Penobscot Bays. Studies have looked for microplastics in intertidal and benthic sediments, within the water column and along the sea surface. We tried three common field sampling techniques: Neuston net tow, intertidal sediment grabs and Whole Water collection. Our study found the Whole Water sampling technique to be an advanced methodology for microplastic monitoring, providing a true picture of plastic pollution through lowering contamination by sampling equipment. We found an average of 15.6 microplastic pieces per liter of seawater. The results show a higher concentration of microplastics than any other study published to-date. Further research using this technique needs to be employed on a larger scale to understand true microplastic density and distribution.

Lichens of Selected Vernal Pools in Acadia National Park, Maine

Jason Barton¹, Nishanta Rajakaruna¹, Brett Ciccotelli¹, Fred C. Olday¹, Bruce Connery², Alan M. Fryday³

1 College of the Atlantic

2 National Park Service, Acadia National Park, Bar Harbor, Maine

3 Dept of Plant Biology, Michigan State University

Six selected vernal pools in Acadia National Park were surveyed to identify lichen diversity in temporary pool habitats. Sixty-seven species were identified, including seven species never reported for Acadia National Park. The survey represents the first survey of lichens found in vernal pools in Acadia National Park and our findings represent the richness of lichen assemblages to be found in this unique habitat type. Further work is needed to determine how lichen assemblages are distributed across the range of temporary pool habitats found throughout the park and in New England.

Phylogeography of the Smooth Green Snake (*Opheodrys vernalis*) across its North American range

Brian Blais¹, Brian Smith¹, Kristen Ober², Steve Ressel², Bruce Connery³

1 Black Hills State University, Spearfish, SD

2 College of the Atlantic, Bar Harbor, ME

3 National Park Service, Acadia National Park, Bar Harbor, Maine

Acadia National Park is located within the natural range of the Smooth Green Snake, *Opheodrys vernalis* (Family: Colubridae), which spans the northern half of the U.S. and southern Canada. Within its range, isolated populations are scattered intermittently and several subspecies have been proposed based on scale morphologies, but was rejected by the herpetological community soon after (Collings, 1992; Ernst & Ernst, 2003). The work presented herein is part of a larger study on a range-wide phylogeography of this species using genetic analyses to settle any taxonomic discrepancies among disjunct populations of *O. vernalis*.

From June-September 2013, I collected tissue samples *in situ* at Acadia National Park using visual encounter surveys, and cover boards to attract snakes. The Acadia samples will be genetically analyzed and compared to samples from several other states to uncover range-wide operational taxonomic units (OTU's). Similar research has had success in deciphering lineages, speciation, life histories, and conservation implications for other reptiles (Burbrink & Castoe, 2009; Burbrink *et al.* 2008; Starkey *et al.*, 2003).

Population expansion at a seasonally varied grey seal (*Halichoerus grypus*) colony on Mount Desert Rock in the Gulf of Maine

Alex J. Borowicz, Tanya Lubansky, Christopher J. Tremblay, and Sean K. Todd

College of the Atlantic, Bar Harbor, Maine

Increases in the western North Atlantic stock of grey seals have resulted in expansion of this species into new territories and haul-out sites in the Gulf of Maine over the past forty years. Here we report

on the foundation and growth of a grey seal colony at Mount Desert Rock, a 3.5 acre island located on the biologically productive Inner Schoodic Ridges in the Gulf. Although logistically challenging, in 2013 we conducted our third consecutive winter field season as part of a new research program at Mount Desert Rock; preliminary observations of this site indicate it is a productive pupping colony during the winter, although possibly temporally delayed in comparison to other pupping sites in the Gulf. We find that from 1972 - 1992 the island has experienced a significant positive trend in grey seal haul-out numbers, as averaged from daily counts performed throughout the summer. However the winter seal population may be yet larger, stressing the importance of Mount Desert Rock as a relatively new haul-out and pupping ledge in the Gulf of Maine. This might have important implications for a resident and sympatric colony of harbor seals (*Phoca vitulina*) that cohabit the island in the summer, and for interactions with local fisheries.

The new Surficial Geology map of the Southwest Harbor 7.5' quadrangle portion of Mount Desert Island

Dr. Duane D. Braun

Professor emeritus, Bloomsburg University of PA., cooperating geologist, Maine Geologic Survey

The Southwest Harbor 7.5' or 1:24,000 scale quadrangle Surficial Geology (glacial deposit) map was revised in 2013 using one meter resolution Lidar imagery to produce a much more accurate and detailed map than was previously produced. About 200 recessional moraine (till) ridges were mapped across the map's nine mile south to north distance. A pair of much larger, thicker moraines lies at the southern ends of Great Long Pond, Echo Lake, and Jordan Pond and form the Somes Sound Narrows. These thicker till or sand and gravel deposits buried a portion of the preglacial Hadlock Brook and Jordan Stream valleys, diverting them to their present courses across granite ledges. Hadlock Brook originally drained south from the Upper Hadlock Pond area, beneath present day Route 198, to enter the northern end of Northeast Harbor. Jordan Pond originally drained to the south to Seal Harbor. Most of the moraines are below the 220-230 ft. elevation of the highest marine submergence of the region and are "wave washed", some to just a linear pile of boulders lying on bedrock ledges. A number of beach ridges or strandlines covered with boulders and cobbles were mapped, particularly on Great Cranberry Island, Hio Hill near Southwest Harbor, and along the south slope of the Western Mountains. A distinct scarp at the 220-230 ft. elevation was cut into till around the northern two-thirds of Beech Hill. That scarp marks the boundary between cleared farm fields on top of Beech Hill and forest (originally mostly sheep pasture) on the lower side slopes of Beech Hill. Marine mud (silt and clay), called the Presumpscot Formation, buries much of the lower elevation areas between bedrock knobs and moraines in the lowlands southwest of the village of Southwest Harbor and locally elsewhere in the quadrangle. On the east side of Mansell Mountain, there is an arcuate re-entrant that probably represents a large rock block slide that dropped down 200 ft. or so and out into Great Long Pond.

Vegetation composition, structure and ecophysiology of maritime ledge ecosystems

Amanda L. Butak and Michael E. Day

School of Forest Resources, University of Maine

Ledge and rocky outcrops are common geomorphologic features along the eastern coast of the Gulf of Maine. Plant communities consisting of pines, spruce and ericaceous shrubs typically dominate these localities. However, coastal currents that regulate local climates create a sharp distinction between communities lying to the east of Frenchman's Bay and those from Mount Desert Island westward. These maritime climates provide for contrasting vegetation assemblages dominated by two pine species. Pitch pine is the dominant tree in ecosystems at more southwestern sites and jack pine at more eastern localities. Within each ecosystem two co-occurring vegetation communities are present, one developing under the direct influence of pines and the other lacking pines. Pines appear to have keystone roles, creating divergent species assemblages between pine-dominated and non-pine communities. Our continuing study is focused on the ecophysiological relationships of plants in these four ecosystem-community variants.

We have found that plants growing near pines are less stressed by drought than their non-pine counterparts. Pine-dominated communities have greater soil depths, species richness, a more complex and stratified structure, and higher productivity in dominant shrub species. Significantly higher concentrations of nutrients associated with marine aerosols were found in shrubs associated with pines, suggesting that pines may efficiently capture fog and marine aerosols, providing additional water and nutrients to surrounding plant communities. In addition, pine communities have significantly higher concentrations of elements that correlate with bedrock weathering than non-pine communities, suggesting that pines may tap deep water sources, potentially reducing water stress in co-occurring plants through hydraulic redistribution.

Manipulation of leaf-to-air vapor pressure deficits (VPD) enabled assignment of species to functional groups by their response to water stress, and both functional groups and preferences of individual species correlate with ecosystem-community distribution patterns. Groups that demonstrated limited ability to respond to VPD show preference for cooler, moister combinations, while those found in the most stressful sites tended to be able to avoid water stress by stronger responses to atmospheric VPD.

Our continuing study incorporates the roles of temperature and atmospheric humidity on composition, structure and ecosystem processes. Foliage in both ecosystems and cover-types are being analyzed for nutrient composition, carbon isotope composition as an indicator of relative water stress, and hydrogen and oxygen isotopes to identify plant water sources.

Protecting Resources Through Adaptation of the NEPA Process

Chris Buzcko

National Park Service, Acadia National Park, Bar Harbor, Maine

Because the development and implementation of NEPA has largely been delegated to agencies so long as they meet its objectives, adaptation and modification of the process is possible. As science increasingly becomes complementary to the decision making process, future debate is likely to focus on the 'where and when' science is included. Acadia National Park recognizes the important role science plays in the decision making process and has increasingly sought to involve science nearer a project's inception rather than waiting for a formal or established review period.

Planning for Climate change Impacts to Cultural Resources at Acadia National Park

Rebecca Cole-Will and Judith Hazen Connery

National Park Service, Acadia National Park, Bar Harbor, Maine

NPS climate change response has primarily focused on understanding climate change impacts to natural resources. NPS cultural resources managers are working to understand the potential impacts to cultural resources, which have their own unique sets of issues. Cultural resources are unique, irreplaceable, and once lost, they are lost forever. If moved or altered, they may lose context, significance and meaning.

NPS cultural resource management planning for climate change is based on two tenants:

(1) Cultural resources are primary sources of data regarding human interactions with environmental change; and ,

(2) changing climates affect cultural resource preservation and maintenance.

Case studies of managing Acadia's nationally significant cultural resources affected by a changing climate are illustrated.

What Do Bees Want?

Alison C. Dibble, Lois Berg Stack, Francis A. Drummond

University of Maine, Orono, Maine

Maine has more than 265 species of native bees . Their role as pollinators of the lowbush blueberry crop might be increased through installation of effective bee gardens. Toward that aim, we are testing

bee response to floral resources through the growing season . In a common garden study we call the Bee Module at four farms in 2012-2013, we observed bee visitation rate on flowers of 60 plant species. Bees landed on flowers in 49.2% of the 8097 one-minute observations. Bee groups (e.g., bumble bee, honey bee, sweat bee, etc.) differed in their visitation rate, and plants varied widely in the abundance of bees they attracted. Top bee plants so far include anise hyssop, summersweet, Greek oregano, butterfly milkweed, and a yellow, single-flowered French marigold. The project includes two more years of data collection and additional plant species.

Are green crabs responsible for eelgrass loss in Frenchman Bay?

Jane Disney¹, George Kidder¹, Lukas Thorburn², Duncan Bailey¹, Jordan Bailey¹ and Rick Martens¹

1 MDI Biological Laboratory P.O. Box 35 Salisbury Cove, ME

2 University of Massachusetts, Amherst, MA

Eelgrass beds in upper Frenchman Bay failed to produce shoots during the 2013 growing season. We investigated three possible causes for this apparent die-off: a nutrient deficiency or toxicity of sediments, decline in water quality over years and destruction by invasive green crabs. We assessed the growth rate of eelgrass in sediment from the Bar where eelgrass had not been lost and eelgrass from Hadley Point where eelgrass had been lost. There was no difference in growth rate of plants under these two different conditions. We compared results of water quality tests conducted over five sites over the last four years and found no significant changes in turbidity, salinity, or dissolved inorganic nitrogen, phosphorus, or dissolved oxygen levels. Water temperatures were not outside the tolerable range for *Z. marina*. There was, however, a precipitous drop in levels of silicate over the last four years, which could have weakened plants. In order to assess the impact that green crabs might be having on eelgrass, we set up two fenced areas in the sub-tidal area at Hadley Point and transplanted eelgrass inside and outside of the fenced areas. Crabs were regularly trapped from one of the fenced areas and from outside the fences. There was no difference in the number of crabs trapped from inside and outside of the fence. However, after 6 weeks, there were significantly more plants missing and damaged on grids outside than inside of fenced areas. We conclude that a change in sediment was probably not the cause of eelgrass decline. However, a precipitous drop in silica in the bay over the last several years may have made plants susceptible to green crab damage and other impacts and may explain eelgrass loss in Frenchman Bay.

Green Crab Proliferation and Eelgrass Loss: Friends of Taunton Bay's Approach

Frank C. Dorsey

Friends of Taunton Bay

FTB held a Public Conversation with stakeholders (Maine Community Foundation funded) about this and several other current ecological problems. Posters on each of the several problems were used to trigger discussion.

We developed a schematic diagram to identify the questions associated with understanding and trying to remediate the green crab – eelgrass conundrum. Within the schematic we identified manageable research strategies regarding:

- viability of eelgrass rhizomes in formerly covered eelgrass beds with UMM
- effect of green crab proliferation on the Taunton Bay horseshoe crab population

In addition, we will augment our Bay monitoring activities through collaboration with COA and some DMR instrumentation. As a result of the conversation, several attendees volunteered to aid in the monitoring.

Changes in chiropteran community structure associated with the white-nose syndrome epidemic: evidence for competitive release?

Adam Eichenwald

Bowdoin College

The recently discovered invasive fungus *Pseudogymnoascus destructans* has been implicated in the deaths of millions of cave-hibernating bats in North America. While the loss of these individuals is likely to cause unknown environmental ripples in numerous ecosystems, one possible outcome is the sudden availability of foraging opportunities for migratory bats unaffected by the fungus. Recognizing the likelihood of this scenario, we hypothesized that areas witnessing dramatic losses of once-common bat species – such as the little brown bat *Myotis lucifugus* – would have concomitant increases in abundance of bats species that had been rarely detected or observed in the same areas – such as the eastern red bat *Lasiurus borealis*. Reduced competition would allow the numbers and periods of use to increase for the once-uncommon bat species, a phenomenon called competitive release. To test our hypothesis, we repeated an acoustic study of foraging bats at two locations in Acadia National Park (ANP), Mount Desert Island (MDI), ME. We used Wildlife Acoustics SM2BAT ultrasonic recorders nightly from April to October 2013 to acoustically identify species and to quantify echolocation rates from sites at Jordan and Bubble Ponds in Acadia National Park. These data were compared to recordings collected in the same months in 2010, one-and-a-half years prior to the discovery of the fungus on little brown bats in Acadia.¹ We performed this comparison to see whether echolocation activities of unaffected bat species' activity have increased at the sites of the recorders, which would suggest an increase in abundance at Acadia National Park. In addition, we compared meteorological conditions (average precipitation, temperature, sky cover, and wind speed) between years to determine whether changes in echolocation activity may have been attributed to changes in environmental conditions. There were no statistically significant differences in weather between 2010 and 2013. Detection of echolocation calls from little brown bats dropped significantly from 1468 calls per night per month in 2010 to 37 in 2013 (t-test, $p < 0.001$), while recorded occurrences of eastern red bats increased from 16 calls per night per month in 2010 to 83 in 2013 (t-test, $p < 0.001$). These data are consistent with the competitive release hypothesis, suggesting that abundance of migratory

bats is rising, in some part, due to increased mortality of cave-dwelling bats.

1. Connery, B., DePue, J., & Froschauer, A. (2012, March 21). White-nose syndrome confirmed in Acadia [Press release].
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What's in the air? Creating an interactive air quality educational display

William G. Gawley¹, Ardrianna F. McLane², Melanie V. Peters³, Colleen Flanagan³, and Julie Winchester⁴

1 National Park Service, Acadia National Park, Bar Harbor, Maine

2 College of the Atlantic, Bar Harbor, Maine

3 National Park Service, Air Resources Division, Denver, Colorado

4 Colorado State University, Fort Collins, CO

Visitors to Acadia National Park (ACAD) expect to experience pristine environments and unspoiled scenic views, but are occasionally disappointed to find that even "protected areas" are not immune to damage from pollution and other global environmental problems. Air pollution is particularly problematic, since short of enclosing a national park in a protective bubble, there is no way to insulate park resources and visitors from pollution effects.

ACAD resource managers and interpreters collaborated with air quality specialists from the National Park Service Air Resources Division and media design experts at Colorado State University to create an interactive exhibit designed to inform visitors about some of the air pollutants that can degrade visibility and threaten human and environmental health. Using a question-based approach, the touch-screen display guides viewers through text, photos, and animated graphics explaining the 4 major pollution types at ACAD, their sources and effects, how they are monitored, and what we all can do to help reduce air pollution.

The interdisciplinary project builds on the air quality research and monitoring conducted at Acadia for over thirty years by creating a connection between the science and park visitors. Air quality worldwide is under constant threat of further degradation, and pollution is not deflected by park boundaries. The only way to truly protect Acadia's scenic views and fragile resources is by understanding the park's connection to global air quality issues, and working to improve the problem through research, monitoring, and education.

Migratory distance shapes behavioral response to predation risk during fall migration

David P. Grunzel^{1,2}, Brian J. Olsen^{1,2}

1 Climate Change Institute, University of Maine, Orono, Maine.

2 Department of Ecology and Environmental Science, University of Maine, Orono, Maine.

Migratory animals face the difficult task of balancing the energetic requirements of large-scale movement with the predation risk inherent in unfamiliar habitats. Optimality theory suggests prioritizing time or energy along the way will shape migration for different species, particularly in response to variation in predation risk. Migration distance may place further constraints on these strategies. We conducted an aviary experiment at four sites along the coast of Maine to determine if migratory distance predicts time versus energy tradeoffs and, under increased predation risk, activity versus vigilance trade offs. We used data from nine banding stations in our region to test if behavioral tradeoffs between migration strategies were evident in size corrected masses at sites with high and low raptor abundance during migration. Neither longer nor shorter distance migrants exhibited behavior in accordance with the predictions of Optimal Migration theory. Longer distance migrants were less active under increased risk, while shorter distance migrants were more active. Losses in mass for longer distance migrants at high risk sites reflect their behavioral tradeoff. These passerine species exhibited two distinct behavioral responses in the face of increased predation risk. Rather than optimizing for time or energy, the difference in risk aversion may be attributed to differential life expectancy between longer and shorter distance migrants.

Defining whole watershed nitrogen dynamics with ^{15}N

Marie-Cécile Gruselle¹, Ivan J. Fernandez^{1,2}

1 University of Maine, School of Forest Resources, 5722 Deering Hall, Orono, ME 04469

2 University of Maine, Climate Change Institute, 5790 Bryand Global Sciences Center, Orono, ME 04469

Chronic elevated atmospheric nitrogen (N) deposition and a warming climate are likely to accelerate N cycling in the future. The environmental consequences of chronic N inputs on northeastern US forests are not yet well understood. The Bear Brook Watershed in Maine (BBWM) was established in November 1989 to bridge this knowledge gap. The BBWM is a long-term, paired watershed experiment established in Maine approximately 60 km north-east of Acadia National Park studying the effects of simulated N addition and acidification on the biogeochemistry of forested watersheds. The treated watershed, West Bear (WB, 10.3 ha), receives $25.2 \text{ kg N ha}^{-1} \text{ yr}^{-1}$ and $28.1 \text{ kg S ha}^{-1} \text{ yr}^{-1}$ continuously since November 1989. The biogeochemical reference is the East Bear watershed (EB, 11.0 ha). A major emphasis for this research has been the study of N cycling in these watersheds. Recently, a state-of-the art method using stable isotopes of N (i.e., the common ^{14}N and heavy but rare ^{15}N) has been used at the BBWM to detect subtle changes in ^{14}N and ^{15}N ratios of plants, soils, and stream water, which indicate changes in N transformations rates due to the long-term manipulation. The isotopic measurements were done at the natural abundance level as well as after a one time watershed-scale ^{15}N tracer (98 atom-% $(^{15}\text{N-NH}_4)_2\text{SO}_4$) addition. The latter was carried out by backpack sprayers in both watersheds at the dose of 0.4 kg ha^{-1} of ^{15}N tracer on June 5, 2012. Before and after the tracer application, we sampled forest components (e.g., tree foliage, litter fall, forest

floor, mineral soil, stream water) and followed the redistribution of the ^{15}N tracer over time. Here we report the WB and EB forest components' $\delta^{15}\text{N}$ natural abundances before the tracer application as well as their $\delta^{15}\text{N}$ enrichments across the 2012 and 2013 growing seasons. Our results show that the long-term N+S additions in WB significantly increased $\delta^{15}\text{N}$ natural abundances in plant tissues, forest floor, and mineral soil compared to EB. Moreover, ^{15}N tracer enrichment was found to significantly increase the $\delta^{15}\text{N}$ in forest components over that of the natural abundances, indicating a successful experimental labeling with ^{15}N in both watersheds. Lastly, the most enriched forest component was the top layer of the forest floor in both watersheds, which persisted across two growing seasons. The lower layers of the forest floor were significantly more enriched in ^{15}N in WB compared to EB across two growing seasons but no evidence of enrichment was found in the mineral soil in any watersheds during the same period. We conclude from the enrichments that N transformations occur at higher rates in WB due to the long-term experimental N addition and acidification compared to EB.

Gull Response to Human Disturbance

Anneke Hart

College of the Atlantic

Conservationists and natural resource managers are interested in understanding the effects of human disturbance on populations of colonial nesting seabirds, including species that nest on islands within Acadia National Park and elsewhere in the Gulf of Maine. Great Duck Island and Mount Desert Rock are offshore islands that differ greatly in habitat and area, but are both inhabited by nesting populations of Herring gulls (*Larus argentatus*) and Greater Black-backed gulls (*L. marinus*). Mount Desert Rock is approximately 1/70 the size of Great Duck island, and nesting gulls are forced to live in close proximity to humans at all times, whereas Great Duck contains large areas uninhabited by either humans or gulls, yet an increasing number of gulls have selected human occupied areas to nest in. Both islands contain research facilities that are occupied by humans during the summer months, after nesting sites have already been established. During the summer of 2013, I spent 6 weeks researching the differences in response of gulls to human approach to nests, obtaining data from both islands and from gulls nesting in a variety of habitats. My results reveal that gulls on Mount Desert Rock are much “tamer” -i.e. allow significantly closer approaches by humans than gulls on the much larger Great Duck Island. In addition, I found that the flushing distance of gulls nesting on the rocky shoreline of Great Duck Island was significantly closer than that of gulls nesting in more open habitats. I suggest that the closer flushing distance of gulls nesting on the shoreline occurs because this area is occupied by a denser population of gulls, which may give individuals a sense of protection through numbers or a masking effect similar to that of a “selfish herd.”

Nutrient budgets for the Bass Harbor Marsh estuary at Acadia National Park

Thomas G. Huntington¹, Charles W. Culbertson¹, Christopher Fuller², Luke Sturtevant¹

1 U.S. Geological Survey, Augusta, Maine

2 U.S. Geological Survey, Menlo Park, California

Eutrophication in the Bass Harbor Marsh estuary on Mount Desert Island, Maine, is an ongoing problem manifested by recurring annual blooms of green macroalgae species. The U.S. Geological Survey and Acadia National Park have collaborated for several years to better understand the factors related to this eutrophication problem. The current study involved the collection of hydrologic and water-quality data necessary to investigate the relative contribution of nutrients from oceanic and terrestrial sources during summer 2011 and summer 2012. It was evident that during these summers tidal inputs of inorganic nitrogen and total dissolved phosphorus to the estuary substantially exceeded inputs from watershed runoff and precipitation. These data provide resource managers at Acadia National Park with a baseline that can be used to evaluate future conditions within the estuary. Climate change, sea-level rise, and land-use change within the estuary's watershed may influence nutrient dynamics, sedimentation, and eutrophication, and these potential effects can be studied in relation to the baseline data. The Route 102 Bridge in Tremont, Maine is constructed over a bedrock sill that controls the amount of tidal flushing by restricting the duration of the flood tide, and structural changes to the bridge could alter tidal nutrient inputs and residence times for watershed and ocean-derived nutrients in the estuary. Ongoing sea-level rise is likely increasing ocean-derived nutrients and their residence time in the estuary on the one hand and decreasing the residence time of watershed-derived nutrients on the other.

What would Charlie Do?

Charlie Jacobi

National Park Service, Acadia National Park, Bar Harbor, Maine

Leave No Trace in a national low impact backcountry education program consisting of seven principles. In this poster we illustrate a number of the visitor use challenges in Acadia, using inquiry as the mode of communication, and challenging the reader to think about Leave No Trace and their own outdoor recreation experiences.

Acadia's Hawk Watch: Citizen Science, Twenty Years and Counting!

Angi King Johnston¹, Seth Benz², and Abe Miller-Rushing¹

1 National Park Service, Acadia National Park, Bar Harbor, Maine

2 Schoodic Institute, Winter Harbor, Maine

For nearly 20 years, park rangers, interns, and volunteers have been connecting visitors and the community of Acadia National Park to the annual autumn raptor migrations passing over Cadillac

Mountain on Mount Desert Island, Maine. Together, the trained specialists and visitors have amassed over 4,300 hours engaging more than 79,000 participants in the spotting, counting and identification of passing hawks. To date they have tallied over 56,000 individual birds of 13 raptor species! This important method of data collection, which enlists the help of volunteer observers and the public to the scientific researcher, is a strong example of hawk migration citizen science, one that takes place across the world. Acadia's Hawk Watch data is contributing to a continent-wide database, administered by the Hawk Migration Association of North America, uniting observations made across a network of sites along major migration corridors. We are beginning to analyze the data from Acadia's Hawk Watch program to assess changes in the abundance and phenology (or timing) of their migrations. We are addressing questions such as: How are hawk migrations changing over time? And how is the timing and abundance of raptor migrations related to weather and the timing of other phenological events, like the migrations of songbirds (prey for some raptors) and plants. Our analysis will provide insights into raptor migrations in an important location—at the head of the fall raptor migration corridor in eastern North America. Looking ahead, new questions and pertinent analysis will allow the Acadia Hawk Watch's ongoing citizen science to advance its role in understanding raptor conservation issues and promoting ecological stewardship of the world in which we live.

Citizen Science efforts of the Gulf of Maine Research Institute

Sarah Kirn, Graham Sherwood, Lisa Kerr

Gulf of Maine Research Institute

Citizen science is an essential tool used by the Gulf of Maine Research Institute (GMRI) to pursue its mission around Science, Education, and Community. GMRI has long included commercial fishermen, recreational fishermen, students, teachers, and the public in scientific research efforts. From 2003 to 2009 we worked with ~250 fishermen and >30 scientists to frame research questions, develop research methods, and collect data to explore cod population structure and movement in the Gulf of Maine (GMRI collated data from 182,000 tag releases and over 10,000 tag recaptures; <http://www.gmri.org/tagging>). GMRI scientists are also partnering with 10 lobster vessel owner/operators to survey herring biomass and distribution in nearshore Maine waters. In 2009 GMRI launched vitalsignsme.org, a web-based citizen science project to engage Maine people of all ages in mapping where invasive species are and where they are not and where are the native species that might be impacted. Augmented by free educational resources, Vital Signs has gained a following of hundreds of Maine educators and over 60 scientists who are using the data for research and monitoring. Our most recent effort, Snap-a-Striper, has a target audience of recreational fishermen and was launched in the spring of 2013 in collaboration with the Maine chapter of the Coastal Conservation Association in an effort to collect population data to inform better management of this species.

Remediation strategies for mercury contamination in Hodgdon Pond, Acadia National Park: the use of zero- valent iron and granular activated carbon

Ariel Lewis¹, Aria Amirbahman¹, Thomas Huntington²

1 University of Maine, Orono, Maine

2 U.S. Geological Survey, Augusta, Maine

Wetlands are well-known hotspots for storing mercury (Hg) and converting it to its more toxic form, methylmercury (MeHg). MeHg is subsequently released into adjacent water bodies and taken up by fish. In 2010-2012, an expansive survey of more than 125 lakes and ponds in Maine suggested that fish with the highest MeHg burdens were found in waters with a large wetland contribution. Among these systems, Hodgdon Pond, Acadia National Park, Maine, had the highest levels of fish MeHg due to the large proportion of adjacent wetlands. As such, a sustainable remediation of wetlands with respect to Hg contamination is of interest to the public.

The objective of this work was to determine if zero-valent iron (ZVI) or granular activated carbon (GAC) application is an appropriate MeHg remediation strategy for the pond. Twelve mesocosms were constructed in the inundated fringing wetland of Hodgdon Pond, and ZVI and GAC were applied as treatments. Sediment and porewater samples were collected at different times, and analyzed for relevant parameters. Results indicate that both ZVI and GAC significantly lower the concentration of MeHg in porewater, and that more MeHg is present in porewater in summer than fall due to plant activity. We are presently conducting lab microcosm experiments with wetland plants to study MeHg uptake by macroinvertebrates. Further studies are needed to determine the longevity and the effect of these additives on wetland plants and organisms.

Nest Site Selection of the Black Guillemot

Meaghan Lyon

College of the Atlantic, Bar Harbor, Maine

This paper focuses on the distribution of Black Guillemot (*Cepphus grylle*) nesting sites along the rocky berm of Great Duck Island, Hancock Co. Maine. During 8 weeks of research I attempted to discern where the Black Guillemites were nesting and whether nesting habitat exhibited a particular pattern. I located 137 individual nests out of an island-wide estimate of approximately 400 pairs. Throughout the process I marked nests and incorporated their locations into an island-wide GIS. I also recorded the dimensions of the crevices the birds used for nesting areas. Statistical analysis revealed that the dimensions of Black Guillemot nests within my data set fall within a consistent distribution. GIS analysis showed clear clumping of nests in particular regions. Both results are important in long-term management questions as they may serve to help identify islands and areas within islands that are of particular importance to this species.

BioTrails, Barcoding and BioBlitzes: piloting DNA-assisted species identification for citizen science

Michael Marion, Michelle Bailey, and Karen James

Mount Desert Island Biological Laboratory

BioTrails is a collaboration of the Mount Desert Island Biological Laboratory, the Schoodic Institute, and the National Park Service, funded by the National Science Foundation. The aim is to pilot and begin to hone practices for employing DNA-based species identification (DNA barcoding) to enhance and expand both the scientific and learning outcomes of environmental research and restoration projects that involve public participation in scientific research (citizen science). To support this pilot project, we are developing two DNA barcode reference libraries – one for the insects of the Schoodic Peninsula and one for marine invertebrates associated with eelgrass habitat in Frenchman Bay – against which unknown specimens collected by citizen scientists participating in the BioTrails program might be identified by their DNA alone. Here, we present, analyze and discuss preliminary data from the development of the insect library using specimens collected and identified during BioBlitzes in Acadia National Park.

Changes in the flora of Acadia National Park

Caitlin McDonough MacKenzie¹, Abraham Miller-Rushing², Richard B. Primack¹, and Glen Mittelhauser³

1 Boston University, Boston, MA

2 National Park Service, Acadia National Park, Bar Harbor, Maine

3 Maine Natural History Observatory, Gouldsboro, ME

The flora of the Acadia National Park region has attracted botanists and flower lovers to Maine for over a century. However, the flora that earlier botanists observed and collected has changed as species disappeared, declined in abundance, and appeared over the past one hundred and seventeen years. From the 1894 *Flora of Mount Desert Island, Maine* to the recent publication of *Plants of Acadia National Park*, a comparison of Mount Desert Island's vascular plant catalogue reveals dramatic shifts in species' abundances. Mount Desert Island's historic and present-day flora is comprised of 714 wildflowers: the island experienced a species loss of 18.5% (91 species), while an additional 20% of the species in the flora declined in abundance since 1894. These national park results match the extinction rates found in similar historical comparison studies on the urban/suburban towns of Worcester and Concord, Massachusetts. Species that were more rare in the past have declined and disappeared at a higher rate than species that were common, suggesting that identifying and monitoring populations of rare plants is an important management priority. We found that non-native plant species are colonizing (there are 99 new non-native species recorded since 1894) and increasing in abundance (an additional 35 non-native species have increased in abundance since 1895), especially in fields and disturbed habitats. Finally, there is no statistically significant link between habitat type and population status: plants are disappearing and declining from every habitat.

Though succession and land use change have altered the distribution of habitats on the island — providing less open fields and grasslands and more woodlands today than in 1894 — these changes alone do not explain the high levels of native species loss and decline in Acadia National Park.

Decision-making processes for beach and shellfish management: A scoping analysis for NEST's Safe Beaches and Shellfish Project

Bridie McGreavy¹, Brianne Suldovsky², Stephenie MacLagan³, Kathleen P. Bell³, Stephen H. Jones², Laura Lindenfeld²

1 New England Sustainability Consortium, UMaine

2 Department of Communication and Journalism, UMaine

3 School of Economics, UMaine

4 Natural Resources and Marine Science, University of New Hampshire

Comparison of decision making processes associated with beaches and shellfish growing areas reveals interesting commonalities and distinctions in coastal resource management and associated public health risks. We completed a scoping analysis for the New England Sustainability Consortium (NEST)'s Safe Beaches and Shellfish Project that focuses on advisory and closure decision-making processes. Using Maine and New Hampshire as our study regions, we synthesized information acquired from interviews with key decision makers and from analysis of resource management and outreach documents and websites. Several key findings emerged. First, differences in the goods and services and the mix of agencies and institutions associated with beaches and shellfish create important distinctions in decision-making. Notably, shellfish consumption inspires more formal guidelines and greater standardization in management across states. Second, we found similarities and differences in how decisions about beach advisories/closures and shellfish classifications and status determinations are made. Both states do marine water quality testing and have processes in place to interpret these tests and inform advisories and closures. In addition, both states focus on fecal indicators of water quality contamination. While Maine and New Hampshire both rely on federal guidelines, the states have different on-the-ground decision making for beaches and shellfish management. Beach monitoring and decision-making are more decentralized in Maine than in New Hampshire. Maine has a municipal shellfish management program and in New Hampshire the shellfish resource is managed by Fish and Game Department. These findings, among others, inform the design of future decision-support tools and research activities. We highlight the implications of this work and ongoing research efforts as part of this project within Frenchman Bay.

8 Years of Forest Health Monitoring in Acadia National Park

Kate Miller and Jesse Wheeler

Northeast Temperate Network Inventory & Monitoring Program, Acadia National Park, Maine

Background

Since 2006, the Northeast Temperate Inventory and Monitoring Network (NETN) has been monitoring forest health annually in Acadia National Park, and biennially in 9 National Historic Parks in New England, New York, and New Jersey. The monitoring program uses a protocol based on the USDA Forest Service's Forest Inventory and Analysis program, and relies primarily on an Ecological Integrity Scorecard to interpret forest condition to park managers. The Ecological Integrity Scorecard rates condition for a suite of metrics that address forest structure, composition and function. For each metric, assessment points were defined that distinguish acceptable or expected conditions from undesired conditions based on current scientific understanding of their natural or historic range of variation. Ecological Integrity is then interpreted using three categories for each metric: Good, Caution and Significant Concern. "Good" represents acceptable or expected conditions; "Caution" indicates a problem may exist; and "Significant Concern" indicates undesired conditions that may need management action.

Results/Conclusions

Ecological integrity metrics in Acadia NP indicate that forests are approaching mature stages of forest succession, but are lacking late successional structure such as large snags. Forests are largely un-invaded by invasive plant species and exotic earthworms, and have adequate regeneration. Stressors that may be impacting forest health in Acadia NP include acid deposition and forest pests and diseases. Major threats to forest health in Acadia NP include introduction of forest pests such as emerald ash borer, Asian longhorned beetle, and hemlock woolly adelgid, stressors induced by climate change, and new invasions of exotic plants.

Protocol development for DNA-based identification of marine invertebrates in Frenchman Bay

Jane Pappas, Jane Disney, Karen James

Mount Desert Island Biological Laboratory

Eelgrass restoration in Frenchman Bay is an important project in Frenchman Bay due to the many benefits an eelgrass-rich environment may have, and the population had been in a decline since 2007, when the bulk of the restoration began. We have been working to develop baseline data for what organisms live in and around eelgrass-rich areas. This will allow us to compare what organisms have lived in eelgrass in the past to what may live there in the future, and thus give us a better idea of how the environment changes. In order to get a more detailed picture of what lives in the eelgrass, we have endeavored to use DNA Barcoding to identify the organisms by more than simply their morphological attributes.

This tool could enable non-taxonomists – both scientists and citizen scientists alike - to identify organisms to the species level. In this academic-year high school internship project, we have optimized laboratory methods for the major groups of organisms that live in the eelgrass habitat in

Frenchman Bay. We have tested a variety of organisms, including mollusks, gastropods, and polychaetes, all of which are small and can be found in eelgrass habitats. We have optimized existing protocols for DNA extraction using the Qiagen DNEasy kits for a more effective and concentrated extraction of DNA from small organisms, and we have tested a variety of the PCR primer sets recommended in the published literature.

Our main conclusion from this research is that a DNEasy extraction kit is effective in extracting DNA, with a few adjustments based on the yield. We have also concluded that the most effective way to improve PCR results is to use a primer set and thermocycling protocol that has historically worked for other scientists on that same organism class. Here we present optimized DNA extraction and PCR protocols for the major classes of organisms associated with Frenchman Bay eelgrass habitat.

Using functional traits to solve the mystery of the extirpation of native plant species in Acadia National Park

Alexandra Perry¹, Christine Lamanna¹, Caitlin McDonough MacKenzie², and Abe Miller-Rushing³

1 University of Maine, Orono, ME

2 Boston University, Boston, MA

3 National Park Service, Acadia National Park, Bar Harbor, Maine

While Acadia National Park today is home to over 800 plant species, the park has lost nearly 20% of its native species since the first floristic surveys were conducted in the late 1800s. Although these surveys can tell us which species are no longer found in the park, the cause of these extirpations remains unknown. Over the last century human activity in the park has increased, invasive species have been introduced, acid rain has increased, fire has burned thousands of acres, and the climate has been changing. Functional traits, or measurable characteristics that reflect a species' life history strategy and ecological niche, can shed light on the mechanism or mechanisms responsible for various plants' persistence or extirpation from Acadia. During summer 2013, we collected 10 functional traits of more than 50 herbaceous species currently growing within Acadia National Park. We present preliminary data on the functional diversity of these species, and our plans for collecting functional trait data for the extirpated species using data from herbaria records and local botanists. The functional traits of the plants can help us determine the ecological history of the park over the past two hundred years and can hopefully help prevent further loss of native species as the environment continues to change.

Parasites and population genetics of *Fundulus heteroclitus* in New England: variation among several Maine estuaries

Petersen C.W.¹, Z. Rutins¹, R. VanDyke¹, H.C. Hess¹ and C. Wray²

1 College of the Atlantic, Bar Harbor, ME 04609

2 MDI Biological Laboratory, Salisbury Cove, ME 04672

Fundulus heteroclitus, the mummichog, is the most common estuarine fish in New England, and the genetic structure of populations has been well documented throughout most of its range. In the early 1970's the Goose Cove estuary was blocked, and the site became an open pit mine for several years, until it was again opened to the sea and re-established itself as a salt marsh. This old mine is now a Superfund site with high concentrations of several heavy metals in the sediments and tissues of local organisms. In this study, we compared the genetic structure of this population with those in other nearby estuaries, and also compared the species of parasites exploiting fish from the mine site with those of other estuaries in nearby bays. Results from eight microsatellite loci suggest low to moderate restrictions to gene flow in *F. heteroclitus* among estuaries, with modest divergences in allele frequencies among sites; there were no remarkable patterns at the mine site regarding these neutral loci. Most *F. heteroclitus* have some form of metazoan parasite in all salt marshes, but the fish from the superfund site had strong similarities to a separate study at another contaminated site in New Bedford, and had unique parasite profiles compared with the fish from three nearby estuaries. We are currently examining several genes and promoters as well as gene expression patterns specific to immune systems and metal detoxification to look for potential local adaptation in *F. heteroclitus* at the Superfund site.

Winter land use of river otter (*Lutra canadensis*) associated with North American beaver (*Castor canadensis*) in Acadia National Park

Christopher M. Phillips¹, Bruce Connery², and Stephen Ressel¹

1 College of the Atlantic, Bar Harbor, Maine

2 National Park Service, Acadia National Park, Bar Harbor, Maine

Six ponds in Acadia National Park were surveyed for signs of otter activity between January 29th and March 8th, 2013. Undergraduate students enrolled in a winter ecology course recorded the locations of otter tracks, slides, open leads, and scat around the Breakneck Ponds, Half-moon Pond, the Beaver Ponds, and Witch Hole Pond. A total of 13 signs were found during the ten surveys. Mapping the field data with GIS software showed a spatial correlation between otter land usage and beaver activity. Areas with recurring tracks are highlighted for future research and monitoring programs, while the current work has implications for the park's wildlife management practices.

Assembling a teaching collection at COA: outcrop, hand-sample, and thin-section analysis of rocks from Mt. Desert Island and Mt. Desert Rock

Tyler Prest, Jane Strader, Miranda Galey, Sarah R. Hall

College of the Atlantic, Bar Harbor, ME 04609

The establishment of a geology program at the College of the Atlantic in 2012 prompted the need for a geologic teaching collection of regional rocks and minerals. During the summer 2013, we gathered samples from outcrop locations on Mt Desert Island and Mt Desert Rock, as well as some regional locations on the mainland, to begin building a collection that will be used by COA students and community members to learn about local and regional rock types. We describe these samples at the outcrop, hand-sample, and thin-section scales in terms of their mineralogy, petrology and structural elements. Here we present examples of our initial collection of ~25 samples including a location map and descriptions of some of the samples. Our goal is to eventually provide an opportunity for both COA students and interested community members and visitors to view these data, potentially through a museum exhibit or written guide.

Bathymetric Mapping and a Comparison of Models for Beaver Dam Pond in Acadia National Park, Maine

Alyssa G. Reischauer^{1,2}

1 National Park Service, Acadia National Park, Bar Harbor, Maine

2 University of Southern Maine, Gorham, Maine

Hydrologists and water resource managers use bathymetric models to calculate lake volumes, flushing and nutrient loading rates, and to create maps of lake depths. These bathymetric maps are especially helpful when planning water sampling and aquatic vegetation surveys so that effort can be focused on the appropriate depth zones. Water sampling and temperature and oxygen concentration depth profiles are often conducted at the deepest spot, whereas aquatic vegetation surveys are done in shallower water. Depth data for many lakes in Acadia National Park is completely lacking or not sufficient to create useful bathymetric models. One such water body is Beaver Dam Pond. Water depth and shoreline location data was collected in the field for Beaver Dam Pond. Depths were determined for multiple locations across the pond. Several different methods in ArcGIS were used to interpolate the bottom surface of the pond and create bathymetric models from the field depth data. Lake volumes associated with each model were calculated. The results of the different models were compared to determine how sensitive lake volume calculations, depth contours, and location of maximum depth were to model selection. These comparisons can provide guidance for model selection. Field measurements of water depth at several new locations on Beaver Dam Pond will be made to evaluate the accuracy of the various models created.

A new automated sensor system to monitor changes in Jordan Pond

Jasmine E Saros¹, Bill Gawley², Courtney Wigdahl¹, Alyssa Reischauer² and Shannon Wiggin²

1 Climate Change Institute, University of Maine, Orono, Maine

2 National Park Service, Acadia National Park, Bar Harbor, Maine

The chemistry and water clarity of lakes in Acadia have been changing in recent decades, raising the question of how climate change and reductions in sulfur deposition are interacting and driving these changes. In particular, data from the Acadia lake monitoring program reveal that water clarity increased in Jordan Pond from 1985 to 1997, but has now been declining since 1997. Concentrations of dissolved organic carbon (which can impart a brown stain to lake waters) have increased since 1997 in Jordan Pond, while no consistent changes in chlorophyll have occurred. To better understand the causes of rapidly changing water clarity in Jordan Pond, we have implemented a new sensor array into the lake that collects a suite of physical (temperature, water clarity), chemical (carbon, oxygen, pH, conductivity), and biological (chlorophyll) parameters every 15 minutes from early spring to late autumn. These data are being coupled with those from a weather station mounted nearby to assess drivers of lake response.

The biogeographic origins and population structure of Maine's island red-backed salamanders (*Plethodon cinereus*)

Nikko Shaidani¹, Michael T. Kinnison¹, Cynthia S. Loftin², Linda Welch³, Bruce Connery⁴, Phillip deMaynadier⁵

1 School of Biology and Ecology, University of Maine, Orono, ME 04469

2 U.S. Geological Survey, Maine Cooperative Fish and Wildlife Research Unit, Orono, ME 04469

3 U.S. Fish and Wildlife Service, Maine Coastal Islands National Wildlife Refuge, Milbridge, ME 04658

4 National Park Service, Acadia National Park, Bar Harbor, ME 04609

5 Maine Department of Inland Fisheries and Wildlife, Bangor, ME 04401

Island populations of terrestrial species have an increased potential to adapt and diverge, as these populations are often isolated from other populations and subjected to novel pressures compared with mainland populations. Indeed, extended isolation can elicit dramatic changes within populations and is recognized as a common driver of speciation. It is for these reasons that island populations are often a priority for conservation. Recently, red-backed salamanders (*Plethodon cinereus*) have been identified on many of Maine's coastal islands. Plethodontid salamanders are among the most terrestrial of Maine's amphibians and are not tolerant of prolonged exposure to seawater, suggesting these populations are strongly isolated. Moreover, *P. cinereus* is often typified as a forest obligate species, and yet, many of Maine's islands, such as Petit Manan, Eastern Brothers, and Western Brothers are non-forested. Hence, there is potential for local adaptation to such atypical conditions. Our research seeks to determine the biogeographic origins, population genetic structure, and potential local adaptations of Maine island salamanders. Using 7-9 microsatellite loci, we are genotyping individuals spanning island and mainland sites along the entire coast of Maine to assess alternative island colonization scenarios, including the possibility that red-backed salamanders colonized marine islands 6,000-11,000 YBP when lower sea levels linked islands to the mainland. We are quantifying body morphology and coloration patterns to begin to assess possible local adaptation. Here we present current progress in an effort to obtain feedback regarding future directions.

Vital Sign Monitoring in Acadia National Park

Edmund Sharron

Northeast Temperate Network

The Northeast Temperate Network (NETN) helps keep track of the ecological health of Acadia National Park through long-term natural resource monitoring programs. This information is essential in the management decision-making process and also aids in research, education, and promoting public understanding of park resources. There are currently 11 monitoring programs in Acadia that are either underway or in development, and NETN's website provides access to a host of relevant materials including reports, resource briefs, species lists, and more.

Presence and trophic transfer of methylmercury around two offshore islands, Northern Gulf of Maine

Rachel Sullivan-Lord

College of the Atlantic, Bar Harbor, Maine

Persistent contaminants such as mercury found in the marine environment disrupt neurological, developmental, and endocrine processes and may negatively impact the health of marine organisms. Species occupying higher trophic levels are exposed to higher levels of contaminants through bioaccumulation. We investigated the presence of methylmercury in local food webs surrounding two offshore islands (Mount Desert Rock (MDR), Maine 43.9686° N, 68.1283° W, and Great Duck Island (GDI) 44.1522° N, 68.2486° W) and identified food web interactions by collecting baseline data on diet content and total mercury in tissues of marine mammals and seabirds. To analyze contaminants, we collected samples of regurgitate (8), blood (22), and eggs (33) from herring gulls (*Larus argentatus*), and black backed gulls (*Larus marinus*), on MDR and GDI from 2012 to 2013, subsampled and froze them for total mercury analysis. We also collected harbor seal scat samples from MDR during 2012-2013. Grey seal scat samples were collected from the southern Gulf of Maine in 2007. All scat samples were subsampled and frozen for mercury analysis. After subsampling, scat samples from MDR were washed through a series of sieves to collect prey hard parts such as otoliths and squid beaks, which were used to characterize diet. Gull diet during 2012 and 2013 was characterized by observing gull chick feeding events from two lighthouse towers. The most common prey items in harbor seal diet in 2012 and 2013 were Atlantic herring, silver hake, Acadian redfish, and white/red hake. Gull diet included fresh herring and mackerel, crab and lobster bait. Mercury was found in all tissue samples and ranged from 0.01 µg/g, ww to 1.35 µg/g, ww. Mercury was highest in seal scat, followed by gull eggs, then blood and regurgitate, which had the lowest levels. Grey seal scat had lower levels of mercury than harbor seal scat. No change in mercury between seasons was detected for any tissue type. Assessing toxins in herring gulls, black backed gulls, and seals on MDR and GDI provides baseline data for contaminants around these two islands, and a rare perspective on methylmercury in offshore systems.

Mapping dikes and faults at Schoodic Point, Acadia National Park

Mark T. Swanson

University of Southern Maine, Gorham, Maine

Preliminary mapping of brittle geologic structures that cut through the homogeneous Devonian-age granite at Schoodic Point has focused on the long-famous dike intrusions as well as newly-discovered small-scale brittle strike-slip (sideways moving) faults that occur in complex interacting patterns. The faults display spectacular fault breccias with coarse angular fragments in a finer grained dark matrix that developed during very early stage fault zone development within the granite. Digital survey-grade RTK GPS rovers and electronic total stations are being used to precisely delineate the exact geometry of the fracturing and faulting associated with the dike intrusion process and the early stage fault zone development preserved within these exposures. Precision digital survey data is being compiled, displayed and analyzed in GIS. This mapping effort has covered nearly 50 separate dike intrusions from cm to several meters in width and included early light-colored felsic dikes as well as the more familiar dark-colored mafic dikes, revealing the complete fine scale detail of their contact geometries. Hundreds of individual fault segments have been mapped which have accommodated displacements that range from a few cms to 10's of cms with possible meter scale displacements for the largest zones where smaller faults have merged together. Projected connections between mapped fault segments reveal a 200 m x 20 m fault lens structure suggesting fault growth by linkage of smaller scale en echelon segments to form the through-going Schoodic Point Fault Zone.

Using Remote Cameras To Assess Disturbance Pressures Of A Double Crested Cormorant Nesting Colony

Bik D.R. Wheeler¹, Erickson Smith^{1,2}, John G.T. Anderson² and Bruce A. Connery¹

1 National Park Service, Acadia National Park, Bar Harbor, Maine

2 College of the Atlantic, Bar Harbor, Maine

In 1972-1989 double crested cormorants (*Phalacrocorax auritus*) were regularly documented to be a successfully breeding colony of at least 200 nesting pairs on The Thrumcap in Frenchman Bay, Maine (Allen et al. 2012). Two consecutive years (2011 and 2012) the colony failed to rear a single chick despite pairs remaining on territory throughout the nesting season. It was hypothesized that characteristics of disturbance lead to the failure. In May 2013 we mounted 3 remotely triggered trail cameras to monitor the colony for an initial assessment of disturbance characteristics facing the nesting colony. We have documented and characterized disturbance to the site and made recommendations for future work to refine disturbance monitoring.

Comparing metrics of forest health between Acadia National Park and surrounding forestlands

Jesse S. Wheeler¹, Kate M. Miller¹, Fred W. Dieffenbach² and Brian R. Mitchell².

1 Northeast Temperate Network Inventory & Monitoring Program, Acadia National Park, Maine

2 Northeast Temperate Network Inventory & Monitoring Program, Marsh-Billings-Rockefeller NHP, VT

The Northeast Temperate Network (NETN) has been monitoring forest health annually in Acadia National Park (ACAD), and biennially in 9 additional parks in New England, New York, and New Jersey since 2006. The NETN forest monitoring program uses a protocol based on the USDA Forest Service's Forest Inventory and Analysis (FIA) program, which has been monitoring forest resources in the eastern US since the 1930s. In the 1990s, the FIA program went through a major revision, and this included the addition of a Forest Health Monitoring component to a subset of plots. The newly revised FIA protocol was implemented in 2000. By using similar methods as FIA, we can examine regional trends with the larger FIA dataset, and compare NETN park forests with the surrounding matrix of forestlands. We developed an MS Access database that contains the publicly available fuzzed, swapped FIA plot data, and calculates metrics of forest cover, land ownership, and forest health. For comparisons with NETN parks, we calculated metrics from FIA plots in the same Ecological Subsection as each NETN park. Where FIA methods were compatible, we calculated and rated the ecological integrity metrics that were developed for the NETN forest monitoring program. While over 60% of the area surrounding ACAD is forested, the vast majority of these forests are under private ownership. Forest lands in the surrounding matrix are also primarily managed for timber production, whereas forests in Acadia NP are protected from harvesting. The difference in management regimes has resulted in forests in Acadia that are distinct from the surrounding forest matrix. The proportion of forest plots in late successional and mature forest is higher in Acadia than surrounding forestlands. Indicators of older forest structure, such as coarse woody debris volume and density of live trees over 30 cm diameter at breast height (DBH), are more abundant in Acadia than the surrounding matrix of more intensively managed forests. Tree growth and mortality rates also vary between Acadia and surrounding forestlands. These results suggest that forests in Acadia may represent regionally significant, older forest habitat within a matrix of more intensively managed forests.

Public Participation in Biotrails: Learning to Support Learning

Bill Zoellick and Hannah Webber

Schoodic Institute, Winter Harbor, Maine

"Pathways to BioTrails" is a cooperative effort of Mount Desert Island Biological Laboratory, Acadia National Park, and the Schoodic Institute that is funded by the National Science Foundation. The aim is to explore ways to increase the diversity of citizen science learning experiences available to a wide variety of people visiting and living around national parks. The central idea is that new technologies

such as DNA-based species identification ('DNA barcoding') have the potential to enable new kinds of engagement in scientific work by more people. This poster summarizes participant engagement in the first Pathway to Biotrails citizen science event last fall, which focused on marine invertebrates, and describes thinking behind the programs planned for this summer.