

PROCEEDINGS OF THE ACADIA NATIONAL PARK SCIENCE SYMPOSIUM

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Summary

The October 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, and will particularly highlight our understanding of rapid environmental change, its impacts, and solutions. The symposium featured five invited speakers and 29 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:

Protected area science in a rapidly changing environment - Abe Miller-Rushing, National Park Service, Acadia National Park

Declining water clarity in Acadia National Park: A new approach to understanding recent changes - Jasmine Saros, University of Maine

Climate change adaptation in coastal communities - Esperanza Stancioff, University of Maine Cooperative Extension & Sea Grant

Cultural landscape preservation on context: Responding to a changing environment - Bob Page, Olmsted Center for Landscape Preservation

The race for spring: How climate change alters plant communities - Elizabeth Wolkovich, Harvard University

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

Applying for a Research Permit in Acadia National Park

Emma Albee^{1,2} and Abe Miller-Rushing²

1 Schoodic Institute, Winter Harbor, Maine

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

A brief overview of how to apply for a research permit at Acadia National Park.

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

Emma Albee^{1,2}, Abe Miller-Rushing², Robyn King², Rebecca Cole-Will², Katherine Pontbriand², and Caroline Childress²

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.

Population genetics of the invasive European green crab (*Carcinus maenas*) and its role in eelgrass (*Zostera marina*) loss in the Gulf of Maine

Mary Badger¹, Alden Dirks², Larissa Williams³, George Kidder⁴, Anna Farrell⁴, Jane Disney⁴

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3 Bates College, Lewiston, ME

4 Mount Desert Island Biological Laboratory, Bar Harbor, ME

At the end of summer 2012, there was a complete loss of eelgrass (*Zostera marina*) in upper Frenchman Bay, Mount Desert Island (MDI), Maine. In summer 2013 eelgrass failed to come up from shoots or seeds in former eelgrass areas. We examined the relationship between the most recent invasion of novel haplotypes of the European green crab (*Carcinus maenas*) and eelgrass prevalence in Frenchman Bay and around Mt. Desert Island. While *C. maenas* is an invasive species that has been present in the Gulf of Maine for over 100 years, a second invasion of *C. maenas* in Nova Scotia occurred during the 1980s and 1990s, bringing novel haplotypes of the species from Northern Europe that may be more cold tolerant and voracious as compared to other haplotypes. The presence of these new haplotypes may be a contributing factor to the increasing disruptive effects of green crabs in the Gulf of Maine. In 2013, northern haplotypes of green crab were documented in upper Frenchman Bay where eelgrass had disappeared. In order to assess the relationship between genetic type of green crabs and eelgrass loss, the cytochrome oxidase I (COI) haplotype was determined for 15 adult crabs along with the abundance of eelgrass from each of 7 locations around MDI. No correlation was found between crab type and eelgrass abundance. A follow-up study showed no correlation between crab abundance and density of eelgrass at these same locations. The prevalence of eelgrass may not be related to the genetic composition or abundance of green crabs. We are investigating whether inherent or environmental factors may cause eelgrass to be susceptible to green crab damage.

Anecdata.org: A versatile tool for environmental citizen science

Duncan Bailey and Jane Disney

MDIBL Biological Laboratory, Salisbury Cove, ME

The Internet and mobile devices have opened new opportunities for citizen science, but existing citizen science websites are limited in the scope of the data they can collect. Anecdata.org, developed at MDIBL's Community Environmental Health Laboratory, is a new mobile-friendly web app for environmental citizen science which addresses many of these limitations. Anecdata allows students, teachers, researchers, regulatory agencies and community organizations to crowd-source a wide range of environmental data. While existing citizen science sites (for example, Project Noah and iNaturalist) only accept reports where a species is present, Anecdata collects species presence and absence reports as well as environmental data related to habitat quality and pollution events. Project creators can make custom datasheets with lists of locations where users can add data. Users can include their device's GPS coordinates, upload photos and videos, and add additional fields on the fly while posting. They can also run

advanced searches and download custom reports in spreadsheet or Google Earth format. Anecdota will enable many groups from around the globe to get started on environmental projects without having to invent data management or mapping tools. Some anticipated uses of Anecdota include: researchers collecting data on habitat quality from volunteers; teachers and students testing their hypotheses by collecting information and comparing their data to other groups' data; and regulators collecting input from citizens who may not be able to attend public hearings.

Emerging trends from the Schoodic Point Christmas Bird Count, a citizen science effort of 50 years and counting

Seth Benz¹ and William Townsend²

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2 Count Compiler, Bar Harbor, Maine

The Audubon Christmas Bird Count is a global citizen science bird survey conducted annually in early winter. Volunteer observers canvas a local circular area originating from a consistent central point with a radius of 7.5 miles, counting every bird of each species identified. In Maine alone, there are nearly 30 count circles. The authors report specifically on data accrued over a 5 decade span from a count circle whose center is located in Gouldsboro, including trends in observer participation, selected species presence and abundance, and species which indicate a shift in life-cycle range over time.

The converging discussion between policy, values and resource management regarding the potential scientific application of Unmanned Aerial Vehicles (UAVs) in Acadia National Park

Chris Buczko

Environmental Protection Specialist, Acadia National Park

No abstract.

Species composition and diversity of maritime ledge ecosystems

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¹ School of Forest Resources, University of Maine, Orono, Maine

² National Park Service, Bar Harbor, Maine

Ledge and rocky outcrops are common geomorphologic features along the eastern coastline 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 (*Pinus rigida*) is the dominant tree in ecosystems at more southwestern sites and jack pine (*Pinus banksiana*) 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, meaning they are necessary for the survival of their associated vegetation. Our continuing study is focused on species composition and diversity differences between ecosystems and community-types (pine-dominated and non-pine), and how the role of temperature and atmospheric humidity (vapor pressure deficit) affect species distributional patterns. The ability for plants to be successful in these high-stress coastal environments is related to strategies to avoid or compensate for moisture stress, with response to vapor pressure deficit being a major factor. We have found that individual species differ in their ability to respond to vapor pressure deficit, which correlates with species distributional patterns. Higher trends in species richness and diversity were found in Schoodic (jack pine ecosystem), which tends to experience lower temperatures and increased atmospheric humidity than Wonderland (pitch pine). This results in lower transpirational demand for plant species in Schoodic, making it a more suitable environment for species that lack the ability to respond to high moisture-stress environments. Higher temperatures and moisture-stress in Wonderland result in higher dominance and more stress-adapted plants, which contributes to the lower richness and diversity. Pines appear to play powerful roles in these ecosystems, as both ecosystem engineers and keystone species. Pines provide a more suitable microclimate for plant communities by decreasing high-light and temperature extremes and increasing atmospheric humidity beneath the canopy. In addition, pines qualify as keystone species as their ecophysiological characteristics make them adapted to establish plant communities in environments prohibitive to other tree species. We have found that plants growing in pine-dominated community-types experience less seasonal water stress (?13C) and exhibit greater productivity compared to their non-pine counterparts. Pine-dominated communities also have greater soil depths, contributing to a higher availability of water and nutrients for understory plants. Significantly higher concentrations of nutrients associated with marine

aerosols were found in plants associated with pines, suggesting that pines may efficiently capture fog and marine aerosols, providing additional water and nutrients to surrounding plant communities. In addition, pines have significantly higher concentrations of elements that correlate with bedrock weathering, suggesting pines tap a deep source of water. Understanding the physiological differences between species and how this relates to species distributional patterns can be valuable for resource managers to protect the pines and special species within these communities in a warming climate.

The Effects of Ocean Acidification on Intertidal Communities of Acadia National Park

John A. Cigliano

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No abstract.

Invasive Red Pine Scale Found on Mount Desert Island

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4 National Park Service, Northeast Temperate Network

An invasive exotic forest pest, red pine scale (*Matsucoccus matsumurae*, formerly *M. resinosae*), also known as Japanese pine bast scale, was confirmed on Mount Desert Island in September, 2014, after infested samples were submitted to the Maine Forest Service by a local gardener. This is the first confirmation of this insect in Maine. Native to Japan, red pine scale was first detected in the US in 1946 in Easton, Connecticut. It is considered one of the most serious pests of red pine in the US, and has severely affected red pines in southern New England. Red pine scale kills red pines in two to three years after being infested. It can be moved by wind, birds, mammals (including humans) and machinery, except in winter. Salvage harvests have not been successful in containing outbreaks. Red pine in Maine is also being affected by two fungal shoot blights: *Sirococcus conigenus* and *Diplodia pinea*; though unlike scale, they affect outer portions of the crown first. The National Park Service will be working with conservation partners, including the Maine Forest Service and the US Forest Service, to plan and implement a science-based response that includes delineating the distribution of the scale,

managing hazard trees that pose a safety risk, continuing public education to prevent further spread and encourage reporting, and supporting research on this little-studied insect threat.

Bat Species of Maine & What is The White-Nosed Fungus

ME Dept of Inland Fisheries & Wildlife¹ and Bruce Connery²

1 ME Dept of Inland Fish & Wildlife Bangor Maine

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

Read about the Bat Species of Maine & About the White-Nosed Fungus in Maine.

Visitor Management Effectiveness in the World's Protected Areas: Understanding Manager & Expert Perceptions

Jessica P. Fefer, Sandra De Urioste-Stone, John Daigle, and Linda Silka

University of Maine: School of Forest Resources

This research seeks to understand the effectiveness of the visitor management framework developed by the U.S. National Park Service, known as VERP (Visitor Experience and Resource Protection). The goal is to assess the effectiveness of this framework based on the perceptions of academic experts, national park managers, and national park planners. The study includes two phases. The first phase includes the collection of data from international and academic experts regarding their perceptions on the most important elements to be included in a successful visitor management framework; this is done using the Delphi technique in order to reach consensus. Seventeen (17) individual experts participated in the first round of the Delphi process. The second phase includes qualitative semi-structured interviews with selected U.S. park managers and planners across different regions in the US to better understand the facilitating and limiting factors of the VERP framework. An embedded case study design is used for the second phase. There will be a total of approximately fifteen (15) individual interview participants from four (4) National Parks and two (2) NPS planning offices. Preliminary results show that experts perceive that VERP allowing for adaptive management methods, and the emphasis on creating indicators and standards to determine a quality visitor experience are the most important facilitating factors of the framework. Experts perceive lack of funding and resources, and management biases in interpreting visitor data to be the two largest challenges associated with VERP implementation. There have been few studies to indicate the strengths and weaknesses associated with VERP based on the perceptions of park managers. This research aims to bring some the major successes and challenges associated with existing

frameworks to the forefront, helping to determine next steps in successfully managing for the increasing visitation to protected areas.

Citizen scientist assessment of phenological mismatch during fall migration

Richard E. Feldman¹, Angi King-Johnston², Ariel Powers², Hannah Webber², Joellyn Colangelo², Seth Benz², Abe J. Miller-Rushing³

1 University of Massachusetts Amherst

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3 National Park Service

No abstract.

The Challenge of Cadillac Mountain

Jacobi, Charles D.

Acadia National Park

Cadillac Mountain is the most popular destination in Acadia National Park. How can the NPS manage the summit to ensure resources are well protected and visitor experiences are of high quality? What do we now know that can inform decisions? Are resources degraded? Are there too many people? Too many cars? Too many buses? What are acceptable conditions for resources and visitor experiences. There are no easy answers. IN this poster we will frame the challenges.

Towards establishing Acadia National Park as the first national park in the world with a comprehensive DNA-assisted species identification capability

Karen E. James¹ and Frank W. Buaas²

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2 Jackson Laboratory, Bar Harbor, Maine

Understanding, predicting, and managing how species respond to climate change and other environmental changes is a critical challenge in environmental biology. Collection of the individual-organism-level data needed to feed and test the scaled-up, predictive models to meet this challenge typically requires the identification of biological specimens. Unfortunately, this task is difficult and labor-intensive, and is compounded by a dearth of taxonomic experts – the “taxonomic impediment”. Citizen science is proposed as a mechanism for expanding the scientific workforce to address difficult, large-scale or computationally intensive ecological research questions; yet, projects that engage the public in identifying biological specimens, including “bioblitzes”, still rely heavily on professional taxonomists to identify collected specimens, and the taxonomic impediment remains in place. DNA-assisted species identification (“DNA barcoding” and related techniques) can help extend taxonomic expertise to identify specimens collected by researchers and citizen scientists alike. We propose to develop Mount Desert Island, including Acadia National Park and the surrounding ocean (“the Acadia region”) as a model for implementing comprehensive DNA-assisted species identification in combination with citizen science to meet research, management, and educational needs. Progress towards generating DNA barcode reference libraries for whole biotas – all eukaryotic species at single, geographically defined sites – has been made at Moorea in the South Pacific, Churchill, Manitoba in the Canadian low arctic, Wales, and Kruger National Park in South Africa. We propose to elevate Acadia National Park (ANP) and the adjacent ocean into this category, and, in doing so, make it the first national park in the world to have all of its terrestrial, freshwater, and marine animals and plants represented by at least one DNA barcode sequence in the Barcode of Life Data Systems (BoLD) reference database. Towards this goal, we wrote custom R scripts to assess how many Acadia region species are already represented in the BoLD database, and to generate lists of species to target for collection from existing specimen collections or, if necessary, from the field. Here we report the methods and results of this analysis, including target species lists.

Is the Timing of Raptor Migration changing at Cadillac Mountain?

Angi King Johnston¹, Seth Benz¹ and Abe Miller-Rushing²

1 Schoodic Institute at Acadia National Park

2 National Park Service, Acadia National Park

No abstract.

Dynamic Pulse-Driven Flowering Phenology in a Semiarid Shrubland

Natasha Krell¹ and Shirley Papuga²

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2 University of Arizona, Tucson, Arizona

Elevated springtime temperature has been convincingly linked to an increasingly earlier onset of phenological activity. Studies highlighting this phenomenon have generally been conducted in ecosystems where energy is the primary limiting factor. Importantly, phenological studies in semiarid ecosystems where water is the major limiting factor are rare. In semiarid ecosystems, the timing of phenological activity is also highly sensitive to discrete moisture pulses from infrequent precipitation events. The objective of this study is to identify the triggers of flowering phenology in a semiarid creosotebush-dominated ecosystem. Creosotebush (*Larrea tridentata*) is a repeat-flowering evergreen shrub that is the dominant species in three of the North American deserts. We present results from five years of daily meteorological and phenological data collected within the Santa Rita Experimental Range, southern Arizona. Our site is equipped with an eddy covariance tower providing estimates of water and carbon fluxes and associated meteorological variables including precipitation and soil moisture at multiple depths. Additionally, three digital cameras distributed within the footprint of the eddy provide daily images of phenological activity. Our results highlight substantial interannual variability in flowering phenology, both in spring and summer flowering. We show that spring flowering activity tends to be associated with energy triggers (e.g. temperature, growing degree days), whereas summer flowering activity tends to be associated with moisture triggers (e.g. large precipitation events, deep soil moisture). Our study suggests that changes in frequency and duration of precipitation events will impact timing of phenological activity resulting in important consequences for vegetation dynamics and pollinator behavior.

Environmental Compliance at Acadia: Culvert Replacement on the Carriage Road around Eagle Lake

Hilary D. Krieger

Environmental Protection Intern, Friends of Acadia

Environmental protection is often thought of as just a bunch of paperwork and sitting behind a desk. However, I have found through my internship at Acadia National Park that the Environmental Protection office does much more than pushing pencils. The Environmental

Protection Specialist works closely with both the Maintenance division and the Resource Management division to determine the best possible outcome for every project.

Comparison of survival rates of Herring Gull (*Larus argentatus*) fledglings on Great Duck Island

Porcia Manandhar and J.G.T Anderson

College of the Atlantic, 105 Eden Street, Bar Harbor, ME 04609

Great Duck Island (GDI) is an 89 hectares island, located around 25 kilometers south away from Acadia National Park. It is also one of the two stable nesting sites in the gulf of Maine for local herring gull (*Larus argentatus*) population since the 19th century. GDI is a possible indicator site for the overall health of the gull population in the greater Acadia region as gull populations in other parts of the northeastern United States have declined significantly over the past quarter century. To measure the growth and survival of the gulls, hatchlings were banded and then weighed every other day during the nesting season each year. When data from 2012, 2013, and 2014 were compared, a significant decline in successful fledging and an increase in death of immature fledglings were determined in 2014. Causes of mortality have yet to be studied.

Barcoding Acadia's plants: building a DNA reference library for the plants of Acadia National Park

Michael Marion and Karen James

MDI Biological Laboratory, Salisbury Cove, Maine

This project aims to complete a working reference library of "DNA barcodes" for all of the vascular plants of Acadia National Park. DNA barcodes are short DNA sequences derived from specimens of known species to support the identification of unknown specimens. On completion, Acadia will become the first national park in the United States to have such a resource available to researchers, educators, and citizen scientists. The process of obtaining DNA barcodes from plants involves isolating and sequencing two different chloroplast genes from each specimen, evaluating and manually editing the sequences, and then adding them together with specimen information to the Barcode of Life Data Systems (BoLD) database. Using small samples of vegetative material from voucher specimens in the Acadia National Park herbarium at College of the Atlantic, we are generating new barcode sequences for high priority Acadia species and those yet unrepresented in BoLD. This resource will enable identification of unknown specimens, or fragments of specimens, collected in the course of botanical,

environmental or climate change research by their DNA alone. Here we present our progress toward the development of the barcode library for Acadia's plants, and discuss potential applications in research, conservation, and management.

Preliminary findings from a common garden experiment on Cadillac Mountain, Mount Desert Island, Maine

Caitlin McDonough MacKenzie¹, Abe Miller-Rushing², and Richard Primack¹

1 Boston University, Boston, Massachusetts

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

Shifts in spring phenology — including leaf out and flowering times — are a recognizable and accessible ecological effect of climate change on plant communities. Across New England, a pattern of earlier spring leaf out in response to warmer temperatures has been recorded in recent decades. In Acadia National Park, fieldwork has begun to monitor variations in spring phenology across a suite of species growing at all elevations. This study explores the relative effects of environment and genetic differences among populations on the leaf out phenology of reciprocal transplants. With the help of Friends of Acadia volunteers, three raised beds were constructed at different elevations on Cadillac Mountain in September 2013. Filled with low-bush blueberries, sheep's laurel, and three-toothed cinquefoil from all three elevations, these gardens provide a natural warming experiment as transplants from the summit will experience a milder climate in the mid- and low-elevation gardens. After monitoring the gardens for leaf out in 2014, we have preliminary data to explore the importance of source population versus microclimates at each garden in determining the date of leaf out for these plants.

9 Years of Forest Health Monitoring in Acadia National Park

Kate M. Miller and Jesse S. Wheeler

Northeast Temperate Network, Acadia National Park, Bar Harbor, 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.

You, me, and mountain ash: Developing a phenological species interaction study

Abe Miller-Rushing¹, Seth Benz², Hannah Webber², Angi King-Johnston², Richard E. Feldman³, Ariel Powers², Joellyn Colangelo²

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3 University of Massachusetts Amherst

The migration of birds, budding of leaves or fruit, and arrival of plant pollinators--the timing of such events across the seasons and over the years is known as phenology. One of the ways climate change can impact species is by altering the timing of such phenomena. Observations of phenological events by researchers and volunteers help document changes in these, and other, life-history events. However, changing climate may not affect all interdependent organisms to the same degree, which may lead to ecological mismatches—fruit ripening before birds migrate through an area, for example. At Schoodic Institute and on Mount Desert Island, we have developed a monitoring program to look for changes in American mountain ash (*Sorbus Americana*) phenology as well as phenology of the organisms that rely on the mountain ash—specifically birds and insects. We are looking to answer the question “How are species interactions affected by climate-related changes in phenology?” Collecting data for this project relies heavily on volunteer observations, thus we must consider observer variability in the analysis of the data. In this poster we present the Species Interactions project and methodology—specifically the methodology used to compare variability among observers.

Linking abiotic to biotic: servicewide baseline data for mercury in national parks

Sarah J. Nelson¹, Collin Eagles-Smith², James Willacker², Colleen Flanagan Pritz³, David P. Krabbenhoft⁴, Celia Chen⁵, Roger Haro⁶, Hannah Webber⁷

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In partnership with staff from over 40 national parks, we have worked toward developing the use of dragonfly larvae as bio-sentinels for mercury (Hg) in aquatic food webs. To validate the use of these sentinels, and to gain a better understanding of the connection between biotic and abiotic ecosystem components, the project has supported collection of land cover/landscape data, surface water chemistry including Hg and Hg-relevant chemistry (pH, sulfate, dissolved organic carbon (DOC)), and most recently, sediment Hg. Because of the geographic scope of the research, which is occurring in parks from Alaska to Maine to Florida to Hawaii, the project also provides a nationwide snapshot of Hg in these diverse media, primarily in undeveloped watersheds. In 2013, 23 parks submitted samples. In water, total Hg (THg) ranged over two orders of magnitude (0.16-28 ng/L; median=2.2 ng/L), and pH ranged 5.5-9.2 (mean=7.7). In dragonfly larvae, THg concentration was 154 ± 124 (mean $\pm$ SD) ppb, dw. THg in surface water was only weakly correlated with THg in dragonfly larvae (Pearson's $R=0.38$). Sites with the greatest THg concentrations were located in New England as well as western sites that were influenced by volcanic activity and urbanization. Whereas dragonfly and water THg concentrations were generally greater in parks situated in the eastern US than in the western US in 2012 (12 parks participating), addition of parks with potential local Hg sources in the west has changed the geographic pattern of Hg in water and biota. However, site-to-site variability within a park was great; one park included a site with the greatest concentrations of THg in dragonflies and fourth-highest concentration of THg in water, but also a site where dragonfly THg fell in the lowest quartile of all the data. Our ongoing research is evaluating multivariate approaches to determining factors that influence water and dragonfly Hg, as well as sample collection across a broader.

NETN Water Monitoring in Acadia National Park: What have we learned since 2006?

Alyssa Reischauer, Shannon Wiggin, and William Gawley

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

The Northeast Temperate Network (NETN) water monitoring program at Acadia National Park (ANP) builds on almost 70 years of water quality data collected by National Park Service (NPS) staff and researchers. The program assesses general water quality and quantity and nutrient levels of 37 park lakes and streams. As part of the NPS “Vital Signs” Inventory and Monitoring Program (I & M Program), goals include determining status and trends, early detection of abnormal conditions of park waters and providing data to better understand the dynamic nature of park ecosystems. After 8 years of monitoring using the NETN protocol, the ANP water resource team is beginning to get a glimpse of the range of natural variability and seasonal trends of Acadia National Park’s water quality and quantity.

Visitors’ perceived effects of climate change on outdoor recreation and tourism in Acadia National Park and Mount Desert Island

Matt D. Scaccia, Sandra De Urioste-Stone, Jacob Foster, Amy E. Scaccia, and Dimitrije Howe-Poteet

University of Maine, School of Forest Resources, Orono, Maine

Survey/interviews were conducted with visitors to Acadia National Park and Mount Desert Island to better understand their travel behavior and their attitudes toward the effects of climate change on the region. Visitors who participated in this study were recruited to participate on random dates at popular visitor sites throughout Acadia National Park, as well as sites outside of the park on Mount Desert Island. The survey results show 56.9% of participants believed that climate change would affect recreation and tourism on Mount Desert Island while 23.2% of participants did not believe it would. Those who believed climate change would affect recreation and tourism most frequently cited sea level rise as their primary concern while those who did not most frequently believed that visitors would adapt and continue to visit Mount Desert Island regardless of the effects of climate change.

Ecosystem Indicators and Tools in the Gulf of Maine

Christine M. Tilburg¹, James S. Latimer², and Kathryn Parlee³

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3 Environment Canada, Halifax, Nova Scotia

The Gulf of Maine Council on the Marine Environment (GOMC) is a U.S.-Canadian partnership of government and non-government organizations focused on the health, environmental quality and productivity of the Gulf of Maine. In 2006, the EcoSystem Indicator Partnership (ESIP) commenced activities in seven priority theme areas: aquaculture, coastal development, climate change, contaminants, eutrophication, aquatic habitats, and fisheries. Subcommittees were established for each theme area. Currently more than 150 volunteers from local, state and federal governments, along with academics and partners from non-government organizations participate in one or more of these subcommittees. Based on a consensus-based process, the subcommittees have selected priority indicators for each of the theme areas. Following the indicator selection process, ESIP developed an Indicator Reporting Tool (www.gulfofmaine.org/esip) to provide an easily accessible site for data on the priority indicators. The Tool allows users to visually assess data and use a graphing function to view status and trends at specific sites or for specific time periods. As data compilation is completed for each theme, fact sheets are released to provide an overview and current state of the priority indicators. Fact sheets have now been released for five themes and the indicator data is also available through the Indicator Reporting Tool. By providing this compilation of information and making it easily accessible in different formats, ESIP is accomplishing one of its primary goals: assisting users in locating, understanding and utilizing information on priority indicators in the Gulf of Maine region.

5 years of Intensive Exotic Plant Management at Acadia National Park

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No abstract.

Citizen Scientists in the Rockweed: A monitoring program for intertidal phenology

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One changing climate metric affecting marine organisms is sea surface temperature. Relationships between sea surface temperature and reproductive phenology, or the timing of life cycle events, are known for many species of macroalgae, phytoplankton, and sea turtles. *Ascophyllum nodosum* (rockweed) is a long-lived foundational species found on sheltered, rocky intertidal shores. Release of *Ascophyllum* gametes (eggs and sperm) begins when sea surface temperatures are 6°C (43°F) and peaks when water temperatures reach 10°C (50°F). Little is known how increases in sea surface temperature may alter *Ascophyllum* reproductive phenology, as well as what cascading effects shifts in reproductive timing will have within the nearshore marine environment. Signs of the Seasons (SOS) is a New England-wide, citizen science-driven phenology monitoring program developed by the University of Maine's Cooperative Extension, Maine Sea Grant, and partnering research scientists. The coastal SOS program has developed protocols to monitor *Ascophyllum*, collecting phenological data to document changes in the timing and duration of reproduction accompanied by water temperature and salinity data. We present data from the first season of *Ascophyllum* phenology monitoring here at Schoodic and at the other five locations along the coast of Maine and New Hampshire.

Preliminary Results of Tree Ring Analyses in Acadia National Park

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Background In 2013, the Northeast Temperate Network (NETN) began coring trees adjacent to forest plots in Acadia National Park (ACAD) to better understand age dynamics of forest stands, and to see how age correlates with indicators of forest structure, composition and function. Currently we have collected cores for 32 plots on western Mount Desert Island (MDI), four plots

on Isle au Haut (IAH), and two plots on eastern MDI. We will continue to collect cores from western MDI and IAH until all plots have been sampled, and will expand this project to other units in ACAD and other NETN parks as resources allow. The objectives of this work are to estimate the stand age for each forest plot, to determine the relationship between diameter at breast height (DBH) and tree age at DBH, and to compare stand ages with land parcel acquisition to the National Park Service and forest metrics that are expected to differ between mature and late-successional forests, including structural stage, snag abundance and coarse woody debris (CWD). Results/Conclusions Results supported our assumption that larger DBH trees tend to be older than smaller trees, but there was a lot of variability in the data, indicating that DBH is not the best predictor of tree age. Comparisons between codominant and intermediate tree ages within the same plot revealed that plots with co-dominant trees less than 80 years old at DBH also had similar ages (<20 yrs difference) for intermediate trees. This follows patterns expected for mature forests, which are generally composed of a single-aged cohort of trees. Stand ages derived from tree cores mostly supported the stage designated by our structural stage ecological integrity metric, although the ecological integrity metric may be a bit conservative about classifying late-successional plots. Forest stands originated on average 19 yrs prior to NPS ownership, though this varied between 100 yrs before to 36 yrs after land acquisition. Overall, results from the first two years of coring revealed valuable information about forest stands in Acadia, and we expect to learn more as more plots are cored. As time permits, it will also be important to expand this project to all units of ACAD to increase sample size and examine if patterns hold up across the park.