

PROCEEDINGS OF THE ACADIA NATIONAL PARK SCIENCE SYMPOSIUM
Tuesday, October 23, 2012

Summary

The 2012 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 the park boundaries. The symposium featured 3 invited talks and 46 posters describing results and plans for research in a range of disciplines, including natural sciences, social sciences, and the humanities. The goals for the symposium were to facilitate communication and collaboration among scientists, students, park staff, and others working in a range of fields and to solicit input into the development of science priorities for SERC.

Discussions at the symposium were dynamic and highlighted many challenges facing resource managers and scientists, including the need to support long-term research, manage data effectively, adapt management practices and research techniques to a rapidly changing environment, and connect research with management actions. These discussions were in addition to the abundance of research presented on specific natural and cultural resource topics. Many undergraduate and graduate students were present, which contributed a multi-generational aspect to the dialogue throughout the symposium.

SERC is in the midst of a strategic planning process and is identifying how it can best serve the scientific community and achieve its vision to support science and education to support communities and conservation. Symposium attendees contributed ideas for how SERC can best support science through three methods: (1) oral comments during a plenary discussion, (2) written comments on a poster board available during the poster sessions, and (3) responses to a researcher survey. The most frequent recommendations included providing an online map of monitoring and research sites in the region, continuing to hold the annual science symposium, improving access to online data and information resources, and providing small grants to researchers. These and the rest of the recommendations will contribute substantially to SERC's strategic planning process.

We plan to continue this symposium on an annual basis. The 2013 symposium will probably be themed around climate change adaptation, which we hope will facilitate even more substantial and productive discussions and new collaborations.

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

www.sercinstitute.org

Abraham J. Miller-Rushing, Science Coordinator
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Speaker abstracts

Preserving rare species in protected areas

Peter Dratch

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In its first forty years, the Endangered Species Act has been successful in preventing extinction of many federally listed populations. National Parks, National Wildlife Refuges, National Monuments, and other protected lands have had been important habitats for species recovery efforts, whether officially designated as critical or not. Twelve years of collecting data on status and trend of listed species in National Parks have not only provided important information for park staff and the public, it has helped focus efforts at restoring or augmenting listed species with competitive grants at a national level. This data collection effort has been pursued by other bureaus in the Department of Interior. While often equated in the public perception, differences in the mission and culture of the Park Service and the Fish & Wildlife Service have played an important role in determining the steps taken by these two agencies to preserve rare species. As wild-life populations become transformed on protected areas by rapidly changing conditions, managers may find it increasingly necessary to take actions deliberately favoring some species over others so that these lands will continue to serve as refuges of biodiversity.

Peter Dratch has spent this career working in conservation biology, mostly for the Department of Interior: first with U.S Fish & Wildlife Service Forensics Laboratory, then with the National Park Service Biological Resource Management Division working on endangered species, and returning to Fish & Wildlife to start the refuge Inventory and Monitoring (I&M) Program. NPS and FWS I&M are collocated in Fort Collins, Colorado. Dratch did his PhD on the population genetics of elk and red deer at the University of Edinburgh.

Conserving freshwater systems in Acadia National Park: An opportunity for reconciliation ecology?

Cynthia S. Loftin

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Degradation of freshwater systems is a worldwide conservation challenge. Decreasing populations of freshwater biota and their biodiversity are central to this imperilment. Freshwater systems provide critical and varied resources for humans, yet these environments and their inhabiting biota are vulnerable to stresses resulting from this use. Human activities that threaten freshwater systems and the biodiversity they contain have been categorized by Dudgeon et al. (2006) as overexploitation, pollution, hydrodynamic alterations, habitat destruction or modification, and invasion of exotic species. These threats rarely occur individually, given the hydrologic connectivity within freshwater systems as well as with the landscape in which they are embedded. This spatial integration complicates conservation and management of these resources, especially when they are subject to multiple uses simultaneously. There is an urgent need to develop collaborative conservation and management approaches for freshwater systems that invite community participation so that biodiversity, ecosystem function, and system resilience are maintained while providing opportunities for human use of these resources. Simultaneously conserving these systems and allowing for human use of their resources will require tradeoffs and compromise, an approach recently termed “reconciliation ecology” (Rosenzweig (2003). This presentation will examine stressors to freshwater systems in Maine and Acadia National Park, consider perspectives of the public and opportunities for their collaborative engagement in freshwater system conservation, and explore the potential suitability of the “reconciliation ecology” approach to management of the park’s freshwater resources.

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Dr. Loftin is the Unit Leader of the US Geological Survey, Maine Cooperative Fish and Wildlife Research Unit at the University of Maine, where she holds a graduate faculty appointment as an Associate Professor in the Wildlife Ecology department. She received academic degrees from the University of Virginia, Auburn University, and the University of Florida. Dr. Loftin's interests in systems, landscape, and wetlands ecology drive her research program involving ecosystem restoration issues. Recent collaborations with her students and colleagues include identifying effects of fish introductions on invertebrate communities in Maine's naturally fishless lakes; examining amphibian use of fishless habitats and the surrounding terrestrial landscape; identifying characteristics of wetlands supporting shrubby cinquefoil, host plant for Clayton's copper butterfly; using remote sensing data to estimate water clarity in Maine's lakes; examining uptake of marine derived nutrients by food web components in Atlantic salmon nursery streams; developing methods to remotely monitor disturbance of nesting seabirds; relating algal assemblages to stream water quality; and, studying vegetation response to fire in Okefenokee Swamp, GA

The need for long-term data to understand the ecological impacts of environmental changes

Peter Petraitis

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Populations and communities are constantly in flux and so it is very difficult to evaluate the impacts of changes in distributions and abundances without information about long-term variation. Long-term data allow us to benchmark the seriousness of sudden changes; without benchmarks, how can we know if a particular event is important? The value of long-term data will be illustrated with three examples from the Gulf of Maine – the decline of sea anemones in The Anemone Cave between 1991 and 2007, the 22% increase in body size of dogwhelks over the last 100 years, and the decadal effects of ice scour on rockweeds and mussels. Various approaches to increase the amount of long-term data and to improve access to these data will be examined.

Peter Petraitis is a Professor of Biology at the University of Pennsylvania and an ecologist known for his work in rocky intertidal shores in Maine where he has been working since 1981. His research focuses on understanding sudden changes in natural communities, and he has just completed a book for Oxford University Press on the detection of multiple stable states in natural ecosystems. He also works in Mongolia where he is the lead investigator on a collaborative effort with the University of Mongolia to study the impacts of climate change and nomadic herding on steppe grasslands in Lake Hovsgol National Park. Professor Petraitis has ongoing collaborations with colleagues in Australia and in Chile, where he was a Fulbright Senior Scholar at Pontificia Universidad Católica de Chile in 2006 and where he studied the effects of the tsunami after the 2010 earthquake. Professor Petraitis received his Ph.D. in ecology from Stony Brook University in 1979 and was a postdoctoral scholar at Woods Hole Oceanographic Institution before joining the faculty at the University of Pennsylvania.

Poster abstracts

Chiropteran foraging behavior and wind directionality at Bubble Pond, Mount Desert Island, Maine

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Bat foraging activity and wind direction were recorded at the N and S sides of Bubble Pond on Mount Desert Island (MDI), Maine. Ultrasound detectors were used to record 21.23 hours across 6 field nights. The audio files were analyzed to determine the number of call sequences recorded on each side of the pond, which were converted to frequency rates. There was a significant difference in call sequence frequency upwind and downwind with the average call sequence rate on the upwind side of the pond 3.2 times greater than on the downwind side. The effect of wind directionality on chiropteran behavior has implications in the design of efficient research and management programs, including energy development.

Colony collapse in herring and great black-backed gulls: An assessment of possible causes and consequences

John G. T. Anderson

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Islands in the Gulf of Maine currently provide nesting sites to as much as 50% of seabirds nesting in the contiguous United States east of the Mississippi. Species include Herring and Black backed Gulls, Black Guillemots, Double-crested and Great Cormorants, several species of terns, and Leach's Storm Petrels. Herring and Black-backed Gull (*Larus argentatus* and *L. marinus*) populations in parts of the northeastern United States have declined significantly over the past quarter century. Aerial surveys conducted by the U.S. Fish and Wildlife Service in Maine in 1995-6 and 2008 suggest that this decline is non-uniform, with some colonies increasing while others decrease or are eliminated entirely. In general a pattern of near-shore losses is only partially compensated for by off-shore increases. Boat and nest counts of 8 colonies in mid-coast Maine focusing on islands either within Acadia National Park or under easements with the National Park Service indicate that this trend is continuing. Colonies recorded as healthy or even increasing in 2008 had been abandoned by 2012, or showed few or no fledglings. In some cases colonies that had persisted for decades were completely abandoned during the course of a single season, while others declined more gradually.

Glossy buckthorn in Acadia National Park

Frank Archuleta

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No abstract

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

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The European fire ant is an invasive pest that is negatively impacting native fauna in Acadia National Park. In 2011 a site specific integrated pest management plan was implemented on Mount Desert Island across six heavily infested sites in an attempt to control this serious threat. *M. rubra* populations were mapped at each site and a combination of different baited insecticide treatments were deployed. Follow-up sampling and mapping were continued throughout two field seasons in 2011 and 2012. Ant sampling revealed reduced fire ant populations for all sites in 2011. In 2012, novel ant control products were tested in the laboratory and a subset of these were deployed in the field. Sampling at the start of the 2012 field season revealed positive carryover effects from year one treatments as well as continued suppression of fire ants across the park from additional treatments in 2012.

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

Elissa Ballman and Eleanor Groden

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The European fire ant is a serious threat to the health of Acadia National Park. During 2011 and 2012, multiple baited insecticide treatments were deployed against the ants 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, sweep samples, pitfalls, pollinator surveys, and specific host surveys were conducted to measure insect populations at three types of sites: 1) ant infested which were not treated, 2) ant infested which were treated, and 3) uninfested untreated sites. Abundance and diversity of arthropods were recorded and compared among site types. Our preliminary results indicate fire ants have a negative impact on other insects, whereas the management treatments have no major detrimental effects on non-target organisms.

Surficial plankton densities and surface currents around Mount Desert Rock, Maine

Barbara Beblowski

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Surface currents and plankton density can provide insight to the oceanographic patterns and productivity in the area. Currents and upwelling around the Gulf of Maine, particularly around Mount Desert Rock, a small island 25nmi offshore, bring foraging cetaceans to the area during the summer months, due to the highly productive area. Large-scale current tracking work has occurred in the Gulf of Maine (Brooks, 1989), but prior to June 2012 fine scale work (within 5nmi of MDR) had not occurred. Using a DAVIS CODE drifter (Manning, 2009) and a 250µm plankton net, data was collected 5 and 20 times respectively from July-September 2012. This study is providing baseline data for Allied Whale's summer research and will provide understanding to some of the foraging and behavioral data collected on MDR in the 2012 season and beyond.

Participatory science as a means to integrate science, management, and education at the Schoodic Education and Research Center in Acadia National Park

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It is a part of the mission of national parks to support resource management, science, and education, and parks are widely recognized for the quality of their work in these areas. However, a variety of factors frequently limit integration of these activities. At the Schoodic Education and Research Center, one of 19 research learning centers at national parks across the country, we have developed a program that is working to effectively integrate these three fields and developing ways to measure the outcomes that result.

We have found that a tiered approach that includes basic management, science, and education activities, but features participatory science is particularly effective. To measure the outcomes and optimize techniques, we are developing a program aimed at exploring the entire lifecycle of participatory science—from project development to implementation, data analysis, and evaluation—in both formal and non-formal education settings. We have found that successful projects must have explicit science and education goals, provide substantive training throughout a project (sometimes in skill sets not recognized during project development), and be evaluated from both the science and education perspectives throughout their duration.

Signs of the Seasons: A Maine Phenology Program

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Signs of the Seasons is a citizen science monitoring program that involves volunteers of all ages in tracking the local effects of global climate change. By observing and recording phenology (seasonal changes) of common plants and animals in their own backyards and communities, *Signs of the Seasons* volunteers help scientists, resource managers, and others document, understand, and predict changes that affect Maine's environment, economy, and cultural heritage. Phenology is one of the most sensitive indicators of global climate change, and one of the few ways to understand how global-scale changes are affecting plants, animals, and people locally. Scientists, naturalists, farmers, gardeners, fishermen, and many others have been recording their observations of seasonal changes for centuries. By comparing historical observations with more recent ones, climate scientists have identified shifts in long-term phenological trends that closely match records of Earth's warming temperature. The University of Maine Cooperative Extension and Maine Sea Grant manage the program in partnership with the USA National Phenology Network, Acadia National Park, Schoodic Education and Research Center, US Fish and Wildlife Service, Maine Maritime Academy, Maine Audubon, and climate scientists and educators at the University of Maine.

Cultural values of public and private in northern Maine

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Distinctions between public and private in northern Maine are frequently blurred when it comes to land use and access. Cultural expectations about public use of private lands set the stage for how conservation is unfolding and what the future public access will be on privately held lands designated as working forests. This cultural anthropological study began in July 2012 and will run through June 2013 asking what the possibilities for large landscape conservation are given a complex set of values that transect northern Maine. Using ethnographic methods ranging from semi-structured interviews to textual analysis this research traces how changing land ownership overlaps with the values people hold toward public and private land. This research is funded through an environmental leadership grant from the Switzer Foundation and affiliated with the SERC Institute and the University of Maine's Anthropology Department.

Moraines, pipes, and faults – New features on the Mount Desert Island geology maps

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The Mount Desert Island (MDI) geology maps, both Surficial and Bedrock, will be revised over the next three years at 1:24,000 scale to incorporate research findings since the 1980's and to make use of recently available Lidar topographic imagery. This year the Southwest Harbor 7.5' map is being done, with the eastern side of MDI to be done in 2013 and the western side of MDI in 2014. The Lidar imagery at the 1:24,000 scale permits features only a few feet high to be distinguished. This has permitted the identification and tracing of 100's of small scale glacial moraine ridges, 5 – 15 ft. high, with many of them draped over bedrock ledges.

Geologic research on the Cadillac Mountain Intrusive Complex (CMIC) since the 1980's, particularly by Wiebe, 1994, and Seaman et. al., 1999, has developed the picture that at about 420 Ma the CMIC fed a volcano at the surface having a 10 mile wide caldera. The Cranberry Island Series (CIS), 9000 ft. of pyroclastics and lava flows, are the extrusive products of the CMIC granite and gabbro intrusions (CIS is given as being older than CMIC intrusions on the existing MDI bedrock geology map). The lower CIS layers are rhyolitic (granitic) while the upper CIS layers are basaltic (gabbroic). Seamans et. al., 1999, proposed that conduits or pipes of gabbro must cut through the CMIC granites to reach the surface to feed the upper CIS. The current mapping has identified four such pipes, one on Flying Mtn., a second near Burnt Hill, a third south of Manset and a fourth on Pine Hill, with more expected to be found as detailed mapping proceeds.

The present land surface of MDI is thought to have been eroded about two miles below the land surface when the CMIC was active and the CIS was being deposited. Since the CIS still exists at the present land surface, tilted at a steep angle to the south, CIS must have been dropped down and tilted by one or more faults after CMIC activity ceased. Current mapping between Southwest Harbor and Seawall has identified a few zones of intensely sheared rock within the lower CIS and the CI felsite that may represent such faults. Additional mapping will hopefully provide further field evidence of down faulting of CIS on the southern part of MDI.

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Protecting resources through adaptation of the NEPA process

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The National Environmental Policy Act (NEPA) charges federal agencies and those projects supported by federal funding with determining if and how their proposed actions will impact the natural and/or human environment. Because the development and implementation of the process has been largely delegated to departments and agencies so long as the objectives of NEPA are met there exists parameters for adaptability and modification. Acadia National Park recognizes the important role science imparts on the decision making process and has increasingly sought to involve science nearer a project's inception. Early initial involvement has shown to save time, money and result in a superior product further promoting our desire to involve science and scientists at the stage of a projects inception rather than waiting for a formal review period.

Pitch pine vegetation communities on coastal outcrops

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Bedrock outcrops along the eastern Gulf of Maine contain 'vegetation islands' inhabited by ericaceous shrubs, grasses and forbs. The most successful of these vegetation islands develop around one or more pitch pine (*Pinus rigida*) trees. Our preliminary investigation suggests that 'pine-island' plant communities are less stressed by summer drought than their non-pine counterparts and have greater soil depths, resulting in communities with greater species richness, a more complex and stratified community structure, and higher productivity of dominant shrub-stratum species. Large differences between pine-dominated and non-pine communities indicate that pitch pine is a keystone species in these communities. The presence of a pine shifts community attributes between two alternative stable states and is required for a successional sere that, if undisturbed, moves these sites from bare ledge to a maritime spruce forest.

Pitch pine may contribute to community success through several mechanisms. Pitch pine almost always establishes in fissures, suggesting that they are tapping water sources that are located well below the surface, and supplying co-occurring plants with soil water through hydraulic redistribution to upper soil strata. The higher aerial profile of pitch pine may also contribute to water and nutrient availability by interception of fog and marine aerosols, decreasing leaf-to-air vapor pressure deficits, and adding leaf and branch litter to soil organic matter. However, geographic isolation and poor migration potential make pine islands one of the most at-risk community types in a changing climate. The knowledge base we are developing will be critical for management of these unique plant communities.

Conservation genetics of brook trout (*Salvelinus fontinalis*) in Stanley Brook, Acadia National Park

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Stanley Brook has been the site of a long-term, individual-based ecological study of brook trout (*Salvelinus fontinalis*) since 2006 through 2012. Detailed demographic data have been collected over this time period, including abundance, survival rates, and individual growth rates. Furthermore, fishing was stopped in the middle of this time period, in 2009. This study therefore provides an opportunity to examine demographic and evolutionary responses to the cessation of size-selective harvest. Here, we used genetic data from subsets of individuals distributed throughout the stream to estimate the effective number of breeders (N_b) for the 2006, 2008, 2009, 2010 and 2011 cohorts. We then compared estimates of N_b to estimates of the number of adult (N_a) brook trout present in the stream at the time of spawning. Following the cessation of fishing, N_a increased by approximately 123%, whereas N_b declined by about 50%. One possible explanation for this result is that skew in reproductive success has been greater since fishing stopped and the size of adults has increased. We performed a detailed analysis of reproductive skew for the 2008 cohort, prior to when fishing stopped. Based on the distribution of full-sibling family size, reproductive skew was low for that cohort, consistent with high N_b at this time period. An additional test of a later cohort would be required to test for the predicted increase in skew following the cessation of fishing. The full sibling analysis allowed us to accomplish a secondary goal of examining the spatial distribution of spawning locations in Stanley Brook. We found distinct spatial clustering of families, suggesting that spawning and juvenile habitat is used throughout the stream. Our results lead to a counterintuitive result for management: since the closure of fishing, population size has increased, but N_b , that is, the number of individuals successfully reproducing and transmitting genes to the next generation, has decreased. While an increase in population size bodes well for short-term persistence, a decrease in N_b may lower the likelihood of persistence over a longer time period. Future genetic monitoring will be needed to determine if the trend in declining N_b continues.

A population study of showshoe hare (*Lepus americanus*) on Great Duck Island, Maine

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Great Duck Island is an approximately 90 hectare island located about 10 kilometers south of Acadia National Park's properties on Mount Desert Island, Maine. Snowshoe hare (*Lepus americanus*) were introduced to the island in the 1930s and have had significant impacts on the island's vegetation ever since. In spite of the hares' near complete elimination of spruce forest recruitment on the island, prior to 2012 no comprehensive studies had been done regarding the hare population. During the summer of 2012 I tagged 20 hare around the island and attached radio tags and GPS loggers on each individual in order to determine the distribution, maximal dispersion, and typical home range of the hare. Results from radio tagging and additional mark and recapture studies during the summer of 2012 indicate that the estimated population size is currently no more than 70 individuals. The relatively small home ranges of individual hare suggest high food availability during the summer months. This may therefore contribute to the survival of the hare and their impact on the spruce forest during the winter months.

New monitoring initiative for the national wildlife refuges: How well are science and conservation linked at different spatial scales?

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The National Wildlife Refuge System (NWRS) Improvement Act of 1997 widened the emphasis from focal wildlife species to maintaining the biological integrity, diversity and environmental health of the Refuge System. Policy-makers, scientists, and conservation planners developed, in 2010, a strategy for continuing this refuge mission in the face of rapid environmental change. Implementation of the new strategy calls for population monitoring at the refuge and landscape level, with results that can be rolled up to regional and national levels. Several approaches have been used within the NWRS to inventory and monitor wildlife populations. Some tie directly to management decisions (e.g., supporting Adaptive Management), while others serve to document the health of populations through surveillance trends. This poster presents examples of scientific activities that have and will be used to inform and support refuge management. Currently, data for the inventory and monitoring program are predominately generated from inventories or short term surveillance monitoring (< 5 years). These activities have not generally been tied directly to the management decision process. There are far fewer examples of targeted monitoring that tie directly to decisions in a true Adaptive Management process. We recommend strengthening the link between surveillance monitoring and management decisions.

Ammonia excretion in the Atlantic hagfish (*Myxine glutinosa*)

Olivia Erickson

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The aim of the study was to investigate how *Myxine glutinosa*, (Atlantic hagfish), regulate levels of ammonia within its blood. Hagfishes offer a unique view of vertebrate evolution because they are ancient fishes; fossil records indicate that they have remained relatively unchanged for at least 350 million years. The modern hagfish represent the transition between invertebrate and vertebrate evolution. This study will improve understanding of the mechanisms that hagfish use to survive in environments while feeding. The animals were injected with ammonium chloride and water samples were taken for ammonia excretion measurements over a 24 hour period. Ammonia excretion was significantly increased at the 1 hour time point. Ammonia excretion by the animals had returned to basal levels by 2 hours.

Citizen scientists study mercury in dragonfly larvae at national parks

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Mercury is a globally distributed contaminant that can harm human and wildlife health, and threaten resources the National Park Service (NPS) is charged with protecting. Due in part to emissions and long-range transport from coal-burning power plants, even remote national park environments receive mercury deposition from the atmosphere. In an effort to increase public awareness regarding the mercury issue, a citizen science project was expanded in 2012 to collect dragonfly larvae for mercury analysis in national parks. Dragonfly larvae (*Odonata: anisoptera*) can serve as indicators of ecosystem health by characterizing the risk and potential trophic transfer of mercury. These aquatic macroinvertebrates are long-lived before emerging as adult dragonflies, widespread across the U.S., predatory, important prey for fish species, they reflect the mercury sensitivity of a specific watershed, and they are relatively easy to collect.

Fourteen national parks across the U.S. are participating in the initial effort: Acadia (ME), Big Cypress (FL), Cape Cod (MA), Channel Islands (CA), Denali (AK), Great Smoky Mountains (NC/TN), Mammoth Cave (KY), Marsh-Billings Rockefeller (VT), North Cascades (WA), Rocky Mountain (CO), Saint Croix (WI/MN), Saint-Gaudens (NH), Santa Monica Mountains (CA), and Zion (UT). This citizen science project engages students, teachers, and visitors in national parks. Moreover, the project supports the “Call to Action,” the NPS Centennial Initiative, by connecting people to parks and advancing the educational mission.

Preliminary data indicate that there are significant differences among sites, even within a park, suggesting that these bio-sentinels could be useful in describing fine-scale differences in mercury risk. For example, in two ponds at Acadia National Park where marked differences in fish mercury were reported in earlier research, dragonfly larvae mercury followed the same pattern: dragonfly larvae mercury was approx. two times greater in the pond with higher-mercury

fish (dragonfly mercury mean $\pm$ SD=237 $\pm$ 30 ppb, wet weight) as compared to the pond with lower-mercury fish (dragonfly larvae mean $\pm$ SD=111 $\pm$ 45 ppb, wet weight).

In addition to increasing public awareness about mercury issues, this study provides baseline data to better understand the spatial distribution of mercury contamination in national parks. It expands the geographic scope of research previously conducted by scientists and provides data that can be compared across parks. Funding options for future years are currently being explored.

Preserving Acadia's historic roadside views

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Acadia National Park's historic motor road system was developed beginning in 1922 to provide access to park scenery. Seventy-one roadside vistas documented at Acadia National Park in 1961 are identified for continued preservation in the 1982 General Management Plan. Yet following their documentation in 1961, many of Acadia's roadside views have become blocked by the widespread growth and maturation of forest vegetation. Because of this, the visitor experience has become increasingly foreshortened to an episodic experience of travelling viewpoint-to-viewpoint, where the growing scarcity of roadside vistas induces motorists to stop, exit, and take in each surviving view. These circumstances have magnified both traffic congestion at viewpoint pullouts and environmental impacts related to increased pressure on small parking areas and the proliferation of unplanned foot trails within the diminishing number of unobstructed viewpoints.

Scheduled for completion in 2013, the National Park Service is involved in an effort to update Acadia National Park's 1961 Vista Management Plan, reviewing historic documentation, and physically reconciling historic vista locations marked on a 50-year old paper map with current landscape conditions utilizing contemporary geospatial technologies. This process had delineated boundaries for small areas alongside the historic motor road that may be effectively managed to preserve vistas. The boundaries of these roadside polygons are intended to serve as the limits within which all physical management activity for the vista will be considered, such as pruning and thinning or decisions linked to the removal or retention of individual trees. Establishment of these areas will help resource managers make site-specific evaluations of the existing condition and integrity of each historic vista, and make decisions leading to a choice among preservation, maintenance, rehabilitation, or abandonment of specific historic vistas. Data collected and recommendations presented as part of this project will help establish work priorities that are responsive to annual park funding, and will assist work crews in the field toward accurately directing the geographic scope of vista management work.

Is there something in the air? Air quality monitoring at Acadia National Park

Bill Gawley, Beth Arsenault, Matt Duggan

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Acadia National Park (ANP) periodically experiences high concentrations of a variety of air pollutants, primarily as a result of long-range transport by prevailing winds. Located along the mid-coast of Maine, the park is downwind from large urban and industrial areas in states to the south and west. The National Park Service (NPS) has established a comprehensive Air Resource Management program at ANP, a Class I area under the Clean Air Act (CAA), to better assess air pollution impacts and protect air quality related resources. The air monitoring program at ANP, which began in the early 1980s, is conducted in cooperation with state and federal agencies. Core program elements include long-term monitoring for gaseous pollutants (such as ozone, sulfur dioxide, nitrogen oxides), volatile organic compounds (VOC's), fine particulates, visibility, mercury deposition, and acid precipitation. In addition, there is an ongoing effort to determine the ecological effects of selected air pollutants on park resources.

Breeding status, habitat selection, and food preference of corvids on Great Duck Island, Maine

Erica Georgaklis

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Extensive documentation has shown Corvids favor pelagic seabird colonies as a readily available food source. In the past 25 years, seabird colonies including Herring and Black-backed Gulls (*Larus argentatus* and *L. marinus*), Leach's Storm Petrels (*Oceanodroma leucorhoa*), Common Eiders (*Somateria mollissima*), and Black Guillemots (*Cepphus grille*) in the Gulf of Maine have been declining. The decline may be partly attributed to the increasing Bald Eagle (*Haliaeetus leucocephalus*) population and the ever-increasing American Crow (*Corvus brachyrhynchos*) and Common Raven (*Corvus corax*) populations. During the 2011 Field Season on Great Duck Island, Maine, both American Crows and Common Ravens were anecdotally observed opportunistically predating on the seabird colonies while the resident Bald Eagles hunted from above. Previous to the 2011 field season, no data on Corvid activity existed on the island. This field season it was determined that two pairs of American Crows and one pair of Common Raven nest on the island. All three nest areas were in the southern half of the island, and were set back in dense conifer forest. Perch locations of Corvids were mapped using GPS coordinates and a regulated observation path to identify the area most utilized by American Crows and Common Ravens. The Corvids were observed in 4 different Gull colonies, interspersed with Common Eider and Black Guillemot feeding areas and nests. No predation was observed over 120 hours. The Common Ravens were observed assuming a hunting posture, but no kills were made. Constructed gull nests in 5 locations around the island were routinely destroyed by both American Crows and Common Ravens. The nests were raided in a shorter amount of time (average 4.9hrs, n= 6) when the nests with preserved

gull eggs were unaccompanied by a crow decoy, a gull decoy, or both. Predation by both American Crows and Common Ravens of Leach's Storm Petrels and their burrows were observed, and is of concern.

Geographic variation in Nelson's sparrow (*Ammodramus nelsoni*) song

Laura Hilberg

Antioch University New England, Keene, New Hampshire

Many bird species display geographic variation in their song, which can occur as graded variation across the landscape, or as dialects, which have sharp boundaries (Podos & Warren, 2007). It occurs over varying spatial scales, and is primarily observed in passerine song. Because birdsong plays such a central role in avian behavior, it is crucial to understand normal variation in order to recognize changes that could affect social communication, territory establishment and defense, mating behavior, and, ultimately, reproductive success. One factor that may affect song is mercury, a dangerous environmental contaminant that accumulates in watersheds (Evers et al. 2012). Several studies have suggested that high mercury levels could cause changes in the song of several species, including Nelson's Sparrows (Gorissen et al 2005, Hallinger et al. 2010, McKay 2012). Nelson's Sparrows are often used as an indicator species to identify mercury 'hotspots' in estuaries (Evers et al. 2012). Little is known about their song, and it is vital for researchers studying the possible effect of mercury on Nelson's Sparrow song to know whether geographic variation regularly occurs in this species. The purpose of this study is to provide important background information on normal variation in the song of Nelson's Sparrows. I recorded the song of 33 sparrows at 4 salt marshes along the northern coast of Maine in June 2012, and am currently analyzing several song parameters to determine whether geographic variation occurs in this species. Important variables will be identified using a principal component analysis, and I will use regression analyses to determine whether those variables vary significantly on a spatial scale.

Using passive acoustic monitoring of migratory flight calls to track spatial and temporal patterns of bird migration in the Gulf of Maine, a complex flyway system

Rebecca Holberton, Wes Wright, David Bridges, and Adrienne J. Leppold

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

Recent initiatives for land-based and offshore wind energy development have spurred greater urgency for more comprehensive information about spatial and temporal patterns of bird movements in the Gulf of Maine region. The Northeast Regional Migration Monitoring Network (NRMMN) was established to bring together a wide array of expertise and resources to study this regional flyway on multiple scales. In 2010 and 2011, 5-7 inland, coastal, and offshore sites for recording migratory flight calls (MFC) were established from the Bay of Fundy to mid-coast Maine. Cornell's Raven Pro 1.4[®] software was used to analyze MFCs, which were extracted

using detector parameters that yielded the most effective detector for each site. While all sites illustrated the general seasonal transition in species group composition (% 'warblers', 'sparrows', 'unknowns') from 'warbler'-dominated to 'sparrow'-dominated MFCs, nightly total calls and call rates (MFC/h) varied among sites. Higher numbers and call rates were more likely inland and further south, perhaps reflecting a greater catchment area of birds coming from the west as well as the north and northeast. Stable deuterium isotope signatures indicated that many birds originated from as far as 1000 km to the west. Coastal and island site recordings documented dawn arrival of nocturnal migrants in addition to passage throughout the night. Banding, stable isotope analyses, and passive acoustic monitoring are collectively helping to gain a better picture of this dynamic and complex flyway system.

Nestling growth and survival in a herring gull colony in eastern Maine

Anne S. Hurley

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Great Duck Island (GDI,) is a small (90 hectare) island located approximately ten kilometers south of Acadia National Park, in Eastern Maine. The island has served as a significant nesting location for Herring Gulls since at least the last quarter of the 19th century and continues to do so today. During the summer of 2012, approximately 1100 pairs of Herring Gulls nested on GDI, along with Great Black Backed Gulls, Black Guillemots, and Leach's Storm Petrels. During the 2012 field season, I identified, observed, and interacted with 37 nests in the southwest sub-colony of GDI. Chicks were banded within 48 hours of hatch. Banded chicks were weighed every other day over an eight week period (June 10, 2012-July 19, 2012.) 3 chicks were recorded dead, 47 chicks were recorded MIA, and 21 chicks were recorded as definitely alive by the last week of the study. Sources of mortality included predation, developmental problems, and competition for parental attention. Given the significant declines in gull numbers in other regional colonies it is important to maintain long-term records of productivity whenever possible. Great Duck provides a possible indicator site for the overall health of the gull population in the greater Acadia region.

Acadia by the numbers: Visitor use and then some

Charlie Jacobi

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

Acadia National Park can be described by many numbers. Most of us have seen Acadia National Park visitation quoted in a newspaper article or other publication and assumed it was correct. Was it? Find out here! Other numbers get thrown around as well. In this poster we will highlight a few visitor use statistics for you as well as an eclectic pot pourri of other park numbers, like miles of boundary, infrastructure datums, size of the park in acres, number of easements, number of mammal species, visitor program attendance, number of search and rescue

missions, rolls of toilet paper used annually and who knows what else. We've done our best to ensure accuracy.

From education to impact: The effects of messaging on environmental conditions in Acadia National Park

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Education to change or discontinue depreciative behavior is a primary intervention for protecting park resources and preserving experiential quality. When effectively applied, education has the potential to mitigate use related impacts to park resources in a way that is unobtrusive and sometimes even enhances experiential quality. However, it is often difficult to monitor and quantify the changes that result from educational campaigns. This is particularly true for environmental impacts that may take years to reflect changed visitor behavior. Study of cairns and their disturbance by visitors in Acadia National Park provides a unique opportunity to overcome these difficulties. Visitors to Gorham Mountain in Acadia were treated with a range of educational messages, based on multiple theories of effective communication, to discourage cairn disturbance. The condition of cairns before and after each treatment was monitored and their effects analyzed. Educational messages are demonstrated to be effective interventions for protecting park resources.

Biodegradable grids enhance success of eelgrass restoration in Maine

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Community Environmental Health Laboratory, Mount Desert Island Biological Laboratory, Salisbury Cove, Maine

In the past, we have successfully restored eelgrass (*Zostera marina*) in Frenchman Bay by tying plants to wire grids and setting the loaded grids on the ocean bottom. While eelgrass plants successfully root and spread from these grids, these grids must subsequently be removed, both for general housekeeping and because our Army Corps of Engineers general permit requires it. Removing grids inevitably uproots 25% to 60% of the plants. We have designed a biodegradable grid (BDG) using spruce side rails laced with a grid of sisal twine, and weighted with sand in cotton bags. We compared the transplant efficiency of BDGs to traditional wire grids in three different areas of the bay. The transplant efficiency of BDGs is as high as or higher than found with wire grids, before the latter are removed. The BDGs provide opportunities for volunteer participation, both in construction of the grids and in tying plants and deploying grids with

plants. We conclude that this is the transplant method of choice for community-based eelgrass restoration in Maine.

Acadian Internship in regional conservation and stewardship

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In the mid-1990s, units within the U.S. National Park System (NPS) began establishing research and education centers intended to promote the NPS mission of protecting resources and encouraging the recreational use of its lands. The Schoodic Education and Research Center (SERC), located in Acadia National Park along Maine's rugged "Downeast" coast, is the newest and largest Center within the NPS. In 2010, a partnership between SERC, Harvard University, the Lincoln Institute of Land Policy, the Quebec-Labrador Foundation, and the University of Maine led to the creation of the Acadian Internship – a six-week course in landscape-scale regional conservation for college-level students and early-career professionals. The 3-credit course features a mix of classroom instruction and field-based experiential learning. Students from around the world spend their first week at SERC learning about the region, landscape ecology, conservation tools, conflict resolution, and environmental communication from nearly two dozen experts. Student interns then spend four weeks in the field working on various projects with local nongovernmental organizations (NGOs), governmental agencies, and other institutions engaged in sustainable development. Students return to SERC after their field experience to report on their activities and share new knowledge. The Acadian Internship provides an innovative and readily transferable model of how national parks and other protected areas can partner with academic institutions and local conservation-based entities to address and solve complex sustainability-related problems. Students not only make measurable improvements in the local area, but learn from and take home new-found skills in field research, community outreach, and the operations and challenges facing protected areas and conservation-based NGOs. Recent program participants have come from countries as diverse as the U.S. and Oman, Hungary, Ethiopia and Brazil. In 2012, students interned with seven local NGOs across coastal Maine and New Brunswick, and worked on projects ranging from resource inventory and stream restoration for the endangered Atlantic Salmon, to a study of microplastics within the waters surrounding Acadia National Park.

Predicting the past for planning the future: Archaeological assessment of Acadia National Park

Karen Mack and James Clark

TRC, Ellsworth, Maine

This poster presents the results of a park-wide archaeological assessment of prehistoric or Precontact Native American and Early Contact Period archaeological resources within Acadia National Park. This research continues the Park's efforts to meet the goals of the Systemwide Archaeological Inventory Program (SAIP) of the National Park Service, which includes conducting systematic scientific research to locate, evaluate, and document archaeological resources on National Park System lands. The goal of this park-wide archaeological assessment is to develop predictive models for identifying locations within Acadia National Park that are sensitive for, or likely to contain, Precontact or Early Contact period cultural resources. These models were then used to create Geographical Information System (GIS) based sensitivity maps that indicate areas of moderate or high sensitivity for archaeological resources in the Park. In addition, the poster includes preliminary results of the first stage of field testing of the predictive models through the use of archaeological field investigations, including walkover assessment and subsurface testing. These field investigations provide information necessary for refining and implementing the predictive models.

Aquatic insect biodiversity at Acadia National Park: Preliminary observations from the 2012 BioBlitz

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A total of 61 people spent 1,419 hours to collect, sort, pin, and identify aquatic insects from streams, ponds, and freshwater wetlands around the park July 14-15, 2012. This biodiversity discovery event was the park's 10th consecutive annual BioBlitz. Participants used a variety of active and passive sampling techniques (e.g., hand picking, dip nets, light traps, minnow traps) to collect adult and larval insects that spend at least part of their life in aquatic habitats. Field work took place both on the Schoodic and Mount Desert Island sections of the park. So far, 226 species have been identified in 10 orders of insects; collected chironomids are still being identified. Many of the sampling sites on Mount Desert Island were habitats previously surveyed by William Procter (of the Procter and Gamble family) between 1927 and 1945. Procter eventually documented the presence of 6,578 species of insects and spiders during his 27 years of field work. In the future, we hope to compare the results of our 2012 Aquatic Insect BioBlitz to Procter's findings. A technical bulletin summarizing the first nine years of the Acadia BioBlitz program was published in 2012 by the Maine Forest and Agricultural

Experiment Station and can be found at:

http://www.umaine.edu/mafes/elec_pubs/techbulletins/tb206.pdf

Defining critical habitat for migratory songbirds in the Downeast coastal region of Maine

Jennifer McCabe and Brian Olsen

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The processes that govern habitat quality during migration affect individual success and population viability across the annual cycle for many songbird species. The importance of migratory habitat is thus disproportionate to the time it is used, and this pattern is amplified further at migratory bottlenecks, such as coastal habitats along the Gulf of Maine for north temperate and boreal songbirds. We are investigating the importance of habitat type, structure, and food availability for migratory songbirds in the Gulf of Maine Flyway. Results from our first field season indicate songbirds utilized habitats containing a shrub component more often than forest or field habitats regardless of position from the mainland. During fall 2011 we conducted a small-scale experiment at two sites to test the effect of food availability and vegetation structure on shrub-habitat use of migratory songbirds. Results showed a relationship between structure and food on songbird abundance.

Climate change in Acadia National park and beyond: Long-term trends in flowering phenology and floral abundance

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Climate change threatens natural communities across the globe. National Park managers must be able to monitor the ecological effects of climate change in order to protect the ecological integrity of some of the country's most iconic and biologically significant places. Phenological monitoring — monitoring the timing of biological events, such as flowering — has been embraced as a useful, accessible, and effective method for tracking the ecological effects of climate change. Warmer temperatures causing shifting plant phenology can lead to disruptions in community interactions, losses of species, increases in invasives, and changes in ecosystem functions. However, new phenological monitoring programs lack the long-term data to uncover trends in flowering over long time periods. Without a historical context, monitoring programs do not have the ability to compare current flowering times to the historical norm.

Acadia, the oldest National Park east of the Mississippi, contains arguably one of the richest collections of natural history observations made at a single location in the United States. The Park's Herbarium collection, housed at the College of the Atlantic, contains over five thousand plant specimens collected within Acadia's boundaries and some that pre-date the Park by thirty years. In the late 19th century a group of natural history enthusiasts and Harvard students formed the Champlain Society with a mission to explore nature on Mount Desert Island. The Mount Desert Island Historical Society now holds the Champlain Society's records of fieldwork and photographs from their summers in the park. These resources, held on Mount Desert Island in archives and herbarium cabinets, have been minimally used by ecologists to date. This project took advantage of the wealth of natural history records to examine long-term changes in the plant communities on Mount Desert Island. I digitized the entire collection of herbarium specimens from Acadia at College of the Atlantic and made them publicly available through the Park's IRMA database. I used the 1894 *Flora of Mount Desert Island*, co-authored by an original member of the Champlain Society, as a record of historical species abundance for over seven hundred wildflowers. These historical abundances were compared to abundance descriptions compiled for the recently published "Vascular Flora of the Acadia National Park Region, ME." By providing a historical context for today's phenology monitoring, this study will inform management decisions and enhance park efforts to communicate with the public about climate change.

Collaboration and social resilience: Interdisciplinarity and engagement in a learning organization

Bridie McGreavy, Laura Lindenfeld, Linda Silka, Karen Hutchins, Hollie Smith, and Colleen Budzinski

University of Maine, Orono, Maine

As part of the Knowledge Action Collaborative with the Sustainability Solutions Initiative (SSI), we conducted a mixed methods study of how SSI researchers work across disciplinary and institutional boundaries to involve citizens, policy makers, industry representatives and other "stakeholders" in solutions-oriented research projects. The objective of this research was to identify approaches to linking knowledge with action to improve our collective work across different types of boundaries in an engaged learning organization model. We conducted 41 interviews with SSI faculty and students and implemented a quantitative survey with questions partially derived from interviews.

Our results emphasize who researchers engage, how they engage and respective level of involvement in SSI research. We found that researchers described stakeholders following a distinct typology and we propose a nested framework that considers stakeholders at individual, organizational, community, societal and more-than-human scales. We identified the mean level of involvement by stakeholder type and noted that researchers saw themselves as most involved, followed by SSI as an organization, municipal officials, state agencies and non-profit organizations. A principal components analysis revealed patterns in the reasons respondents gave for why they engage stakeholders. A commitment to sustainability science principles emerged as a key factor (eigenvalue=4.98, VAR=31.5%). We found that 69% (n=57) reported that they feel

they are getting better at stakeholder engagement and 88% (n=72) said that they intend to continue to engage stakeholders after the grant is finished. We conclude that these findings demonstrate potential sources of resilience, an important consideration in planning for the future of sustainability science in the State.

Seven years of forest health monitoring in Acadia National Park

Kate Miller, Jesse Wheeler, and Brian Mitchell

National Park Service, Northeast Temperate Inventory and Monitoring Network, Bar Harbor, Maine and Woodstock, Vermont

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.

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 appear to 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.

Use of the mid-water region by resident and transient birds off of Great Duck Island, Maine: Potential implications for offshore windpower development

Lindsey E. Nielsen

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There is increasing concern in the North Eastern United States about the impact that off shore wind power development may have on migratory and resident birds. Risk models that assume a single passage by birds through a given area on migration in spring and fall may under-estimate threats posed to foraging seabirds that may cycle through a portion of ocean multiple times while foraging from a nesting site or during pre- and post-breeding dispersal. By assessing the

diversity of species, their abundance, and peak times of area use in the mid-water region currently favored by wind development, mitigation strategies can be suggested to reduce the potential “take” or disturbance to local and migrant birds. This study provides data on species diversity and population density of Great Duck Island, Maine. Great Duck Island has five resident seabird species: Herring Gull, Greater black-back Gull, Black Guillemot, Leach’s storm-petrels and Common Eiders. In addition 20 transient species were observed. Trends in the abundance of resident and transitory species observed in the mid-water region were significantly influenced by temporal and/or seasonal factors for several species. This pilot project provides a test of methodology for assessing bird species richness and abundance off the coast of Maine.

Monitoring nitrogen loading and land use change in an estuarine watershed at Acadia National Park

Martha G. Nielsen

U.S. Geological Survey, Augusta, Maine

Since 1999, the U.S. Geological Survey and the National Park Service have been monitoring land use and nitrogen runoff in a 10 square mile estuarine watershed at Acadia National Park, Mt. Desert Island, Maine. The initial study linking land use and nitrogen load entering the Northeast Creek estuary was completed in 2000, and was used to develop a decision-support system (DSS) to help guide local land-use decisions. At that time, the amount of nitrogen entering the Northeast Creek estuary was low, and there was no evidence of degradation due to excessive nutrient loading into the *Ruppia*-dominated estuarine ecosystem. A new round of water-quality monitoring to determine nitrogen loading was conducted from 2009-2011 to evaluate the effects of increased amounts of rural residential housing within the watershed since 2000. Based on a 2.6-percent increase in residential housing land use from 2000 to 2010, the DSS predicted a 7-percent increase in nitrogen loading to Northeast Creek. The loading measured in the Northeast Creek tributaries, however, increased more than predicted. This increase is primarily a result of much wetter conditions prevailing during the second sampling period compared to the first sampling period, as concentrations of nitrogen in the samples were similar in both studies.

Effects of anadromous alewife on seasonal patterns of nutrient limitation in Maine lakes and streams

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Anadromous alewife (*Alosa pseudoharengus*) link marine and freshwater environments, and may subsidize streams and lakes with nutrients via excretion, gametes and carcasses. Currently, the potential role of alewife as a nutrient vector to freshwater systems is poorly known. In the northeastern USA, alewife runs have declined dramatically over the past 150 years mostly due to damming. The goal of this study was to measure the ecological effects of alewife nutrient subsidies to lakes and streams using nutrient limitation assays and to compare limitation patterns of linked lake-stream systems. We evaluated alewife nutrient subsidies by examining the nutrient limitation status of 7 lakes and outlet streams with and 7 without alewife access. Sampling was done before, during and after alewife runs and after fall lake turnover. Nutrient-diffusing substrates and microcosm bags were used in streams and lakes respectively, to test for nitrogen, phosphorus or co-limitation of primary producers. Lake and stream water dissolved inorganic nitrogen (DIN) and total phosphorus (TP) was measured seasonally. Seasonal patterns of carbon and nitrogen stable isotopes in zooplankton and fish were examined at a subset of the lakes to determine if marine nutrients transported by alewife were incorporated into the lake food web.

During in-migration, DIN in alewife streams was marginally higher by 10.49 $\mu\text{g/L}$ ($P=0.06$) than in reference streams, but was not different between the two for other sampling periods. Stream TP, and lake DIN and TP showed no increase during alewife presence. Nutrient limitation remained steady across all periods in alewife streams, while limitation of reference streams increased slightly during the run period followed by a significant decrease ($P<0.01$). This indicates a possible alewife subsidy that deterred increasing limitation during runs as seen in reference streams. Some alewife streams exhibited a shift from co-limitation to nitrogen or no limitation following alewife presence, but this also occurred in one reference stream. Few lakes and their associated outlet streams (4 of 14) had similar nutrient limitation patterns. Lake zooplankton were enriched in ^{15}N in one of two alewife lakes during spawning compared to reference lakes. While alewife may have subsidized some of the systems, we found no distinct, coherent signature of alewife as nutrient sources across systems. This may be due to variation in alewife run size or role of other limiting factors among systems. Further research should be conducted as dam removals on northeastern U.S. rivers allow for returns of more alewife.

Toxin load decreases the capacity of common loons to adapt to climate change

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In the face of environmental change, the viability of wildlife populations is continually challenged. Thus a central goal for conservation biologists and evolutionary ecologists is to determine the adaptive capacity of populations. Adaptive capacity is the ability of populations to evolve adaptations to new environmental conditions (genetic change), the ability of individuals to adjust phenotypes adaptively (plasticity), or the ability of populations to evolve plasticity (reaction norm evolution). Slowly reproducing birds with long generation times should possess adaptive reaction norms to deal with historically common environmental variability, like interannual weather differences. The ability of individuals to exhibit these reaction norms, however, may be limited by new changes to the environment. We examined reproductive success in the Common Loon, *Gavia immer*, under a wide variety of weather conditions for adults that experienced a blood mercury burden that was or was not above the Lowest Observed Adverse Effect Level (3.0 µg/g ww) for the species. For adult loons with low mercury burdens, reproductive success was not predicted by interannual variability in weather conditions (i.e. individuals were able to succeed equally across different environmental conditions). For adult loons with high mercury burdens, however, interannual reproductive success was predicted by interannual weather variability. Birds carrying a significant mercury load were unable to adjust their phenotype adaptively to maintain reproductive success in years with poor weather, although their reproductive success was similar to birds with low mercury burdens in good years. This interaction highlights an important additional impact of environmental toxins, mainly that they have the potential to limit the adaptive capacity of wildlife populations for changes in climate or other environmental characteristics.

Derelict fishing gear: A buoy island map

Robin Owings

College of the Atlantic, Bar Harbor, Maine

This poster presents an ongoing study of marine buoys that attempts to determine distribution of marine debris in the Acadia region. During the summer of 2011, over 1500 buoys were photographed and documented on Great Duck Island (GDI). These buoys have subsequently been mapped based on likely points of origin according to ownership patterns. This poster will present this map as well as findings from a re-photography project conducted in partnership with Acadia National Park archives, which compares photographs of surrounding island coastlines taken in 1968 and 2012.

The watershed of Taunton Bay

Steve Perrin

Friends of Taunton Bay, Hancock, Maine

No abstract

Coverboard sampling of terrestrial salamanders in Acadia National Park: Employing citizen scientists to monitor the population dynamics of amphibians

Stephen Ressel

College of the Atlantic, Bar Harbor, Maine

Whether amphibians face threats to their future existence on earth that are taxon-specific and more imminent than that of other vertebrate taxa has been the focus of much discussion and research over the past quarter century. One of the greatest challenges for researchers addressing this issue is elucidating declines in populations that reflect mortality rates and reduced recruitment that deviate from natural fluctuations. In addition to robust data sets, conservation biology also requires widespread public support of the science and policy needed to minimize or halt the probability of a species going extinct. From 2008 to present, we enlisted citizen scientists in an effort to collect long-term species abundance data on terrestrial salamanders native to Acadia National Park via coverboard sampling. We placed 100 wooden coverboards in a grid array at two different Northeast Temperate Network (NETN) sites within park boundaries. Following a brief training period, volunteers examined the microhabitat under coverboards either weekly or once/month in the spring and fall for the presence of salamanders. Field data included species identification, snout-vent and vent-tail length, color phase, and general assessment of body condition. The demographics of volunteers who conducted monthly surveys ranged from middle-school age children to adult island residents. Regardless of age or level of scientific background, volunteers were able to collect reliable data for all parameters except body length measurements of small juvenile salamanders. Preliminary data analysis of salamander abundance and a general assessment of the use of citizen scientists within the context of this study are discussed.

Native bee biodiversity in climate sensitive habitats

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How many species of native bees depend on NPS protected habitats service-wide? Insect biodiversity is often overlooked by NPS managers when they think about the resources they protect even though these communities provide critical ecosystem services. A three-year study of native bees in climate sensitive habitats in 50 different national parks (including Acadia), has already identified more than 650 species and we are still counting. High elevation, coastal, and arid areas are particularly vulnerable to climate change and these areas are often hot spots for bee and plant endemism. This poster will highlight the current data from Acadia and compare it to some interesting results from across the country.

From landscapes to lightscapes: The importance of darkness and the night sky to national park visitors

Ellen L. Rovelstad and Robert E. Manning

University of Vermont, Burlington, Vermont

The National Park Service has recently extended the definition of the landscapes it protects to include the night sky, or *lightscapes*. However, visitor perceptions of and attitudes toward the night sky and darkness as resources are not fully understood. A survey was developed to explore the importance of darkness and the night sky to visitors and their recreation experiences. The survey was administered to visitors in two campgrounds in Acadia National Park, Maine. Respondents were asked to rate how the ability or inability to see objects in the sky or varying light sources added to or detracted from their experience. Results will be presented using a variation of Importance-Performance analysis to offer suggestions for management. Findings from this study will inform park managers about the quality of nighttime recreation experiences and the importance of the night sky and darkness as resources to be protected for current and future generations.

Presence and trophic transfer of methylmercury around Mount Desert Rock, northern Gulf of Maine

Rachel Sullivan-Lord

College of the Atlantic, Bar Harbor, Maine

Accumulations and effects of persistent contaminants such as methylmercury, other heavy metals and organochlorines have been identified as significant threats to marine ecosystems worldwide, including the Gulf of Maine. Humans have close contact with this region, particularly through extraction of marine resources that contribute to local economies. Contaminants found in marine resources have serious implications for human health and ecosystem health including disruption of neurological and endocrine processes in various marine organisms. In summer 2012 a baseline study was conducted on Mount Desert Rock, an island 20 miles offshore, investigating the presence of methylmercury in local food webs. Marine species of the area range from the lowest trophic levels of zooplankton, to higher trophic levels including seabirds and marine mammals. Samples from zooplankton, benthic invertebrates, seabird blood and harbor seal scat were collected and preserved for mercury analysis. Additional information on food web interactions was obtained from daily plankton tows, observations of seabird feeding events and analysis of seal scat samples for prey hard parts such as fish otoliths and squid beaks. Assessing toxins across these trophic levels will provide baseline indications of the health of the marine ecosystem around Mount Desert Rock regarding heavy metals, and more information about food web interactions around this pelagic site.

New technologies reveal foraging behavior, nest site attendance, and migratory pathways of pelagic seabirds

Linda Welch

Maine Coastal Islands National Wildlife Refuge, Milbridge Maine

Maine Coastal Islands National Wildlife Refuge used coded radio tags (LOTEK nanotags) to document foraging behavior, flight direction, and colony attendance rates of seabirds breeding on Petit Manan Island in 2012. We deployed 21 nanotags on incubating Arctic and common terns and black guillemots. We erected three automated receiving stations to document the birds' movements at the colony and at associated foraging grounds. Birds were monitored until they departed the colony at the end of the breeding season, until the tag failed, or until the tag fell off the bird. Several of the birds were monitored for over 50 days, far surpassing the monitoring period associated with traditional radio tags used on terns. We have documented over two million records at the three receiving stations. This was a pilot study to test the efficacy of the equipment in this environment and our attachment methods. Additional tags will be deployed in 2013. The Refuge and National Audubon Society equipped Arctic terns nesting on Metinic Island and Eastern Egg Rock with geolocators to document migration pathways. Geolocators are light-sensing units that can be used to estimate location based on day length and the time of sunrise and sunset. The geolocators were deployed in 2010 and retrieved when the terns returned

to their breeding colonies in 2011 and 2012. This project confirmed that Arctic terns have the longest known annual migration, with the birds traveling an average distance of 88,915 km.

Early detection of invasive species – Surveillance monitoring and rapid response for northeast parks

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In 2010 the Northeast Temperate Network (NETN) began implementing an invasive species early detection (ISED) program in 12 national park units. The ISED program was designed to facilitate detection of priority pests and exotic plants at early stages of establishment while the costs of eradication are still low and the chances of successful eradication are high. The major components of the ISED program include:

- 1) Maintain a target “watch list” of early detection species for each park.
- 2) Provide laminated field guides for each park containing the target list and identification cards for each target species.
- 3) Timely reporting to ensure park managers and NETN staff are informed quickly of detections.
- 4) Manage and annually report on early detection data.

In 2012, NETN expanded the ISED program to include aquatic plants and the Mid-Atlantic Network (MIDN) started a pilot season in 12 national park units for its ISED program of invasive pests and plants. While National Park Service (NPS) staff are actively monitoring for Early Detection (ED) species, much of the opportunity for detection may rely on other “eyes and ears in the field” like, volunteers, cooperators and informed park visitors to report new invasions.

Height modernization for Acadia National Park

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Acadia National Park (ACAD) has an increasing need to understand and measure elevations of its resources due to its location on the coast and the potential impacts of changing sea level. Having a distributed network of survey benchmarks with highly accurate and precise locations aids long-term monitoring. In September 2012, a team of NPS employees, using survey-grade GPS equipment, completed a height modernization for ACAD, providing locations & elevations for 21 survey marks on NPS fee-owned lands, 3 marks on NPS conservation easement land, and one mark on adjacent conserved land. The resultant locations are precise to within 1.3cm ,

horizontal and vertical, of the National Spatial Reference System (NSRS) and relative to the local tidal datums of Bar Harbor, ME.