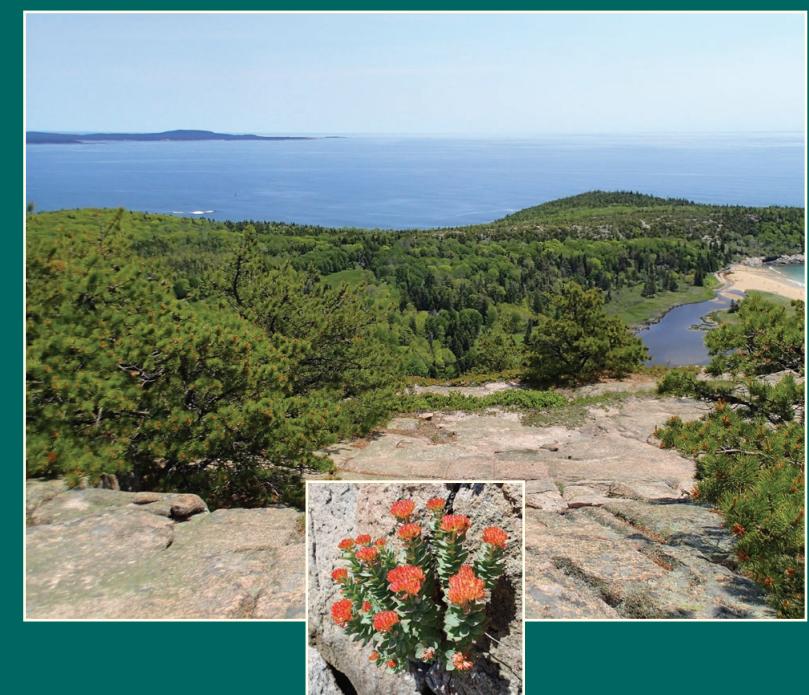




Mark Berry

## *Impacts of Climate Change: Acadia Prepares and Responds*

I consider myself fortunate to live in Maine, and to have the opportunity to raise my son near Acadia National Park, where he first developed a love for hiking on the dramatic boulders and slabs of granite. The park is justly renowned for its outstanding hiking and scenery.



**I**t is less well known that Acadia's founders intended the park to serve as a destination for science and, perhaps most importantly, to inspire people to pursue conservation elsewhere. Welcoming its many visitors and providing them with outstanding experiences are important to accomplishing these broader purposes.

## ENVIRONMENTAL CHANGES AT ACADIA

Yet, Acadia's founders could not have anticipated the environmental changes that now threaten the quality of the experience. Speak to people who have been connected to the coast of Maine for several decades or more, and they'll usually have stories to tell about changes they've seen.

Residents have noticed the earlier springs—and much longer growing seasons. Some seasonal visitors find they now happily stay later into the fall, enjoying warmer weather than their parents or grandparents once experienced. Across Maine, the average annual temperature has warmed 3 degrees Fahrenheit over the last 120 years (*Maine's Climate Future*, 2015).

The changes to our winter experiences have been dramatic—an unusually cold winter now, such as we experienced in 2014-2015, is similar to a typical winter of the past. Of course, many people appreciate the milder winters, and opportunity to hike on trails free of snow and ice. But traditional winter recreation, from

## Residents have noticed the earlier springs—and much longer growing seasons.

cross-country skiing to skating and ice-fishing, is consistently less available in coastal Maine than it once was.

More intense storm events threaten erosion damage to trails and roads, and greater challenges for maintenance. Coastal roads

that provide access to the park and local communities, sometimes built just above the high-tide line, are vulnerable to storms and rising seas.

Most obvious evidence of change is in the responses of plants and animals—flowers opening earlier,

timing of migration changing, and new species arriving.

These changes leave many of our plants and animals vulnerable. The diversity of Acadia is largely due to its location in a zone of transition between temperate and northern

*Page 48: Schoodic Peninsula, Acadia National Park. (Photo: Barbara Southworth)*

*Page 49: View across Frenchman's Bay toward Schoodic Point; and rose root. (Photos: Schoodic Institute)*

*This page: Schoodic Peninsula. (Photo: Barbara Southworth)*





species—many species reach either their northern or southern range limits in or near Acadia. Projections indicate that climate change will decrease habitat suitability for many of our current species, and increase habitat suitability for species now found to our south. Acadia's plant

## INSTITUTE RESEARCH AND EDUCATION STAFF

**Dr. Nick Fisichelli**, Forest Ecology Program Director, leads experiments on how tree seedlings of northern and southern species perform under current climate conditions, along with observational studies of forests along a maritime to inland climate gradient from Schoodic Point north to Schoodic Mountain.

The Institute's Bird Ecology Program, led by **Seth Benz**, engages the public in monitoring fall migrations of raptors in Hawk Watch on Cadillac Mountain and of seabirds from Schoodic Point. He leads birding tours that contribute to global databases of bird observations through "eBird." Seth also works with researchers studying the timing of songbird migrations and the changing availability of fruit and insect prey.

The Institute's Education and Research Projects Manager **Hannah Webber** has a particular interest in intertidal ecology, where she collaborates on studies of rockweed and building understanding of healthy intertidal communities. She also monitors ocean acidification that is occurring as a consequence of increased levels of carbon dioxide in the atmosphere.

**Bill Zoellick** leads education research and oversees education programs for the Institute. He focuses on authentic science learning experiences for students—where they participate in the scientific process to investigate questions that interest them—and on teacher learning and leadership. The Institute, in partnership with Acadia and others, reaches hundreds of students annually, and thousands more indirectly through programs with teachers.

The Institute also helps coordinate and facilitate research in Acadia led by scientists from many colleges and universities throughout the country. The Institute's **Emma Albee** works closely with Acadia National Park Science Coordinator **Dr. Abe Miller-Rushing** to coordinate research permitting and help the park maintain a public, searchable database of research activities and reports.

communities have already changed dramatically, with one in five of the species documented a century ago by the Champlain Society no longer found in the park. While our forests are likely to adapt over time with a new mix of species, the transitions can be disruptive. Trees under stress may be killed more easily by pests and pathogens, including invasive species. A recent example is the widespread and unexpected death of many of Acadia's red pines. Since trees take decades to mature and reach great size, the process of their loss and replacement by others seems traumatic to us.

### More intense storm events threaten erosion damage to trails and roads.

We are a part of this equation, too. Visits to Acadia—now up to an estimated 3.3 million per year—are strongly influenced by weather, and therefore, over the long-term, the changing climate. The park now experiences a longer busy season. With a workforce composed largely of seasonal employees, it is difficult for the park to adjust to the longer season. The increase in visitation is contributing to crowding, sometimes unsafe conditions, and damage to natural resources at favorite destinations such as Cadillac Mountain. The park is now engaged

in creating a new transportation plan in hopes of resolving some of these challenges and continuing to provide high-quality experiences for visitors.

Acadia's visitors are also now becoming accustomed to the health risks represented by Lyme and other diseases carried by ticks, with climate change implicated in the increase in ticks and these diseases throughout coastal and southern Maine.

Though many changes are evident, and predictions can help us prepare for more, there is much we don't yet know about exactly how climate change will affect plants and animals in Acadia or throughout Maine.

## THE WORK OF SCHOODIC INSTITUTE

Because of these risks and uncertainties, the nonprofit organization Schoodic Institute at Acadia National Park Service is investing in ecosystem science to understand environmental change. The Institute is based within Acadia at Schoodic Point, on a beautiful campus created from a former Navy facility and is dedicated to advancing science and learning in a public-private partnership.

*Left: Planting native seedlings on Cadillac Mountain outcrop. (Photo: Noah Rosenberg)*

*Right, top: Tour to identify migratory shorebirds on local mudflats. (Photo: Noah Rosenberg); middle: Hiker on Acadia's granite. (Photo: Schoodic Institute); bottom: Red spruce, a northern tree vulnerable to a warming climate. (Photo: Schoodic Institute)*



The Institute supports stewardship both within and beyond Acadia—helping to leverage the park's resources to benefit a broader region, while supporting Acadia's purpose of inspiring further conservation.

The Institute has staff with expertise in education and the ecology of forests, birds, and the intertidal zone, and is leading research and programs that engage students and members of the public.

## SECOND CENTURY STEWARDSHIP

To accelerate its work, Schoodic Institute has created a new collaboration with the American Association for the Advancement of Science (AAAS) and the National Park Service called Second Century Stewardship. Launched first at

### The increase in visits is contributing to crowding, sometimes unsafe conditions, and damage to natural resources.

Acadia, Second Century Stewardship seeks to provide parks with quality science research to help address critical societal challenges while leveraging parks to reach broad segments of society, enhancing public appreciation for science.

The program's first step was establishing a competitive research fellowship to attract early-career scientists to research in parks. Four fellowships have been awarded, and

a new call for proposals is scheduled for the fall of 2017. The second component is to invest in science communication—in July, Schoodic Institute hosted a workshop to empower the research fellows, along with Institute and park staff, to be more effective communicators.

Third, the science conducted by the research fellows will be translated into resources for teachers around the country, with educators helping to develop these materials and share them in their schools. Finally, the partners will pursue solutions to critical issues for our parks and our planet by convening thought-leaders for focused conversations in the inspiring setting of the Schoodic Institute campus.

### HIKERS CAN HELP

Schoodic Institute and Acadia are particularly interested in understanding the biodiversity of the park and region—where species occur, and at what times of year they are here or are active. Thanks to advances in technology and the field of citizen science, it's easy for anyone to contribute their observations to science in ways that are useful—they don't even need expertise in identifying what they see.

One of the Institute's favorite tools is "iNaturalist" (from the California Academy of Sciences),

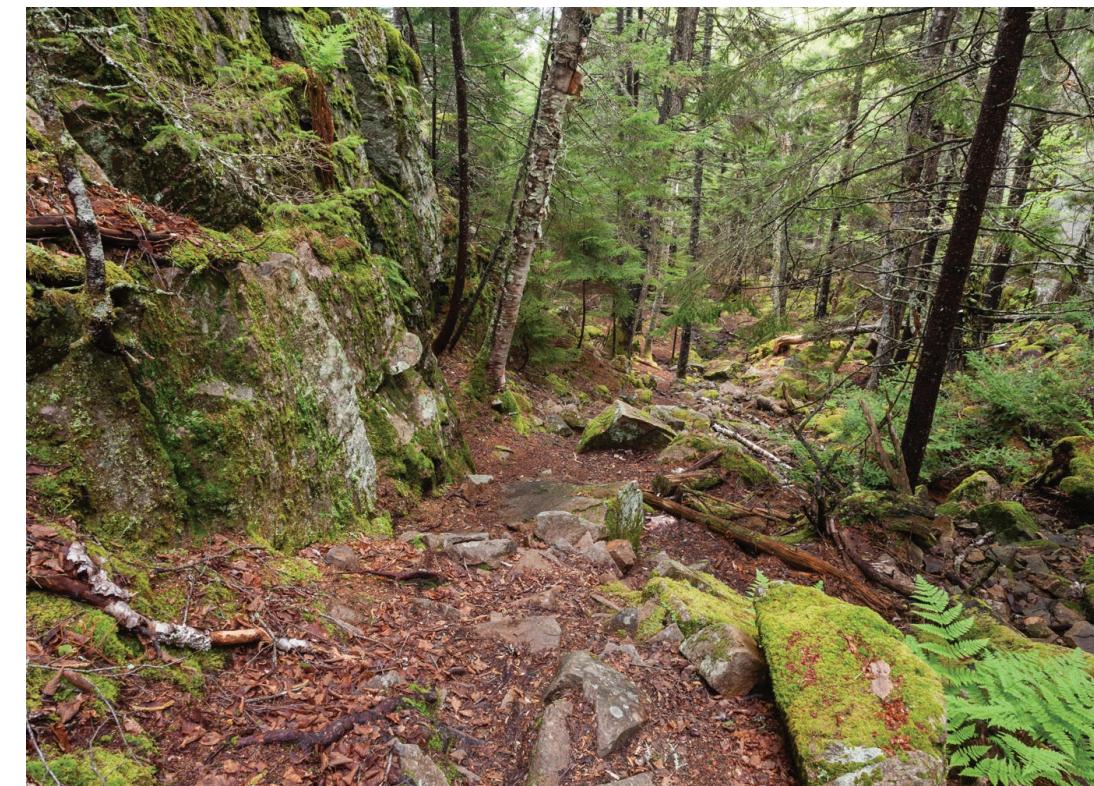
which engages observers' curiosity and desire to contribute to science. With this app on a smart phone, you can simply take a photo, of any organism, and submit it. The app will record a location, suggest a possible identification, and invite other users in an online community to add their identification to your photo. If you know what you're seeing, you can identify it yourself—but if not, gaining the help of amateur or professional scientists is powerful.

Most hikers carry a smartphone but not a lot of field guides in their packs, and downloading the iNaturalist app is an easy way to learn and contribute to science at the same time. Over the last year in the Downeast and Acadia region of Maine, over 400 observers have made nearly 10,000 observations, and have

been helped by over 500 people making identifications of over 1,800 species, including over 800 insect and nearly 600 plant species.

The Institute also encourages park visitors and residents to submit their observations of birds to "eBird," either through their app or online. It's an easy interface for submitting lists of bird observations and a powerful tool to build scientific understanding of bird migrations and distributions. These tools are not limited to use in Acadia or Downeast Maine, of course; they can be used anywhere.

Perhaps the most obvious ways hikers and other visitors can help are by reducing their own impacts by avoiding more crowded areas or busier times and practicing Leave No Trace principles. Keeping in mind Acadia's purpose as a destination for science and a place inspiring further conservation, visitors today can help by communicating the changes they see, by encouraging others to connect with and care for the natural world, or by volunteering for and financially supporting conservation, research and educational organizations.



Left: Luna moth at Schoodic Institute. (Photo: Schoodic Institute)

Above: Trail through Acadia. (Photo: Barbara Southworth)



Hikers and other visitors can help by reducing their own impacts: avoiding more crowded areas or busier times and practicing Leave No Trace principles.