

UMaine Today

The background of the entire page is a dense field of microscopic organisms, likely from the Gulf of Maine. These organisms are rendered in shades of light blue and white against a dark blue background. They include various shapes: some are circular with internal structures, some are elongated and spindle-shaped, some are branched or chain-like, and others have long, thin appendages. The overall effect is a complex, textured pattern of biological forms.

CREATIVITY AND ACHIEVEMENT AT THE UNIVERSITY OF MAINE

SPRING/SUMMER 2015

Making waves

What a half-century of
marine research tells us
about the Gulf of Maine



Photos clockwise from top left: Carnegie Hall, circa 1930s; UMaine Asian Student Association, 2009; State 4-H Tractor Clinic, circa 1956; Skate with the Bears, 2013; Women's basketball, 1926; Advanced Structures and Composites Center, 2012; Civil engineering, 1879; Darling Marine Center, 2008; Marching band, circa 1970s; Chemical engineering, 2011. Center photo: Winter Carnival, circa 1940s.



THIS SPRING, the University of Maine had a series of events as part of Women in Leadership Week, including my installation as UMaine's 20th president. Reflecting on the theme of that week, I was drawn to a definition that describes leadership as derived from influence, and can come from anyone at any level, fulfilling any role. I am drawn to this focus on leadership because it doesn't rely on prominence of position.

It is true that as you move up the organizational structure, you gain power. But, you gain more authority by the use of less power. Persuading people to do things because it is in the collective best interest is a more powerful and reliable way to lead. Thought-leading at its best.

The University of Maine has a legacy of 150 years as a leader of education and innovation for the state of Maine. Contributions run the gamut, from Francis Crowe, class of 1905, who was the construction engineer for the Hoover Dam, to Clifford McIntire, class of 1930, who was the Congressman who co-sponsored the McIntire-Stennis Cooperative Forestry Research Program legislation. Edith Patch, who received a master's in 1910, pursued a lifetime of significant work in Orono. She warned against the loss of insect pollinators due to indiscriminate use of pesticides many years before Rachel Carson published *Silent Spring*, and was the first woman president of the Entomological Society of America. Chuck Peddle, class of 1960, was one of the founders of the microcomputer industry as lead developer of the chip that started the computer revolution of the 1970s and 1980s.

UMaine is where Phi Kappa Phi, the national honor society recognizing excellence in all academic disciplines, was founded by students, including Marcus Urann, who went on to start Ocean Spray. We boast alumni with national and international reputations in fields that span the range of human endeavor. We have well-known writers, a Tony Award-winning lighting designer, an Academy Award-winning film producer and a Nobel Prize-winning physician among our 105,000 living alumni.

In this, our 150th year, there is more recognition than ever that the land grant university can — and must — play a key role in enhancing the quality of life for citizens all across Maine and beyond. It is a leadership role members of the UMaine community have embodied for a century and a half — and continue to embrace.

A handwritten signature in black ink that reads "Susan J. Hunter". The signature is fluid and cursive.

Susan J. Hunter
President

features

- 10 For Nancy**
 A partnership between a diversified Maine orchard and a top New England brewery began with the delivery of 500 pounds of sour cherries.
- 16 Making waves**
 Darling Marine Center celebrates a half-century of internationally recognized research and experiential learning in the Gulf of Maine.
- 28 Save the snow**
 Undergraduate researcher Abigail Bradford conducted fieldwork on Ruth Glacier in Alaska’s Denali National Park to inform the future of New England winters.
- 40 Click**
 In her STEM education research, Michelle Smith demonstrates that active learning is more effective than lectures.
- 46 Where’s Chuck?**
 While conducting research on glaciers in Peru and Tajikistan, UMaine graduate student Charles Rodda is peppered with questions — from schoolchildren. And that’s just what he signed up for in the Follow a Researcher program.
- 50 Alternative futures**
 In the School of Forest Resources, researchers are helping communities across Maine and beyond visualize landscapes of the future to make informed decisions today.



departments

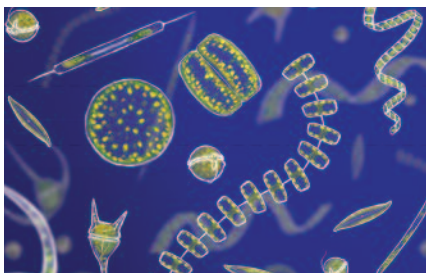
- | | | |
|--|---|--|
| <p>4 Flagship difference
 Fresh and safe
 Telling time
 Intertidal ecology
 Staying power
 Sources of inspiration</p> | <p>15 Students first
 Hooked on science</p> <p>33 Black Bear success
 From the start</p> <p>34 UMaine engaged
 The kernel of an idea</p> | <p>37 Students first
 Coming home</p> <p>44 Students first
 Get a grip</p> <p>60 Insights</p> |
|--|---|--|



Photo by Edwin Remsberg

46

“Where’s
Chuck?”



ON THE COVER: *UMaine Today* is commemorating the Darling Marine Center’s 50th anniversary with profiles of UMaine research on five seminal Gulf of Maine species, including phytoplankton. See story on page 16. Other Darling Marine Center anniversary stories, including reflections from alumni, are on *UMaine Today* online (umainetoday.umaine.edu).

Illustration by Haley Viehman



About UMaine

Leadership

Susan J. Hunter, President
 Karlton Creech, Director of Athletics
 Robert Dana, Vice President for Student Life and Dean of Students
 Jeffrey Hecker, Executive Vice President for Academic Affairs and Provost
 Carol Kim, Vice President for Research and Graduate School Dean
 Ryan Low, Vice President for Administration and Finance
 Eric Rolfson, Vice President for Development and Alumni Relations
 Megan Sanders, Vice President for Human Resources and Chief of Staff
 Jake Ward, Vice President for Innovation and Economic Development

Research Centers

Advanced Structures and Composites Center
 Aquaculture Research Institute
 Center for Community Inclusion and Disability Studies
 Center for Research on Sustainable Forests
 Center on Aging
 Climate Change Institute
 Forest Bioproducts Research Institute
 Institute for Molecular Biophysics
 Laboratory for Surface Science and Technology
 Maine Center for Research in STEM Education
 Maine Sea Grant
 Margaret Chase Smith Policy Center
 National Center for Geographic Information and Analysis
 Senator George J. Mitchell Center for Sustainability Solutions

UMaine Today Magazine

Managing Editor

Margaret Nagle

Designers

Valerie Ireland
 Michael Mardosa
 Carol Nichols

Photographers

Holland Haverkamp
 Adam Küykendall
 Michael Mardosa

UMaine Today is produced twice a year by the Division of Marketing and Communications, University of Maine, 5703 Alumni Hall, Room 213, Orono, Maine 04469-5703, 207.581.3745.

Printing and distribution of *UMaine Today* are underwritten by the University of Maine Foundation.

Volume 15 Issue 1

©2015 University of Maine System

The University of Maine does not discriminate on the grounds of race, color, religion, sex, sexual orientation, including transgender status and gender expression, national origin, citizenship status, age, disability, genetic information or veteran status in employment, education, and all other programs and activities. The following person has been designated to handle inquiries regarding nondiscrimination policies: Director, Office of Equal Opportunity, 101 North Stevens Hall, 207.581.1226.



UMaine food science research will focus on the effectiveness and mechanisms of inactivating bacterial, viral and parasitic pathogens using light and gaseous treatments.

Fresh and safe

IN RECENT decades, there has been a significant increase in the consumption of produce and low-moisture foods, such as nuts, cereals and spices, which are susceptible to contamination by pathogens — from pre- to post-harvest. The challenge for food scientists is to develop new technologies that will improve the safety and extend the shelf life of food products without compromising safety or sensory properties.

THE UNIVERSITY of Maine has been awarded two competitive food safety grants from the U.S. Department of Agriculture's National Institute of Food and Agriculture, including a \$4.9 million, five-year award to improve processing technologies to enhance the safety and quality of fresh produce and low-moisture foods, such as raw grains, spices, seeds and nuts. The awarded projects are led by Vivian Wu, professor of microbiology and food safety in the School of Food and Agriculture. Unless fresh fruits and vegetables are consumed raw, most foods are thermally preserved or cooked at high temperatures. Nonthermal treatments allow for the processing of foods below the temperatures used during pasteurization and canning, causing minimal changes in flavor and quality while removing pathogens. The five-year project will investigate emerging nonthermal technologies, such as decontaminating lights, gaseous treatment and cold plasma (ionized atmospheric air) — processes used on an industrial scale for manufacturing of electronics and medical instruments. Wu's team will use combinations of technologies to optimize product quality and inactivate pathogens, with a goal of commercializing the process. ■

Telling time

“

The **next frontier** is to determine **millennial records** so we can get a better sense of **what was normal** for ocean acidification in cold water coastal zones.”

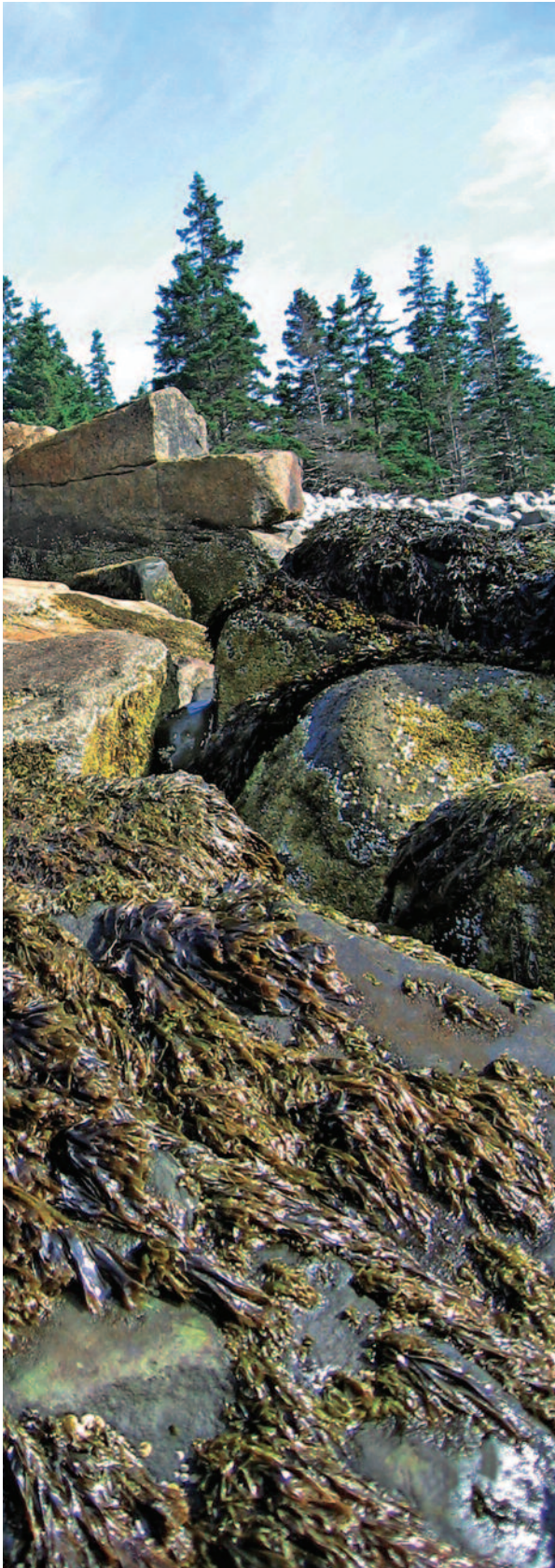
Robert Steneck

UNIVERSITY OF Maine marine scientist Robert Steneck is part of an international team that has unlocked an underwater time capsule in the North Pacific that has been monitoring the climate for centuries. The time capsule is the long-living, slow-growing alga *Clathromorphum nereostratum* that creates massive reefs in shallow coastal regions of Alaska’s Aleutian archipelago. These solid calcium carbonate structures have fine growth rings — similar to tree growth rings — that Steneck says contain historical environmental information. The team used a cutting-edge micro-isotopic imaging technique to reconstruct 120 years of seasonal changes in ocean acidification (pH) in the region. The technique uses lasers to measure isotope ratios of the element boron at the scale of tenths of millimeters, providing researchers with a detailed historical timeline, including rate of ocean acidification both seasonally and over hundreds of years. The scientific team, led by researcher Jan Fietzke of the GEOMAR Helmholtz Centre for Ocean Research Kiel in Germany, learned that since before the Industrial Revolution in the late 19th century, the ocean has been acidifying at a rate that corresponds with rising carbon dioxide levels in the atmosphere. ■

CORALLINE ALGA grows approximately 1 millimeter every three years. Plants collected last year that are nearly a half-meter thick could easily be more than 1,000 years old. UMaine postdoctoral associate Doug Rasher was recently in Scotland analyzing specimens he and Robert Steneck collected last year in Alaska. To retrieve specimens for the research, Steneck dove in 34-degree water off the Aleutian Islands and used a jackhammer to cut off chunks of the *Clathromorphum nereostratum*. The chunks were loaded into cargo nets, brought to the surface, towed to a boat and lifted aboard with a crane. Onboard, Steneck cut the chunks into pieces.

Clathromorphum nereostratum





Intertidal ecology

UNDERSTANDING THE biodiversity of bacteria associated with marine algae that contribute to ecosystem health in the rocky Atlantic intertidal zone is the focus of a study led by three University of Maine researchers. Susan Brawley, a professor of plant biology in the School of Marine Sciences, is leading the three-year project. At UMaine, she is working with John Singer, a professor of microbiology, and Benildo de los Reyes, a professor of biological sciences.

The study is a collaborative research project with Hilary Morrison at the Marine Biological Laboratory (MBL) in Woods Hole, Massachusetts, and is funded by a more than \$1.4 million grant from the National Science Foundation — \$986,515 to UMaine and \$480,016 to MBL. The research will focus on interactions between microbes and intertidal macroalgae — seaweeds — and how their relationships change in response to natural and human-driven environmental stresses.

Intertidal macroalgae provide shelter and food to many invertebrates and young fishes. Although much is known about how intertidal algae react to natural stresses, little is known about their associated bacteria. Past studies found that some macroalgae disintegrate after bacteria are removed, suggesting the bacteria are essential to the algae's health, according to the researchers. ■

TO LEARN how macroalgal microbiomes change in space and time, scientists will examine the biodiversity of bacteria associated with seaweeds that are important to the health of marine ecosystems. The study will determine how the bacteria change depending on the season, position within the intertidal zone and latitudinal range. The research has the potential to serve as an important trans-Atlantic baseline of the microbiomes' biodiversity.

Photo courtesy of Susan Brawley

FOUR UNIVERSITY of Maine student researchers completed the survey project, “Revitalizing Bangor: Keeping Professionals in Central Maine,” as part of their Engaged Policy Studies course, led by Robert Glover, UMaine assistant professor of honors and political science. Glover will continue to work with the city of Bangor and the university to implement the recommendations. In addition to the city of Bangor, particularly City Councilors Gibran Graham and Ben Sprague, other collaborators on the yearlong project were the University of Maine Alumni Association and the *Bangor Daily News*.



Staying power

A GROWING concern for the Bangor area, as well as the state, is Maine’s demographic decline. Simply put, there are not enough young adults to replenish the diminishing pool of working-age adults in the state. Four University of Maine seniors — Cameron Huston, Sarah Nicols, Spencer Warmuth and Gareth Warr — spent the past year identifying the factors that affect young professionals’ decisions to stay in the Bangor area after graduation. The student researchers surveyed nearly 900 UMaine students and alumni, and presented their findings to the Bangor City Council in April. The survey found that students’ work experience in the community greatly increased the attractiveness of the Bangor area as a post-graduation settlement destination. Among the findings: Students who acquired an internship in the area were twice as likely to consider Bangor as an attractive destination, with 42 percent of them saying they would move there after they graduated. The student researchers suggested some solutions, including better branding of the city, a partnership among local businesses and the UMaine Career Center, and more internship opportunities. ■



Sources of inspiration

JENNIFER NEPTUNE completed the ceremonial Penobscot Nation headdress, collar and cuffs moments before Chief Kirk Francis donned them for his 2014 inauguration, but they had already been infused with tribal spirit and tradition.

“It was important to do it in a really good way with good energy,” Neptune says of the 18-month project to re-create the tribal artifacts. “Part of bringing it to life was infusing it with spirit.”

The project included a multiday canoe trip that retraced the 1857 Thoreau-Wabanaki expedition on the branches of the Penobscot River. Neptune also took the set on another paddle of the West Branch of the Penobscot and to Chesuncook Village. She carried the pieces to Mount Katahdin, the Penobscots’ sacred mountain, and to a petroglyph site, where she prayed for them.

The University of Maine graduate who majored in anthropology and minored in Native studies also took them to socials where Native songs were sung, and to a language immersion camp, where the languages of the Wabanaki — People of the Dawnland: the Maliseet, Micmac, Passamaquoddy and Penobscot — were taught.

While beading the collar, cuffs and headdress, Neptune

sought and received direction from tribal ancestors. When she was unsure about her next move, she asked for and received guidance from Penobscots who did beadwork centuries ago.

“The connection is right there if you know how to ask in a respectful way and be quiet enough to listen to their answers,” Neptune says.

Serving as inspiration were a collar and cuff set made circa 1870, worn by Peter Nicola, Penobscot chief in 1911–12, and Walter Ranco, now found in UMaine’s Hudson Museum.

When she was in her teens, Neptune felt a calling to do beadwork. Her mother worked at UMaine and Neptune spent a lot of time in the Fogler Library stacks on campus, looking at photos of Penobscots and objects of tribal culture, including beaded pieces.

“Seeing those, it made me want to be able to make them. They were powerful and I was curious and wanted to learn more,” she says. “I wanted to see the objects in person and not in black-and-white pictures.”

One of the reasons Neptune studied anthropology was to have access to Penobscot artifacts in museums. In their presence, she says she feels a bond with her ancestors.

“

Sometimes I imagined bead workers’ spirits hovering while I worked, whispering, **‘Do it this way,’** and **‘Put that design over there.’**” Jennifer Neptune

Neptune says she feels privileged to return re-created Penobscot items to the community so they may inspire today’s Penobscots and be used in tribal ceremonies.

“Having access to them and being able to re-create them is my way of giving back to my community,” she says. “I think our ancestors would be proud. We’re alive and we’re strong.”

Through this project, Neptune has made the ceremonial Penobscot Nation headdress, collar and cuffs come alive again in the community, says Hudson Museum Director Gretchen Faulkner, who supported the National Park Service Cultural Heritage grant to Penobscot Nation for the re-creation.

“The collar and cuff set at the Hudson Museum on which Jennifer based her work is extremely fragile and can no longer be worn for the inauguration ceremony. They can only be displayed,” Faulkner says.

Neptune’s first re-creation of a Penobscot collar was for elder Charles Shay, whose nephew saw an archival photograph of Charles’ mother wearing a collar. James Eric Francis Sr., director of cultural and historic preservation for Penobscot Nation, learned the collar was at the Smithsonian Institution in Washington, D.C.

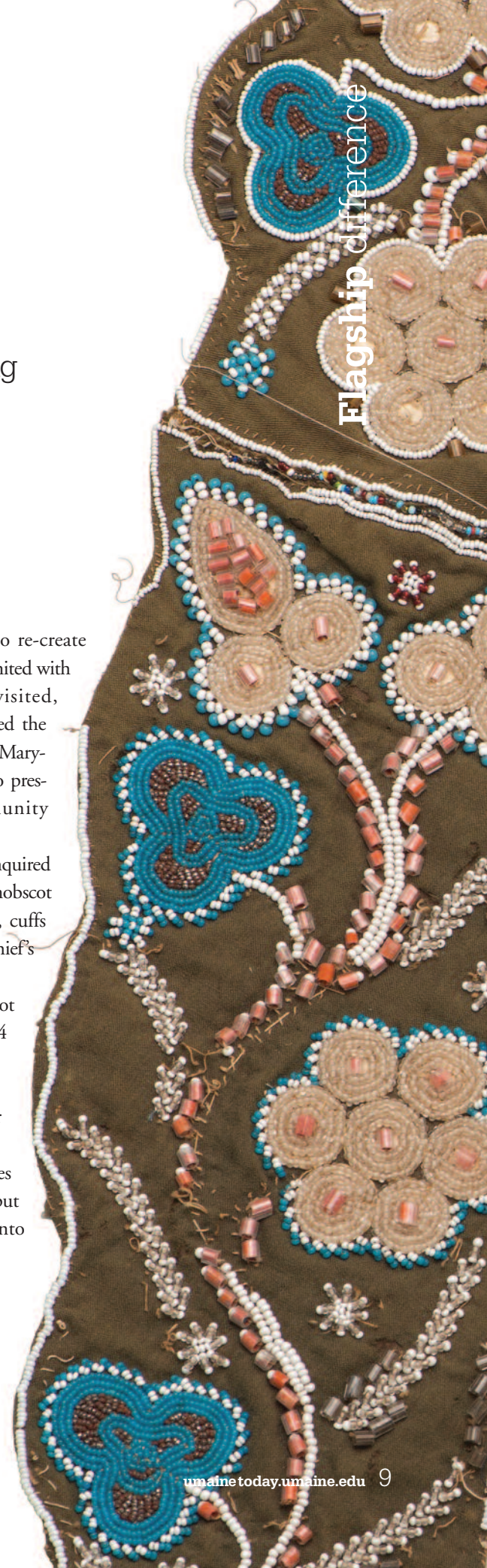
Shay asked Neptune to re-create the collar so it could be reunited with his family. Neptune visited, photographed and measured the collar at a storage facility in Maryland, and made a replica to present to Shay at a community event.

Tribal members then inquired about re-creating other Penobscot items, including the collar, cuffs and headdress used in the chief’s inauguration ceremony.

All of the living Penobscot chiefs attended the fall 2014 inauguration of Chief Francis, and each held and blessed the re-created collar and cuffs.

Neptune says she hopes the love, heart and spirit put into the project radiates into the future. ■

THE BLUE, tan, pink, white and green beads on the cuffs and collar made in the 1800s formed an interconnected floral pattern on the dark brown wool. A three-leaf flower design on the cuffs is the centerpiece for the re-created headdress.





For Nancy

**A crop of sour cherries united a diversified
Maine orchard and a top New England brewery**



By Beth Staples
Photographs by Holland Haverkamp

FOR NANCY Bunting, farming hasn't always been a bowl of cherries. But it has included harvesting thousands of pounds of the sour fruit for Allagash Brewing Company to use in its beer.

In honor of Bunting, Allagash named its October 2014 limited edition copper-colored beer "Nancy." The taste of the sour red ale is a medley of tart cherry, citrus and pie spice, according to Jason Perkins, brewmaster at Allagash Brewing Company. Its aroma is a blend of cherries, bread crust and cinnamon.

Nancy says she's blessed to work with Allagash and be the namesake of the niche brew.

For more than two decades, the Buntings have experienced both blessings and challenges associated with farming.

For 22 years they've owned Doles Orchard, sited atop a scenic ridge above Lake Arrowhead in Limington. Mid-June through October, guests arrive in waves to pick their own fruit — cherries, raspberries, peaches, plums, pears, strawberries, elderberries, blueberries and 24 varieties of apples.

Hayrides, a straw maze, homemade pies and preserves, Sunday music performances, as well as Arrow, their playful German shepherd, make the orchard a destination spot.

The Buntings' relationship with Allagash began several years ago when brewers at the Portland, Maine-based company inquired about purchasing 500 pounds of the Buntings' sour cherries to use in Coolship Cerise, a traditional, Belgian-inspired, spontaneously fermented beer.

The brewers were so impressed with the flavor and quality of the sour cherries, they decided to build a beer around them.

"Their fruit inspired us to brew 'Nancy,'" says Perkins. "Over the years, we've been honored to develop a relationship with Earl and Nancy, and we have been so inspired by their approach to farming."

Bunting laughs recalling that Allagash initially proposed naming the distinctive brew after her husband.

"Then they found out there already was a beer named Earl," she says light-heartedly. "I'm second fiddle."

THE BUNTINGS have supplied Allagash with more than 6,000 pounds of cherries they picked, packed and delivered in their homemade wooden apple boxes.

For the last 11 months, 3,000 pounds of Balaton and Montmorency cherries have been fermenting with beer in a horizontal stainless steel tank (converted

Allagash Brewing Company first bought 500 pounds of sour cherries from Doles Orchard in Limington, Maine, to make its Coolship Cerise. The brewers were so impressed by the flavor and quality of the cherries, they decided to build a beer around them and name it for one of the farmers — Nancy Bunting.



For Nancy

from a milk tank) to produce the next batch of Nancy. The tank is in the wild barrel room, so named because brews there are made with nontraditional fruits and microbes.

“Working with local farmers, it’s so nice to have a connection to where the ingredients come from ... it translates to quality. So much more love goes into growing them,” Perkins says, adding the cherries remain on the tree until they’ve ripened to perfection.

The same day that Earl and Nancy pick the cherries and deliver them to the brewery, Allagash employees place them in the stainless steel tank to start fermenting for the next batch of beer.

The care and attention to detail paid by the Buntings, Perkins and Rob Tod, founder of Allagash, are noticed. In the April 2015 *Boston Magazine*, reviewers rated Allagash No. 2 among the 21 top beer-makers in New England.

The writers also called Nancy a “don’t miss” selection.

“(Rob) Tod and brewmaster Jason Perkins continue to push palates in new and interesting directions, particularly with their limited-edition brews, which use all manner of fruits and berries, mead barrels, and even 2,700-gallon wine foudres,” according to the review.

That’s welcome praise for Tod, who thought after college that he would be a cabinetmaker or geology teacher. But while looking for work in Vermont more than 22 years ago, a friend at a brewery offered him a job washing kegs.

“Within the first few months, I developed a love of beer,” Tod says, adding that brewing beer combines his interest in science, working with his hands and creativity. “I was 100 percent sure that’s what I wanted to do with the rest of my life.”

In 1995, Tod formed his then-one-man brewing company to share the flavors and traditions of Belgium with people in the United States. Twenty years later, Allagash employs 80 people and brews nearly 50 kinds of beer. And its brewers are creating more tasty suds all the time.

“

I have a fruit growing class and I stress **the best resource** anyone can get **is the (UMaine Cooperative) Extension.**” Earl Bunting

INNOVATION, ONE of Allagash’s core values, is evident in the beer and elsewhere in the company, including the wooden crates that bottles of the House Beer are sold in at the retail store.

When brewery personnel spied the rustic boxes in which the Buntings delivered the cherries, they asked them if they could manufacture crates to hold 24 bottles of beer. The couple has since made and sold nearly 6,000 of the stylish, practical containers to the company.

Beer sold in wood crates is traditional in Belgium. And Tod says the House Beer that comes in the boxes branded with the Allagash name is the top-seller at the retail store.

Nancy enjoys the independence of farming and developing niche markets — such as the homemade poplar crates and slate coasters.

Three years ago, while Nancy was building crates in the shop adjacent to the couple’s autumn gold farmhouse, she experienced what felt like an electric shock on her left hand.

The table saw had severed several of her fingers.

Emergency room care, surgery and follow-up visits took a financial toll, because the Buntings didn’t have health insurance. But they worked out a payment plan and Nancy



devised ways to adapt and continue her work on the farm.

“I’m still amazed at how much I can accomplish relatively hassle-free,” she says.

After the accident, with each month that passed, Nancy could do more and more on the farm, including making and branding crates.

“I love being in the shop in the winter months with the woodstove going,” Nancy says, adding that she has been humbled by the caring and support of family and friends.

Nancy is also humbled by the generosity and goodwill of Allagash Brewing — which routinely gives back to the community by donating some of its profits.

After Allagash officials asked her which group she’d like a portion of the brew’s proceeds to go to, Nancy’s daughter Ashlee suggested she consider AgrAbility.

THE NATIONWIDE U.S. Department of Agriculture-funded program assists farmers, fishermen and forest workers with challenges or limitations so that they can continue to be productive and work safely — something with which Nancy could readily identify.

Maine AgrAbility is a nonprofit collaboration between

University of Maine Cooperative Extension, Goodwill Industries of Northern New England and Alpha One.

Nancy and Earl Bunting already had a solid connection with University of Maine Cooperative Extension. For years, they’ve sought and received expert advice from UMaine Extension educators about farming topics — from garden pests to egg production.

“Every year, the first Saturday in May, I have a fruit growing class and I stress the best resource anyone can get is the (UMaine Cooperative) Extension,” says Earl. “They have peer-reviewed information and they’re free or very inexpensive. They’ve been invaluable to us.”

Each summer, Earl says David Handley, Cooperative Extension vegetable and small fruit specialist, monitors pests at Doles Orchard.

“I’ve been farming all of my adult life and when I have a question, they’re the first place I go,” Earl says.

And after speaking with Maine AgrAbility personnel, Nancy was so impressed with the group’s purpose and work, she asked Allagash officials to spread their generosity and good cheer to the organization.

Maine AgrAbility program coordinator Lani Carlson

At Doles Orchard, Earl and Nancy Bunting built wooden boxes that they used for apples and other produce, including cherries they delivered to Allagash Brewing Company. The rustic boxes inspired the brewery to order custom-built crates for bottles of its House Beer.



For Nancy

says since the project formed in 2010, it has provided technical information to 247 farmers and conducted on-site assessments and recommendations for 75 others whose agricultural businesses include dairies, Christmas tree farms, vegetable stands and hay sales.

Maine AgrAbility clientele, says Carlson, include area farmers with chronic health impairments, post-traumatic stress disorder and traumatic brain injury, as well as growers with aging-related issues, including arthritis and hearing loss.

“To educate people about the program is a huge thing,” Nancy says. “I’m happy to be getting the word out about this great program and all the ways it can help people.”

To date, Allagash Brewing Company has gifted nearly \$10,000 to Maine AgrAbility. Caring — by being an

engaged community member — is another of the company’s core values.

“That’s one we’re especially proud of,” Tod says. “We really weren’t able to give back to the local community for the first 10 years or so because there wasn’t money to give back. But we’ve gotten to the point where we can give back — and we do.”

Richard Brzozowski, director of the Maine AgrAbility program, says the organization is honored to receive the gift.

“The money will help us in our mission to assist Maine farmers and growers who have chronic health issues or injuries to gain more control over their lives and to continue to farm successfully,” he says.

Which is more than a cherry on top. ■

“

Over the years, **we’ve been honored** to develop a relationship with Earl and Nancy, and we have been **so inspired by their approach to farming.** Jason Perkins

Allagash Brewing routinely gives back to the community by donating some of its profits. Allagash officials asked Nancy Bunting to pick a local organization to receive a portion of the proceeds from sales of the ale named in her honor. The response: Maine AgrAbility.



Rob Tod

Hooked on science

UMaine's valedictorian found her passion for research as a first-year student

AT THE University of Maine, Gwendolyn Beacham of Farmington, Maine, participated in research that prepared her for her graduate work at Cornell University and her career goal: to be a scientist. The biochemistry major and honors student was UMaine's 2015 Valedictorian and the Outstanding Graduating Student in the College of Natural Sciences, Forestry, and Agriculture. **AWARD-WINNING ACHIEVEMENT:** She received the Barry Goldwater Scholarship, a national award given to rising undergraduate juniors and seniors in the STEM fields, and the George J. Mitchell Peace Scholarship to study abroad in spring 2014 at University College Cork in Ireland. Most recently, she was awarded a National Science Foundation Graduate Research Fellowship. **HOOKED ON SCIENCE:** In her first year at UMaine, Beacham got involved in the national Phage Genomics Program, sponsored by Howard Hughes Medical Institute, by taking the HON 150/155 Phage Genomics course. She went on to intern at the Boyce Thompson Institute for Plant Research, an affiliate of Cornell University, where her work focused on commercial algae biofuel production, and at Mount Desert Island Biological Laboratory, studying cilia differentiation in sea urchin and sand dollar embryos. **IN THE LAB:** Beacham's research has focused on mycobacteriophages — viruses that infect bacteria of the genus *Mycobacterium*. In collaboration with Assistant Research Professor Sally Molloy, Beacham studied a particular phage named Ukulele that was isolated at UMaine in the Phage Genomics course Beacham took in her first year. Beacham's project focused on identifying which genes encode the proteins that are involved in regulating Ukulele's life cycle. **JUST FOR FUN:** Beacham has been involved in many student organizations, including the UMaine chapter of Engineers Without Borders, Alternative Breaks and All Maine Women. In 2013, she took first place in the annual Rezendes Ethics Essay contest. ■

This fall, Gwen Beacham will enter the Ph.D. track at Cornell University in biochemistry, molecular and cell biology. She hopes to be a professor and contribute to science policy.



Making waves

Darling Marine Center celebrates 50 years of renowned research and experiential learning in the Gulf of Maine and beyond

Introduction by Beth Staples

A FORMER gentleman farmer's estate on the Damariscotta River in Walpole, Maine, has been home to world-renowned marine researchers for 50 years.

In spring 1965, when Ira C. Darling donated his 127-acre seaside property to the University of Maine for the development of an oceanography program, the campus included a farmhouse, tractor, and cow and horse barns.

Horse stalls were transformed into offices and the hayloft into a conference room. Over the years, a fleet of boats, as well as flowing seawater laboratories, biogeochemistry and marine culture labs, and a library were added to the idyllic coastal property. The Darling Marine Center now includes a 64-bed dormitory, dining hall, conference center complex and shellfish hatchery.

The mix of stunning scenery, pristine seawater, small-community friendliness and big-picture science at Darling Marine Center is distinctive, making the year-round facility a destination — for marine researchers and students from UMaine, as well as scientists from around the world and schoolchildren from more than a 20-mile radius.

UMaine partners with fisheries stakeholders, marine industries and coastal communities to help develop solutions for the broad array of issues associated with marine resources in the Gulf of Maine.

Faculty at the Darling Marine Center are fellows in the American Association for the Advancement of Science and Explorers Club, and National Geographic Society risk-takers. They solve mysteries about ships buried in lower Manhattan, and are real-life characters in Trevor Carson's book, *The Secret Life of Lobsters*. Professors and students are covered by media worldwide, from *Science* and National Public Radio to "The Colbert Report."

Darling Marine Center faculty members have been and are all over the map — literally and figuratively. On research vessels and in deep-dive submersibles they explore the Earth's oceans and inhabitants, with a priority focus on the Gulf of Maine as part of UMaine's land and sea grant mission. They lead and collaborate with international research teams,

contributing to our understanding of marine habitats that make up the majority of our planet.

Half a century of research important to people and the world have roots at the marine center. A smattering of topics in which faculty and students have participated include starting oyster aquaculture in Maine, monitoring thermal effluent from Maine Yankee, predicting future lobster populations, tracing carbon dioxide movement into the deep ocean, documenting ecosystem flips and locks, studying cold-water corals and invasive species, and forecasting extreme weather and implications of climate change on seafarmers' practices and coastal water quality.

Discoveries have led to better understanding of all manner of marine life, as well as ocean carbon exchange and acidification, and have resulted in comprehensive ecosystem-based ocean management strategies.

In the past half-century, UMaine faculty members have inspired next-generation scholars worldwide. And for decades, Darling Marine Center alumni have advanced marine science.

Today's undergraduate students at the center rave about the inspirational, hands-on Semester-by-the-Sea program that immerses them in marine sciences, and summer internships that provide unparalleled opportunities to join graduate students and faculty in the field, including research cruises in the North Atlantic.

The estate has retained its family feel and hospitality. Commitment to go above and beyond is routinely praised; students are holiday guests at staff members' homes and, at least once a semester, chefs prepare everyone's favorite meal. There are kayaks to paddle to explore the bay and bikes to pedal to explore the trails. And at the height of summer, there's always the opportunity for a refreshing swim off the dock.

For 50 years, the center has been home base for big discoveries. And Ira C. Darling made it possible. After the Chicago insurance executive bought the Walpole property for \$12,500 in 1939, he and his family summered there for years. The family and caretakers tended to vegetable gardens and livestock. They hayed and planted a tree farm.

And in 1965, when Darling and wife, Claire, could no longer travel to the farm, he gifted the estate to the university with the expressed intent of establishing a marine laboratory. He also created one of the largest trusts in UMaine history to help maintain and improve the property, and created two chaired professorships. Darling's vision and generosity enabled the University of Maine to launch a graduate program in oceanography in 1969, and later amalgamate a larger School of Marine Sciences.

Today, the Darling Marine Center is still mostly wooded acres with nearly 3,300 feet of saltwater frontage. And the travels and accomplishments of its scientists, alumni and students span the globe.

The Darling Marine Center will celebrate its 50th anniversary with three days of activities, including an Alumni Day and open house, Aug. 6–8. Details are online (dmc.umaine.edu).

UMaine Today is commemorating the center's anniversary with profiles of five seminal Gulf of Maine marine species and UMaine's related research contributions. Other Darling Marine Center 50th anniversary stories, as well as archival photographs, are on *UMaine Today* online (umainetoday.umaine.edu).



ABOUT THE ARTIST: Haley Viehman of Camden, Maine, is pursuing an interdisciplinary Ph.D. in engineering and the natural sciences at the University of Maine. She received a master's degree in marine bioresources from UMaine in 2012, and a bachelor's degree in civil engineering from Cornell University. At UMaine, her research has focused on assessing the effects of tidal energy turbines on fish. She uses hydroacoustics to monitor fish movements in Cobscook Bay, the site of the first grid-connected tidal turbine in the United States. Viehman has been drawing and painting since she could hold a pencil, and particularly enjoys illustrating living things.

Oysters

SINCE DARLING Marine Center's founding, it has been the premier site for shellfish aquaculture research in the state. Although research has involved a variety of species, including mussels, scallops and razor clams, the bulk of the research has centered on the eastern oyster *Crassostrea virginica*.

Graduate students under the direction of Herbert Hidu first learned how to grow eastern oysters in the original Darling Marine Center shorefront "lab" more than 40 years ago. Many of the students recognized the commercial potential of oyster aquaculture and established their own businesses. As the industry they founded has grown, so too has the market reputation of farmed oysters from Maine's coast.

Eastern oysters from throughout Maine are known for their sweet, salty taste and superior meat quality, and are regularly found on menus in white-tablecloth restaurants of America, and in high-end raw bars in Boston, New York, Philadelphia, Washington, D.C., and Atlanta.

Oyster brood stock development has been the primary focus of aquaculture research at the Darling Center. One of the foundations for increased agricultural and aquacultural production is genetic improvement, through the purposeful selection of individuals demonstrating unique or high-quality traits as parents for succeeding generations.

Selective breeding of oysters at the Darling Marine Center was initiated in the 1980s by Robert Hawes, and carried forward by Bruce Barber and Chris Davis. Currently, it is led by Paul Rawson.

Work at the Darling Center initially focused on improved growth in the relatively cold temperatures typically encountered in Maine waters and on resistance to juvenile oyster disease, now known as *Roseovarius* oyster disease (ROD). The program's efforts have resulted in a genetically improved line of oysters with demonstrated resistance to ROD that takes half the time to reach market size compared to wild oysters. More recent work has incorporated resistance to MSX, another major disease of eastern oysters.

Selective breeding for improved growth and disease resistance in eastern oysters has been identified as a priority in states along the East Coast.

Darling Center research involves collaborations among UMaine researchers and commercial, government and academic research partners, which includes funding from the Maine Aquaculture Innovation Center, the Maine Aquaculture Association, Maine Sea Grant and the Maine Agricultural and Forest Experiment Station.

The key partnership supporting Darling Center shellfish research is the direct involvement of oyster farms statewide. In addition to providing valuable input on program goals, many of Maine's oyster farms have served as test sites for growing laboratory-bred oysters under field conditions.

As the shellfish culture industry grows, the Darling Marine Center is ideally positioned to tackle research of industry and scientific relevance, especially in a time of change along the working waterfront and in the marine environment.

In coming years, the center will continue its leading work on shellfish research, and the education and training of new scientists and potential entrepreneurs.

Contributed by Paul Rawson, Associate Professor of Marine Sciences



Work at the Darling Marine Center has been conducted in collaboration with researchers at institutions throughout the region, including the Marine Biological Laboratory, Haskin Shellfish Research Laboratory at Rutgers University, the Virginia Institute of Marine Science, the Connecticut Department of Agriculture Bureau of Aquaculture & Laboratory Services, and the University of Rhode Island. UMaine also partners with the East Coast Shellfish Breeding Consortium.

H. VIEHMAN

Lobsters

THE LOBSTER may be the state's most famous species, marketed worldwide as "Maine lobster." Today, it constitutes nearly 80 percent of the value of all harvested marine species in Maine and is the primary engine that keeps the state's working waterfront working.

When University of Maine marine scientist Robert Steneck started studying lobsters in Maine in the early 1980s, state and federal fisheries scientists considered them seriously overfished and on the verge of collapse. A fisheries scientist from Massachusetts stated publicly he was afraid the species could be driven to extinction.

However, since the mid-1980s, lobster landings have steadily increased in abundance and value to the state of Maine.

In fact, since 1985 the tonnage of landed lobsters has increased six-fold and the value of this resource has increased nine-fold — from \$50 million in the 1980s to more than \$450 million today.

The Maine lobster is the only species in the world that has been targeted for more than 150 years, but is doing better today than ever before.

All of these events represent a sea change in how we think about lobsters.

Remarkably, in the early 1980s almost nothing was known about the ecology of lobsters in their natural habitat. Over the past 35 years, UMaine research has focused on where lobsters live, how baby lobsters get started in life, what lobsters eat, who in the ocean eats them, and how changes in their ecosystem over time has affected their distribution and abundance.

UMaine researchers have learned several extremely important bits of the lobster puzzle over the past 30 years from Darling Marine Center research. They have learned the location of lobster nursery habitats, and learned that once larvae find a safe spot in these habitats, they have a good chance of surviving to harvestable size.

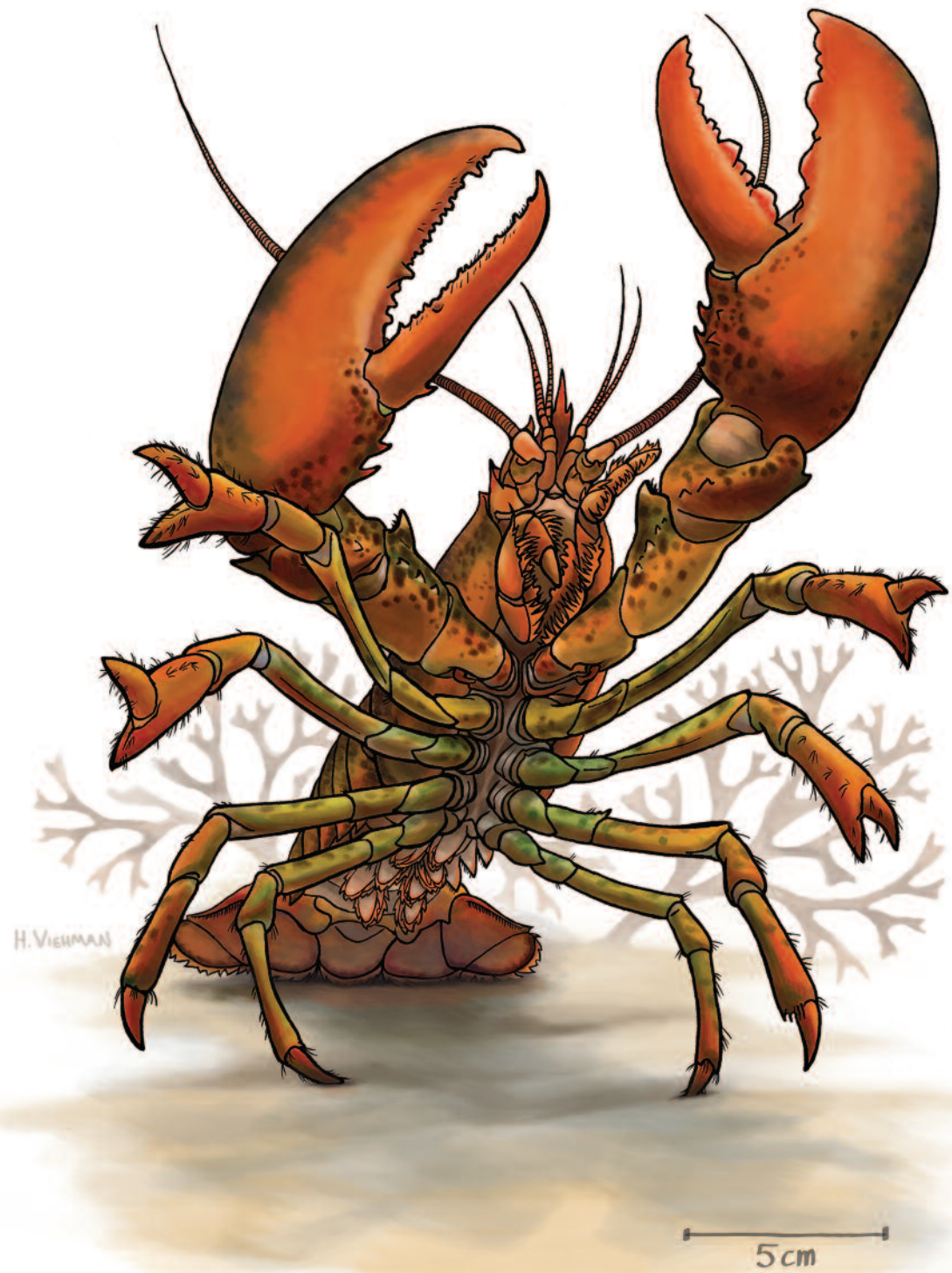
UMaine scientists also has shown that most baby lobsters live in relatively shallow habitats that are easily studied by scuba diving. With the help of the American Lobster Settlement Index, developed by Darling Center research professor Richard Wahle, we can monitor the abundance of baby lobsters to estimate future landings. Through experiments in their natural habitat, researchers learned why larger lobsters leave coastal zones when they become too crowded with other lobsters.

Importantly, UMaine marine scientists determined that humans have effectively domesticated the Gulf of Maine by removing large predatory fish, including cod, and supplying food for juveniles in the form of lobster trap bait. All of these Darling Marine Center-based research findings have revolutionized how we view and manage lobsters today.

Researchers are just beginning to learn how climate and atmospheric change affect lobsters. Ocean warming in the past 30 years has shifted optimal temperatures and peak lobster abundance from the southern Gulf of Maine to Down East Maine.

Currently, Stonington lands the greatest volume of lobsters; it's uncertain where the hot spot will be three decades from now. At the same time, more fish species characteristic of mid-Atlantic states are entering the Gulf of Maine. As biodiversity increases, so too might risks of predation on lobsters.

Contributed by Robert Steneck, Professor of Marine Sciences



Disease remains one of the greatest risks to the Maine lobster. Researchers warn that stresses resulting from ocean warming and possibly ocean acidification may be compromising the lobsters' immune system and possibly contributing to the widespread disease experienced in southern New England. In addition, more research is needed to understand how ocean acidification affects the shell hardening of lobsters.

Zooplankton

THE COASTAL shelf of the northeast United States has experienced unprecedented warming over the past decade. In the Gulf of Maine, sea surface temperatures have recently increased at a rate of 0.4 F per year — 20 times faster than the 100-year average for this region.

The rapid warming's effects on the coastal marine ecosystem have raised concern in research and resource management communities, the fishing industry and the public.

Researchers based at the Darling Marine Center have received a National Science Foundation award to investigate the processes controlling abundance of a planktonic animal particularly vulnerable to the recent warming trend.

The marine copepod *Calanus finmarchicus* is at the foundation of the food web in the Gulf of Maine. In part because of its high lipid content, this zooplankton species is the primary prey for herring and other forage fish, as well as for the endangered North Atlantic right whale in the productive ecosystems of the Gulf of Maine, including Georges Bank.

The nimble crustaceans grow about 3 millimeters long and spend their lives feeding and moving vertically in the water column, transporting carbon and nutrients from the surface. As omnivores, they feast on the spring phytoplankton blooms, eating diatoms and preying on smaller zooplankton.

Recent studies have shown that the average annual sea surface temperature in the Gulf of Maine has risen above the temperature typically associated with its normal, subarctic habitat. The research will examine whether transport of *C. finmarchicus* into the Gulf of Maine from cold Canadian waters, in combination with growth and reproduction in the relatively cold Maine Coastal Current, is sufficient to supply the region with abundant numbers needed to attract and nourish the fish, seabirds and mammals that rely on its energy-rich life stages.

The analysis involves development of a computer model that links extensive biological knowledge of the species' life history with an ocean circulation model that can accurately simulate the region's currents and temperature fields. This coupled physical-biological model will be tested against field collections at two time-series stations, documenting how abundance of *C. finmarchicus* is changing.

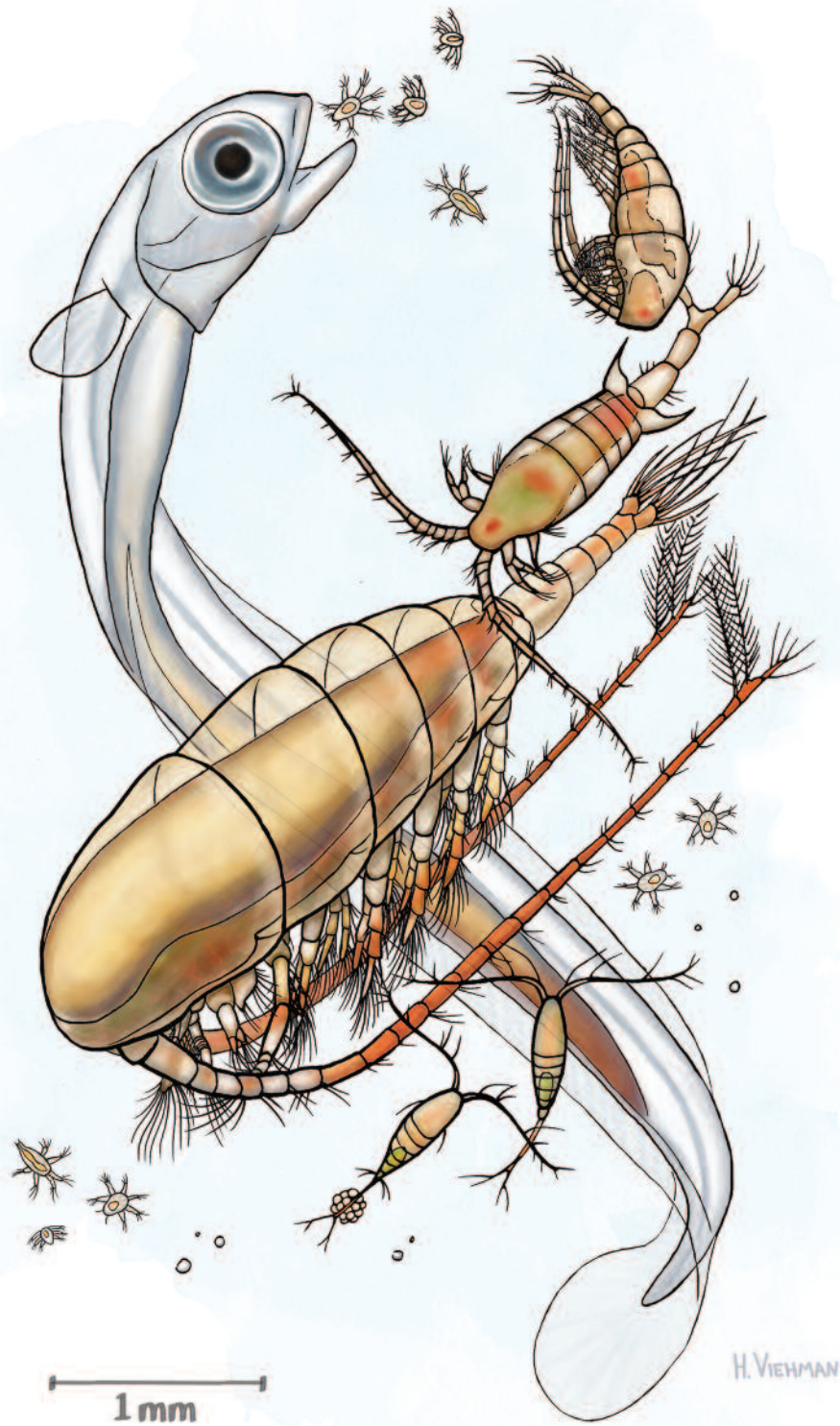
One of these field stations, the Coastal Maine Time Series Station (CMTS), is about 5 nautical miles off the Damariscotta estuary. Since 2008, Darling Marine Center researchers have used the UMaine coastal research vessel *R/V Ira C* to routinely sample CMTS.

Those data, as well as laboratory studies conducted at the Darling Center to measure growth and reproductive rates of *C. finmarchicus*, are essential for development and validation of the model.

One outstanding question that the Darling Marine Center research will address is the extent to which the relatively cool and nutrient-rich Maine Coastal Current contributes to sustaining the high abundance of *C. finmarchicus* on the banks and ledges, and in the basins of the western Gulf of Maine and southern New England.

The research will contribute to data interpretation and forecasts provided by the new Integrated Sentinel Monitoring Network, a joint effort planned by federal and state agencies with academic research participation to monitor future ecosystem change on the northeastern coastal shelf.

Contributed by Jeffrey Runge, Professor of Oceanography



Changes in temperature, timing of the spring phytoplankton bloom and circulation in the Gulf of Maine will likely affect the distribution and abundance of *C. finmarchicus* in the Gulf of Maine, which, in turn, will affect the abundance of herring, mackerel, right whales and other consumers of this energy-rich copepod species.

Marine worms

MAINE MAY be the only state in which digging marine worms is a common way to make a living.

The Maine Department of Marine Resources documents that bloodworms (predominantly *Glycera dibranchiata*) and sandworms (also known as ragworms, predominantly *Alitta virens*) account for roughly \$6 million and \$1.3 million of annual income, respectively, primarily for use as fish bait.

One likely wouldn't know it from Maine's harvest, but polychaete worms are a diverse lot; about 13,000 species are recognized.

Polychaetes have been around since the Cambrian Period (from about 543 million years ago to about 490 million years ago). They dominate most sand and mud communities on the seafloor at all ocean depths. They aerate and mix sediments and, in so doing, play a major role in determining how much carbon gets buried globally. Despite this important role, relatively few marine institutions around the globe house experts in the group.

From its start, the Darling Marine Center has had an unusual concentration and succession of polychaete biologists. David Dean became the center's first director in 1966. He published a diversity of papers on polychaetes, including seminal work on their culture and reproduction. He discovered that both bloodworms and sandworms migrate through the water column at night when they are at low risk from visual predators.

From 1968–91, Dean produced *Polychaeta*, a newsletter about polychaete biology that had global reach and greatly improved communication among researchers. One of Dean's first graduate students, James A. Blake, went on to become a world-renowned taxonomic expert on the group.

Kevin Eckelbarger, Darling Center director from 1991–2014, specializes in reproductive biology of polychaetes, particularly the ultramicroscopic structure of eggs and sperm. He is best known for deciphering the extent to which energy allocation in polychaetes toward reproduction is determined by genetics versus environment.

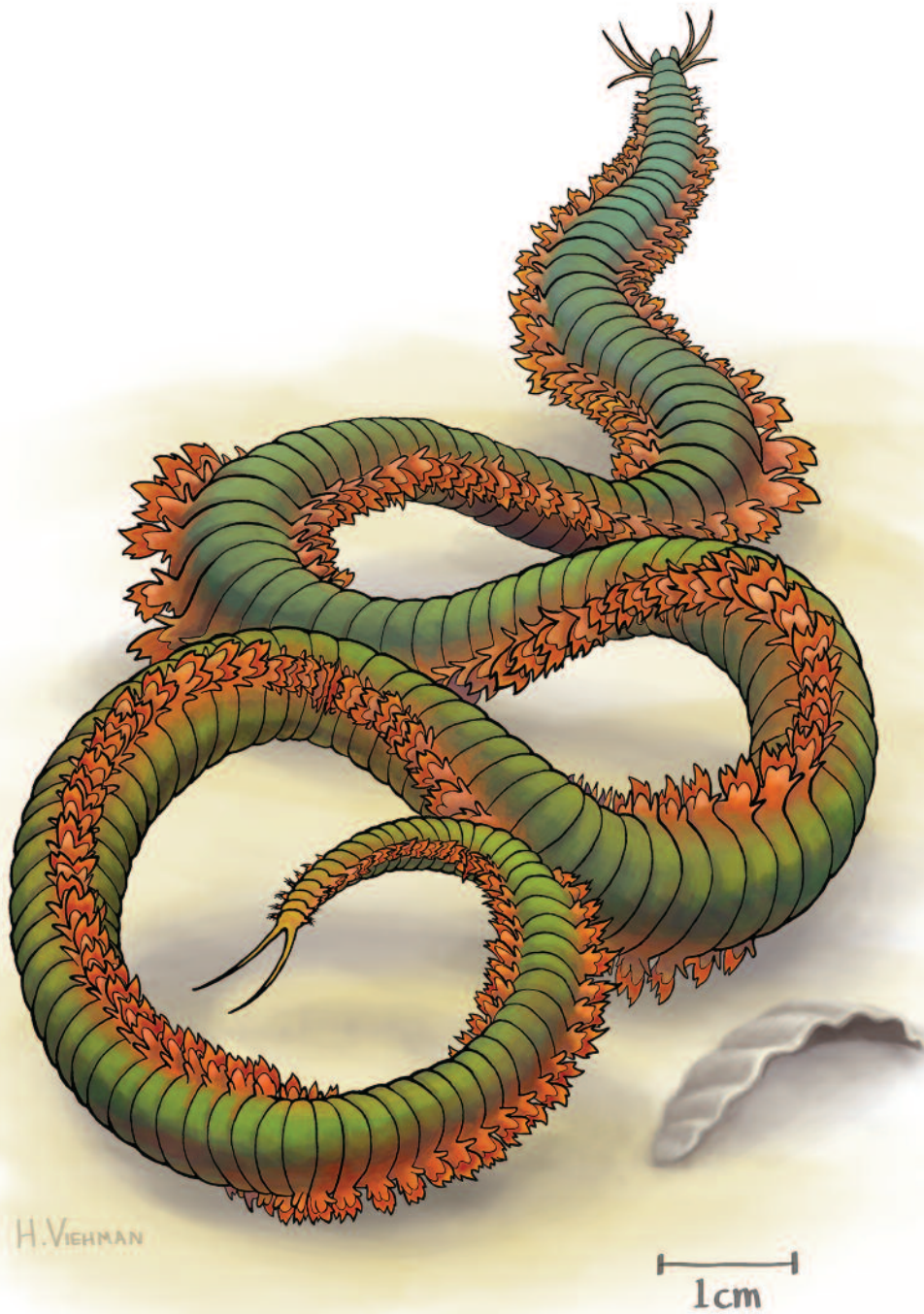
The strong local knowledge of polychaetes and the extensive Darling Center library holdings resulting from decades of local interest in polychaetes attracted still more polychaete researchers.

Pete Jumars began visiting the center in the 1980s to work with geochemist Larry Mayer on digestion in polychaetes. Mayer and Jumars discovered that mud- and sand-eating marine worms use a mixture of enzymes and surfactants similar to commercial washing detergents to remove organic matter from mineral grains. They also identified this digestive process as the major entry route for hydrophobic materials, such as polychlorinated compounds (PCBs) and heavy metals into marine food webs. In 1999, Jumars moved to the Darling Center to continue the collaboration.

Kelly Dorgan, a Ph.D. student with Jumars, solved a conundrum that had deeply worried Charles Darwin in his last published book, *The Formation of Vegetable Mould Through the Action of Worms*. Darwin struggled to understand how a worm could make its way through soil and inferred the only way was to eat its way. Dorgan discovered that marine worms move through mud by using part of their body as a wedge to open a crack, much as one does by levering a spade in the soil, expending much less energy than previously calculated. Ironically, worms and worm diggers use the same method.

Contributed by Peter Jumars, Professor of Marine Sciences and Oceanography

UMaine faculty researchers Peter Jumars and Sara Lindsay, and Ph.D. student Kelly Dorgan published a comprehensive review of the dietary habits of 100 polychaete families, highlighting the needs and opportunities for future research on each.



Phytoplankton

PHYTOPLANKTON FORM the base of Gulf of Maine food webs, as well as most marine food webs throughout the global ocean. Phytoplankton are small organisms (1–100 micrometers), occurring either as individual cells or in chains. Through the process of photosynthesis, phytoplankton harvest solar energy and use the energy to produce organic carbon and dissolved oxygen.

Maine's coastal waters and estuaries support high rates of phytoplankton growth, making Gulf of Maine waters famously productive for higher trophic-level organisms, such as lobsters.

In the Damariscotta River Estuary, where the Darling Marine Center is located, scientists have long studied the timing of phytoplankton blooms (i.e., large increases in phytoplankton abundance).

Spring blooms, both in the estuary and the wider Gulf of Maine, are important events that herald the beginning of the growing season for phytoplankton and the animals that depend on them as a food source, including zooplankton and planktonic larvae of lobsters and fish, oysters and mussels that dwell in shallow water, and deeper-living benthic organisms that feed on sinking dead phytoplankton.

Both the timing and magnitude of these spring blooms are critical to the cycle of life in the ocean.

Since mid-2002, a cadre of postdoctoral fellows, graduate and undergraduate students and technicians have measured phytoplankton abundance every few days at the Darling Marine Center dock, using the photosynthetic pigment chlorophyll as a proxy for phytoplankton concentration.

In this estuary, the bloom begins mid-winter, typically between late January and early March. Oyster and mussel growers typically consult the center's dock sampling website to gauge phytoplankton concentrations and the potential for bivalve weight gain during winter months, as the differences between pre-bloom and bloom phytoplankton concentrations are more than an order of magnitude.

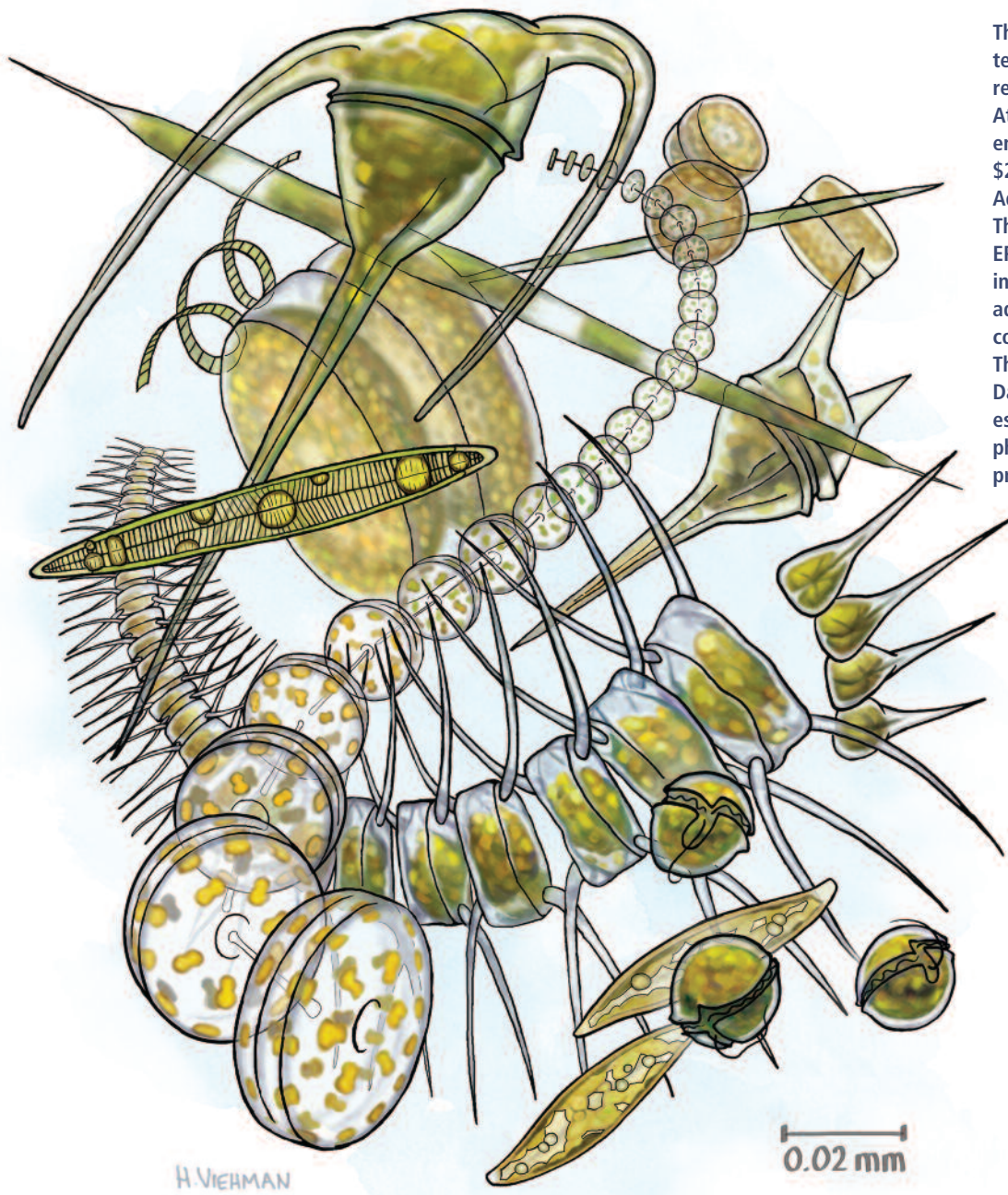
In recent years, spring blooms have either been nonexistent or of lower magnitude in comparison to the previous decade. The reasons for interannual differences in timing and magnitude have not been identified, although temperature, solar radiation and nutrient concentration do not appear to be responsible.

Experimentation will be required to understand the interplay of physics and biology that controls variability in the spring blooms, why late-summer blooms are increasing, and what ecosystem consequences result from changes in both spring and fall blooms. This is a topic Damian Brady, an assistant professor at the Darling Center, will be addressing in the coming years.

The general importance of spring blooms took UMaine researchers and their University of Washington colleagues to the subpolar North Atlantic Ocean, a region responsible for more than 20 percent of net global oceanic carbon dioxide uptake. In the open ocean, deep winter-time mixing removes phytoplankton from the sunlit waters and prevents them from growing. But when the water column becomes stratified, phytoplankton retained in sunlit waters can grow and bloom.

Using a combination of underwater robots, ship observations and models, they discovered how submesoscale eddies (whirlpools) take horizontal density gradients and convert them to vertical density gradients, thereby controlling stratification and timing of the bloom. ■

*Contributed by Mary Jane Perry, Professor of Marine Sciences and Oceanography,
Interim Director of the Darling Marine Center*



The cutting-edge sensor technology used by UMaine researchers in the novel North Atlantic experiment will be employed in Maine as part of the \$20 million Sustainable Ecological Aquaculture Network (SEANET). The National Science Foundation EPSCoR project focuses on the interaction of sustainable aquaculture with coastal communities and ecosystems. The sensors will be used in the Damariscotta and other Maine estuaries to understand phytoplankton growth and productivity.



**Undergraduate researcher
focused on the future
of New England winters**

Save the snow

By Beth Staples
Photographs by Karl Kreutz

WHEN ABIGAIL “Abi” Bradford was 2, her parents strapped skis on her feet, tucked her between their lower legs and glided down the slope.

When she was a bit older and skiing solo, she belted out the “Sesame Street” theme song as she blazed full speed ahead along the main trail at Titcomb Mountain in Farmington, Maine:

Sunny day,

Sweepin’ the clouds away,

On my way to where the air is sweet ...

Today, Bradford is most confident when barreling down the side of a snow-covered hill. And she wants to keep her downhill options open.

“I love the exhilaration of going fast, but being completely in control. Having a freshly groomed trail to myself first thing in the morning is one of my favorite things,” she says.

Bradford, who majored in Earth and climate sciences with a concentration in climate systems, is concerned that near-future climate change could jeopardize the healthy hobby that she and approximately 11.5 million Americans enjoy.

The May 2015 graduate plans to pursue graduate research in regional climate modeling — specifically, para-

meterizations regarding snowfall, quality and retention.

While Bradford hasn’t decided on an initial career focus — she says she frequently changes her mind — it will be climate related.

Abi Bradford **first learned** about climate change in middle school. Since then, she has wanted to **dedicate her life** to addressing **current and near-future** climate change.

Bradford began her higher education in the science department at the University of British Columbia; she planned to eventually study civil engineering and focus on renewable energy.

When she transferred to UMaine, Bradford knew she wanted to study meteorology and climate “and the School of Earth and Climate Sciences

and the Climate Change Institute at UMaine employ some of the top scientists in their fields,” she says.

Bradford remembers first learning about climate change in middle school. She says it was scary. She wondered why she hadn’t heard about it before and why more people weren’t discussing an issue of such global magnitude.

Since then, Bradford has wanted to dedicate her life to addressing current and near-future climate change.

She plans to promote awareness about how climate change may impact skiing by creating a website — she favors the name “Save the Snow” — that includes maps and graphs of climate data, including ones she made of snow depth in Maine since the 1950s in a climate modeling class.

Bradford, a UMaine 2014–15 Center for Undergraduate Research Fellow, envisions the website inspiring her peers to lead more sustainable lives and to call on policymakers to take action to mitigate climate change.

BRADFORD HAS skied in some incredible places, including Whistler Mountain in British Columbia, Arapahoe Basin (A-Basin) in Colorado and Mount Baker in Washington.

And in spring 2014, she skied on “the steep short pitches with corn snow”

5 must-haves

when trekking on Ruth Glacier,
Denali National Park, Alaska:

Abi Bradford:

- ✓ Skis
- ✓ Camera
- ✓ iPod
- ✓ Sunscreen
- ✓ Buff

Karl Kreutz:

- ✓ Music
- ✓ Books
- ✓ Cards
- ✓ Spices
- ✓ Camera



(small pellets created by alternate melting and freezing of a snow layer) on Ruth Glacier in Denali National Park.

That experience came about when Bradford was conducting fieldwork for her senior capstone requirement.

UMaine paleoclimatologist Karl Kreutz invited her to assist with the spring 2014 field season research in Alaska. Kreutz is in the midst of a multiyear study funded by the National Science Foundation that examines temperature change and glacial depth, and retreat in the last 1,000 years in the Alaska Range. Results are expected to inform future planetary sea level rise.

“Probably the most valuable aspect of the trip was witnessing what a career as a scientist can consist of,” Bradford says. “Most directly, I witnessed Karl and Seth’s (Campbell, UMaine research assistant professor) work as grant-funded researchers.”

To prep for the adventure, Bradford bought and borrowed gear, and ramped up her workouts with her cousin, who was training to climb the 20,320-foot Denali, which in Inuit means the “great one” or the “high one.”

On the glacier, Bradford says the crew awakened naturally, ate a large breakfast, prehydrated and tested equipment. Before heading out on skis, they harnessed themselves together in case one of them fell into a crevasse.

For hours, they towed ground-penetrating radar equipment across Ruth Glacier. Researchers determine the depth of the glacier by how quickly the pulse reflects off the bedrock and returns to the surface.

“Since it was so sunny and reflective

on the glacier, it would feel really hot during the day,” says Bradford. “I wore very thin layers, but covered my whole body and wore a lot of sunscreen to avoid getting sunburned.”

After long days towing equipment, the crew skied back to camp, which Bradford jokes “was cruelly located at the top of a very long, gradual hill.”

For four days, reporters from the National Science Foundation and Public Broadcasting Service filmed and interviewed the crew for stories.

In the evenings at the camp, the researchers boiled snow for drinking water and cooking, then ate while soaking in the view. Bradford says her diet during the three-week trip included bagels with peanut butter, pumpkin seeds, Craisins, cereal, granola bars, Snickers bars, frozen vegetables, sandwiches, smoked salmon, soup, noodles, tea and cocoa.

“The scenery was constantly stimulating. The glacier was such a foreign landscape to me — very alien and remote and beautiful. Everything was white and black, except for the pools of water, which are an insane turquoise color due to how the fine-grained glacially eroded dust in them reflects light,” she says.

“There would be beautiful sunsets that lasted forever because the sun didn’t really set. Our camp looked right at the peak of Denali and the light would catch the snow blowing off of it and create beautiful images. My cousin was climbing Denali at the time so we would always look at it and try and gauge if they were getting good weather to summit.”



Abi Bradford, foreground, and Seth Campbell used ground-penetrating radar to determine the depth of Ruth Glacier in Denali National Park.

IN SEPTEMBER, the Westport Island, Maine resident began analyzing the samples she gathered on the glacier. She analyzed isotope ratios of snow samples to try to determine whether a Jan. 23, 2014 atmospheric river (AR) event that originated near Hawaii and impacted the Alaska Range yielded precipitation statistically distinct from that of other 2014 storms.

An AR is a fast-moving, long, thin stream of moisture in the atmosphere that forms ahead of a cold front associated with an extratropical cyclone. An AR can hold more water than the

Amazon River and when it hits land, it unleashes torrential rain that can cause severe flooding and avalanches.

“Atmospheric rivers are capable of transporting heat and moisture long distances in a short time,” says Bradford. “Therefore, they may have a significant effect on the energy and mass balance of glaciers.”

Bradford also has been processing ground-penetrating radar data to confirm the presence of an ice layer corresponding to the AR event, which would indicate the storm resulted in melting, thereby significantly affecting

the glacier’s mid-winter energy and mass balance.

She is re-creating the storm’s track from historical weather data and climate reanalysis, and plotting pertinent data using NCL, a coding language that generates weather maps and graphs.

In May, Bradford presented the results at the international American Geophysical Union Joint Assembly in Montreal, Canada, and wrote a paper — the culmination of her capstone.

Kreutz says involving undergraduate and graduate students in research trips so they can conduct authentic research

is one of the most satisfying parts of his job.

“There are a lot of opportunities at UMaine to travel and/or conduct research,” Bradford says. “Search for them online and ask your professors if they know of any. There are many experiences that aren’t built into our degrees here, but that exist and are invaluable opportunities.”

Bradford’s opportunity may give her perspective about her career plans, including efforts to preserve skiing and other traditional New England winter livelihoods and recreational activities.

Some forecasts about the future of skiing are bleak.

A study by Daniel Scott, a professor at the University of Waterloo who specializes in human dimensions of global climate change and sustainable tourism, indicates by 2039, more than half of 103 Northeast ski resorts won’t be able to sustain a 100-day season.

In 24 years, Connecticut and Massachusetts likely will not have any economically viable ski resorts, whereas eight of 14 resorts in Maine and seven of 18 in New Hampshire will remain feasible, according to the study.

While the future for skiing in this region may be bleak, Bradford says near-term climate predictions can be uncertain. In the next few decades, New England may have longer, colder, snowier winters as the region enters the negative phase of the Atlantic Multidecadal Oscillation.

What is certain is Bradford plans to work to ensure the next generations are able to enjoy childhood ski experiences like those she cherishes. ■

Digging deep

MUCH LIKE Abi Bradford, Karl Kreutz also is drawn to outdoor winter activities. He says his climate change research is a natural way to combine his academic and recreational interests.

“I’d be out there anyway,” says the native of western New York. “It’s a bonus to work outside in nature and contribute to science.”

For Kreutz, “out there” often has been Denali National Park in Alaska. The University of Maine climate change scientist has traveled there multiple times for a collaborative multiyear ice core-drilling project funded by a \$1.1 million grant from the National Science Foundation.

In 2013, Kreutz, Seth Campbell (then a UMaine graduate student, now a research assistant professor) and researchers from Dartmouth College and the University of New Hampshire visited a 13,000-foot plateau on Mount Hunter in the Alaskan range and drilled through the glacier to bedrock to collect two 700-foot, 3-inch-diameter ice cores encasing 1,000 years of regional climate history.

“You know you’ve got the longest climate record from the glacier at that point,” Kreutz says. “When you hold a piece of 1,000-year-old ice, it’s hard not to think about world history and what was happening when that ice was being formed.”

As well as what may happen in the next 1,000 years.

Understanding past climate, he says, is critical to comprehending the future.

“The Arctic is warming rapidly and Alaskan glaciers are shrinking as a result,” says Kreutz. “If we have a better understanding of the snowfall and climate change the last 1,000 years, we can better predict what will happen to glaciers in Alaska in the future as global warming continues, and how that will impact global sea-level rise.”

Kreutz says he and the other researchers chose the Mount Hunter site because it’s cold enough so there isn’t a lot of summer melting and deep enough to contain 1,000 years of climate history.

“It took a few years to find the right combination,” he says.

Pieces of the ice cores — timelines of climate history — are at UMaine and at the collaborating universities for analysis.

Kreutz says researchers are at the beginning stages of isotope and chemical analyses, which include determining the amount of dust, sea salt and pollutants in the ice.

The layers of the glacier resemble cake layers and tree rings, and each layer represents a year of snow accumulation.

Preliminary examinations of the ice cores indicate an increase in the occurrence of summer melt on the glacier since the 1930s. By reconstructing the temperature changes through the years, researchers can observe how glaciers in Alaska have responded, which informs scientific predictions about future trends.

Kreutz says when data about Alaska glaciers are considered with data about glaciers in Greenland and Antarctica, a more complete picture forms about glacial melt and sea-level rise on a global scale.

Maine family traces its UMaine heritage to first graduating class



Johanna Haskell, center, graduated May 9. On hand that day to see her carry on the family tradition were her sister, Jessica Gallant, and her father, John, who graduated from UMaine in 1971.

From the start

FIVE GENERATIONS of the Haskell family have graduated from the University of Maine since it opened its doors in 1868.

Edwin Haskell was first in 1872. He was one of the six students in the first graduating class at the university, then called the Maine State College of Agriculture and the Mechanic Arts.

This year, Haskell's great-great-granddaughter Johanna Haskell was among the estimated 1,687 undergraduates and graduate students participating in UMaine's 213th Commencement.

Edwin's focus was in elective studies. Johanna earned a bachelor's degree in English, with a concentration in technical writing.

"The UMaine legacy is a source of pride for my family," says Johanna, adding that when she used to walk around campus, she'd often think about how her parents met at the university and about how the landscape would have looked when Edwin studied and worked on the campus farm.

"It was a personal goal for me because of the value placed on graduating college in my family and the love of UMaine."

Edwin's direct descendants who graduated in the 143-year span between he and Johanna are his son, Benjamin in 1912; his grandson, Rev. Stanley Haskell in 1966; and his great-grandson, (Johanna's father), John in 1971.

For Edwin, attending school included working on the campus farm three hours a day five days per week. To gain admittance from 1868–71, students had to be male, at least 15 years old and pass an exam that included arithmetic, geography, English, grammar, United States history and algebra as far as quadratic equations. Edwin went on to found Haskell Silk Mills in Westbrook, Maine.

For Johanna, a licensed cosmetologist who operates a hairdressing business and is raising three children — Darcy, 6, Daphne, 4, and Miles Edwin, 2, with husband Sean Tardif — attending school required excellent time management skills. Being able to set her work schedule was key, she says, as was the support of her extended family and the opportunity to take online courses. ■

The kernel of an idea

**UMaine partners with Maine-based Cerealus
to help take concepts to commercialization**



By Beth Staples

CERES, THE goddess of agriculture, corn and fertility, is the namesake of Cerealus, the Waterville, Maine-based company that Tony Jabar formed in 2004.

Ceres also means to grow, produce or create.

It's all fitting, Jabar, an entrepreneurial chemist, is utilizing corn to innovate sustainable pulp and paper products and processes.

"I'm excited about the prospects," says Jabar, whom Mainebiz listed in 2010 as one of its 10 Nexters — movers and shakers — projected to positively impact the state's economy.

"It's market-driven — we see what the opportunities are, look at which ones we have something we can bring to the party — and match that with being able to develop something commercially viable."

Jabar and collaborators at the University of Maine Process Development Center (PDC) are bringing zein, (zee-in), a protein in corn, to the party.

The renewable protein is insoluble in water and has oil- and grease-resistant properties similar to those in fluorinated compounds that are commonly used and potentially toxic.

Incorporating zein in products isn't new. Jabar says in World War II, it was in a substance used to coat floors on battleships. And in the '50s, zein sometimes replaced cotton in spun fibers.

Pharmaceutical tablets and candy now have zein-based coatings, and Jabar's plan is for the edible, tasteless, odorless resource to replace paper and packaging coatings that contain synthetic compounds.

Jabar has enlisted collaborators at PDC to make that happen.

"I didn't have the resources to be able to start up with nothing more than an idea," Jabar says. "They (UMaine) have been as helpful and supportive as you can imagine. I can't think of a better place to go; the home-grown support is fabulous."

PDC IS a self-sustaining, state-of-the-art facility where researchers, entrepreneurs and industry front-runners develop new products and advance manufacturing processes.

It provides companies with open access to its resources and equipment, as well as opportunities to tap into the expertise of 11 full-time staff members, whose specialties include chemical and mechanical engineering, chemical synthesis and analysis, and product development.

PDC Director Michael Bilodeau says the center can assist partners, including Cerealus, with all phases of development of a product or process — from concept to commercialization.

Such was the case when Cerealus and UMaine developed HOLDOUT®, a patented nontoxic, biodegradable oil- and grease-resistant coating additive. The goal, Jabar says, is for fast food sandwich wrappers, french fry boxes, microwave popcorn bags and parchment-type cookie sheet paper to be made with HOLDOUT®.

"Its name expresses what it does," says Jabar of the coating that prevents food oil and grease from saturating the food wrap.

To move forward with HOLDOUT®, Jabar needs to secure a manufacturer to extract zein from corn at a reasonable cost.

Cerealus, which has four employees, and UMaine also developed Agricultural Mulch Film®, an eco-friendly crop cover alternative to the black plastic that U.S. farmers use on more than 3 million acres each year. The film, which is coated with zein and other biodegradable products, suppresses weeds, regulates moisture and increases temperature. Just like plastic.

The difference, says Jabar, is that after Ag Mulch has done its job, farmers can till it into the soil.

Plastic, he says, can't be recycled. And if pesticide residue is on the plastic, it must be treated as a hazardous waste.

Ag Mulch, patented in 2012, is in commercial development and the product is being field tested.

JABAR SAYS he likes being his own boss, and in the early 2000s, the time was right for him to form a company rooted in sustainability.

His aha moment came when he went to a store to buy a stain-guard upholstery spray and found it was off the market because it contained fluorinated chemicals that possibly were carcinogenic.

He knew next-generation, green products would be needed to replace fluorocarbons.

"It fit my values, an opportunity developed and it made business sense," says Jabar. "It matched work I had been doing," including developing FDA-approved nontoxic coatings for pharmaceuticals.

Jabar had worked for several multinational corporations, including the Organic Products Division of Henkel Corporation and Global Protein Products.

He developed a biodegradable substance to preserve



We bring a lot of different assets to a project. **It's what sets us apart from research centers** — we have access to a breadth of technology and resources." Michael Bilodeau

The kernel of an idea

vegetables, and in 1999, the U.S. Department of Agriculture awarded him a Small Business Innovation Research Grant for his agricultural advances.

Jabar's career path, though, wasn't always a given. The chemistry major at Acadia University in Nova Scotia considered a career in dentistry until he job shadowed and learned the profession wasn't for him.

While the Waterville native considered career options, he taught chemistry at Maine Central Institute in Pittsfield and, in 1982, earned a certificate from the University of Maine Pulp and Paper Institute.

WHEN JABAR formed Cerealus, Bilodeau was one of the first people he called. Bilodeau, who has a chemical engineering degree from UMaine, had worked for S.D. Warren/Sappi for two decades before joining PDC in 2003.

"We (at S.D. Warren) had used the university as a collaborative research partner on a number of our projects — and it had been cost-effective to use the equipment when we needed it," Bilodeau says.

"We bring a lot of different assets to a project. It's what sets us apart from (other university) research centers — we have access to a breadth of technology and resources," including networking with other labs and universities, and informing researchers about possible funding sources, says Bilodeau.

PDC also helps companies to advance ideas to products, and products to market "at a fraction of the cost it would take to do it themselves."

As many as 50 companies a year — from local startups like Cerealus to Top 10 Fortune 500 companies — work with the university each year, Bilodeau says, adding it's

rewarding to see products on the market that PDC helped get there.

Another of Jabar's ideas — dry strength starch encapsulation technology — is patent-pending and undergoing evaluations. It got there in collaboration with PDC.

CERECARB® is a technology that uses starch from corn to increase the strength of paper products — from envelopes to magazines to cereal boxes — allowing papermakers to leverage the increase in strength for economic benefit, Jabar says.

Depending on the product, papermakers might choose to make lighter-weight paper, develop new grades or improve its quality.

Jabar recently forged an agreement with an international company with production sites in France and China. Jabar says it could advance papermaking around the planet, reap financial rewards for Cerealus and boost the local economy.

"I'd like to be a successful businessman both financially and doing something of value. That's important. I don't mean saving the world, but doing something good in the piece of the world I live in." ■

“

I didn't have the resources to be able to start up with nothing more than an idea. **They (UMaine) have been as helpful and supportive as you can imagine.** I can't think of a better place to go; the home-grown support is fabulous." Tony Jabar



Tony Jabar

Research focuses on combat fatigue in the War of 1812 and its relevance for all who return from conflict

Coming home

By Elyse Kahl

RAQ WAR veteran Joe Miller has experienced combat and, like many other soldiers, he lives with its long-lasting effects. The doctoral history student at the University of Maine is using his personal insight and knowledge of history, as well as psychology literature on trauma, to better understand soldiers' mental illness in the War of 1812.

In his dissertation, "Veterans reintegration in North America following the War of 1812," Miller contends historical perspective is an effective mode to study trauma and battle fatigue.

The conflict between the United States and Great Britain was an obvious research focus for Miller, who studied the American Revolutionary War before his deployment.

Defining war trauma is difficult, Miller says, because research continues to discover conditions linked to traumatic experience. The most common definition Miller has seen describes war trauma as a shift in character following combat that becomes an all-encompassing and life-altering change in temperament. Trauma also is a condition drawn from specific experiences and, therefore, can be different in successive generations, Miller says.

Miller is applying his research on stress and his perspective of trauma to past events to show that combat fatigue can be seen in historical contexts.

MILLER, WHO dealt with trauma issues following his service, initially felt reluctant studying war and the associated suffering, as well as sharing his own experiences. He has since found the openness beneficial for himself and others.

"To me, overcoming trauma is a result of survival," Miller says. "Even if they're awful experiences; it's a good thing to survive, even if it's hard to get to a good place. I want to do what I can to help vets get to that place; give them words, let them see what others are going through."

Through research and writing, Miller says he's able to look at life more deeply. He educated himself about psychology, learned how to write for a more general audience and pushed himself to be more expressive about his own struggles.

"I've had to be very open," Miller says. "I'm not just using personal experience, but the experiences of all the people I've been through it with."

Miller says it's easier to spot mental illness or a traumatic event in history records now that he has seen it firsthand.

Coming home

And that initial finding is what pushes him to look for more evidence, as well as to help today's soldiers.

Veterans coming home need community, Miller says, adding it can take the average veteran about four to five years to readjust to civilian life, with often lifelong consequences. Today, towns don't rally around returning veterans and provide the jobs and support they used to, he says.

"If people can understand trauma, they can help people come home," Miller says. "The more people can understand my research, the more insight they have, the more useful they will be for this generation of Mainers coming home."

WHILE STUDYING to become a military officer, Miller read a lot of military history that resonated with him, and he fell in love with the subject.

"I wasn't a good student in high school, but I was good in college because I really enjoyed history," he says. "And now it's my job."

By the time the Georgia native left the Army, he had served three tours in Iraq and was ready for a fresh start in a new, rural environment. Miller got a job in the Army Reserve Officers' Training Corps (ROTC) Department at UMaine, where he feels welcome, and viewed as a resource and an asset.

After learning about tuition benefits for ROTC faculty, Miller started to pursue his master's in history and began his research on the War of 1812; he plans to finish his dissertation by spring 2017. Throughout his interdisciplinary research, Miller has worked with faculty in the History Department, Psychology Department, and the Department of Modern Languages and Classics.

A few scholars in Canada are studying PTSD during the War of 1812. Soldiers from New England are an ideal

group to study, he says, because the region was opposed to conflict during the war and the soldiers' level of introspection was different from those who supported the war.

Part of his research will address camp illnesses and how stress likely played a role in exacerbating ailments, such as malaria and dysentery.

MILLER HAS discovered several fatigued veterans throughout history who found solace in agricultural pursuits after the war. He also sees evidence in Canada pension records that battle fatigue was often experienced, but commonly silenced as people, especially men, refused to talk about the issue.

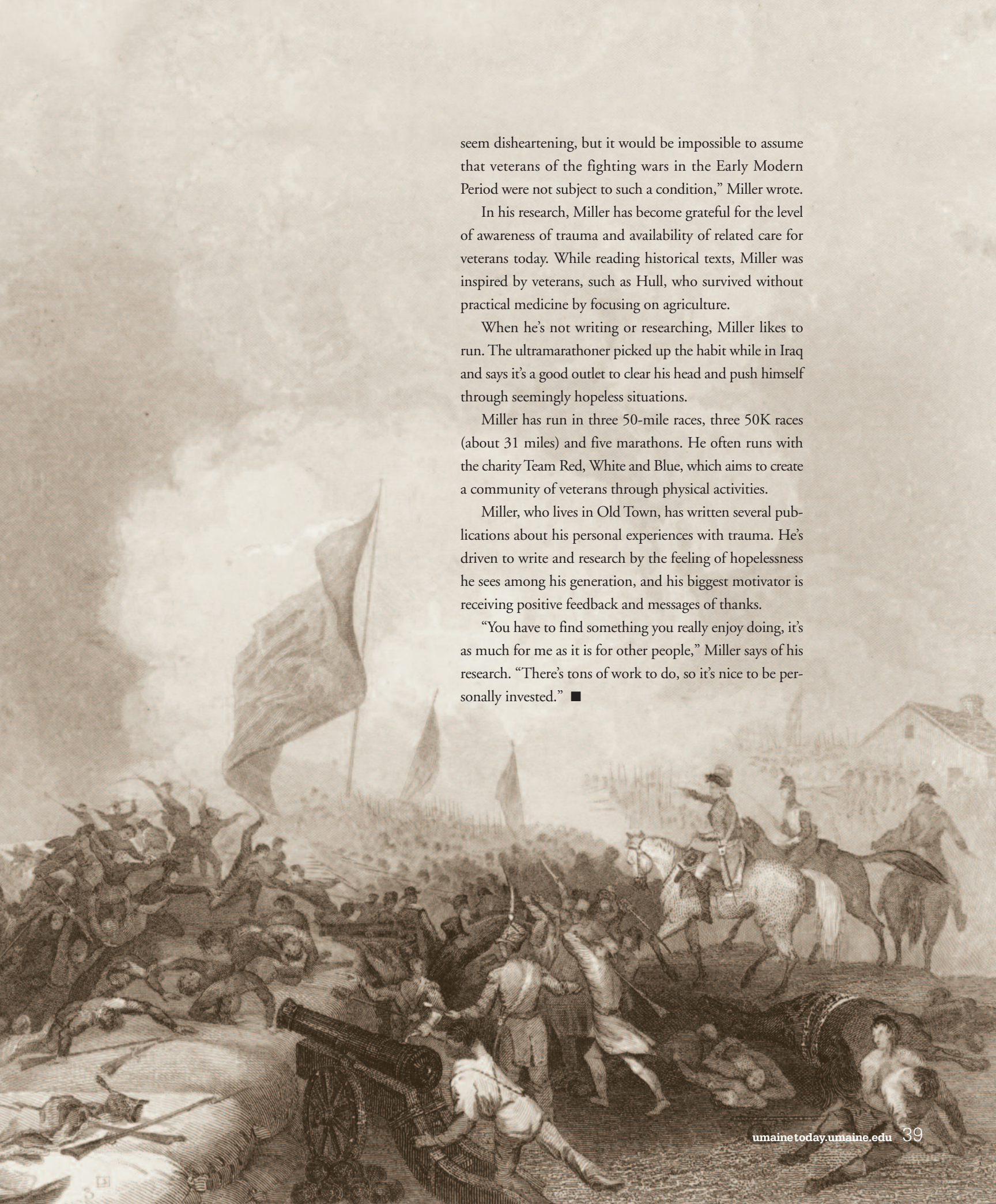
William Hull is one prominent figure Miller has researched. Due to Hull's heroic service during the American Revolution, he led the Northwest Army's invasion of Upper Canada at the outset of the War of 1812.

In an article published in the *Canadian Military Journal* and in his master's thesis, Miller explored Hull's command in 1812 and how his actions greatly differed from his time in the American Revolution. During the War of 1812, Hull surrendered Fort Detroit and his Army to the British without a fight. After Hull's questionable leadership in Detroit, he faced charges of treason, cowardice, neglect of duty and unofficer-like conduct, but was only acquitted of treason, Miller wrote. A month after the trial, President James Madison spared his execution.

Miller argues that without the benefit of contemporary psychological methods, it would be difficult to rationalize the fall of Detroit unless Madison recognized Hull's condition on a subconscious level.

"It is important to explore the idea of a subconscious knowledge of post-traumatic stress disorder (PTSD). The absence of a specific dialogue in the historical record may

Battle of New Orleans, James David Smillie, engraver
Published in *Graham's* magazine, July 1845
Courtesy of Library of Congress Prints and Photographs Division, Washington, D.C.



seem disheartening, but it would be impossible to assume that veterans of the fighting wars in the Early Modern Period were not subject to such a condition,” Miller wrote.

In his research, Miller has become grateful for the level of awareness of trauma and availability of related care for veterans today. While reading historical texts, Miller was inspired by veterans, such as Hull, who survived without practical medicine by focusing on agriculture.

When he’s not writing or researching, Miller likes to run. The ultramarathoner picked up the habit while in Iraq and says it’s a good outlet to clear his head and push himself through seemingly hopeless situations.

Miller has run in three 50-mile races, three 50K races (about 31 miles) and five marathons. He often runs with the charity Team Red, White and Blue, which aims to create a community of veterans through physical activities.

Miller, who lives in Old Town, has written several publications about his personal experiences with trauma. He’s driven to write and research by the feeling of hopelessness he sees among his generation, and his biggest motivator is receiving positive feedback and messages of thanks.

“You have to find something you really enjoy doing, it’s as much for me as it is for other people,” Miller says of his research. “There’s tons of work to do, so it’s nice to be personally invested.” ■

Nationally recognized research focuses on the value of active learning in STEM classes

Click

Assistant Professor of Biological Sciences Michelle Smith is the principal investigator on four projects and a co-principal investor on another, all aimed at improving nationwide science instruction and assessments.

By Beth Staples

TEACHING SCIENCE clicks for Michelle Smith.

The assistant professor in the School of Biology and Ecology is a national leader in a charge to improve science education. And clickers — wireless personal response systems (think of a television remote control) — are part of the equation.

For students in Smith's spring 2015 genetics course, learning about sister chromatids and homologous chromosomes involved pointing and clicking.

And for Smith, understanding how undergraduates grasp genetic concepts is a rewarding aspect of teaching.

In a heralded study with Scott Freeman of the University of Washington, Seattle, and others, Smith found undergraduates in college science classes that actively engage them in learning are more apt to pass and are more likely to earn better grades than peers in lecture-format classes.

The researchers reanalyzed 225 studies that compared grades of students enrolled in undergraduate science, engineering and mathematics courses taught in a typical lecture format with grades of students in STEM courses that utilized active learning methods.

They revealed that students in classes that

incorporated active learning techniques were 1.5 times more likely to pass than those in traditional lecture format classes.

And they found students in active learning sections earned grades nearly one-half a standard deviation higher, or, for example, a B rather than a B-, than students listening to a lecturer.

The study, “Active learning increases student performance in science, engineering, and mathematics,” was published in the *Proceedings of the National Academy of Sciences of the United States of America*.

Aleszu Bajak wrote about the research in a piece titled “Lectures Aren’t Just Boring, They’re Ineffective, Too, Study Finds,” for *ScienceInsider*. The article was *ScienceInsider*’s third most popular of 2014; plagiarism and Ebola took the top two spots.

In Bajak’s article, Harvard University physicist Eric Mazur was quoted saying the research is important and “it’s almost unethical to be lecturing if you have this data.”

He continued: “It’s good to see such a cohesive picture emerge from their meta-analysis — an abundance of proof that lecturing is outmoded, outdated, and inefficient.”

Not surprising, then, that Smith is invited by colleges nationwide to share her research about active learning.

And Smith’s research is growing.

In 2013, she became principal investigator on four projects and co-principal investigator on another, all aimed



Students in classes that incorporated active learning techniques were **1.5 times more likely to pass** than those in traditional lecture format classes.

The best clicker questions, according to research, are those that **concentrate on concepts** the instructor believes are **most important**.

at improving nationwide science instruction and assessments.

Those five projects earned \$6.8 million in funding from the National Science Foundation; UMaine's portion is more than \$1 million.

SMITH SAYS she wasn't always at the head of the class.

In middle school, she says she struggled to learn and was placed in remedial classes. She's grateful that a teacher who believed in her gave her extra interesting science-related work.

"I gravitated to it," Smith says. "It struck a chord. I would say that biology always came more natural to me, and I also really loved thinking about how to approach problems."

She doubled up on science and math offerings, and progressed out of remedial classes.

Smith excelled at Hanover College in Indiana, graduating magna cum laude in 1998 with a bachelor's degree in biology. In 2000, she earned a master's in biology from the University of Dayton in Ohio and in 2006, she was awarded a doctorate in biology from the University of Washington, Seattle.

When selecting a school and topic for postdoctoral research, Smith says she often found herself daydreaming

about how people learned and what they learned.

"That's really what I wanted to do," she says.

Smith was elated that the University of Colorado Boulder had postdoc research in the Science Education Initiative.

"I was the happiest postdoc," she says. "I admired my mentors and loved what I was doing."

She still does. In the 2015 spring semester, Smith taught genetics in UMaine's recently constructed active learning classroom in Estabrooke Hall. Features include 10 round workstations, each of which seats up to nine people, 10 wall-mounted video screens and full-wall white dry erase boards.

In the first class of the semester, Smith invited students to go with her on an adventure and to come to class with their minds turned on.

She introduced research on best practices, including active learning in science and math. She said the course would help students understand genetics with regard to their own health, as well as crime forensics and various genetic disorders, including Down Syndrome, hemophilia and cystic fibrosis.

And she said understanding genetic concepts would be necessary for those who wished to be veterinarians, environmental conservationists, physicians and forensic scientists.



MOLLY PICILLO, an undergraduate student learning assistant who previously took and excelled in the class, encouraged students to take advantage of the active learning method and called it amazing.

All through the semester, students used their clickers to select answers to multiple-choice questions Smith posted on the large video screens. In real time, a computer recorded the responses and showed Smith and students the results.

The best clicker questions, according to research, are those that concentrate on concepts the instructor believes are most important. They also have several credible answer choices that both prompt discussion and reveal where student confusion exists with the concepts.

Smith listens to small-group discussions at each table to further understand their thinking processes.

“Instead of thinking, ‘I can’t believe they don’t know this’ — I find it interesting how I can move them in a direction,” she says.

Smith says she reinforces challenging genetic concepts three or four times — with a clicker question in class, as part of homework, in a follow-up clicker question where students apply their knowledge to a new situation and on an exam.

In addition to utilizing active learning techniques to share her knowledge of genetics with upperclass students

at UMaine, clickers also are used in introductory biology classes with large numbers of students.

Thanks to Smith and Farahad Dastoor, a lecturer of biological sciences, 800 UMaine students in three introductory biology sections also embraced clickers and engaged in small group conversations rather than sitting and listening to information dispensed by a “sage on a stage.”

Smith and Dastoor were featured in a recent National Science Foundation story, “Rules of engagement: Transforming the teaching of college-level science.”

Smith, whose research brings together other universities, as well as UMaine administrators, faculty, postdoctoral and graduate students, undergraduates and area K–12 teachers, “is helping to re-envision science education on her campus as well as across the country,” states the article.

Smith recalls a valuable gift she received as a postdoc with the Science Education Initiative at the University of Colorado Boulder.

She says she used to preface or qualify her research by saying she could switch back to molecular biology. Then an adviser encouraged her to stop apologizing for her field of choice.

The advice clicked and she’s embraced it ever since.

“I’m doing science education,” she says. “It’s important and really great.” ■

Get a grip

Undergraduate's research looks at claw strength
to determine shipping viability



DEVELOPING A noninvasive procedure to determine the viability of lobsters for shipping was the goal of a recent cross-discipline research project led by a University of Maine undergraduate student.

Matthew Hodgkin, a fourth-year animal and veterinary sciences major from Colebrook, Connecticut, developed a method to evaluate lobster livelihood based on claw strength. He collaborated with Bob Bayer, executive director of the Lobster Institute at UMaine; Michael Peterson, a mechanical engineering professor, and Thomas McKay, a fourth-year mechanical engineering technology student.

Inspiration for Hodgkin's research came from Bayer, who had approached Peterson two years ago as a result of a press inquiry about the strength of lobster claws. Peterson and McKay then built a device to measure the closing strength of a lobster's crusher claw.

Hodgkin has since worked with Bayer to determine if the device could be used to predict the viability of lobsters for shipping. Knowing a lobster's viability is relevant to Maine's primary seafood industry because it can determine if the crustacean is most suitable for shipping live or going straight to a processing plant, according to Hodgkin.

"This research would save the distributors money from losses incurred during shipment. If the most healthy and viable lobsters were picked to ship, there would be less casualties due to weakness," he says.

The device is an alternative to the commonly used invasive procedure to measure serum protein content in lobster blood. Shipping facilities use handheld refractometers to measure the protein once lobster blood is extracted by a syringe, according to Hodgkin.

The serum protein measurement reflects the amount of a lobster's muscle mass. Lobsters with less muscle mass would not be able to handle the stress of shipping.

The technique was developed in the 1980s by Bayer and graduate student Dale Leavitt. The new device allows for muscle mass measurements to be determined by claw strength. The prototype contains an aluminum load cell located at the point where the most pressure is exerted by the lobster when it closes its claw.

"In our first trial, the gripper was made from plastic, and that did not last long with the lobsters," Hodgkin says.

Once the rectangular gripper is placed in the lobster's grasp, the load cell measures the pressure in pounds per square inch. Digital measurements then appear on an attached electronic reader.

Hodgkin examined lobsters of the same size in different stages of the molt cycle. He tested crusher claw strength with the load cell meter and used a refractometer to evaluate serum protein. Comparing the methods, he found the closing strength of a crusher claw correlated with serum protein.

The prototype has been field tested at local lobster dealers and seems to work well, Hodgkin says. He adds that more testing is needed to study the effects of water temperature on lobsters' strength and their ability to close their crusher claws.

Funding for the project came from the UMaine Center for Undergraduate Research and the Lobster Institute.

Hodgkin also co-owns a lobster-related business with Bayer; Lobster Institute Associate Director Cathy Billings; and Stewart Hardison, a community business partner. Lobster Unlimited LLC, formerly LobsteRx, aims to develop products from lobster-processing industry waste, such as shells. The company's goal is to get more money to lobstermen and improve Maine's economy.

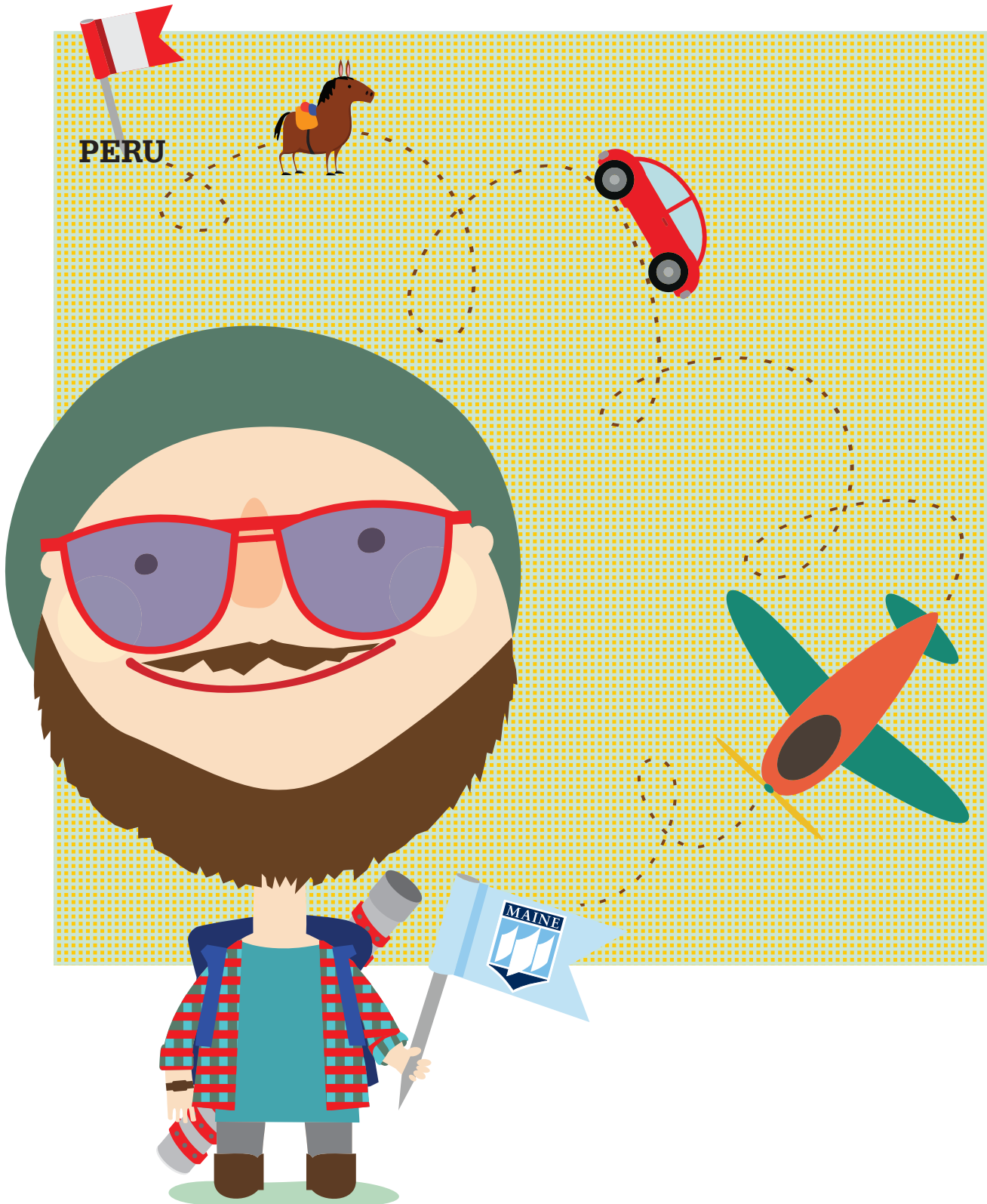
Hodgkin, who graduated in May, continues to work at Lobster Unlimited. Eventually, he plans to pursue a graduate degree in food science and human nutrition at the university. ■



This research would **save the distributors money** from losses incurred during shipment. If the **most healthy and viable** lobsters were picked to ship, there would be less casualties due to weakness."

Matthew Hodgkin

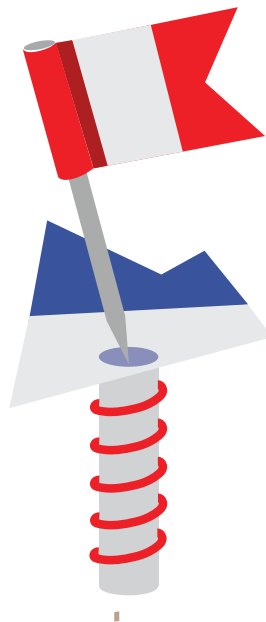
Where's Chuck?



WHEN UNIVERSITY of Maine climate change researchers Charles Rodda and Kit Hamley took a lunch break from drilling ice cores on a glacier in Peru this spring, they hiked to camp and sat down to eat. That's when they got a volley of questions via text: "How will you keep all of your ice cores from melting?" "What is your camping setup while on the glacier?"

The interviewers weren't scientists or locals, but elementary and middle school students in Maine and throughout the country who connected with the researchers through a new program offered by University of Maine Cooperative Extension with support from UMaine's Climate Change Institute (CCI) and the Maine 4-H Foundation. The Follow a Researcher program gives students a glimpse into a scientist's world by providing live expedition updates, and facilitating communication between youths and researcher.

"Science isn't just white lab coats and pouring things into beakers," says Rodda, a doctoral student at CCI who helped develop the program and is one of its first researchers. In his case, science means putting on crampons, scaling glaciers and drilling ice cores in Peru



Technology called inReach Explorer, a global satellite communicator created by DeLorme, tracked the UMaine researchers' movements and generated an online map so students could follow their trek in nearly real time.

and Tajikistan to conduct research focused on abrupt climate change.

In March 2015, Rodda and Hamley traveled to Peru to collect snow and ice from glaciers high in the Andes. This summer, Rodda will travel to Tajikistan to join an international team that will retrieve and research samples from the Fedchenko Glacier, the world's largest nonpolar glacier that covers about 270 square miles and extends about 48 miles.

While in Peru, Rodda and Hamley

interacted with participating classrooms and students by sharing prerecorded weekly videos and live tweeting in response to questions. Rodda also will connect with students when he's in Tajikistan.

TO COMMUNICATE with students, Rodda and Hamley used the inReach Explorer, a global satellite communicator created by Maine-based company DeLorme. The tool allowed them to tweet to students from the glacier. It also tracked the researchers' movements and generated an online map so students could follow their trek in nearly real time. To document the journey, the researchers also took several cameras, including a GoPro; a solar panel and battery pack to charge electronics; an iPad; satellite receiver; and memory cards.

In advance of the weekly question-and-answer sessions, prerecorded videos of Rodda explaining aspects of the expedition and research were released. The videos were created to spark discussion among students and were aligned with Next Generation Science Standards.

An elementary school in Hudson was one of 26 schools or individuals in Maine and 43 sites in the country to participate in the program this spring.

Innovative STEM education initiative connects K–12 students with researchers working in the field, anywhere in the world

By Elyse Kahl

Where's Chuck?

Schools in Iowa, Ohio, Rhode Island, Connecticut, North Carolina, Montana, Minnesota and Massachusetts also participated.

Every week while the researchers were in Peru, about 30 fourth-graders would fill Maine's Hudson Elementary School gymnasium to watch a video, view updates from the researchers and send questions.

The two classrooms — an entire fourth-grade population — also connected the program to other subject areas they were currently studying, such as historical fiction, geography, and the use of Twitter and other technology.

"Real life is so abstract when you're 9 and 10 years old," said teacher Sherry Blanchard. "So when you can give kids that hands-on experience that connects them to their lives in the moment right now, that's what we want for our kids."

RODDA, WHO has participated in several outreach events around the state as a UMaine Extension 4-H STEM Ambassador, says having a science-literate society is important, and getting students interested at an early age is essential.

"I think that's the time — middle and early high school — when students seem to decide if they're going to be interested in science or not. There's great research happening here at the University of Maine and we want to make sure students know about it," he says.

Blanchard and Hudson Elementary fourth-grade teacher Cheryl Wood are learning how to use Twitter with their students. One day after the students

had gone home, the two teachers tweeted the researchers to see if they would visit the schoolchildren when they returned.

Rodda and Hamley, who had already planned to travel to participating Maine classrooms, confirmed that they would. The teachers printed the response and taped it to the classroom board for students to see when they arrived.

The next morning, students noticed right away and immediately became excited, Blanchard says.

That excitement and connection is exactly what the organizers hoped for when creating the program.

"Follow a Researcher is part of a big effort to connect youth in Maine with current university students. It may be the first time a youth has contact with someone who is going to college, or their first connection to a university," says Laura Wilson, a 4-H science professional with UMaine Extension.

IN PERU, Rodda and Hamley looked at signals that have been captured in the ice during El Niños events, or warming of the waters of the equatorial Pacific. They hope to see what El Niños look like in the ice cores to determine if those events may have triggered abrupt climate system shifts in Central and South America.

Rodda completed preliminary research in Peru in 2013.

This summer in Tajikistan, Rodda will work with a team of international researchers to drill a long ice core that will be split among teams from the University of Idaho, Japan, France and Germany. Rodda will focus on the core's chemical makeup, while others will focus on other characteristics, including physical measurements of the ice or biological signals, such as stable isotopes, he says.

In advance of the Peru trip, youth in grades six through eight took part in a UMaine 4-H Science Saturday workshop on campus where they were challenged with determining how to

"How do you convince someone who doesn't believe in global warming that your data proves it?"



keep ice core samples frozen and intact for research. Students were given ice and materials and were tasked with designing a container that would keep ice frozen under a heat lamp for a set amount of time.

In reality, Rodda says bringing ice cores home from Peru is more like *Planes, Trains & Automobiles*. It involves horseback transportation, long car rides, even longer airplane trips, and a lot of dry and blue ice, which he describes as heavy-duty freezer packs.

“It’s a great way to get students on campus to sort of demystify the university, and show them some of the cool stuff we do at the university and in the sciences,” Rodda says of 4-H Science Saturdays, which are offered by UMaine Extension.

Organizers would like to continue Follow a Researcher after the pilot year, as well as expand it to other disciplines throughout the university. Connecting youth to campus may inspire them to explore higher education, and perhaps come to UMaine in the future, Wilson says. ■

“Are you exposed to Peru’s culture when you are there?”



STEM statewide

4-H STEM Ambassadors are trained University of Maine students who facilitate hands-on science, engineering, technology and math (STEM) activities with 8- to 14-year-olds statewide. The ambassadors work with after-school programs, libraries, schools and camps, and, in some cases, start science or engineering clubs, says Laura Wilson, a 4-H science professional with University of Maine Cooperative Extension.

In addition to community offerings, 4-H STEM Ambassadors provide opportunities tied to academic offerings on campus, such as 4-H Science Saturdays. Through 4-H STEM Ambassadors, youth become connected to the research, resources and scientists at Maine’s public universities.

Charles Rodda, 4-H STEM Ambassador and Follow a Researcher lead, led a 4-H Science Saturday workshop at the Climate Change Institute before his research trip to Peru. In the session, students were challenged to keep ice core samples frozen and intact for research over a long period of time. Other recent workshops focused on horses, led by veterinarians at UMaine’s J.F. Witter Teaching and Research Center, and marine sciences at the Darling Marine Center in Walpole. The workshops are offered by UMaine Extension with support from the Maine 4-H Foundation.

Alternative fut

Research focuses on helping communities in Maine and beyond visualize how and why landscapes evolve

By Elyse Kahl



ures



Photo illustration by Adam Küyükdall and Michael Mardosa



Alternative futures

ROB LILIEHOLM can't predict the future. He can, however, work with stakeholders to envision and illustrate plausible scenarios of the state's landscape based on current behaviors and planned uses.

To ensure Maine's quality of place remains intact, the University of Maine forest resources professor uses alternative futures modeling to provide a glimpse of what the future may hold. Through historical and projected maps, Lilieholm acts as something of a Ghost of Maine's Land-Use Future, helping residents visualize how and why landscapes evolve, what the implications might be and how citizen actions can influence those changes.

Lilieholm has witnessed that recognition by residents through his land-use planning research in Maine, where he is working to form a sustainable economic development pathway from Penobscot Bay to Baxter State Park that protects and leverages the region's natural resources. He's done the same in Africa, where he researched the effect of development on residents and migrating animals. The concept and methods were pioneered through earlier studies with the U.S. military in southern California and with dozens of communities in rapidly growing Utah.

The alternative futures modeling technique Lilieholm uses predicts how landscape conditions might change by depicting scenarios under various land-use policies, as well as socio-demographic, economic and biophysical catalysts of change. To create the models, researchers use remote sensing satellite data, logistic regression statistics, and

expert knowledge models such as Bayesian belief networks.

Alternative futures modeling is, in essence, "understanding how today's decisions affect tomorrow's outcomes," says Lilieholm, UMaine's E.L. Giddings Professor of Forest Policy.

"We're not good at recognizing incremental change," Lilieholm says. "The slow changes through time — we don't really perceive them. So if there's a way that we can visually accelerate the process with maps and try to get a better handle on the cumulative effects and what might happen over time, then we can make better decisions."

VISUALIZING FUTURE landscapes provides a common reference for decision making, allows stakeholders to assess current conditions and trends, anticipates opportunities and conflicts between uses, and offers a way to explore issues at multiple scales.

"Maps really resonate with people," Lilieholm says. "When you bring a map into a town meeting, people immediately go to it. I haven't met anyone who doesn't like a map."

While in Kenya in 2005, Lilieholm attended a community meeting held by the International Livestock Research Institute (ILRI). The institute had finished digitizing all the fence locations within two of the major wildlife migration corridors south of Nairobi National Park and released the maps at the meeting.

Kenya, which is home to some of the world's greatest wildlife and large mammal migrations, is increasingly threatened by human pressures, including urbanization, mining, deforestation, fencing and agriculture, as well as climate change, Lilieholm says.

The dominant tribe people in the southern region of Kenya are Maasai pastoralists, whose culture calls for herd-



Alternative futures modeling is, in essence **understanding how today's decisions affect tomorrow's outcomes.** Rob Lilieholm



Rob Lilieholm, the E.L. Giddings Professor of Forest Policy at the University of Maine, makes presentations statewide, across the country and abroad, and uses the Maine Futures Community Mapper developed at UMaine to help communities explore their future under alternative scenarios.

Since the meeting, the region's officials put a program in place to inform residents about the importance of migration corridors, and programs are emerging to pay landowners to take down fences, either permanently or during key migration times, according to Lilieholm.

"We can't predict the future, but hopefully we can use these maps to get people to think about the future and how they might change behaviors to try to tweak that landscape into something that will better meet their needs," he says.

While education is key to making major land-use changes, Lilieholm thinks it may be too late for the area around Nairobi National Park — at least for some key wildlife species. Already, wildebeest populations have fallen precipitously, with the roads and fences already in place having a significant effect. He predicts that in 10 to 15 years, the park's southern migration corridor will no longer be viable for both pastoralists and many species of wildlife due to increased population and development.

He recently wrapped up his own Kenya study funded by the National Science Foundation that began in 2008 with a team from Colorado State University and UMaine doctoral students Michelle Johnson and Spencer Meyer.

Similar to the work started by the ILRI, the project looked at how future development and climate change will affect the sustainability of pastoralists, wildlife and historic migration patterns in Kenya. The researchers modeled how wildebeest move across the landscape using hourly GPS tracking, as well as alternative future scenarios of development and fencing based on roads, distance to water and existing development density.

"Once we have these models of how the animals behave, we can then start to explore the effects of future landscapes," Lilieholm says. "We can take the current landscape and basically move it through time with different scenarios of fencing and development. Then we start to get an

ing cattle while coexisting with wildlife, Lilieholm says. Historically, locals have migrated across large areas of land with their cattle, but the pastoral livelihood became less feasible over time as more fences, houses and roads spring-up across their traditional grazing lands.

"It was really amazing to see the reaction of people, because the maps really reinforced what they felt; what they thought was going on," Lilieholm says. "But to see it in black and white; it spoke to the power of what you can do with technology and how you can help people visualize change."

Alternative futures

Members of the Maine Futures Community Mapper team included doctoral students Michelle Johnson and Spencer Meyer. Johnson now works for the USDA Forest Service's Northern Research Station in New York City. Meyer is a post-doctoral researcher at the Yale School of Forestry and Environmental Studies.

idea of how the animals, based on their behavior today, might behave on these new landscapes that they haven't seen and won't see for 20, 30 or 40 years."

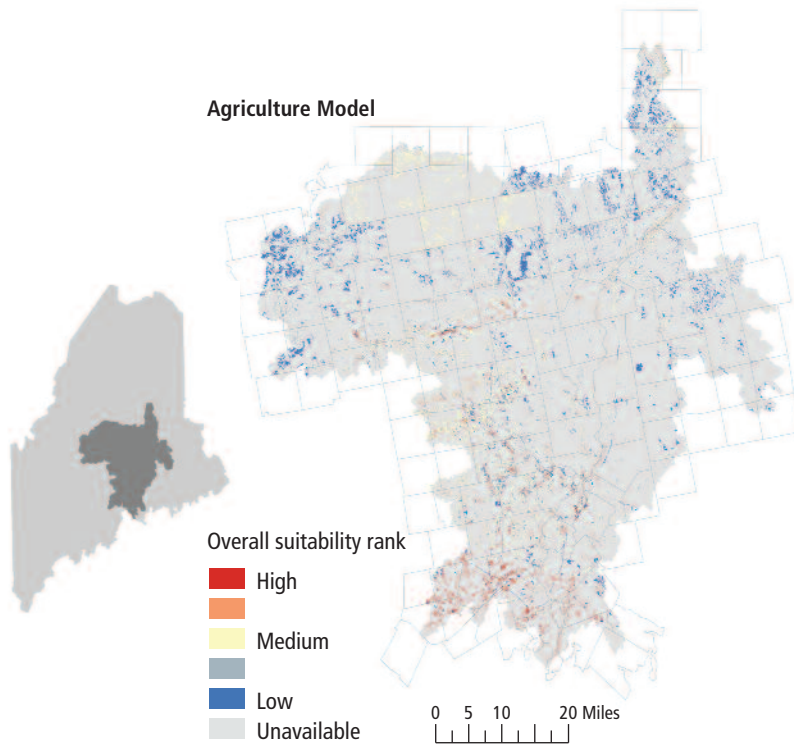
By modeling how wildebeest migrate, researchers can start to understand how wildlife will react to changing human and natural systems by developing a range of alternative futures, engaging stakeholders, identifying areas for critical needs and anticipating future conflicts. Ecotourism is an important economic driver in Kenya, Lilieholm says, so protecting wildlife is a key factor for economic growth.

"We talk a lot about how to do science that actually makes a difference. We want to make sure that what we're doing is relevant," he says, adding that one of his colleagues in Kenya was recently elected governor to the study area south of Nairobi. The team hopes to use its connection to inform policies that are taking place due to rapid population growth.

"We're hoping we can combine efforts to better protect

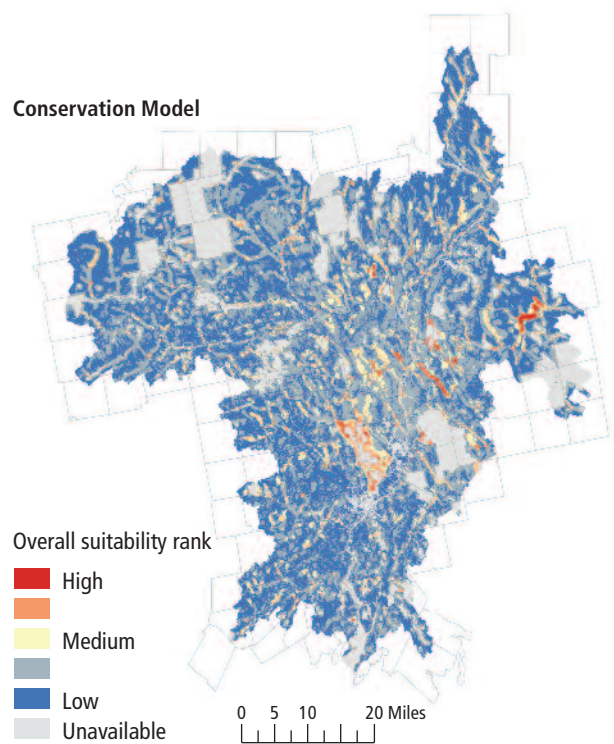


Agriculture Model



Rob Lilieholm's futures modeling team engaged dozens of stakeholders from across the state to develop suitability rankings for major land uses in Maine.

Conservation Model



The process combined expert knowledge and over 100 spatial datasets using Bayesian networks. Shown above are land suitability rankings for four major land uses in the Lower Penobscot River Watershed.

these open migration corridors while at the same time fostering development that better serves human needs — things like access to clean water, sanitation, education and health care,” Lillieholm says.

UNLIKE KENYA, development pressures in Maine are far less pressing, creating different issues and challenges.

“In one sense, it lessens the urgency because we’re not seeing high levels of development pressure in many parts of Maine — in fact, we’re seeing depopulation in many rural areas. Yet these limited growth pressures in one sense makes development even more important to our future because growth can either add or subtract from an area’s quality of life,” he says.

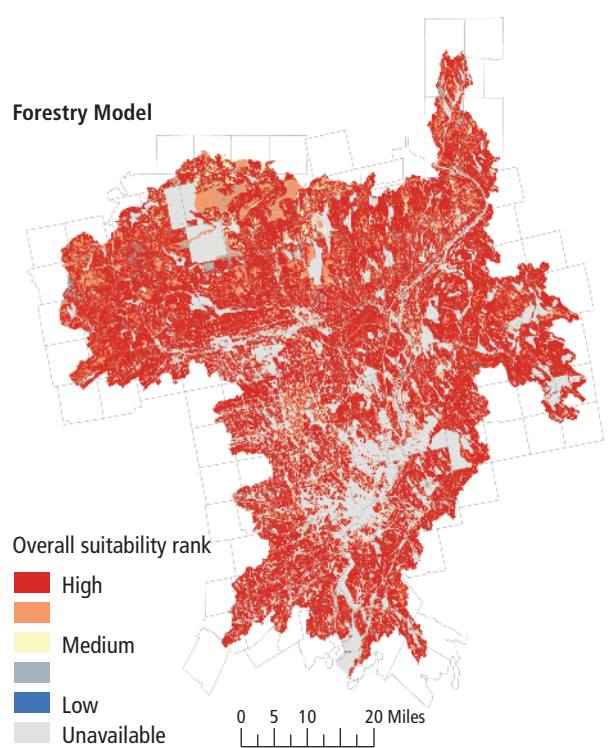
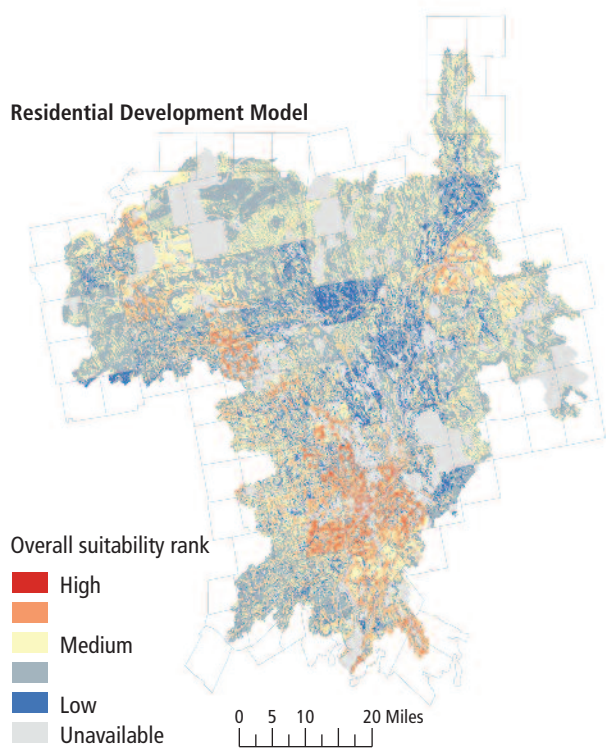
“In Maine, we have to be very careful that what we do has a net-positive impact.”

To aid in future land-use planning, Lillieholm and a team of UMaine researchers created the Maine Futures

Community Mapper (MaineLandUseFutures.org), an online tool for communities, businesses and citizens to explore the state’s future under alternative scenarios. The mapper helps Mainers identify locations that are most suitable for future development, conservation, agriculture or forestry; identify potential conflicts and compatibilities between different land uses; and envision future landscapes under different possible scenarios.

Meyer, who is now a postdoctoral researcher at the Yale School of Forestry and Environmental Studies, led the mapping tool development over four years with team leader Lillieholm; Christopher Cronan, a professor of biology and ecology; and Johnson, who now works for the USDA Forest Service’s Northern Research Station in New York City.

The tool was developed with the belief that Maine’s most important asset is its quality of place, with local communities at the heart. The goal is to help ensure a future in which Maine people can count on vibrant communities



The urban past



Photo by Gregory Zaro

CITIES ARE a dominant factor in global environmental change today, but as a long-term process, urbanization has played a significant role in shaping our planet's landscapes and environments for millennia, effectively creating anthropogenic landscapes. This recognition opens the door for archaeological research to make significant contributions to contemporary urban/ecological issues, while also generating cross-cultural knowledge about urbanism in the ancient, historic and modern worlds.

Gregory Zaro, a University of Maine associate professor and chair of the Department of Anthropology, is leading a study on urban transformation and landscape change during an archaeological project this summer along the Adriatic Sea in Croatia.

Joining Zaro are colleagues from the University of Zadar, Croatia, and students from the University of Zadar and UMaine. The excavation, funded by the National Geographic Society, is the next phase in building a long-term program of study concerning human society, environment and climate in the eastern Adriatic region.

Twelve UMaine students will participate as part of Zaro's archaeological field school. They will be trained in archaeological methods and research design, visit neighboring archaeological sites, Mediterranean Island landscapes, and several historic cities.

The initiative to study at the Nadin archaeological site in Croatia grew out of Zaro's Fulbright experience at the University of Zadar in 2013.

The project is a field program of archaeological excavation and analysis at the site, a moderately sized center in Croatia's Ravni Kotari region along the Adriatic Sea. It is near the 3,000-year-old city of Zadar, an important social and economic center in the region today, but one facing significant urban ecological challenges.

With a nearly 2,500-year record of (possibly intermittent) occupational history, Nadin affords the opportunity to investigate the relationship between phases of urban growth and decline, and broader changes in landscape and environment — processes that persist in Zadar today.

The project will generate archaeological data related to urban form, spatial organization, economy, subsistence and environment from the site's inception in the Iron Age.

It also will more precisely delineate the site's chronology — an essential prerequisite to articulating changes in urban form with broader changes in landscape and environment.

Knowledge of the human-environmental interactions in the Zadar region will offer deep-time perspectives on contemporary issues.

with vital economic development and a sustainable natural resource base, according to the researchers.

Since 2010, the team has involved more than 75 community stakeholders, including policymakers, conservationists, farmers, foresters, business leaders and scientists.

"It's important to engage with stakeholders; it's a whole other world. It's like driving down the highway and taking your hands off the wheel," Lillieholm says. "It's easy to stay in your office and work with your grad students, but by doing that you might be creating something with limited impact."

The mapper looks at two large watersheds in Maine — Casco Bay/Lower Androscoggin, which includes Portland and Lewiston; and the Lower Penobscot River, which includes Bangor. Both watersheds cover about 4.5 million acres and were identified in 2006 by the U.S. Forest Service as being among the top 15 watersheds in the U.S. that are expected to experience major conversions of forest cover to residential land uses.

By focusing on watersheds, or ecosystems that contain land that drains downhill into a river basin, the researchers can examine the ecological impacts of land use, such as the effect of urbanization on stream conditions.

Lillieholm says the tool works well at showing areas with potential conflicts, such as around the Bangor City Forest and Bangor Mall, but the more useful application is predicting future problems.

"The value of the tool is that we can leapfrog ahead in time and anticipate where we're going to see future development pressure so that, if some of those areas are ecologically sensitive or have high-value agricultural soils, folks can explore protection options before the survey stakes are driven in the ground," he says. "By then, it's probably too late."

While meeting with stakeholders, the researchers found developers want to avoid conflict as much as possible and seek certainty when investing time and energy into developing a site.

"We never tell anyone what to do, we can't tell anyone what to do," Lillieholm says. "But we can give them better information to make better, informed decisions."

Lillieholm cautions against costly unplanned and scat-

tered development occurring in both Maine and Kenya.

“In Maine, many of us aspire to have some acreage with woods and pasture, but collectively, when we do that across the landscape, it can impose a lot of costs,” he says, citing expanded road networks or additions to power, sewer and water lines, which end up costing taxpayers.

The 2006 Brookings Institution study, “Charting Maine’s Future: An Action Plan for Promoting Sustainable Prosperity and Quality Places,” estimated the state spent about \$200 million to build new schools in response to population dispersal at the same time student enrollments were declining.

New development on the outskirts of municipalities while downtown storefronts sit empty is another common example of scattered development in Maine, Lilieholm says.

“Are there ways we can encourage those town centers to continue to be part of the economy instead of becoming derelict? That’s a real challenge we face across the state,” he says.

Lilieholm and his team have found areas of land, especially in the lower Penobscot, that are highly suitable for development over other uses.

“If there’s a way to encourage development in those areas that are near services like schools, sewer and power,

Surveying in the Bay-to-Baxter Corridor

UNIVERSITY OF Maine professors and Center for Research on Sustainable Forests (CRSF) leaders Sandra De Urioste-Stone and Robert Lilieholm are conducting a survey to identify sustainable economic development strategies for the Penobscot River corridor that protect and leverage regional natural resources and quality of place.

Three thousand residents along the Penobscot River are being surveyed to learn their views on recreational use of the waterway, as well as their thoughts on the community and its ability to adapt to changing social, economic and environmental conditions.

“It is extremely important to understand and incorporate residents’ views and feedback for effective use and sustainable development planning to occur,” says De Urioste-Stone, leader of the CRSF Nature-Based Tourism Program.

The survey is part of the larger project, “Promoting Sustainable Economic

Development and Quality-of-Place in Maine: The Penobscot River ‘Bay-to-Baxter Corridor’ Initiative,” led by De Urioste-Stone; Lilieholm, CRSF’s conservation lands lead; Claire Sullivan, associate dean for community engagement; Linda Silka of the Margaret Chase Smith Policy Center; and John Daigle, associate professor in the School of Forest Resources.

The survey is expected to inform ongoing and future sustainable economic development efforts from Penobscot Bay to Baxter State Park.

The Lower Penobscot River Watershed offers an ideal setting for studying and integrating stakeholder participatory scenario modeling, community resilience and sustainable economic development, De Urioste-Stone says.

The region faces multiple sustainability challenges, including an aging population, poverty, energy and food insecurities, high dependence on resource extraction, heavy reliance on social assistance programs,

strong urban-rural gradients, active species and watershed restoration efforts, and public health challenges.

The issues are not unique to Maine, posing risks to social, political and economic systems around the world.

Even with its set of growing challenges, the watershed has several assets that can develop and leverage community health and economic growth. These assets include UMaine, the Greater Bangor area, the I-95 corridor, Bangor International Airport, an international border, an abundant coastline, and natural and cultural amenities that attract tourists. Recent development proposals have sought to build upon and leverage those resources, the researchers say.

The project will use community feedback for alternative futures modeling led by Harvard Forest and funded by the National Science Foundation that aims to support improved regional land use and economic development decisions.





Alternative futures

then we take pressure off surrounding areas while at the same time better utilizing the infrastructure that's already in place," Lilieholm says.

FOR FOUR years, Lilieholm has been involved with the Acadian Program in Regional Conservation and Stewardship. The summer internship program, which is held at the Schoodic Institute in Acadia National Park, brings together young professionals from around the world to learn about large landscape conservation using Down East Maine and the Lower Penobscot River Watershed as a living classroom and laboratory.

After reviewing modeling work by Lilieholm's team and touring the region, students in the program helped create the Bay-to-Baxter Initiative, a regional conservation and economic development corridor from Penobscot Bay to Baxter State Park. The proposal aims to leverage the Penobscot's natural amenities for economic growth. It combines efforts such as river restoration, the Katahdin region's national park proposal, Baxter State Park and the Appalachian Trail, which Lilieholm says are all critical elements of a regional tourism sector, but aren't well promoted or connected to economic development.

"Even our own work; we weren't really looking at the river, we were looking at the land. The Penobscot River Restoration Trust was focused on the water and not looking at the surrounding land," Lilieholm says. "It took the students to tell us it was all one system and it should all be looked at as a cohesive project."

Lilieholm cites the Bangor Waterfront as an example of positive development along the river. Starting in 2008, the area was revitalized — with more than \$200 million in public/private investment — from an old railroad site into picnic areas, walking paths and a successful concert venue that has brought an estimated \$47.5 million to the area

economy during its first four seasons, according to a study by UMaine economist Todd Gabe.

"Our greatest asset is that river. We have something that so few states have. It should be an asset and not a liability. How do you wrap all of our strengths into one broader effort? Creating that vision helps everyone do whatever it is that they want to do," Lilieholm says. "Protecting quality of place, keeping working farms and working forests, attracting new businesses and residents. We've got a thousand mules and we're all pulling in the same direction — that is, we're all striving to protect our quality of life and promote economic development. The problem is that despite all these efforts, we're not hooked up and pulling together in a recognizable way."

LILIEHOLM SAYS in today's economy, the greatest competition is for people — attracting new residents, highly trained workers and their families. And this is where Maine's high quality of life is a key strength. It is the state's greatest economic asset.

Because of that, Lilieholm advocates for academic institutions as conservation catalysts, and has been involved with Academics for Land Protection in New England (ALPiNE), an emerging network that seeks to explore and expand the role that New England academic institutions play in conserving the natural heritage of the region.

Lilieholm says colleges and universities can make a difference in protecting land and quality of place through student research, community engagement, service-learning opportunities and citizen science. He hopes large landscape modeling can be used to create and catalyze regional conservation partnerships.

"It's a way for all of us to work together to try to build these broader scenarios that are going to have more impact," Lilieholm says of ALPiNE. ■

“

We can't predict the future, but hopefully we can use these maps to **get people to think about the future and how they might change behaviors** to try to tweak that landscape into something that will **better meet their needs.**" Rob Lilieholm

It takes a village

JARED STAPP is giving a voice to often underrepresented communities by studying forest resource management issues in the buffer zone of Chitwan National Park in southern Nepal.

Deforestation in Nepal threatens complex social-ecological systems, including rural populations that depend on forests and the country's biodiversity, says Stapp, who is from Logan, Utah, and earned a bachelor's degree in environmental studies at Utah State University before coming to the University of Maine for his master's degree.

"Two-thirds of Nepal's population relies on forests and these pressures are likely to increase in the future," Stapp says. "This, coupled with high population densities and rates of growth, highlights the importance of studying the relationship between human communities and forest management institutions."

Through his research, which he began in 2013 under the guidance of faculty adviser Rob Lilieholm, Stapp aims to understand how household attitudes toward forest conservation correlate with empirical forest cover trends. He also seeks to understand which sociodemographic variables influence supportive attitudes toward forest conservation.

Community-based forest management has been influential in reducing forest degradation rates and conserving local biodiversity in many regions of the world. Forest cover in the buffer zone of Chitwan National Park fell between 1989 and 2005, and regenerated significantly between 2005 and 2013.

Since 1989, forest loss rates have decreased significantly when Nepal began its Master Plan for the Forestry Sector and



Local residents gathered in Bachauli to listen to a village leader discuss the work that Jared Stapp was conducting in Nepal. Many of the women pictured here participated in the survey in June 2014.

implemented modern community forestry, Stapp says.

In summer 2014, Stapp traveled to Nepal to conduct household surveys in two communities — Narayani and Bachauli. He surveyed 114 residents with help from the World Wildlife Fund–Nepal and SeedTree, a U.S.-based nongovernmental organization that has been engaged in reforestation and environmental education outreach in Nepal for the past two decades.

Narayani has an agriculture-based economy and has seen the highest percentage of forest cover loss in recent years. Bachauli's economy relies heavily on ecotourism from the park and has had significant forest regeneration.

Stapp found that economic status highly influences attitudes, with poorer people more likely to be supportive of

forest conservation. People in both areas seemed to value forests for ecotourism and agriculture. Participants generally indicated the political climate in Nepal does not support sustainable forestry.

The findings are timely as Nepal's Master Plan for the Forestry Sector has expired, and the country is in the process of developing a new strategy, says Stapp, who completed his graduate degree in May and is headed to the University of California, Berkeley.

Stapp and his team suggest the new legislation should ensure equal distribution of rights, responsibilities and revenue for the poorer, marginalized populations of Nepal. They also say government entities and representatives need to become more transparent, consistent and considerate in their management practices and relationships.

East Rapti River, Chitwan National Park

Photo by Lewis Tse Pui Lung



DELIVERING FRESH SEA VEGETABLES

UNIVERSITY OF Maine associate professor Denise Skonberg and graduate student Dhriti Nayyar are working with a Bristol, Maine company to study the shelf life and nutritional values of aquacultured sea vegetable products.

Maine Fresh Sea Farms, a startup based on the Damariscotta River, is one of five Maine companies to share more than \$471,000 in Value Added Producer Grants from the U.S. Department of Agriculture's Rural Development Program. The federal grants were awarded in August 2014 to preserve rural jobs at companies that process and add value to agricultural products.

Maine Fresh Sea Farms received \$71,673 to help create a business plan and study the feasibility of delivering fresh aquacultured sea vegetable products to the marketplace using agricultural produce and seafood distribution systems, the USDA said. The funds also will help the company retain jobs and create more over the next decade.

To study the products, the company turned to Skonberg, a professor of food science and human nutrition in the School of Food and Agriculture. Skonberg and Nayyar are collecting baseline data on the length of time several species of sea vegetables can be considered fresh while under refrigeration.

They also are conducting basic nutritional analyses to help meet nutritional labeling requirements. The study will provide key information about the nutritional benefits and shelf-life stability of four varieties of sea vegetables farm raised in Maine.

“ The results (from our research) **will promote the production of locally sourced, high-quality and nutritious seaweed products from Maine** and help in job creation along the coast.” Denise Skonberg



In partnership

Expanding engineering and manufacturing solutions to Maine companies

THE UNIVERSITY of Maine's Advanced Manufacturing Center (AMC) has entered into a new agreement with the Maine Manufacturing Extension Partnership (Maine MEP) that will expand the center's capacity. The partnership, which will place a Maine MEP project manager at AMC, will promote closer collaboration between the organizations with the goal of enhancing the services available to manufacturers in the state, according to Maine MEP.

Forest Wentworth, a UMaine graduate with a bachelor's degree in mechanical engineering technology, has been hired as the MEP/AMC project manager. Wentworth will provide research, design and manufacturing services to private sector clients and

will serve as Maine MEP's liaison with AMC.

"This partnership expands the capacity of AMC to offer engineering and manufacturing solutions to Maine companies," says John Belding, director of AMC.

Belding said although Wentworth will be mainly responsible for supervising projects in the AMC machine and fabrication shop, he will also contribute to outreach efforts by regularly visiting manufacturers around the state to promote the center's services.

Maine MEP is a program of the Maine Department of Economic and Community Development and an affiliate of the National Institute of Standards and Technology (NIST) under the U.S. Department of Commerce.



CHECK-IN, CHECK-OUT

COURTNEY PACHOLSKI of China, Maine, a Ph.D. candidate in education at the University of Maine, and her adviser, James Artesani, associate professor of special education, are the recipients of the UMaine 2015 President’s Research Impact Award.

Alumna Courtney Pacholski provides professional development to educators on schoolwide approaches to behavioral intervention.

The annual award is given to the graduate student and adviser who best exemplify the University of Maine mission of teaching, research and scholarship, and outreach. The \$2,000 as part of the award is shared equally between the student and adviser.

Pacholski’s research focuses on PBIS — positive behavior interventions and supports — for rural school districts to help students at risk for behavioral issues that could result in failing at school. She has examined the effects, feasibility and possible adaptations of the Check-In/Check-Out model on the behaviors of elementary and middle school students. The results of the study indicate positive outcomes in addressing students’ behavior problems in the classroom while strengthening the student-teacher relationship.

BANKING ON WOOD

WHILE SPRING and summer are not heating seasons in Maine, they are the best times for communities to start wood banks, according to University of Maine professor Jessica Leahy. Leahy, an associate professor of human dimensions of natural resources in the University of Maine School of Forest Resources, has written a how-to guide with Sabrina Vivian, a senior in the Ecology and Environmental Sciences Program.

Wood banks are similar to food pantries, but instead of providing food for those in need, they provide firewood at little to no cost for those who rely on wood to heat their homes.

A Community Guide to Starting & Running a Wood Bank focuses on such topics as types of wood banks, location, legalities, eligibility, firewood sources, volunteers, distribution and equipment needed. The guide also includes profiles and contacts for New England wood banks.

In 2013, when Leahy and Vivian began researching wood banks in New England, they found 12 wood banks throughout the region, with only one in Maine — the Cumberland Wood Bank. All the wood banks started as grassroots organizations without knowing about each other and having to navigate on their own, Leahy says.

In November 2014, Leahy and Vivian wrote an opinion piece for the *Bangor Daily News* titled, “How wood banks could help Mainers avoid an eat-or-heat dilemma.” As a result, residents in Waldo County, Bucksport and Blue Hill were inspired to start their own wood banks.



POPULAR POSTS

Journal Article on Wireless Sensor Research One of the Most Downloaded

A paper co-authored by Ali Abedi, associate professor of electrical and computer engineering, was one of the 50 most downloaded articles in the *IEEE Sensors Journal* in October-November 2014. The paper, “Wireless Sensor Systems for Space and Extreme Environments: A Review” (November 2014), was co-authored by Abedi and Habib Rashvand, School of Engineering, University of Warwick; Jose Alcaraz-Calero, School of Computing, Telecommunications and Networks, University of the West of Scotland; Paul Mitchell, University of York; Subhas Chandra Mukhopadhyay, Massey University.

Psychological Research Paper Among the Top 10 Most-Read in Clinical Case Studies

A research paper by University of Maine psychologists continues to be in the top 10 most-read articles in the journal *Clinical Case Studies*. The research focused on the effectiveness of two years of multicomponent treatment of severe body dysmorphic disorder (BDD) in a 14-year-old girl. The journal article was authored by Rachel Burrows, a former UMaine graduate student who is now a clinical psychologist at Maine General Medical Center; graduate student Janine Slavec; Douglas Nangle, professor of psychology; and April O’Grady, director of the UMaine Psychological Services Center. It was published in February 2013.



52%

of surveyed Maine adults supported increasing monthly electricity bills to invest in renewable energy and/or energy efficiency programs



INVESTING IN EFFICIENT, RENEWABLE ENERGY

FIFTY-TWO percent of surveyed Maine adults supported increasing all Mainers' monthly electricity bills to invest in renewable energy options and/or energy efficiency programs to reduce carbon emissions.

That's according to a University of Maine study that also found 37 percent of the nearly 400 respondents viewed energy efficiency and renewable energy investments as complementary. They divided the money evenly — giving half to renewable energy investment and half to energy efficiency programs.

UMaine economist Caroline Noblet and colleagues conducted the study in 2013, the year fossil fuels and nuclear energy accounted for more than 90 percent of energy use nationwide.

"Energy choice studies generally only gauge support (or not) for a policy, rarely do they take the next step — as we have done here — to look at how people would allocate these investment dollars," Noblet says. "Understanding how Maine people evaluate, and make tradeoffs between, energy policy options is important when we consider investments in our energy portfolio."

The survey included four renewable energy options — hydroelectric energy, land-based wind, deepwater offshore wind and tidal energy. The average dollar amount some households were willing to pay for these programs was \$6.76 a month, or more than \$80 per year.



TALKING ANIMALS

THE SCHOOL of Food and Agriculture's Animal and Veterinary Sciences Program traditionally has a high acceptance rate of student applicants for veterinary schools. This year, that acceptance rate is nearly 90 percent, with seven students graduating and heading to veterinary schools nationwide, and in Scotland and Canada:

Brian Blanchard, Thorndike, Maine, Atlantic Veterinary College, Prince Edward Island

Rachel Chase, Warren, Maine, Ohio State University

Elena Doucette, Cumberland, Maine, University of Glasgow, Scotland

Amy Fish, Mountville, Pennsylvania, University of Edinburgh, Scotland

Taryn Haller, Mystic, Connecticut, University of California, Davis

Jeffrey Vigue Jr., Whitefield, Maine, Virginia-Maryland Regional Veterinary College

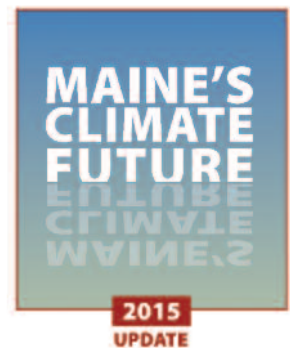
Ariana Wadsworth, Thomaston, Maine, Oregon State University

Two other Animal and Veterinary Sciences Program students from the Class of 2014 applied this year for veterinary school and were accepted. Kristyn Souliere of Saco, Maine, is headed to Lincoln Memorial University College of Veterinary Medicine, and Bethany van Gorder of West Tremont, Maine, is going to the University of Glasgow.

SIGNS OF THE TIMES

CONTINUING OR accelerating warming of the atmosphere and ocean. Intense precipitation events. Rising sea levels. These are signs of climate change, and all of them are affecting Maine people, according to *Maine's Climate Future: 2015 Update*, a new report from the University of Maine. Recent consequences include: a record number of reported Lyme disease cases; a white pine needle disease epidemic; erosion of beaches, farmland and roads; and a Gulf of Maine heat wave in 2012 that resulted in a glut of lobsters on the market and an ensuing price crash.

"This report goes beyond global and national climate change assessments to what is happening in Maine," says one of the report's authors, Ivan Fernandez, a professor in the UMaine School of Forest Resources, Climate Change Institute and School of Food and Agriculture. The new report builds on the report *Maine's Climate Future 2009*.



A TRANSFORMATION mask that William P. Palmer III, '58, bequeathed to the Hudson Museum in 1982 has been revealed to be the inspiration for the Seattle Seahawks logo.

A Kwakwaka'wakw (kwock-KWOCKY-wowk) artist or artists carved the cedar mask in the late 19th or early 20th century. Kwakwaka'wakw is an Indigenous people of the Pacific Northwest Coast. When closed, the mask depicts a bird of prey. When open, it reveals a painted representation of a supernatural being.

Before the Seahawks topped Denver to clinch the 2014 Super Bowl, a curator at the Burke Museum in Seattle began searching for the inspiration mask. Her blog included a photo of the mask — which turned out to be at UMaine, catalogued as HM5521.

Last fall, after UMaine loaned the mask to Burke Museum, the Seahawks rattled off eight straight wins before New England grounded them in Super Bowl XLIX. The mask will return to UMaine this summer.



TRANSFORMATION

COMMUNITY ENGAGED

THE UNIVERSITY of Maine is one of 240 colleges and universities in the United States selected to receive the 2015 Community Engagement Classification of the Carnegie Foundation for the Advancement of Teaching. UMaine first received the classification in 2008.

The Community Engagement Classification recognizes those colleges and universities with an institutional focus on community engagement. To be selected, the colleges and universities provided descriptions and examples of institutionalized practices of community engagement that showed alignment among mission, culture, leadership, resources and practices.

For reclassification, UMaine and the other institutions also had to provide evidence that the ongoing community engagement has become "deeper, more pervasive, better integrated and sustained."

UMaine's numerous university-community partnerships and projects were highlighted. University of Maine Cooperative Extension, Maine Sea Grant, all the colleges and many university centers were represented, demonstrating the range and depth of the university's commitment to engagement, according to Claire Sullivan, associate dean for community engagement in the College of Liberal Arts and Sciences. Several efforts are geared toward the creation of collaborative networks across disciplines, institutions and state organizations.

At UMaine, community engagement is integral to the student experience. Student participation in the Bodwell Center for Service and Volunteerism programs has increased 192 percent in the past three years, with 5,975 students completing 19,400 service hours in 2013. Students are involved in service-learning courses, music and theater ensembles, Alternative Breaks, Engineers Without Borders, sustainable agriculture projects, Black Bear Mentors and the University Volunteer Ambulance Corps, to name a few.



FALKLAND BIODIVERSITY

LEARNING MORE about the biodiversity of the Falkland Islands and what can be done to preserve it is the focus of research by three University of Maine researchers.

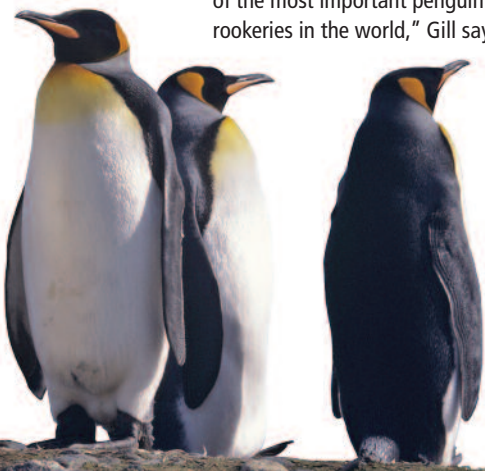
In December, Jacquelyn Gill, an assistant professor of paleoecology and plant ecology in the University of Maine's School of Biology and Ecology and Climate Change Institute, led the fieldwork on the small, remote group of islands about 300 miles east of South America.

With her were graduate students Kit Hamley, who is pursuing a master's degree in quaternary studies, and Dulcinea Groff, a doctoral student of ecology and environmental science, who is part of a two-year fellowship called Interdisciplinary Graduate Education Research Traineeship in Adaptation to Abrupt Climate Change.

The research is part of a new partnership between UMaine's Climate Change Institute and the South Atlantic Environmental Research Institute.

The researchers are studying the islands' environmental history throughout the last 20,000 years to establish a baseline for conservation efforts, and to understand the effects climate change and human land use have on the area's biodiversity.

"The Falklands are home to some of the most important penguin rookeries in the world," Gill says.



\$250M
annual value of Maine's wild blueberry crop

IMPROVING INTEGRATED PEST MANAGEMENT

DAVID YARBOROUGH, a blueberry specialist with the University of Maine Cooperative Extension and professor in the School of Food and Agriculture, has been awarded funds to improve integrated pest management practices for Maine's wild blueberry growers.

The Wild Blueberry Commission of Maine awarded Yarrowbrough and researchers Francis Drummond and Seanna Annis more than \$116,000 from the Maine Department of Agriculture for the yearlong study.

The Wild Blueberry Commission of Maine proposes to develop and implement an integrated pest management (IPM) program on weeds, diseases and insects for the 510 wild blueberry growers in the state.

If IPM practices are not developed to address the challenges, Maine's wild blueberry crop and \$250 million in annual economic impact are at significant risk, according to the researchers.

The focus will be on effective weed resistance management strategies, disease forecasts to reduce crop loss and fungicide use while developing new IPM disease and insect management, and an IPM program for the blueberry tip midge to determine the impact of wild blueberry damage from sap-feeding insects.

ASTHMA AND EXERCISE

CHILDREN WITH asthma can benefit from cardiovascular exercise, according to a study by University of Maine researchers.

In fact, after students ran increasingly faster 20-meter (65.6-foot) sprints for more than a year, children with the chronic lung disease performed as well as youth without breathing difficulties, says Stephen Butterfield, UMaine professor of physical education and kinesiology.

Butterfield's research team used the Progressive Aerobic Cardiovascular Endurance Run (PACER) with 809 students (103 had mild-moderate asthma) in grades 4-8. Five times during a 15-month period, they measured the students' cardiovascular performance when they ran 20 meters at progressively faster intervals.

"Children with asthma increased their performance on the PACER at a rate more than double that of children without asthma," according to the researchers, writing in the journal *Perceptual & Motor Skills*.

"By the end of the study (month 15), performances of both groups were essentially equal. Overall, results of this study strengthen the case for cardiovascular activity for children with well-managed asthma."

As the 9- to 14-year-old children with asthma developed effective pacing strategies, they likely gained confidence in their cardiovascular capabilities, and the PACER is an effective tool for shaping these capabilities, Butterfield says.





“

I am particularly proud to be **named as the university's first woman president** and I feel strongly about supporting the ideals that this fund will advance.”

Dr. Susan J. Hunter

Congratulations Dr. Susan J. Hunter, 20th President of the University of Maine

IN HONOR of the installation as the 20th president of the University of Maine, the University of Maine Foundation has established the President Susan J. Hunter Fund. Distributions from this endowed fund will be made at the discretion of UMaine's ADVANCE Rising Tide Center to provide professional development opportunities for University of Maine faculty. Donations to the fund may be made in honor of Dr. Hunter through the University of Maine Foundation. More information about UMaine's ADVANCE Rising Tide Center is online (umaine.edu/advancerisingtide).

Two Alumni Place
Orono, Maine 04469-5792
207.581.5100 or 800.982.8503



75 Clearwater Drive, Suite 202
Falmouth, Maine 04105-1445
207.253.5172 or 800.449.2629

umainefoundation.org
umainefoundation@maine.edu



Division of Marketing and Communications
5703 Alumni Hall
Orono, Maine 04469-5703

