

TUFTS TODAY

CREATIVITY AND ACHIEVEMENT AT THE UNIVERSITY OF MAINE

FALL/WINTER 2016

**Who cares about
rural health?**

**Fast-tracking top
pre-med students to
meet a critical need**





IN HIS 1916 volume, *History of the University of Maine*, Merritt Fernald wrote about the new day in American education that dawned with the establishment of public research universities. The mathematics professor who was named acting president at UMaine's founding defined research as "diligent, protracted investigation, especially for the purpose of adding to human knowledge," and noted with delight how undergraduates conducted agricultural experiments "as a foundation for their own instruction," all while addressing Maine's needs.

That approach to engagement by students and faculty for the greater good is time-tested at UMaine. It is evident in our century of research in Acadia National Park that has benefited the state, nation and stewards of tomorrow — our students. UMaine's leadership in aquaculture has been ongoing for more than four decades, and is now in its most exciting chapter with the Sustainable Ecological Aquaculture Network (SEANET), established with a \$20 million National Science Foundation grant.

For the past decade, one of the state's most successful partnerships — the Graduate School of Biomedical Science and Engineering — has trained the next generation of biomedical scientists and engineers, and since 2009 in collaboration with Maine Medical Center and Tufts University School of Medicine, our top pre-med students have been fast-tracked to be Maine's next generation of physicians.

Those stories and others in this issue focusing on UMaine research and creative achievement spotlight our dedication to turning knowledge into solutions to accomplish what matters for Maine.

Susan J. Hunter, Ph.D.

President



The University of Maine's Signature Area of Excellence in Forestry and the Environment focuses on the state's sustainable forests and the forest-based economy. UMaine is nationally and internationally recognized in its advanced wood composites, wood processing, biofuels, wood chemistry and forest resources research. Maine's natural resources in communities statewide provide unique hands-on educational opportunities in forestry, wildlife and the environment. At left: the Barbara Wheatland Geospatial Analysis Laboratory in the School of Forest Resources focuses on global positioning systems, geographic information systems and geospatial analysis methods that have revolutionized forest management.

Features

10 **Farming the sea**

For more than four decades, UMaine has conducted research and provided educational outreach related to the farming of aquatic organisms. SEANET is building on that legacy to further advance sustainable Maine aquaculture.

20 **Stellar in STEM**

This year, UMaine had five National Science Foundation Graduate Research Fellows — the largest number held concurrently in the university's history. Their nationally recognized research has state and global implications.

24 **The making of an opera**

A renowned composer and an award-winning poet have collaborated to create an opera on timeless themes — coming of age and unrequited love — based on two well-known literary figures.

30 **'This is where I belong'**

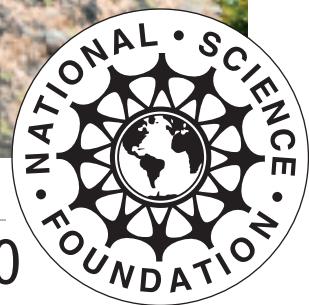
Graduates of the University of Maine and the Maine Track Program at Tufts University School of Medicine soon will be physicians, providing health care to residents in rural communities throughout the state.

38 **A century in Acadia**

Maine's only public research university has had a decades-long working relationship with Acadia, the state's iconic national park. The 2016 centennial of the park was an opportunity to reflect on that legacy of research, including the many initiatives ongoing today.

50 **On the front lines of discovery**

For 10 years, the UMaine Graduate School of Biomedical Science and Engineering has trained the state's next generation of biomedical scientists and engineers. The personal and professional success of the program is told best in the stories of its students and alumni.



Departments

Flagship difference

- 4 SEA Fellows
- 6 In hot water
- 7 Advancing athletics
- 8 From the heart
- 9 Fuel in forests

Students first

- 29 Leading by example
- 37 Going public

Black Bear success

- 56 Championing innovation

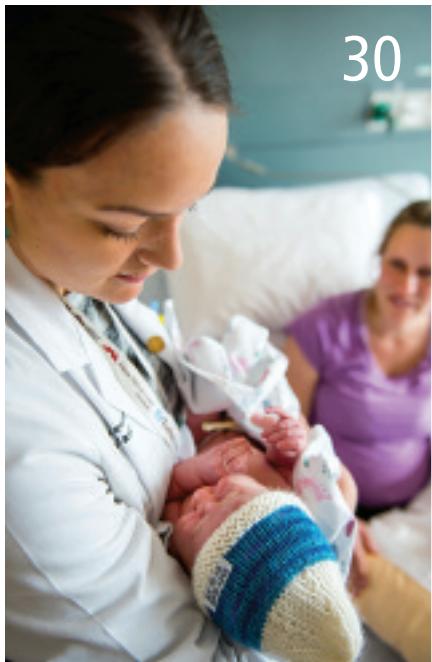
Insights

- 58 UMaine news briefs

On the cover

Since 2011, 29 University of Maine students have been accepted into the Tufts University School of Medicine Maine Track Program, which is a unique collaboration between TUSM and Maine Medical Center in Portland. The program's goals include providing Maine students with an affordable, hands-on, community-based medical school education and boosting the number of physicians in rural Maine communities. Stories about three outstanding UMaine alumni involved with Maine Track begin on page 30.

About UMaine



UMaine Today online

umainetoday.umaine.edu

UMaine Today magazine online provides web-exclusive features, including videos, photo galleries, full-length versions of articles and a comprehensive editorial archive.



Video magazine

umainetoday.umaine.edu/video

Leadership

Susan J. Hunter, President
Carlton 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
Jennifer O'Leary, Director of Strategic Communications
James Settele, Chief of Staff
Jake Ward, Vice President for Innovation and Economic Development
Joel Wincowski, Vice President for Enrollment Management

Research centers

Advanced Manufacturing Center
Advanced Structures and Composites Center
Aquaculture Research Institute
Center for Community Inclusion and Disability Studies
Center for Research on Sustainable Forests
Center for Undergraduate Research
Center on Aging
Climate Change Institute
Forest Bioproducts Research Institute
Innovative Media Research and Commercialization Center
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

Michele Bonin
Valerie Ireland
Carol Nichols

Photographers/videographers

Holland Haverkamp
Adam Küykendall
Ronald Lisnet

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 16 Issue 2

©2016 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, coinfo@umit.maine.edu.

SEA Fellows

SEVEN STUDENTS from Maine universities delved into the science and practice of marine aquaculture this summer as part of an innovative new program developed by the University of Maine and University of Maine at Machias (UMM).

Students visited sites from Walpole to Eastport, led by UMaine Darling Marine Center director Heather Leslie and UMM professor Brian Beal.

Leslie and Beal developed the SEA (Science for Economic Impact & Application) Fellows initiative to catalyze university-industry partnerships related to the state's marine economy.

"Students are hungry to learn more about how their developing skills as researchers can be applied to problems that really matter to Maine communities and marine businesses," says Leslie, who also is the Libra Associate Professor in UMaine's School of Marine Sciences.

SEA Fellows, who hailed from Maine and other states, met with marine entrepreneurs at five industry sites — Mook Sea Farm in Walpole; Maine Coast Sea Vegetables in Hancock; Moosabec Mussels Inc. in Jonesport; A.C. Inc. in Beals; and Cooke Aquaculture in Eastport — during the weeklong orientation.

They also learned from researchers engaged in aquaculture-related work at the Darling Marine Center in Walpole, UMaine's Center for Cooperative Aquaculture Research in Franklin, and the Downeast Institute for Applied Marine Research and Education in Beals.

One emerging theme the entrepreneurs shared with students on the tour: They are engaged in both aquaculture and traditional fisheries.

For instance, the kelp harvested by Maine Coast Sea Vegetables is collected from the wild, but company founder Shep Erhart is starting to culture kelp in collaboration with researchers from the UMaine School of Marine Sciences and Maine Sea Grant.

Moosabec Mussels CEO Ralph Smith is engaged in a similar collaboration focused on mussels with Beal, who also is the scientific director of the Downeast Institute.

Students say they particularly appreciated learning from industry leaders about how research informs business plans, and how science could be helpful in further building Maine's marine economy. The SEA Fellows initiative is funded by a U.S. National Science Foundation award to Maine EPSCoR, which supports Sustainable Ecological Aquaculture Network (SEANET) projects statewide. ■

“

Students are hungry to learn more about how their developing skills as researchers can be **applied to problems that really matter** to Maine communities and marine businesses." Heather Leslie

Pemaquid Point on a misty afternoon
was one of the living laboratory
destinations for the SEA Fellows.

Photo by Melissa Rosa





AT THE Bigelow Laboratory for Ocean Sciences in nearby East Boothbay Harbor, UMaine graduate student researcher Jesica Waller raised more than 3,000 lobster larvae. She took measurements daily for a month, assessing their survival rate, development time, length, weight, respiration rate, feeding rate and swimming speed.

Photos by Jesica Waller

In hot water

LOBSTER LARVAE are more responsive to a 2–3 degree increase in temperature than they are to the near doubling of the carbon dioxide projected for the Gulf of Maine by the end of the century. That temperature rise could mean trouble for lobsters and the lobster industry, according to research conducted at the University of Maine Darling Marine Center and Bigelow Laboratory for Ocean Sciences.

The research is the only published study focused on how larvae of the American lobster will be affected by two aspects of climate change — ocean acidification and warming.

The study found acidification had almost no effect on survival of young lobsters, but did cause changes in larval size and behavior. But lobster larvae reared in water 3 degrees Celsius higher in temperature, which is predicted by 2100 in the Gulf of Maine, struggled to survive compared to lobster larvae in water that matched current gulf temperatures.

“They developed twice as fast as they did in the current temperature of 16 C (61 F), and they had noticeably lower survival,” says Jesica Waller, a graduate student at the DMC and lead author of the study published in the *ICES Journal of Marine Science*. “Really only a handful made it to the last larval stage. We saw more dead larvae in the tank,” she says. “We recognized this could be really important to Maine and may help us understand the future of the lobster industry.

These short-term experiments, though, don’t account for the possibility that lobster populations may adapt to changing conditions over generations.

“We need to do much more research to understand that,” she says. Waller’s co-adviser and co-author of the paper, UMaine research professor Rick Wahle, says last year Maine harvested nearly half a billion dollars in lobsters. “It’s critical to know how climate change will affect the future of our most important fishery,” he says. ■

“With lobsters now comprising over 80 percent of the state’s overall fishery value, **Maine’s coastal economy is perilously dependent on this single fishery.**” Rick Wahle

A\$1.5 MILLION, three-year award from the Harold Alfond Foundation has established the Alfond Fund in the University of Maine Foundation, focused on creating a centralized fundraising structure for UMaine Athletics and continuing support of the football program.

“Through the years, Harold Alfond and the Harold Alfond Foundation have helped the University of Maine achieve excellence in Division I athletics for Maine, and for our fan base on campus, statewide and beyond,” says UMaine President Susan J. Hunter. “This newest award further underscores the leadership role of UMaine Athletics, and will be a game changer for fundraising and friendraising going forward.”

Through a three-year unrestricted grant of \$750,000, UMaine will establish the Alfond Fund, a comprehensive, centralized annual giving program designed to increase the visibility of UMaine Athletics and encourage donor support. The new program, which will launch in spring 2017, will feature streamlined options for giving, greater constituent engagement and a membership-based benefits plan, and development of signature events for athletics.

This portion of the grant, which will encourage giving to all 17 UMaine sports programs, will be the springboard to significantly increase overall giving to Black Bear athletics.

UMaine also will receive a three-year grant of \$750,000 to continue the Harold Alfond Football Challenge. Since 2007, the Harold Alfond Foundation has awarded annual one-to-one matching challenge grants in support of UMaine football of up to \$250,000. ■

“

These grants will bring **transformational change to our athletic giving.**”

Karlton Creech

Advancing athletics



Through the years, the Alfonds' support of UMaine Athletics has totaled more than \$15 million in gifts and pledges.



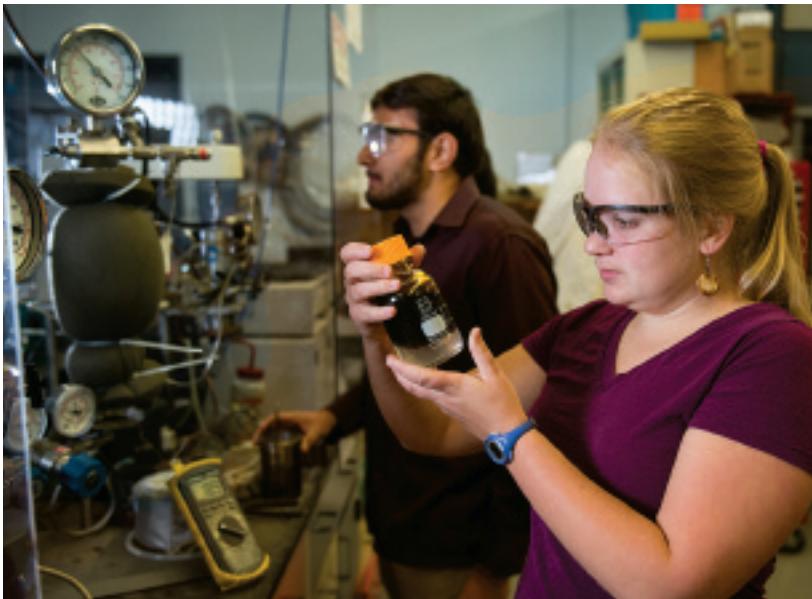
Stephen King, on stage at the book launch with UMaine classmates David Bright and Harold Crosby.

From the heart

HEARTS IN SUSPENSION

includes a reprint of *Hearts in Atlantis*, which tracks the "awakenings and heartbreak" of King's fictional counterpart, Peter Riley, during his first year at UMaine. The novella is accompanied by King's new essay, "Five to One, One in Five," in which he reflects on his undergraduate years. Also included are photographs, documents and four installments of King's student newspaper column, "King's Garbage Truck." A story about the book project is online: umainetoday.umaine.edu.

STEPHEN KING launched his book *Hearts in Suspension* at the University of Maine on Nov. 7 with a reading from the volume and discussion of his student days at UMaine during the turbulent Vietnam War era. He then joined in a conversation with some of his UMaine classmates and friends who co-wrote the collection of essays. The 373-page *Hearts in Suspension*, published by the University of Maine Press, a division of UMaine's Fogler Library, marks the 50th anniversary of King's enrollment at UMaine — fall 1966. In the years that followed, the escalating Vietnam War and social unrest nationwide, especially on college campuses, had "a profound impact on students of the period and deeply influenced King's development as a writer and a man." The book features essays by 12 of King's classmates and friends, including Jim Bishop, one of his college English teachers and the book's editor. ■



UMAINE'S RESEARCH related to woody biomass focuses on finding new opportunities for high-value use as an alternative to direct combustion in biomass power plants, where energy efficiency is often very low. FBRI plans to finish reassembly of its recently relocated biomass hydrolysis pilot plant, designed to convert biomass into levulinic and formic acids, to keep the unique critical research infrastructure operating in Maine and train students.

Fuel in forests

THE U.S. Department of Commerce's Economic Development Administration (EDA) will invest more than \$4 million to help diversify and grow the Maine economy, which includes new funds designed to aid the forest sector, announced U.S. Deputy Assistant Secretary of Commerce for Economic Development Matt Erskine in a news conference at the University of Maine in July.

In addition, an EDA Economic Development Assessment Team (EDAT) is evaluating new and existing economic strategies to address the state's forest-based economic challenges. At the conclusion of the EDAT process, regional and local stakeholders will have a bottom-up strategy, developed with input from the federal partners, designed to foster robust economic growth and recovery.

Erskine also announced several new efforts by other federal partners that will provide support to the Maine economy. They include a \$3.3 million award from the Defense Logistics Agency, Ft. Belvoir, Virginia to advance the wood to jet fuel initiative at the Technology Research Center of UMaine's Forest Bioproducts Research Institute (FBRI), directed by Hemant Pendse. The innovative project is based on FBRI's patented thermal deoxygenation process, which was shown to yield jet fuel test samples that have met key specifications.

To improve process economics, FBRI will investigate co-production of advanced materials, such as nanocellulose composites, as well as some high-value chemicals from woody biomass and liquid hydrocarbon fuels. The project will explore conversion of cellulose and lignin to liquid hydrocarbon fuels, and use of hemicellulose extract and cellulose fiber slipstreams for developing high-value co-products. ■





Oysters and sea vegetables grown in the Gulf of Maine supply restaurants in the state and beyond, including Eventide Oyster Co., in Portland, Maine, where chef and owner Andrew Taylor prepares a plate for the raw bar.

Farming *the sea*



**Maine's aquaculture industry grows
through research, innovation and collaboration**

By Amanda Clark / Photographs by Adam Küykendall

Farming the sea



Matthew Gray,
a postdoctoral
research
associate at the
Darling Marine
Center, collects
data from a
buoy in the
Damariscotta
River, which will
help inform
aquaculture
growers'
farming
practices.

MAINE'S CLARK Cove has long been a farming community. The 40-acre inlet on the Damariscotta River estuary, six miles up the state's rocky coast, is home to numerous farms, and a diversity of crops.

But what's most notable is the way the crops are grown. Underwater.

With clean, cold and nutrient-rich waters, the estuary — where freshwater and saltwater ecosystems meet — is an ideal environment for growing marine animals and plants, including oysters, mussels, clams and sea vegetables.

Aquaculture in the ocean, commonly referred to as sea farming, is one of the major economic engines for the Damariscotta River. Since the establishment of Maine's first sea farm in Clark Cove in 1975, the state's aquaculture industry has grown to 107 companies totaling approximately 113 lease sites, employing approximately 600 people.

In 2014, the overall economic impact of Maine aquaculture was \$137.6 million, according to the Aquaculture Research Institute (ARI) at the University of Maine.

For more than four decades, UMaine has conducted research and provided educational outreach related to the farming of aquatic organisms, such as finfish, shellfish or sea vegetables. On campus and at UMaine's Center for Cooperative Aquaculture Research (CCAR) in Franklin, Maine; statewide through Maine Sea Grant College Program, headquartered on campus; and at UMaine's Darling Marine Center in Walpole, Maine, research in oceanography, production, animal husbandry, genetics and diseases informs the development of Maine's aquaculture industry and trains its workers.

In 2014, that support took a giant step forward with the creation of Maine's Sustainable Ecological Aquaculture Network (SEANET), directed by UMaine Vice President for Research Carol Kim. Paul Anderson, who also leads



Eventide Oyster Co. is one of many restaurants that features Maine-grown seafood on its menu. Today, aquaculture accounts for more than 50 percent of seafood production in the world.

Maine Sea Grant and ARI, is research network director.

Maine EPSCoR and ARI at UMaine oversee SEANET, which is funded by a five-year, \$20 million grant from the National Science Foundation. With its R&D focus, the project includes UMaine and 10 other institutions, as well as a cohort of aquaculture farmers statewide.

Researchers are using Maine's 3,500-mile coastline as a living laboratory to gather environmental data using a buoy-based sensor system to model aquaculture's carrying capacity in the state's dynamic coastal systems.

The network of six buoys — sited in areas with a variety of physical features in the Gulf of Maine — measure oceanographic and biogeochemical conditions to better understand what drives the productivity of Maine's estuaries. The technology records air and water temperature, nutrient availability, turbidity, pH, dissolved oxygen, wind strength and direction, wave height, salinity, concentrations of phytoplankton, and the speed and direction of the current at several depths.

Any changes in these variables impact the marine environment, which subsequently impacts the businesses that rely on these waters to grow their products.

"When an aquaculturist or grower starts, it may take two years to get a lease. Then it might take another two years to get their product to market. So there are a lot of risks along the way," says Damian Brady, an assistant professor at the Darling Marine Center. "We are trying to understand and minimize those risks to help farmers and growers succeed in their business."

Brady oversees Maine Sea Grant's research portfolio and is a lead researcher for SEANET. His work focuses on how changes in marine environments affect the ecophysiology of marine organisms, and looks at how climate change is impacting the aquaculture industry now and into the future.

"What we see here at the Darling Marine Center as our mission is to help the aquaculture industry with the problems that may be impediments to the growth of that industry

Farming the sea



“

When you look at the demand for seafood, such as scallops and oysters, and you couple that with Maine's enormous coastline and wide variety of marine environments, **it's a natural fit.**” Bill Mook



— from disease resistance and enhancing production, to being the R&D arm for this industry,” Brady says.

Matthew Gray, postdoctoral research associate at the Darling Marine Center, was hired to maintain and deploy the buoys, and works with Brady to study how organisms respond to their environment. He is particularly interested in the physiological effects ocean acidification can have on marine invertebrates, such as mussels, clams and oysters.

“The farmers are depending on the environment to provide the food for their crops,” Gray says. “It’s important to understand where that food comes from and the factors that influence its availability, as well as the numerous environmental conditions that help these species grow, like temperature, dissolved oxygen, the acidity of the water — all these things are really important for a grower to know. It makes a real difference to their bottom line.”

“When we run these models, and after all the work is done, we hope that the access to aquaculture is greater, as well as the reliability when it comes to site selection,” he says.

SEAFOOD PRODUCTION is affected by environmental quality, and as these conditions change due to climate change or other factors, it’s important to understand how the species will respond. That’s where the buoy data can help.

For shellfish farmers, the success of their business is dependent on the health of the oceans.

“The work we do here is a very multidisciplinary endeavor. It not only requires a lot of knowledge about oceanography and physics and math and biology, but to be successful, you also have to know how to be a businessperson,” says Bill Mook, owner and founder of Mook Sea Farm and Hatchery in Walpole, Maine.

“I believe aquaculture is one of Maine’s most promising areas for economic development. When you look at the demand for seafood, such as scallops and oysters, and you couple that with Maine’s enormous coastline and wide variety of marine environments, it’s a natural fit,” says Mook.

At the farm, Mook produces over 100 million juvenile

oyster seeds annually to sell to East Coast growers. He also raises adult Wiley Point and Pemaquid Point oysters to sell to restaurants statewide.

Mook is using the data collected by UMaine SEANET buoys in aquaculture farms to help understand the changes occurring in the marine environment. Any change in ocean chemistry subsequently affects his oysters’ development.

Mook, who started his farm 31 years ago, is particularly interested in ocean acidification. At the end of the last decade, he started having trouble growing oyster larvae in his hatchery. A colleague on the West Coast told him that ocean acidification may be to blame.

“Because water quality is so important to us, we become an early warning system for problems. What we’ve experienced with larval problems and ocean acidification is a perfect example of that. We are the canaries in the coal mine in that sense,” says Mook.

Ocean acidification is primarily caused by the uptake of carbon dioxide, which dissolves in seawater and increases the acidity, making it harder for oysters to create their calcium carbonate shells.

Because of increased acidity in the Damariscotta River, Mook buffers the seawater flowing through his hatchery to be optimal for oyster development — a reality that sheds a dark shadow on the future of wild oyster populations.

Mook says the buoy data will provide information that will help relate juvenile oyster performance — growth, survival and quality — to changing seawater chemistry.

Mook’s interest in aquaculture was sparked while working on his graduate thesis on benthic ecology at the Darling Marine Center in 1983. At the time, he was working at a commercial shellfish hatchery in Round Pond, Maine, and has worked in the aquaculture industry ever since.

For Mook, it’s not just about growing delicious and locally sourced seafood. He also is concerned with the health of ocean ecosystems.

His oysters are his greatest warriors.

“I think there are several important things aquaculture

Bill Mook is owner and founder of Mook Sea Farm and Hatchery in Walpole, Maine. His hatchery annually produces 100 million juvenile oyster seeds to sell to growers down the East Coast. He also raises adult Wiley Point and Pemaquid Point oysters to sell to restaurants across the state and beyond.

Farming the sea



brings to the table for Maine. One is that it is a very environmentally sustainable industry. Oysters are filter feeders; they literally clean the water, so just on a biological level, they really are a good thing,” Mook says.

An oyster feeds naturally on available phytoplankton, filtering 30–50 gallons of water a day. In the process, oysters absorb carbon and filter nitrogen out of the water column. Like carbon, nitrogen is an essential part of life — plants, animals and bacteria need it to survive — but too much has a devastating effect on land and ocean ecosystems.

“There are ways that a lot of these climate change-related seawater chemistry problems can be addressed through research and development that I believe will give Maine opportunities that put it in a favorable competitive advantage relative to other New England states,” Mook says.

“The industry is lucky to have the Darling Marine Center right around the corner to help answer these important research questions.”

ACCORDING TO the Food and Agriculture Organization of the United Nations, traditionally the world’s supply of seafood has come from wild-caught fish. But in the last 50 years, aquaculture has grown to account for more than 50 percent of the world’s seafood production.

Though Maine is the largest producer of farm-raised marine food in the country, the U.S. accounts for only 0.8 percent of the farmed seafood in the world, a lag which has serious economic impacts. In 2011, the U.S. trade deficit in seafood was estimated to be \$11.2 billion, according to NOAA’s National Marine Fisheries Service.

“As the human population continues to grow, we will need more food,” says Carter Newell, president and owner of Pemaquid Oyster Co. and Pemaquid Mussel Farms. “The only way to feed the world is to farm the sea.”

Seth Barker, co-owner of Maine Fresh Sea Farm in Clark Cove, grows three species of sea vegetables — sugar kelp, winged kelp and dulse — on horizontal ropes to sell direct to consumers. His crops grow through the winter and are harvested in the spring.

Newell’s interest in aquaculture also was sparked while completing his master’s degree at the Darling Marine Center in 1979, working with soft-shell clams. He decided to start raising mussels and oysters, thinking one of them would fail.

“They both seemed to succeed pretty well,” says Newell as he looks out at his floating farm in Clark Cove.

Newell grows oyster seeds in upwellers and surface trays in the upper Damariscotta and then finishes their development in floating rafts in Clark Cove. Mussels are grown in rafts in Lamoine, Stonington and South Bristol.

His products are distributed to more than 40 restaurants in midcoast Maine, and are shipped to Portland, Boston and beyond.

Newell has experience working with shellfish farms in Ireland, where growers rely on government-sponsored buoy systems that have been collecting data for two years.

“It was exactly what we needed to model the growth of the organisms and to really understand the estuary,” says Newell, who now uses data from a buoy in the Damariscotta River to monitor changes in the ocean environment, which helps inform his farming practices.

Specifically, Newell monitors water temperature in the estuaries to know the optimal time to “plant” 2 million oyster seeds.

Though SEANET is focused on understanding what controls the productivity of Maine’s estuaries, the team of researchers also is working to train the next generation of aquaculture scientists, farmers and entrepreneurs.

“Coastal communities in Maine have a strong cultural and economic tradition of working on the sea, and aquaculture is a continuation of this tradition,” says Anne Langston, associate director of ARI.

Farming the sea



“
As the human population continues to grow, **we will need more food.** The only way to feed the world is to farm the sea.” Carter Newell



THOUGH SETH Barker, co-owner of Maine Fresh Sea Farm in Clark Cove, is relatively new to the aquaculture industry, he has a great deal of experience in the field.

“The potential for aquaculture in the state is enormous,” says Barker, who was a marine biologist for the Department of Marine Resources for over 29 years.

“This form of aquaculture is supplying food locally, regionally and even nationally. The potential is not just for nutritious food that can feed the world, but also for jobs and businesses that are related to and tied to the coast of Maine.”

In the clean waters of the Damariscotta River estuary, Barker grows three species of sea vegetables — sugar kelp, winged kelp and dulse — on horizontal ropes. His crops grow through the winter and are harvested in the spring.

“In many ways, sea farming is a different slant on farming, but the basics are the same. We’re growing a crop, we have an annual cycle, we have things that any farmer needs to deal with, like pests,” says Barker, who founded his company in 2014 with his partners Peter Fisher and Peter Arnold.

Though the three had different specialties — marine biology, seafood sales and sustainability — they all had a similar vision: to sustainably grow and harvest sea vegetables in a way that supports the natural environment, and protects Maine’s working waterfront and marine-based economy.

Three years later, they are doing just that.

“We’re a small farm,” Barker says. “We look at ourselves as being a part of the local farming movement. It just happens that our crops are in the water.”

Barker became interested in sea vegetables when he saw a demonstration project in Clark Cove to help mussel farmers grow sugar kelp on their aquaculture rafts. The project was conceived by Newell, who had begun seeing kelp growing naturally on some of his mussel rafts. Dana Morse, a Marine Extension associate, was one of the leaders of the demonstration project, funded by the Maine Aquaculture Innovation Center at the Darling Center.

Barker uses seedlings grown at the Center for Cooperative

Aquaculture Research and recently established his own nursery at the Darling Marine Center. He also is collaborating with food scientists in UMaine’s School of Food and Agriculture to look at the shelf life and nutritional value of sea vegetables, and with the Advanced Manufacturing Center on campus to find a mechanized way of drying seaweed.

Barker plans to use the data from the UMaine buoys to better understand the growing cycle of seaweed in the Damariscotta River estuary.

“SEANET not only provides answers to specific research problems, but it also provides people to turn to who are interested in the problems that come along and questions that need to be answered within the aquaculture industry,” Barker says.

“The better we can connect sea farmers and researchers, the further along we will move in developing this form of farming. The potential of what we’re doing, I’d like to say, is huge. And I’d like to say we will feed the world.”

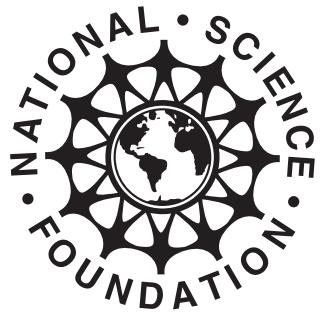
Some of Maine’s biggest aquaculture fans can be found in downtown Portland at Eventide Oyster Co. The intimate oyster bar features warm natural lighting, picnic table seating, and extravagant and inventive seafood dishes, spirits and local beers. The menu bursts with creative dishes, but there’s no doubt what’s the star of the show — fresh Maine-grown oysters offered raw on the half shell.

Chef and owner Andrew Taylor says the expansion of aquaculture in Maine would not have been possible without the public’s interest in locally grown food. He has been amazed by the support of locally grown shellfish since his restaurant opened in 2012.

Taylor, named the 2013 Best New Chef in New England by *Food & Wine* magazine, is one of many chefs who partner with aquaculture growers across the state to provide customers with the freshest possible seafood on the market.

“When we opened this restaurant, it was our goal to showcase some of the best oysters and shellfish in the world,” says Taylor. “The best oysters are the ones that are grown closest to home, right here off the coast of Maine.” ■

Carter Newell is the president and owner of Pemaquid Oyster Co. and Pemaquid Mussel Farms located in Clarks Cove in the Damariscotta River estuary. His mussels and oysters are distributed to over 40 restaurants in midcoast Maine and are shipped to Portland, Boston and beyond.



Stellar in STEM

UMaine boasts five NSF Graduate Research Fellows

By Amanda Clark / Photographs by Adam Küykendall

FIVE UNIVERSITY of Maine graduate students have received a National Science Foundation Graduate Research Fellowship — the largest number to hold concurrent awards in UMaine's history. The three fellows awarded in 2016 — Anna McGinn in the Climate Change Institute and the School of Policy and International Affairs; William Kochtitzky in the School of Earth and Climate Sciences; and Kit Hamley in the Climate Change Institute — joined two others at UMaine — Anne Marie Lausier, civil and environmental engineering, and Karen Stamieszkin, marine sciences.

For the 2016 competition, NSF received close to 17,000 applications and made 2,000 award offers. The fellowship, which has been directly supporting graduate students in STEM fields since 1952, provides a three-year annual stipend of \$34,000, plus \$12,000 for tuition and fees, and myriad opportunities for international research and professional development.



Anne Marie Lausier

Anne Marie Lausier is a continuing fellow and Ph.D. student in civil and environmental engineering. Her research focuses on the inclusion of stakeholder equity considerations in water management and decision-making. She is analyzing case studies of the Integrated Water Resources Management framework and identifying features that contribute to or detract from achieving an environmental stewardship approach. She also is conducting a regional study assessing the current formalized policy and decision processes around water use at the state level. Her goal is to facilitate the movement of water policy closer to sustainability in a changing environment. Lausier was awarded an NSF graduate fellowship in 2014. Before attending UMaine, she received a bachelor's degree from The George Washington University, with a double major in geography and environmental studies.

William Kochtitzky

William Kochtitzky is a first-time fellow and master's student in the School of Earth and Climate Sciences. His undergraduate thesis focused on the volcanic and glacial evolution of the Nevado Coropuna Ice Cap, which sits atop a dormant volcano in the southern Peruvian Andes. The ice cap provides water resources to surrounding communities for drinking water, electricity and agricultural production. His project, in collaboration with the Peruvian Volcano Observatory, is changing regional hazard assessment and resource water planning in southern Peru. Kochtitzky received his bachelor's degree in Earth sciences from Dickinson College in May 2016.





Kit Hamley

Kit Hamley is a first-time fellow. For her master's thesis in the Climate Change Institute, she investigated the origins of an extinct canid — the warrah — that was endemic to the Falkland Islands. Using an interdisciplinary approach that combines the fields of archaeology, paleoecology and paleontology, she worked to determine if pre-European humans introduced the foxes to the islands. She also is interested in the effect of the introduction and eradication of a top predator on the remote island ecosystem. Hamley hopes this study will help respond to questions in conservation and management on islands, such as biological invasions, disturbance regimes and natural variability. She is particularly interested in the role humans play in these interactions. Hamley helped develop the 4-H Follow a Researcher™ program at UMaine, which connects K-12 students with active graduate research. She has continued her research at UMaine this fall as a Ph.D. student in the Ecology and Environmental Sciences Program. She received a bachelor's degree in geology from Bowdoin College in 2010.

Karen Stamieszkin



Karen Stamieszkin was awarded an NSF Graduate Research Fellowship in 2012 and received her Ph.D. in August 2016. Her research explores zooplankton fecal pellet carbon export in the ocean, particularly the portion of fecal material produced by organisms living near the ocean surface. By applying the models to data sets that span the North Atlantic Ocean for more than 55 years, she explored how changing plankton communities and oceanographic conditions can change the export of fecal pellet carbon from the surface of the ocean to deeper depths where it can be stored. Her experiments show that feeding by zooplankton and subsequent fecal pellet production shift the mean size of particles in the water to larger sizes. Since larger particles generally sink faster than smaller particles in the ocean, the process of feeding and defecating is a mechanism through which zooplankton can increase the potential for carbon export. She received her master's in environmental science and her bachelor's in environmental studies from Yale University.



Anna McGinn

Anna McGinn is a first-time fellow and master's student in the Climate Change Institute, and the School of Policy and International Affairs. In her research, McGinn is evaluating existing climate change adaptation projects in developing countries to understand potential co-benefits and/or negative impacts that projects might have on the communities in which they are implemented. She also will look at how these projects are funded to see what role these mechanisms play in facilitating sustainable adaptation projects. McGinn plans to travel to observe each adaptation project case study location to look at current initiatives and how they may impact the surrounding community. McGinn received her bachelor's degree in environmental studies from Dickinson College in 2014, where she focused on climate change governance, climate vulnerability and environmental justice.

A benchmark of quality in graduate education and research programs is the number of nationally competitive fellowships awarded to students.

This year, the University of Maine graduate student body includes:

6 Fulbright and USAID Prestasi Fellows

5 NSF Graduate Research Fellows

2 Switzer Environmental Fellows

1 NASA Earth and Space Science Fellow



The National Science Foundation supports an average of 200 UMaine graduate students each year as research assistants. This accounts for nearly 50 percent of extramural funding support for graduate students — an average of \$1.9 million.





The making of an opera

**A poet and a composer
collaborate to create a
new work in an age-old genre**

By Elyse Kahl

JENNIFER MOXLEY'S life in poetry didn't begin with love.

Rather, it was a calling — "a moment when poetry said, 'I've come for you,'" she says.

"Such a moment is exciting, but also a bit terrifying," says the University of Maine professor of English of the pull of poetry that changed her life when she was in her 20s.

"There is no going back."

Moxley studied literature and writing throughout her college career, which culminated with a Master of Fine Arts degree from Brown University in 1994.

Her 2014 book of poems, *The Open Secret*, won the Poetry Society of America's 2015 William Carlos Williams Award and was a finalist for the 2016 Kingsley Tufts Poetry Award. Moxley also has published five other books of poetry, a memoir and a book of essays.

The making of an opera

And while she adored opera from the first time she saw *Carmen*, Moxley didn't immediately recognize the symbiosis between the dramatic art form and poetry.

"I made no connection between the word art I practiced and the musical drama I consumed. But this was a mistake," Moxley says. "For poetry and opera have, as American poet Ezra Pound wrote of himself and his predecessor Walt Whitman, 'one sap and one root.'"

Composer and clarinetist Beth Wiemann knows the power of music and is passionate about poetry. Her recordings and her classical and electronic musical compositions — which incorporate computer-generated sounds with the music of a live performer — have received critical acclaim.

Her works have been performed from New York to San Francisco, and from the U.K. to Havana, and are on the Capstone, innova and Americus record labels.

In 2011, after reading Moxley's work, including her "entrancing" memoir, *The Middle Room*, Wiemann sought

out her UMaine colleague with a proposal to collaborate on a small chamber opera.

"Setting poetry has always been a big part of my composing life, but having that kind of language tied to a longer-form story line gives a real architecture for the music. Working with that is something I've been hoping to do for a while," says Wiemann, a professor of music who chairs UMaine's Music Division.

Their first step: possible story lines on which to base the opera. Moxley and Wiemann decided on an adaption of *Bid Me to Live*, the novel by American poet H.D. (Hilda Doolittle) that relates her near romance with English novelist D.H. Lawrence.

H.D. is one of the poets central to the scholarship of the National Poetry Foundation, based at UMaine.

The opera tells the story of a woman coming into her own as an artist, and that's a story Moxley says she can relate to. Wiemann was more drawn to H.D.'s melancholy tale of bohemian writers caught up in the trauma of World War I.



Jennifer Moxley, left, and Beth Wiemann

“

Opera is having a kind of revival right now, especially small-scale, independent works. There's a **wave of new opera companies**, as well as **many enthusiastic young singers** willing to take a risk on **the future of this wonderful genre.**"

Jennifer Moxley

One reason the pair settled on *Bid Me to Live*: It was a subject they could “envision working on for a long time, a necessity for an operatic project,” Wiemann says.

IN SPRING 2012, Moxley began redacting the roughly 200-page work into a 25-page libretto, using the basic outlines of her favorite Baroque operas as models. Moxley not only used scenes from the roman à clef, but also language from several of H.D.’s poems, including “Hermes of the Ways” and “Eurydice.”

According to Moxley, many modern operatic works are similar to the early musical dramas created in the 1600s in that the composition is not separated so neatly into aria, the emotional songs; and recitative, the narrative parts. Instead, it follows a continuous melodic flow of the vocal line.

“This is most suitable to the words of a writer like H.D. — written with a great subtlety of rhythm, without rhyme or meter,” Moxley says.

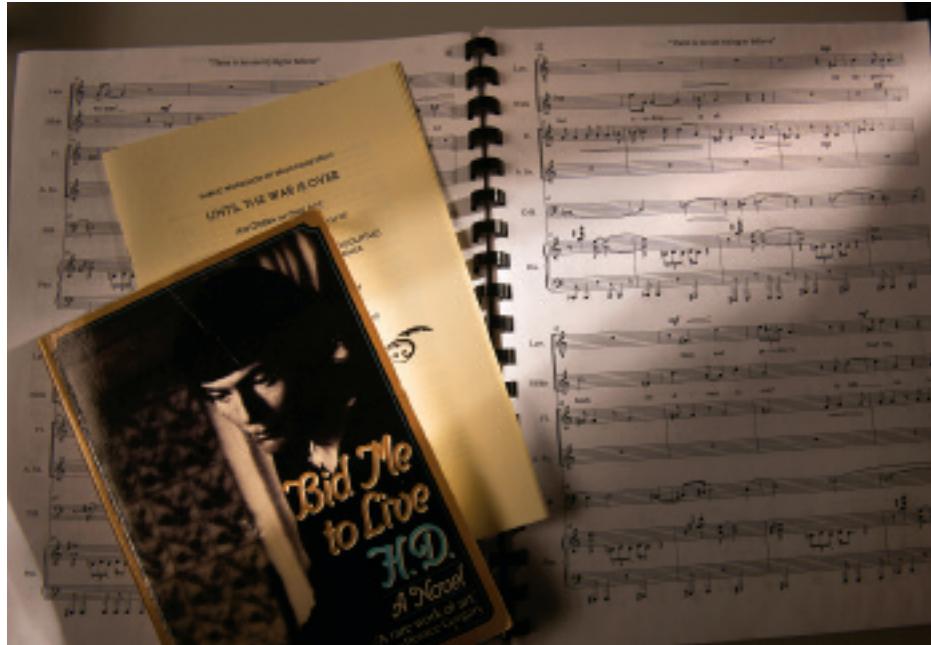
The libretto, titled *Until the War Is Over*, was then passed to Wiemann to compose the score. She wrote most of the music in 2013 and 2014.

While Wiemann had written *Deeds*, a short comic opera with librettist Ron Singer in 2003–04, this project marked the first time she would write music for a dramatic piece.

“Once the libretto had a complete form, I worked on individual sections that Jennifer had marked off as solo arias,” Wiemann says of the creative process. “That way, I could have a sense of what the music for the individual characters would be. Then, I worked outward from those arias, eventually completing the four scenes that feature H.D. in conversation with three other characters.”

A chamber opera is shorter than most operas and written for a small ensemble. In this case: flute, piano, alto saxophone, double bass and electronic sounds. Wiemann wrote for a small ensemble partly because of the intimacy of the source material, but also for practical considerations for future performances.

Once a first draft of *Until the War Is Over* was finished, Wiemann started exploring ways sections could be performed.



Until the War Is Over is based on an adaptation of H.D.’s *Bid Me to Live*, relating the poet’s near romance with English novelist D.H. Lawrence. The novel provided the story line for the chamber opera: a woman coming into her own as an artist against the backdrop of World War I.

In 2013, selections from the opera were performed by UMaine students in School of Performing Arts events. In addition, a 10-minute scene featuring the title characters, H.D. and Lawrence, was selected for performance by Hartford Opera Theatre as part of its New in November festival in 2015 — one of six new operas chosen from more than 40 submissions.

WITH FUNDING from a Maine Arts Commission grant and additional support from the UMaine Humanities Center and College of Liberal Arts and Sciences, the School of Performing Arts also presented selections from the opera in June 2016. The public event, which included a lecture by Moxley, was presented to a full house in the Black Box Theatre in the Class of 1944 Hall.

The performance was directed by UMaine theatre professor Tom Mikotowicz and conducted by Boston-based

The making of an opera

Copyright © 2016 by The Schaffner Family Foundation; used by permission of New Directions Publishing Corporation, agents.



H.D. and D.H.

UNTIL THE WAR IS OVER, a chamber opera by University of Maine professors Jennifer Moxley and Beth Wiemann, is based on the novel *Bid Me to Live* by American poet H.D. (Hilda Doolittle). Published in 1960, the book tells the story of H.D.'s near romance with English novelist D.H. Lawrence, whom she met in 1914.

After the stillbirth of her child with then-husband and English writer Richard Aldington in 1915, H.D. found comfort in Lawrence, whom she referred to as the only one who understood her loss. Their friendship grew and by 1916, they were exchanging poems by mail, according to a biography of H.D. by the Chicago-based Poetry Foundation.

According to H.D., Lawrence rejected her romantically and abruptly ended the friendship after learning of her affair with music historian Cecil Gray.

Despite their complicated relationship, H.D. described Lawrence as her twin, her equal in "cerebral" intensity in *Bid Me to Live*. H.D. also wrote about the relationship in *Tribute to Freud*, and in the unpublished works *Pilate's Wife* and *Compassionate Friendship*. Lawrence cited the relationship in *Aaron's Rod*, *Kangaroo* and *The Man Who Died*.

Bid Me to Live, according to Moxley, is a modernist account of a woman becoming an artist and, as a result, the seams between her and the men in her life begin to fray. Not long after the period the book covers — 1919–21 — H.D. began making a new life with her longtime partner, Bryher (Winifred Ellerman), the daughter of shipping magnate Sir John Ellerman.

Patrick Valentino. Soprano Lindsay Conrad sang the role of H.D. and tenor Stefan Barner sang D.H. Lawrence. Both vocalists also are from Boston.

The workshop was fulfilling for Moxley and Wiemann, as they watched their work move from the page to the stage.

"It was such a thrill to watch Tom Mikotowicz help the singers create a wonderful interpretation of my words and Beth's music. It was magic to see it all come together," Moxley says, adding that the project has allowed her to learn about the complex world of musical performance.

"When I write a poem, there is an expectation of performance, but of a sort so different that there's no comparison," she says.

"When I'm invited to read my poetry in New York or Chicago, I don't need to pay a person to rehearse and perform it, I can just get on a plane, go to the venue and read it myself. With opera, as with all the performing arts, it's much more complicated. You need talented professional people to help bring your vision across."

Although Wiemann, who studied composition and clarinet at Oberlin College and Princeton University, is well-versed in musical performance, the workshop served as a learning experience for her, as well.

"This was the first time I saw the singers work with both a music director and a stage director to shape the scenes presented. The way the singers and directors figured out what was possible for staging within the framework provided by the words and music was inspiring," she says.

Video and audio recordings of the work will be used in an attempt to secure further funding, as well as interest opera companies into the possibility of staging a full production. Future workshops and productions of the opera are planned.

It's a slow process, but an exciting one.

"Opera is having a kind of revival right now, especially small-scale independent works," says Moxley. "There's a wave of new opera companies, as well as many enthusiastic young singers willing to take a risk on the future of this wonderful genre." ■

Leading by example

Barr focused on student success and the first-generation college experience



AT THE New York Institute of Technology near his Bronx home, Zikomo Barr earned a degree in business administration with a concentration in management. But he discovered his passion in the campus activities beyond the classroom — from involvement in student government to serving as president of his fraternity chapter. Because of the difference student engagement made in his life, he decided to pursue a career working with college students. **UMAINE ENGAGED:** Now at the University of Maine, Barr is a second-year master's student in higher education and a graduate assistant with UMaine's Campus Activities and Student Engagement. He's gaining hands-on experience working with student-led organizations and helping organize initiatives that provide opportunities to get involved outside the classroom, including a statewide student leadership summit. **STUDENT SUCCESS:** Barr is committed to helping students recognize their potential as leaders in whatever they do in life. He also is dedicated to the success of low-income students and other first-generation college students. "I'm just in a fortunate position right now, and I try to wake up every day and be as humble as I can and realize that I'm better off than I was the day before. And also, try to reach a hand back and help those who aspire to be in the same position," he says. ■





'This is where I belong'

Tufts program fast-tracks UMaine's top pre-med students to meet critical needs

By Beth Staples / Photographs by Holland Haverkamp

AS THE sun peaked over the Atlantic Ocean in winter 2016, India Stewart walked into Pen Bay Medical Center in Rockport, Maine. By noon, the then-third-year student at Tufts University School of Medicine (TUSM) had participated in several surgeries, including a bilateral mastectomy, a below-the-knee amputation and a cystectomy for bladder cancer.

In the afternoon, the 2013 University of Maine graduate was in the OB/GYN clinic, performing physical exams, providing prenatal care and counseling patients on sexual health.

It was all par for the course during Stewart's nine-month TUSM Longitudinal Integrated Clerkship (LIC)

wherein she cared for patients in family medicine, internal medicine, obstetrics and gynecology, pediatrics, psychiatry and surgery settings with discipline-specific physicians.

Some of Stewart's days at the seaside, 99-bed facility were particularly intense, including the day she spent with a patient who was being taken off life support.

The woman's health care directive had instructed physicians not to prolong her life if recovery wasn't possible or regaining consciousness was unlikely.

The patient's family was unable to be at the hospital, so for hours, Stewart stayed at the woman's bedside, working with staff to keep her comfortable and telling her it was OK to let go.

India Stewart of Bucksport, Maine, a University of Maine alumna and a fourth-year student in the innovative Maine Track Program at Tufts University School of Medicine, plans to practice in her home state.

'This is where I belong'

"I couldn't bring myself to leave that room. I would not want to die alone. Our role is to be a healer and I feel like I helped," she says.

"It takes a tremendous amount of effort, but it is very rewarding. As health care providers, there are many different scenarios and many different needs."

Including soothing someone exiting the world. And helping another to enter.

Two hours after the patient passed away, Stewart assisted in the delivery of a baby.

Stewart, who majored in biology at UMaine, says coaching women during labor, especially first-time mothers, is a powerful experience.

She first witnessed the birth of a baby when she job shadowed a neonatologist at Eastern Maine Medical Center in Bangor as part of UMaine's Mentor Program. Stewart was told then that if she felt ill or uncomfortable to quietly slip out of the room.

It turned out there was no need. Stewart was transfixed. She calls the experience unbelievable and exciting.

"I just felt this smile come across my face," she says. "I thought, 'This is where I belong. It feels like I am doing something truly good.'"

IN 2006, the prognosis for rural health care in Maine was bleak. More than 25 percent of physicians in the state were approaching retirement age, according to a strategic plan conducted by Maine Medical Center (MMC) in Portland.

And 14 of the state's 16 counties were federally designated shortage areas

— or communities with more than 3,500 people and one doctor.

To remedy the situation, TUSM and MMC created the Maine Track Program. It's designed to help students in and from Maine overcome barriers, including cost, to attend medical school as well as to create an innovative curriculum centered on rural community-based education.

The desired outcome is "a pipeline of physicians" with skills in, and understanding of, rural medicine.

From a very early age, it was instilled in me to **put others before myself.**

India Stewart

Organizers believe medical students who gain experience at rural Maine hospitals will be more likely to practice medicine here and "lay the foundation for a future where every Mainer has access to excellent medical care," according to the MMC website.

"Our mantra is find the best, teach the best and then keep the best," says Dr. Jo Linder, an emergency medicine physician and director of student affairs at MMC.

AFTER STEWART'S clerkship at Pen Bay Medical Center, in summer 2016 she arrived for a rotation at MMC. The general medical, surgical and teaching facility is the state's largest. It is

licensed for 637 beds and employs more than 6,000 people.

There, Stewart — who then had begun her fourth year of medical school — had rotations in infectious disease, gynecologic oncology and reproductive endocrinology.

Stewart says her preceptors and the staff at Pen Bay Medical Center prepared her exceptionally well for clinical scenarios she has since encountered.

"Coming from Pen Bay, I really felt like I had the upper hand," she says. "I had an intimate learning environment and so much hands-on experience. I get complimented on my surgical skills and labor and delivery techniques. I attribute that to being at Pen Bay."

As a fourth-year medical school student, Stewart takes part in nine four-week rotations at hospitals in the Northeast. One was at the University of Vermont Medical Center.

And in October 2016, Stewart was based at St. Francis Hospital and Medical Center in Hartford, Connecticut.

She selected rotations to deepen and broaden her OB/GYN knowledge and skills — particularly in perinatology and maternal-fetal medicine (caring for women with complicated and high-risk pregnancies).

Working with medical residents and fellows in a variety of hospital settings is inspiring, Stewart says. She's handling a wide range of medical situations and interacting with thriving professionals who were fourth-year students just a few years ago.

A recent intense learning experience involved a young woman who was 25



“

Working through difficult cases with children is **often very challenging at the beginning, and always incredibly rewarding** to see patients improve back to happy, healthy kids.”

Jonathan Pelletier

Photo by Shawn Rocco/Duke Health

Continuity of care

AS A summer camp counselor during high school and college, Jonathan Pelletier appreciated children's energy and curiosity. These days, the second-year resident specializing in pediatrics at Duke University Hospital also thrives on helping them be healthy.

The 2011 University of Maine graduate, who majored in microbiology, realized during his third year at Tufts University School of Medicine that he also liked working with parents.

“I wanted a field where I could have decades-long continuity with my patients and their families, and a field where patient education was a major part of my daily work,” he says.

Some valuable lessons he's learned along the way: If it doesn't challenge you, it doesn't change you (medicine does both); first be a person, second be a spouse (he's

married to his best friend, Danielle), and third, be a physician; sleep for at least seven hours a night; and accept that what he doesn't know always will be more than what he does know.

Pelletier became interested in medicine after he joined the Falmouth High School EMS (Emergency Medical Service). At UMaine, he participated in UVAC (University Volunteer Ambulance Corps) and in immunotoxicology research with professor Julie Gosse.

Pelletier credits Gosse — who mentored him in basic science research at UMaine and invited him to participate in her lab's peer-reviewed papers — as being instrumental in shaping his career path.

“The skills and training I learned in Dr. Gosse's lab are still helping me five years later as I begin clinical research projects that will carry me toward

fellowship training,” says Pelletier, who since has written a retrospective study during medical school and participated in a smoking cessation research project.

Pelletier applied to Tufts University School of Medicine through the Maine Track Early Assurance Program during his sophomore year at UMaine. His decision to apply was reaffirmed during an Honors College-sponsored medical education trip to rural Tanzania with Global Volunteers.

“I hope that at the end of my career, my family and friends will say that I was fully invested in their lives, and didn't spend my whole life inside the hospital,” he says.

“At the same time, I hope that my patients will say that I was committed to them as people, and that my role as their physician was to help them live a richer life, not just prescribe their medications,” Pelletier says.

'This is where I belong'

weeks pregnant. The woman, admitted for a rare complication of pregnancy, sustained a brain bleed and was shortly thereafter in a vegetative state.

Stewart accompanied the physician who delivered the news to the woman's loved ones.

To come to peace with such anguishing situations, Stewart says she is mindful of her emotions. In addition to yoga and running, Stewart talks with her significant other, Alex Pappas, also a UMaine alum, as well as with her mother and 91-year-old grandmother, both lifelong Maine residents.

It's key, she says, that traumatic and unsettling experiences do not remain unspoken.

As a Maine Track student, Stewart took a healer's art course that teaches techniques to reduce stress and enhance coping skills. And during an ethics and professionalism course, end-of-life care and dealing with death and tragedy were topics of discussion.

You have to take care of yourself first before you can take care of patients, she says. "Doctors, by nature, are empathetic and compassionate, but often forget about their own needs."

In late March 2017, Stewart expects to "match" into a residency program in OB/GYN. And in April, she'll graduate from TUSM.

THE FIRST Maine Track students started at TUSM in 2011.

"Maine is our campus," says Linder. "The first week, students go out and work with doctors from Fort Kent to Kittery and from Eastport to Norway."

TUSM also offers a Maine Track

Early Assurance Program that annually reserves a limited number of slots for sophomores at University of Maine System institutions, as well as at Bates, Bowdoin and Colby colleges.

To be eligible, students must demonstrate academic excellence; have taken two semesters of biology, two semesters of general chemistry, and at

Our mantra is **find the best, teach the best and then keep the best.**

Dr. Jo Linder

least one semester of organic chemistry; and have attained a science GPA and a total GPA of at least 3.5. Competitive candidates also have volunteer or employment experience in a health care setting.

Those accepted into the Early Assurance Program are not required to take the Medical College Admission Test (MCAT), which affords them opportunities to explore other interests, including research, and broaden their experiences, including volunteering at health care facilities.

As many as 20 qualified Maine Track students receive an annual \$25,000 scholarship, provided by MMC, TUSM, philanthropists and Doctors for Maine's Future, funded by the state of Maine.

UMaine Career Center director Crisanne Blackie works with students

interested in applying for the Maine Track Early Assurance Program.

"They are some of our very best students demonstrating academic strength and leadership. They often are involved in research, community service, and working or volunteering in the medical field," she says.

"This group is highly motivated to pursue a career in medicine. I enjoy working with them because they are amazing students who have a commitment to Maine. They are a joy to work with."

The Maine Track Early Assurance Program's first students — including then-UMaine sophomores Jonathan Pelletier and Aaron Perreault — were accepted in 2009 for admission at TUSM in 2011.

Pelletier is a resident in pediatrics at Duke University Hospital in North Carolina and Perreault is a resident in family medicine at the Naval Hospital Camp Pendleton in California.

As of October 2016, 12 UMaine students are enrolled at, or have graduated from or been accepted to TUSM through the Maine Track Early Assurance Program. Seventeen more UMaine students have enrolled in the traditional Maine Track Program.

Linder says physicians and patients at small, rural hospitals have relished the influx of medical students. Doctors, she says, indicate having a role teaching the next generation of physicians is rejuvenating.

And patients, Linder says, enjoy the continuous and personalized care the students provide during the nine-month clerkships.

“

I want to move beyond the physical boundaries of a medical office and **integrate health care into the community.**”

Kim Dao



Community wellness

AS A child, Kimberly Dao loved watching surgeries on medical shows. And when she began volunteering at a nursing home when she was 11, she knew she wanted to work in the medical field.

The 2014 University of Maine graduate now is on track to earn her M.D. in 2018 from Tufts University School of Medicine. She plans to practice family medicine in rural Maine.

“The ability to get to know your patient within the context of their community is a privilege unique to rural medicine and family medicine,” says Dao, a biology major who was in the UMaine Honors College, and minored in child development and family relations.

Dao, who grew up in Saco, Maine, was a 2010 recipient of the Senator George J. Mitchell Scholarship Award at Thornton Academy.

Receiving the award — given to increase the likelihood that youth from every Maine community will aspire to and attain a college education — has had a lasting influence on her desire to practice medicine in the state.

“This state is beautiful and holds character that rings true to me. I have been the recipient of goodwill and dedicated help, not just financially but from people who go out of their way with only the desire to see me accomplish my goals,” says Dao.

“I believe progress is slow-moving and takes diligence, and family medicine in Maine will hopefully be my way of contributing.”

Dao was accepted into Tufts University School of Medicine after applying to the Maine Track Early Assurance Program. Now in her third year of medical school, Dao’s

rotation is at Mid Coast Hospital, a 93-bed independent not-for-profit facility in Brunswick. Her nine-month rotation is part of the Maine Medical Center/Tufts University School of Medicine Longitudinal Integrated Curriculum program.

Dao is training in obstetrics and gynecology, pediatrics, family medicine, internal medicine, psychiatry and general surgery. During her first two years at Tufts, which she describes as a “whirlwind” and two of the greatest years of her life, she has continued to volunteer for a host of projects and causes.

She has provided free health care at night to underserved people in greater Boston, and taught inmates and ex-offenders about wellness and mindfulness as tools to fight addiction and obesity.

Dao plans to open a wellness center that’s a cornerstone of a local community.

'This is where I belong'

THE 25-YEAR-OLD Stewart has had plans to be a physician since she was in kindergarten.

On a piece of green paper dated June 2, 1996 is her photograph, the names of her siblings and dog, and her note that she is going to be doctor when she grows up.

"My father always told me, I would have to be a doctor so I could take care of him when he got old, but little did he know, I really wanted to care for women and babies," Stewart says.

"I grew up the eldest girl to three other siblings and when my father passed away (when I was) 8 years old, I took on the role of being one of their primary caregivers. From a very early age, it was instilled in me to put others before myself."

When Stewart was a standout scholar-athlete at Bucksport High School, she put her career plan into action by job shadowing an obstetrician at Eastern Maine Medical Center in Bangor.

Her sophomore year at UMaine, Stewart was accepted into the Maine Track Early Assurance Program guaranteeing her a spot at TUSM in fall 2013. She proceeded to make the most out of her third and fourth years as an undergraduate and an honors student.

She practiced ballet, took multiple trips to Sugarloaf to snowboard and hiked a lot of mountains.

And as a member of the UMaine Circle K, a nonprofit organization raising money toward pediatric cancer research. Stewart organized the first St. Baldrick's head-shaving event on



UMaine alumnus Dr. Denham Ward is a mentor for the Maine Track Program. This night, his monthly meeting in a local restaurant is with medical students, left to right, Kimberly Dao and Molly Flanagan, both UMaine alumnae, and Nellie Wood. Ward was an honors student who received a bachelor's degree in electrical engineering from UMaine in 1969. He went on to a medical career in anesthesiology, with research focused on respiratory physiology. Ward retired from the University of Rochester School of Medicine in 2011 and moved back to his home state.

campus. In four years, the event has raised more than \$40,000. She is among the 500-plus participants who have shaved their heads in solidarity with children who lose their hair during chemotherapy treatments.

Since that time, she has evolved from being a caring ally to a thoughtful healer. And after a recent long day at St. Francis Hospital and Medical Center, a tired, optimistic Stewart says she's excited to see what the future holds.

She wants UMaine students considering medical school to know their

possibilities are endless, challenging and exciting.

"I truly believe you can do anything you set your mind to," she says. "I feel like I've been adequately prepared for the intense lifestyle I'm about to pursue and I'm most grateful for that."

Stewart appreciates the wide-ranging and enlightening experiences she's had in multiple hospital settings throughout New England. And she always looks forward to returning to Maine.

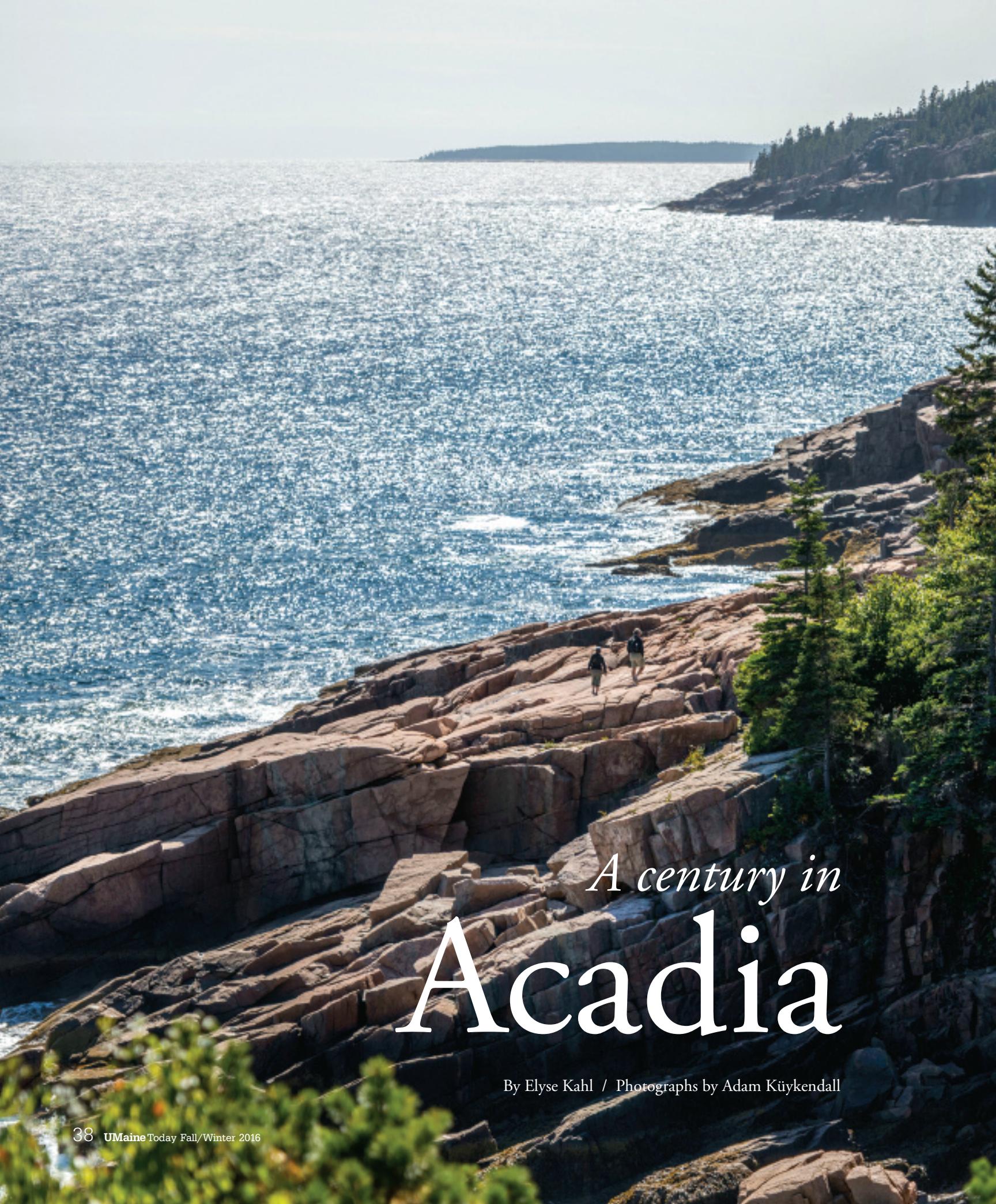
"It's my home," she says. "Maine is where I want to be." ■

Going public

Triple major aiming for political office



FOR UNIVERSITY of Maine fourth-year student Allyson Eslin, it took three majors — political science, psychology and economics — as well as being a student in the Honors College to fulfill her aspirations. “I like to joke that it was more a product of indecisiveness than ambition, but the truth is that a lot of consideration went into the process of picking majors,” says the Bangor native. “The three I chose were the three I felt would make me an effective legislator in the future. My eventual goal being to hold public office.” **MAINE PERSPECTIVE:** Eslin spent the 2016 spring semester interning for Sen. Angus King in Washington, D.C., as part of the Peter Madigan ‘81 Congressional Internship Program. This academic year, she is the editor in chief of *The Maine Campus*, and an undergraduate research assistant for the departments of Anthropology and Economics. Eslin was a 2015–16 Margaret Chase Smith Public Affairs Scholar, and has conducted award-winning research on political decision-making, and its relationship with fiscal and social ideologies. **GLOBAL CONTEXT:** Next year, Eslin will study in UMaine’s dual master’s program in global policy and resource economics. She hopes to attend law school in Washington D.C., then pursue a career with the FBI as an analyst or translator. Her career plans also include serving as a state or federal legislator. ■



A century in Acadia

By Elyse Kahl / Photographs by Adam Küykendall



View of the Atlantic Ocean from Park Loop Road

The symbiosis between a national park and Maine's public research university

IN TRIBUTE to Acadia National Park's centennial in 2016, *UMaine Today* is reflecting on the University of Maine's relationship with the park, particularly in terms of significant research pertaining to the state. Highlighted are some of the current and more recent initiatives, as well as an account of UMaine's earliest connections with Acadia. The projects cover a variety of topics and represent only a fraction of the work between UMaine and the National Park Service.

“Because Acadia is a national park, it is protected, hopefully forever, and therefore offers the opportunity to do long-term ecological research that is otherwise difficult to support or preserve in privately held landscapes,” says Ivan Fernandez, a professor in the School of Forest Resources and the Climate Change Institute.

The park’s diverse landscape and proximity to UMaine also provide benefits.

“Acadia is a beautiful place to work, as well as a really nice natural laboratory,” says Sarah Nelson, director of UMaine’s Ecology and Environmental Sciences Program, and an associate research professor in the School of Forest Resources. “You can go from the mountaintop to the ocean in a very short distance, and there is a huge array of research sites. It’s an easy trip to get lots of environmental samples that help expand our knowledge base about Maine ecosystems.”

Stephen Norton, a professor emeritus in the School of Earth and Climate Sciences, has been conducting research in the park since the early 1980s, making it part of his classroom.

“Several dozen of my undergraduate and graduate students cut their scientific teeth on studies in a remarkably beautiful part of the world,” he says. “Sometimes while performing fieldwork in the park, I had to convince myself that I was being paid to do it.”

The researchers also cite relationships with park staff as mutually beneficial.

“Research in Acadia is highly valued by park staff as they strive to manage this unique resource in the face of increasing stresses from a changing physical and chemical climate, and human use. The value of these long-term studies to Acadia, and to science in general, cannot be overstated,” Fernandez says.

More about the following projects in the words of the researchers is online (umaintoday.umaine.edu).

Exploring Eden

LONG BEFORE Acadia was a national monument or park, University of Maine faculty and alumni were visiting Mount Desert Island and the surrounding area for scientific purposes. Acadia's unique and visible geology, diverse habitats — salt marshes, rocky shores, heaths and swamps, lakes and ponds, and mountain summits — attracted prominent 19th-century naturalists.

In 1861, MDI was included in a statewide survey directed by the legislature and co-led by Ezekiel Holmes, the namesake of UMaine's Holmes Hall. Geologist Charles Hitchcock reported to Holmes that "the name of Eden is truly appropriate to this beautiful place."

A graduate of Brown University and Bowdoin College, Holmes was trained in medicine, but pursued interests in botany and mineralogy. He helped found the state Board of Agriculture and Maine State Agricultural Society and the Maine Farmer newspaper. It was in the newspaper that Holmes advocated for the creation of an independent state

college during the last two years of his life. UMaine, originally named the Maine State College of Agriculture and Mechanic Arts, was founded two weeks after he died in 1865.

Merritt Lyndon Fernald, born in Orono in 1873, began his professional life at the Maine State College, where his father was president. Fernald eventually transferred to Harvard University, where he was a botany professor and editor of Gray's Manual of Botany.

But Fernald's love of plants was fostered well before that. His home ground included MDI, where he often collected botanical specimens and continued to visit after moving to Harvard.

In 1914, he wrote a National Geographic article with George Dorr and Ernest Forbush promoting the creation of a national monument in Acadia. In "The Unique Island of Mount Desert," they described MDI as "the best opportunity along the whole Maine coast for preserving and exhibiting in a single tract its native flora."

Cadillac Mountain



Other affiliated scientists who researched in Acadia included alumni George Merrill, an authority on building stones and the quarries of Mount Desert, and ornithologist Ora Knight, as well as professor of natural history Charles Henry Fernald, who was born at Fernald Point, now part of the park. Women also surveyed flora and fauna, especially plants and birds, often alongside their husbands and on their own. Since they did not hold professional scientific positions their records were less likely to be preserved.

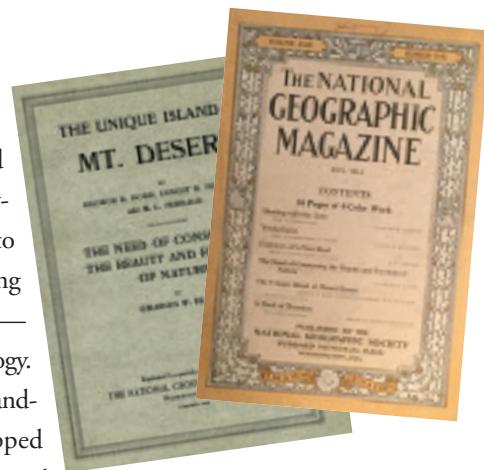
The university's strongest scientific connection to Acadia in the early years may be Clarence Cook Little — Harvard graduate, World War I veteran and UMaine president.

In summer 1924, Cook cooperated with Dorr to establish a biological research station next to the park. Fourteen faculty and students spent the summer in Bar Harbor, studying the area surrounding Champlain Mountain. They were repeating and attempting to build on the work of scientists including Barrington Moore, Norman Taylor and

Edgar Wherry. Science had moved beyond natural history-type lists of species to trying to understand relationships among species and their environment — the emerging discipline of ecology.

Researchers described the landscape, collected insects, mapped forest trees and swamp shrubs, and documented other plants and animals, including flying squirrels. Even the camp staff helped out. Chief cook B.G. Hitchings spent hours between meal prep collecting and identifying insects on Bear Brook Hill. They reported their findings in the *Maine Naturalist*.

Contributed by Catherine Schmitt, communications director for the Maine Sea Grant College Program at UMaine and author of Historic Acadia National Park.



George B. Dorr on the Beachcroft Path, on Huguenot Head. NPS/Archive photo



Above and below

WITH OVER 47,000 protected acres, 45 ponds and streams, and 10 named wetland areas in or adjacent to the park, Acadia is an ideal place to study water and air quality.

Ivan Fernandez, a professor of soil science and forest resources in the School of Forest Resources and the Climate Change Institute, began studying the accumulation of atmospheric nitrogen and mercury in watershed soils and streams in Acadia in the late 1990s.

His team's research focused on two watersheds: Cadillac and Hadlock. Cadillac was part of the approximately 17,188 acres of Mount Desert Island that burned in the Fire of 1947. Hadlock was not burned.

The researchers looked at the contrast between the watersheds to study the accumulation, cycling and loss of atmospheric nitrogen, which contributes to acid rain and is often a limiting nutrient to vegetation; and mercury, a dangerous metal that can come from natural and industrial sources. Compared to Hadlock, Cadillac had dramatic declines in

the pollutants, which were lost to erosion and combustion.

Now, 15 years later, Fernandez is returning to the sites to better understand the rates of biogeochemical accumulation and recovery in carbon, nitrogen and mercury that have occurred since the fire. What he and his graduate student learn in Acadia can inform the understanding of how the rest of Maine's landscape responds to change.

"Knowing how ecosystems function and respond to environmental disturbances is critical to making sure the Acadia of 2100 is as wonderful as it is today," Fernandez says.

At another watershed, Sean Smith, an assistant professor in the School of Earth and Climate Sciences, is focused on improving management of coupled estuary watershed systems that have been altered by humans for several centuries. His work in the Cromwell Brook watershed looks at processes that affect the runoff of precipitation and entrained pollutants from coastal watersheds, leading to the regulatory closure of shellfish beds and beaches.



He and his team developed a model to learn how Maine's coastal watersheds respond to rainfall and what landscape characteristics influence pollutant delivery to tidal estuaries.

"Seafood industries and tourism can be affected by coastal pollution," he says. "Understanding the connections between watershed runoff sources and delivery mechanisms are at the heart of pollution management strategies for coastal areas."

Over the last 30 years, Stephen Norton's research in Acadia has included atmospheric and trace metal pollution; chemical climate and its consequences in stream runoff; and the role of weather on the chemistry of surface waters.

His aluminum-phosphorus studies have helped determine why some lakes are highly productive, or algae-rich, and others are not. Norton's studies of poor air quality in the park reveal that what was once a significant problem has improved in the last few decades with respect to sulfate and trace metals, especially mercury and lead.

"We now know that our society has nearly solved the lead problem in natural environments; mercury will follow," says Norton, a professor emeritus in the School of Earth and Climate Sciences.

For the past five years, Jasmine Saros, a professor of paleoecology in the Climate Change Institute and School of Biology and Ecology, has had a partnership with the park and Friends of Acadia, a nonprofit conservation organization, to conduct research on Jordan Pond. To determine why water clarity, one of the most valued features of lakes, has been declining in Maine since the mid-1990s, Saros and her team installed a sensor buoy in Jordan Pond.

"Some of the chemical and biological changes driven by acid rain actually led to clearer lake waters. The recent decline in lake water clarity in some lakes is a positive sign of reduced air pollution, but may also be driven by increasing storm frequency and severity," Saros says. "The park ecosystems can thus serve as sentinels of broader change."

The Tarn



Being there

WITH UP to 3 million recreational visits annually, Acadia is one of the most visited national parks in the country. By the end of October 2016, the park recorded 3.23 million visits, a 420,000 increase over last year.

With more visitors comes an increased need for successful management strategies. UMaine researchers have conducted several studies to help inform park staff in creating and implementing these plans.

John Daigle started his relationship with Acadia as a park ranger while he was a UMaine undergraduate. Now as a professor of forest recreation management in the School of Forest Resources, his work continues for Acadia in park management research.

“Being able to see things I dealt with as a park ranger and then seeing the value of research improving the visitor experience and management is very rewarding,” he says.

To alleviate traffic congestion and parking problems in the park and surrounding communities, Acadia staff imple-

mented the Island Explorer bus system in 1998. The next year, Daigle began researching use and visitor experience.

Being one of the first bus systems in the National Park Service, Acadia was chosen in 2001 to test intelligent transportation systems (ITS). ITS technologies provide more real-time information, such as bus arrival times and assessment of parking conditions at popular park destinations.

Daigle and his team conducted feasibility studies and found a desire for such information. Based on those findings, ITS were incorporated into the bus system in the early 2000s. Daigle assessed visitor experience and community reactions in 2001–02, finding positive results.

The ITS study generated similar research in other popular national parks, including Rocky Mountain in Colorado and the Grand Canyon in Arizona, says Daigle, a founding member of the National Academy of Science’s Transportation Research Board Committee on Transportation Needs of National Parks and Public Lands.



In addition, Daigle conducted research focused on the management of environmental impacts caused by people walking off trail at Cadillac Mountain. Since 2000, more intensive management strategies — based on placing physical barriers and educational “Leave No Trace” signs for visitors — were employed in the park.

Daigle used remote sensing data to document improvements in vegetation conditions, comparing data sets from 1979, 2001 and 2007.

The visitor experience in Acadia also has been the focus of research by Sandra De Urioste-Stone, an assistant professor of nature-based tourism in the School of Forest Resources. She and her students surveyed visitors about weather and climate change at several sites in Acadia in 2014 and 2015. They found weather influences destination selection, and the majority of visitors are concerned about climate change.

“We hope that by understanding the perceptions of visitors and their potential changes in behavior, suitable

adaptive strategies and early preparedness actions can be developed to cope with the effects of climate change to the nature-based tourism industry in Acadia,” she says.

The findings suggest public education and outreach are relevant strategies for Acadia to use to enhance visitors’ understanding of climate effects in the region and their role in reducing carbon footprint. Study results also might provide insights to tourism planners and businesses across the state, De Urioste-Stone says.

“Tourism is one of the largest industries in the state, so potential changes to tourism patterns could have a significant effect on many communities,” she says.

“Since tourism in Maine is primarily nature based, changes in weather and climate will likely affect where and when visitors travel, and their overall trip satisfaction. Understanding visitor perceptions of climate change, appealing destinations and their essential features will be crucial for sustainable tourism destination development.”

Cadillac Mountain



Engaging nature

A RESEARCH project that began at the University of Maine in 2012 is now engaging students and volunteers in science at about 70 national parks, including Acadia.

The Dragonfly Mercury Project, a collaboration among UMaine, the U.S. Geological Survey (USGS), National Park Service, Dartmouth College and University of Wisconsin-La Crosse encourages students, volunteers and park visitors to collect dragonfly larvae to measure mercury levels in water bodies. The nymphs are sent to UMaine, USGS and Dartmouth College for analysis.

The goal of the project is to better understand human-caused mercury contamination in national parks.

“The Dragonfly Mercury Project provides the ideal vehicle for connecting people with parks and using parks as outdoor laboratories,” says Sarah Nelson, director of UMaine’s Ecology and Environmental Sciences Program, and an associate research professor in the School of Forest Resources.

“The hands-on, minds-on approach can allow anyone interested to participate in a real scientific research study, and learn how to be a scientist for a day,” she says.

The project grew out of Acadia Learning, an education program created by UMaine, Schoodic Institute, Maine Sea Grant College Program and a group of high school teachers across New England to develop field methods that could effectively be used by citizen scientists.

As teachers and students gathered data on mercury in invertebrates around the region, Nelson and other researchers noticed dragonfly larvae were found in a variety of settings, including lakes, streams, ponds and wetlands. Patterns in the mercury concentrations suggested the larvae could be indicators of landscape characteristics that tend to be more conducive to mercury bioaccumulation.

“We are concerned about mercury in parks and other seemingly pristine locations across the U.S. and globe because mercury is toxic and thereby challenges the National Park



Service mandate to maintain resources unimpaired for future generations,” Nelson says.

Hamish Greig and Amanda Klemmer, faculty in the School of Biology and Ecology, are working to broaden the project’s scope to include food web implications.

Over 2,000 citizen scientists — from schoolchildren to Girl Scouts to Youth Conservation Corps to visiting teachers to park visitors — have participated, Nelson says. Citizen science allows the researchers to sample in multiple locations at many times. The thousands of samples collected each year have created what may be one of the largest mercury data sets in existence, Nelson says.

Another UMaine program that engages citizens of all ages was initiated in 2010 to build knowledge and raise awareness about climate change while developing a detailed record of the region’s biological responses.

In *Signs of the Seasons: A New England Phenology Program*, trained volunteers observe, record and interpret

seasonal changes in 19 plants and animals throughout Maine, including Acadia, and southern New Hampshire.

Coordinated by University of Maine Cooperative Extension and Maine Sea Grant, the initiative provides a science engagement opportunity for volunteers and useful information to researchers, according to Beth Bisson, associate director of Maine Sea Grant; and Esperanza Stancioff, an associate professor with UMaine Extension and Maine Sea Grant.

An average of 230,000 observations are submitted annually to the National Phenology Network’s online database, where they are accessible to the public — a resource too costly to build without citizen volunteers, according to the researchers.

Signs of the Seasons has engaged partners, such as Acadia National Park and Schoodic Institute, to develop interpretive programs and conduct ongoing phenology monitoring. The initiatives contribute data to the program and advances the park’s climate research priorities.

Hodgdon Pond



Life in the wild

OVER THE years, UMaine research related to the park's abundant flora and fauna has focused on contaminants in bald eagles and their prey; how invasive plants affect pollination of native plants; mercury levels of amphibians in vernal pools and wetlands; populations of coyotes, deer and snowshoe hares; as well as migration of birds and their use of rockweed.

Ellie Groden, a professor of entomology in the School of Biology and Ecology, has studied invasive fire ants in the park since 2002.

European fire ants (*Myrmica rubra*) became a problem in Acadia's picnic areas and campgrounds in the mid-1990s. Park officials contacted Groden and entomology professor Frank Drummond to investigate the problem and develop management strategies.

The researchers, along with undergraduate and graduate students, looked at the ecology and distribution of the ants in the park. The team found the invasive ants eliminated

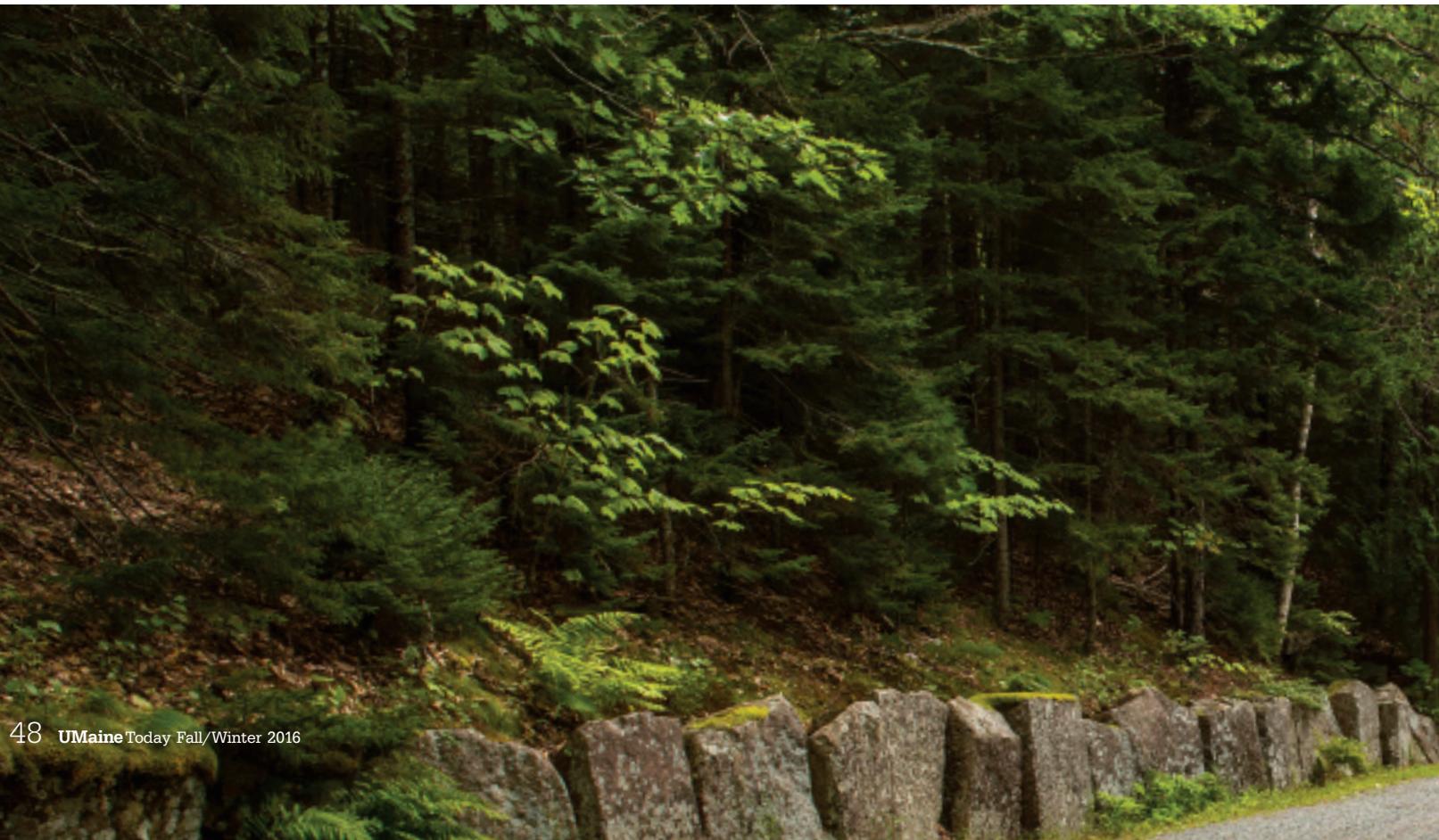
all native ant species and increased the number of plant-feeding and damaging insects.

The team then worked with park staff to develop and test management strategies. In 2012, strategies involving food baits were implemented and evaluated, and educational materials were developed for the park and coastal communities.

"In assessing the impact of treatments, we found the ants had much more of an impact on natural fauna than the treatments themselves," she says. "Ecosystems, including natural insect communities, recovered very rapidly."

Kate Miller, a Ph.D. candidate in the UMaine School of Biology and Ecology, is a plant ecologist for the National Park Service Inventory and Monitoring Program. Based out of Acadia, Miller develops and implements long-term vegetation monitoring programs in northeastern parks, including for forests and freshwater wetlands.

Information gathered from baseline inventories and long-term monitoring of natural resources help guide park



management decisions in response to stressors, such as deer overabundance and climate change, according to Miller.

"We have been monitoring forests in 176 permanent plots in Acadia for 11 years," says Miller, a UMaine alumna who has been with the NPS program since 2006. "Results of our monitoring in Acadia indicate that forests are in relatively good condition, especially compared with forests in more southern parks, which are more impacted by deer overabundance and invasive species. Although we're very concerned about the potential impacts of climate change on Acadia's forests."

The program also partners with the Environmental Protection Agency's National Wetland Condition Assessment to conduct freshwater wetland monitoring.

Linda Bacon, Lake Assessment Section leader of the Maine Department of Environmental Protection's Bureau of Water Quality, received a master's degree in aquatic ecology from UMaine in 1987. She became a lake ecologist

for DEP two years later, and is currently pursuing a Ph.D at UMaine.

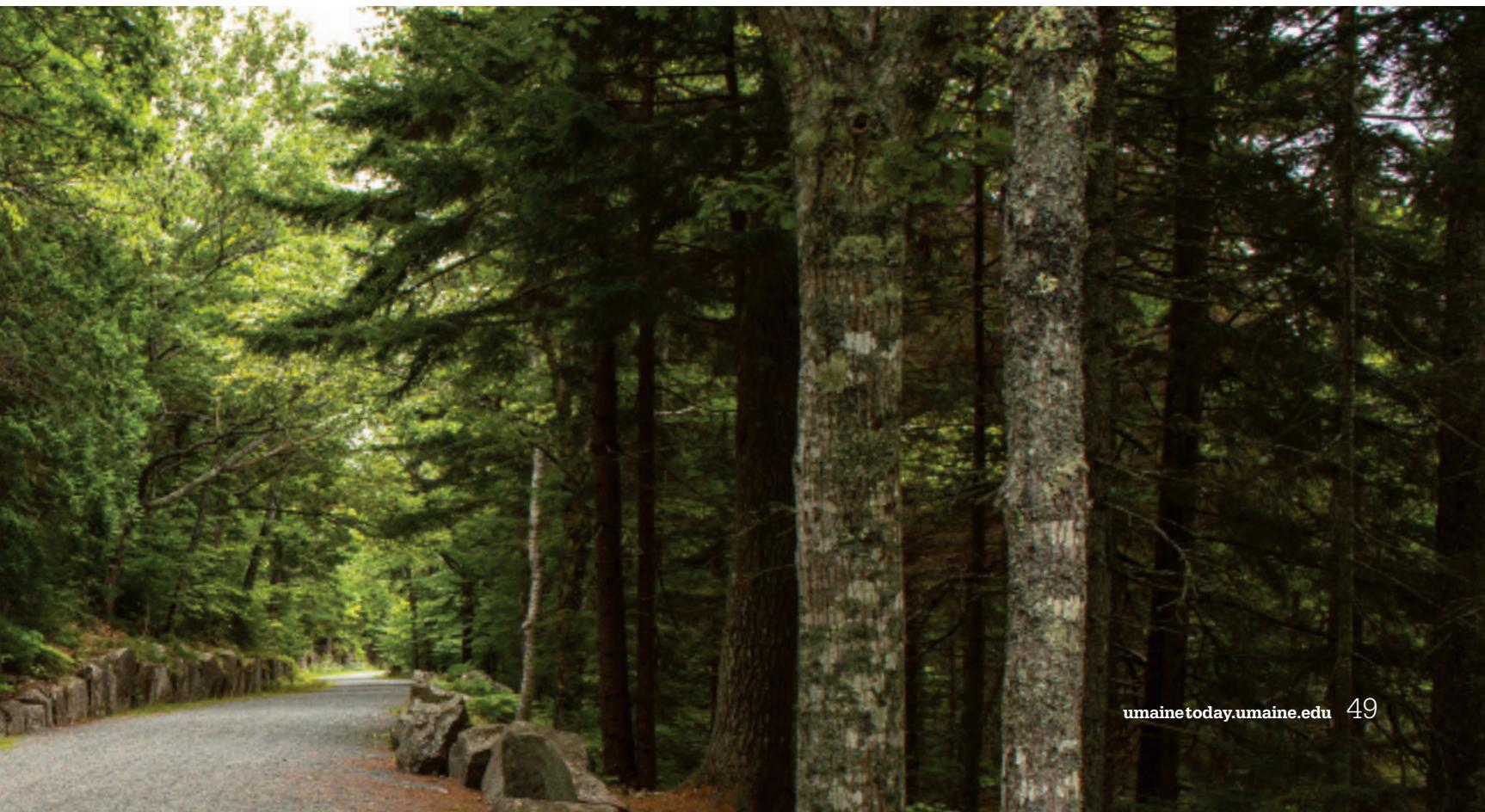
In 2012, Bacon worked with UMaine researchers to evaluate mercury concentrations in tissue of fish found on Mount Desert Island.

Studying in Acadia, Bacon says, provides an environment with minimal human impact due to land use and development, from which reference conditions can be inferred.

Bacon found fish tissue mercury concentrations have not significantly changed in previously monitored lakes, despite the reduction in atmospheric mercury deposition. Her research contributes to the re-evaluation of the statewide freshwater fish consumption advisory.

"Freshwater fish in Maine lakes are of interest to both local and visiting anglers," Bacon says. "Because fish are an important source of protein, it is important for consumptive anglers to evaluate risk posed by mercury contamination." ■

Carriage road near Hadlock Stream





On the front lines of discovery

**Maine's top biomedical research institutions collaborate
to train the next generation of scientists and engineers**

By Walter Beckwith / Photographs by Holland Haverkamp



FOR A decade, the University of Maine Graduate School of Biomedical Science and Engineering (GSBSE) has trained the next generation of biomedical leaders in Maine through one of the state's most successful partnerships.

GSBSE's strength is the result of unprecedented collaboration among the premier biomedical research and education institutions in the state — UMaine, The Jackson Laboratory, Mount

Desert Island Biological Laboratory, Maine Medical Center Research Institute, University of New England and the University of Southern Maine. The partnership also includes leading biotechnology businesses in Maine that need highly skilled employees for new opportunities in the rapidly growing life science industry.

With more than 150 affiliated faculty members and 41 current graduate students performing research statewide, GSBSE has depth and breadth. Much of its research is vital to finding the causes and treatments for some of the most intractable diseases and medical conditions, including those prevalent and particularly relevant to Maine — cancer, muscular dystrophy and aging-related illness.

GSBSE is one of UMaine's Emerging Areas of Excellence.

In their highly interdisciplinary work, GSBSE students are experts in their fields — biological sciences, chemistry, computer science, psychology, engineering — and well-positioned to communicate across disciplinary lines. Their skills are unique and highly valuable to both academic institutions and businesses, allowing graduates to succeed in varied professional fields.

Elisabeth Kilroy

On the front lines

Graduates of the GSBSE — 38 to date — are working at research institutions and businesses throughout the state, nation and world, and, combined, hold more than 150 publications in many top scientific journals.

For the 10th anniversary observance this fall, GSBSE students, alumni and faculty gathered at UMaine to share their research and celebrate their collective role in the many successes of the program. They included Andrew Doyle, the first GSBSE graduate who launched his career in Maine in 2008.

He credits the interdisciplinary skills he gained in the program with helping him achieve his goals and ensuring his success in the state's growing biotechnology industry, despite entering the workforce during the challenging economic recession.

Also attending was Elisabeth Kilroy, a second-year GSBSE student working to gain the technical skills and knowledge to understand the genetic mystery

of her family's muscular dystrophy. Solving the puzzle could lead to new insights and treatments for the disease.

The stories of these two GSBSE student researchers exemplify the program's legacy in the state and its role in Maine's future.

one of the company's many products that Doyle is particularly proud of.

Doyle leads the research and development of GVS North America's chemically intensive products.

“The company I work for has grown tremendously over the years and as we expand our business, I am constantly challenged to learn new things,” Doyle says, “which is very exciting for me.”

Doyle, a Lyman, Maine native, earned a bachelor's degree in biochemistry at UMaine and a Ph.D. with dual concentrations in chemical engineering and functional genomics in 2008 from UMaine via GSBSE.

When he received his doctorate — the first awarded by GSBSE — he entered the job market during one of the most challenging economic downturns since the Great Depression.

Living and working in Maine was a priority for Doyle — a goal he has been able to achieve in large part due



Life science

GSBSE CONDUCTS research that contributes to finding the causes and treatments of some of the world's most intractable conditions and diseases including:

- Cancer
- Diabetes
- Obesity
- Muscular dystrophy
- Cardiovascular disease
- Skeletal malformations
- Cognitive and behavioral disorders



GSBSE's interdisciplinary strength was essential in Andrew Doyle's Maine-based career in biotechnology.

to the strong interdisciplinary nature of GSBSE. The skills he gained during his time in the program allowed him to take advantage of highly competitive opportunities and stay valuable in a rapidly changing industry.

His graduate work focused on the transfer of proteins through cellular membranes; after completing his Ph.D., he was a membrane scientist.

When G.E. Healthcare-Whatman began the hunt for a membrane scientist to aid in the research and development of its manufactured track-etched filtration membranes, Doyle's resume floated straight to the top. But the membrane material the company manufactured and those that Doyle studied were a far cry from one another.

"Shortly after sitting down for the interview, I realized that there had been

a terrible misunderstanding, and I very honestly explained that I was not 'that kind' of membrane scientist," he says.

Despite the confusion, the interview continued. He had been familiar with the track-etched membrane material, having used it during his laboratory rotation at Maine Medical Center Research Institute. Combined with his strong interdisciplinary background in both the life sciences and chemical engineering, Doyle got the job, three weeks after finishing school.

Due to the recession, G.E. Healthcare-Whatman ultimately announced the closure of its facility and, in 2010, a small startup, Maine Manufacturing, LLC, took over the operation and retained 65 of the original 225 jobs. Doyle was the new company's fourth employee.

"Over the years, I have had many different roles, depending on the needs of the business," he says. "I would often work with cell culture, surface science and polymer chemistry, all within the course of a single day, particularly when we were small and everyone had to wear many hats."

Doyle credits GSBSE for giving him the adaptability to grow with the new company.

"This combination of skills was incredibly valuable to the company and it remains so to this day," Doyle says. "It allows me to speak to a customer with a very specific scientific need. I can understand that need and I can design a product to address it. Then I can figure out how to manufacture that product in the most cost-effective way possible."

Points of pride

10 years of biomedical studies.

A partnership among six premiere biomedical research and education institutions in the state — three private research institutes and three universities.

- The Jackson Laboratory
- MDI Biological Laboratory
- Maine Medical Center Research Institute
- University of Maine
- University of Southern Maine
- University of New England

Collaborates with leading biomedical businesses throughout the state, such as IDEXX, to provide experiences for students and potential workforce to the businesses.

Nearly **150 faculty** members located statewide.

41 current graduate students throughout the state.

38 alumni working in institutions and businesses around the state, nation and world.

Less than **10% admittance** rate, resulting in superb, quality students.

Over **150 alumni publications** to date.

At any given time, participating faculty hold an average of **\$30 million** in federal and foundation research funding.

Designated an **Emerging Area of Excellence** by the University of Maine.

In 2014, the Italy-based company GVS Life Sciences partnered with Maine Manufacturing to create GVS North America. Now, many of the products Doyle helped develop in his eight-year tenure are manufactured in Maine and sold globally.

The facility currently employs more than 200 people.

"In my career, I am most proud that I was able to work with a great group of people and take a small startup company and help grow it into the company it is today," Doyle says.

Today, the halls of GVS North America are lined with laboratories, warehouse spaces, clean rooms and a large production facility filled to the brim with custom-engineered robotic manufacturing equipment, much of which Doyle has helped create.

"While I am only a part of this success, seeing how many jobs were saved and created through a very difficult economic time is very rewarding," he says.

Doyle says he has a great deal of emotional investment in GSBSE's continued success. He sits on the program's external advisory board and champions student diversity.

"GSBSE is why I can raise my children in Maine, why my wife and I can see our families on the weekends," says Doyle. "It's a priceless opportunity and I'm very hopeful some of my efforts help to grow the program."

In an address to current GSBSE students and alumni at the program's annual meeting earlier this year, Doyle stressed the valuable skill set GSBSE offers.

"GSBSE will allow you to be nimble and unafraid," he told the audience. "You can do whatever you want. You are all problem solvers."

WHEN ELISABETH Kilroy heads to the gym at dawn, in the middle of the winter and often after a long night in the lab, she's doing it because her father, brother and thousands of others who have muscular dystrophy cannot.

"Regardless of how tired I am or how cold it is outside, I am going to go lift weights and get stronger because they can't," says the certified personal trainer turned biomedical grad student.

"I wake up, and I build muscle for my dad and my brother."

Kilroy is a second-year doctoral student in GSBSE who is searching for the cause of the disease affecting her family.

Muscular dystrophy (MD) refers to a group of genetic diseases that can cause progressive muscle weakness and wasting. It is a disease with no cure and many types have little-understood or outright unknown causes.

Kilroy's father and brother — as well as her aunt and cousin — have an unknown type of the disease. She hopes to change that by identifying the gene causing the illness and, ultimately, opening the door to future treatment.

Much of the variation between different types of MD relates to the specific gene mutations responsible for the illness. Identifying the mutations can greatly inform patients and clinicians about the onset, pace and course of the dystrophy. This infor-

mation is key in developing therapeutic agents.

"You don't have a chance to win a fight if you don't know what you're fighting," says Kilroy.

Kilroy, originally from Brewer, Maine, received a bachelor's degree in exercise science from the College of Charleston before returning to her home state to pursue her Ph.D. in biomedical science.

While she has spent the past year and a half at UMaine studying the causes of the disease, Kilroy's life has been devoted to trying to understand its effects.

Her father, Timothy, was recruited to play ice hockey for Boston University. But after struggling through the summer training regimen and not making the physical gains necessary, he went to a doctor. At the age of 18, he was diagnosed with MD. Now 56, he uses a wheelchair.

Keegan, Elisabeth's older brother, was training at Carrabassett Valley Academy to compete in the Olympics as a freestyle skier when he began to exhibit symptoms. Keegan also was diagnosed when he was 18.

And while her oldest brother Killian is free of the disease, it is unknown if her youngest brother, now 17, carries the gene responsible for the disease.

"There are so many unknowns for our family," Kilroy says. "This is why it is so important to identify the gene."

Working with Clarissa Henry, UMaine associate professor of biological sciences, Kilroy hopes to develop a zebrafish model of her family's genetic mutation.

Zebrafish have a similar genetic structure to humans; 84 percent of genes known to be associated with human diseases have a counterpart in the fish's genome. The fish also share the same major organs and tissues as humans, including muscle. Studying the genetic sequence of zebrafish has led to the discovery of several previously unknown genes involved in other rare forms of MD.

I can't wait for the day I can call my dad and brother and say, **'I found the gene. Now what do you want to name it?'**" Elisabeth Kilroy

Kilroy is beginning her search for answers by sequencing her family's DNA to look for the differences in the genetic code between those with, and those without, MD. This understanding will help begin the development of treatments and therapies for this, and potentially other, rare types of MD.

"I can't wait for the day I can call my dad and brother and say 'I found the gene. Now what do you want to name it?'" Kilroy says.

Kilroy applied to several universities before deciding on UMaine. It was her father who insisted she turn her attention to GSBSE and move back to Maine to have the full support of her family nearby.

He introduced her to Henry's research at UMaine, as well as that of associate professor Greg Cox at The Jackson Laboratory, a GSBSE partner institute.

"I was more than impressed," Kilroy says. "Every other program was too big and the research wasn't exactly what I wanted, but GSBSE was perfect."

Despite a very competitive acceptance rate — less than 10 percent — she says she knew GSBSE was the place for her after the first hour of her three-day interview.

Kilroy was inspired by the exceptional quality of the program's students and faculty, and their dedication to ensuring everyone's success. GSBSE offers students entry into a professional network of partner institutions and industries which Kilroy said made the difference in her decision to enroll in the program.

Kilroy says her family's motto is "adapt and overcome."

Her father earned a Ph.D. in sports administration from the University of New Mexico and was a professor at Husson University.

Her brother Keegan graduated in 2012 from UMaine with a degree in electrical engineering. Today, he and Kilroy collaborate to design some of the analytical methods she's using to study the effects of exercise on MD in zebrafish.

It's unknown if Kilroy has the gene. The two other women with MD in her family did not begin to show symptoms until their late 30s and early 40s.

Kilroy is 24. ■



Championing innovation

Helping scientific entrepreneurs break into the business of biotechnology

By Erin Miller

J EAN GEORGE didn't know exactly what her career path would be when she enrolled at the University of Maine as an undergraduate, but she knew her passion — science.

"It just enthralled me to study any of the life sciences. I always knew I was going to do something in the sciences. What exactly it was, was not clear," says George, a biology major from Clinton, Massachusetts who graduated from UMaine in 1980 and is now general partner at Advanced Technology Ventures (ATV) and Lightstone Ventures (LSV).

Then again, the biotech venture capitalist who was featured on the Forbes Midas List excels at working in the unknown. George intentionally chose to pursue a career in biotechnology in the 1980s because it was a new, exciting industry.

"There were no road maps and you were able to create your own vision for the future. I always tell young people to take risks, because you will challenge yourself intellectually and that is how you truly grow professionally," says George, who focuses on investments in the biopharmaceutical and medical device sectors.

George earned an MBA at Simmons College and began her career in bioresearch. Prior to joining ATV in 2002, she led life science investments for BancBoston Ventures. Her more than two decades in the biopharmaceutical industry include 10 years with Genzyme Corporation, where she was vice president of global sales and marketing, and founder of the tissue repair division.

At ATV and LSV, her investments have included Proteolix, acquired by Onyx; Hypnion, acquired by Eli Lilly; and many others on the NASDAQ, such as Acceleron Pharma, Calithera Biosciences, Catabasis, Flex Pharma, Portola Pharmaceuticals and ZELTIQ Aesthetics.

When George's company invests in a scientist's medical device or therapeutic drug, she helps guide the senior leadership team through the process of product development to commercialization.

On behalf of ATV and LSV, she sits on eight company boards and continues to hunt for researchers with innovative solutions to health issues that range from oncology and rare genetic disorders to cardiovascular and metabolic diseases.

"If you look at my career, what is always there is my love for science and what improves patients' lives," she says.

That vision has its roots at UMaine, where as an undergraduate, George enrolled in graduate-level courses, which she says later paid dividends.

"UMaine surpassed my expectations as an undergraduate student. I will hold up my education to any undergraduate institution. The advanced course I took afforded me a very broad understanding of the space that I was working in. It made me appreciate the complexities of the biological system and taught me how to ask the critical questions," George says.

"That is what I do now. I know how to ask the right questions. My education at UMaine taught me critical thinking about the biological sciences." ■



1 million views

DigitalCommons@UMaine, coordinated by Fogler Library, recently passed 1 million total downloads (since 2012), with more than 400,000 in the past year alone. **DigitalCommons is an online repository of works produced by UMaine faculty, staff and students.** The homepage of DigitalCommons shows a worldwide reader map with real-time download statistics.

“

Conservation doesn't get done without the people part of it.

The reason this process was successful is that we worked with social scientists and diverse interests. This would not have happened without the colleagues from School of Economics and local real estate and development interests.” Aram Calhoun

A PLAN TO PROTECT POOLS

THE FUTURE just became a bit brighter for Maine's amphibians and fairy shrimp under a new plan that encourages protection of vernal pools — primary breeding habitat.

The Maine Vernal Pool Special Area Management Plan fine-tunes existing federal and state regulations to a local level. It will serve as a voluntary mitigation tool that helps towns control their vernal pool resources, provides incentives for rural landowners to conserve their vernal pools and helps developers with a streamlined environmental compliance process.

The plan, which was six years in development, was initiated by Aram Calhoun, a University of Maine professor of wetland ecology, and her colleagues at federal and state regulatory agencies. The Maine Vernal Pool Special Area Management Plan was approved as an alternative mitigation tool by the New England District Corps of Engineers and state Department of Environmental Protection on Sept. 6, 2016.

Calhoun collaborated with the development community, regulating agencies and other scientists at UMaine to ensure the plan would align with the biophysical and social needs of Maine's future. Two Maine towns are in the process of implementing the plan.

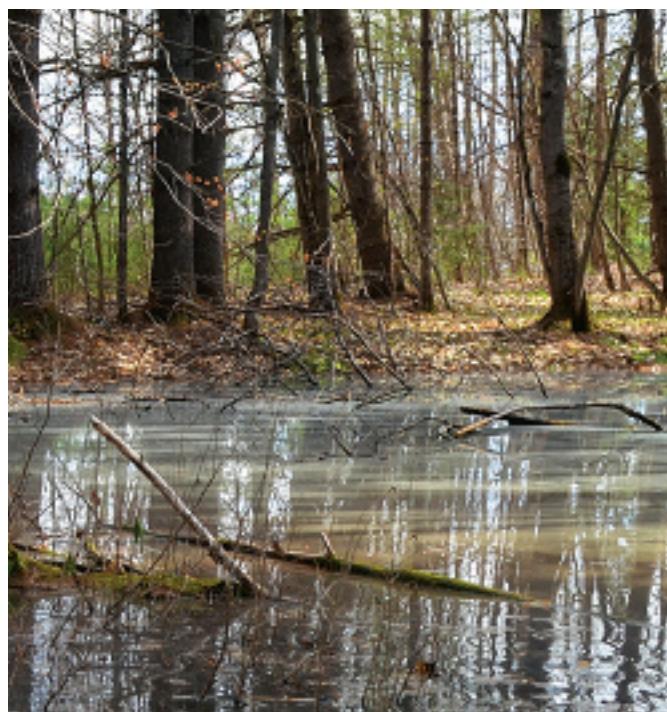
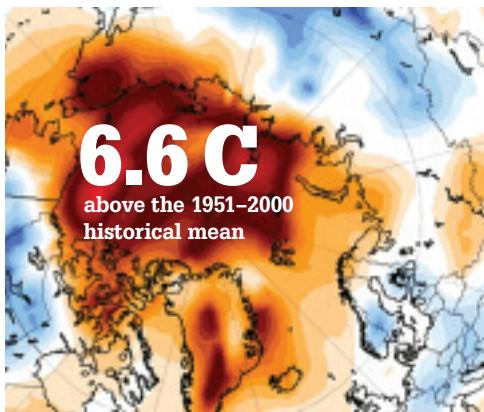
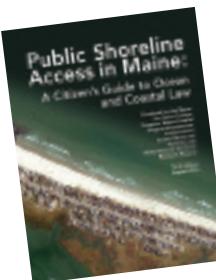


Photo courtesy of vernalpools.me



ARCTIC ANOMALY

THE FIRST half of October 2016 was likely the warmest across the North Pole for that time of year since at least 1948, says Maine state climatologist Sean Birkel, who also is a research assistant professor at the UMaine Climate Change Institute. In the Arctic on Oct. 7, 2016, the mean daily temperature averaged a balmy minus 3.5 C (25.7 F) — 6.6 C above the 1951–2000 historical mean. A steep decline of sea-ice cover has been linked to changing weather patterns across the northern hemisphere, including in Maine. Rapid warming of the Arctic has reduced the mean temperature difference between the equator and pole, which some researchers suggest has slowed the westerly jet stream. This could lead to atmospheric blocking patterns that can cause heat waves, cold waves and extreme rainfall events.



CITIZEN GUIDE TO SHORELINES

THE THIRD edition of *Public Shoreline Access in Maine: A Citizen's Guide to Ocean and Coastal Law*, available online and in print, describes Maine law and prominent court cases related to public use and access to the coast. Those cases range from the 17th-century Colonial Ordinance that reserved the public's right to "fishing, fowling and navigation" in the intertidal zone to the recent decision by the Maine Supreme Judicial Court regarding public use of a private road to access Cedar Beach in Harpswell. The guide was produced by the Maine Sea Grant College Program at the University of Maine; Maine Department of Agriculture, Conservation and Forestry; and the Wells National Estuarine Research Reserve, with funding from the Maine Outdoor Heritage Fund.



BUILDING ON SUCCESS

THE UNIVERSITY of Maine is one of 37 colleges, universities and educational groups nationwide to receive first-ever awards for the National Science Foundation's INCLUDES program. The comprehensive initiative aims to enhance U.S. leadership and collaborative impact in science and engineering by broadening participation in science, technology, engineering and mathematics (STEM).

UMaine will receive \$300,000 for a two-year pilot project that builds on its successful Stormwater Management Research Team (SMART) program based in the College of Engineering that has created a diverse STEM educational pathway with community water research. The pilot projects were selected for their potential to deliver prototypes for bold, new models that broaden participation in STEM, according to an NSF news release.

Near the end of the two-year pilot projects, UMaine and the others in the INCLUDES community will be eligible to be one of the five initiatives selected for up to \$12.5 million each in funding.

NSF INCLUDES (Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science) aims to improve access to STEM education and career pathways at the national scale, making them more widely inclusive to STEM-underrepresented populations such as females and minorities in an effort to develop a diverse science and engineering workforce.

\$300K
two-year
pilot project
grant

The new initiative is led by Mohamad Musavi in the College of Engineering and Jennifer Isherwood in the College of Education and Human Development. UMaine's SMART project will be introduced at City College of New York, Mississippi State University, University of South Florida, University of North Carolina at Charlotte and Boise State University.



VISUALIZE DISCOVERIES

THE EMERA Astronomy Center at the University of Maine is hosting a Science Lecture Series the first Thursday of each month as part of a collaborative project with the Maine Science Festival. The lectures feature research from a variety of science disciplines and take advantage of the new digital planetarium to visualize discoveries in a dramatic, immersive way. Lectures have featured UMaine bioengineer Caitlin Howell exploring proteins; Elizabeth McGrath of Colby College on large-scale structure in the universe; and Paul Mayewski from UMaine's Climate Change Institute on how humans are changing our climate. Information on upcoming lectures can be found at astro.umaine.edu/events/science-lecture-series.

SEEN ON CAMPUS



SELF-GUIDED walking tours focusing on gardens, outdoor sculptures, the historic district and other distinctive sights of the University of Maine landscape are available. The self-guided walking tours are illustrated on a website that is designed to be compatible with mobile devices. The tours, an initiative of the UMaine Division of Marketing and Communications, were created for community members and campus visitors. Two of the principal researchers for the project are authors Marisue and John Pickering, who have multiple connections to UMaine. In the coming year, other self-guided walking tours will be added, including one on distinctive trees on campus.



THOSE WERE THE DAYS

THE SUMMER 2016 issue of the journal *Maine History* (Vol. 50), published by the Maine Historical Society in conjunction with the University of Maine History Department, features five articles related to UMaine history in the past half-century. The issue is guest edited by Howard Segal, professor of history, with guest associate editor Deborah Rogers, professor of English. The articles are: "Back to the Future: Envisioning the University of Maine's Next Decades from the Perspective of the 1965 Centennial Celebration," by Segal; "The Sixties: Turmoil and Transformation in the Nation, in Higher Education, and at the University of Maine," by former UMaine President Peter Hoff; "Marine Science at the University of Maine, 1960–2015," by Catherine Schmitt, Maine Sea Grant, and Shelby Hartin; "At the 'Busy Campus Crossroads': The Last Fifty Years at Raymond H. Fogler Library," by Desirée Butterfield-Nagy, Fogler Library; and "Orono: Growing as a University Town, 1965–2015," by Evan Richert and Sophia Wilson, town of Orono.



NEW MICRODEVICE

RESEARCHERS AT the University of Maine MicroInstruments and Systems Laboratory, in collaboration with The Jackson Laboratory, have developed a new microfluidic tool that reproduces in the laboratory the same physiochemical environment that instructs embryonic stem cells to develop into organized tissue.

Using this device, the research team has successfully generated a portion of the embryonic spinal cord on a chip from stem cells.

During embryonic development, specific chemicals called morphogens direct stem cells to develop and organize into their appropriate tissues. Using the new microdevice to duplicate that spatial distribution of morphogens in the laboratory results in the same tissue organization, says UMaine chemistry professor Scott Collins with UMaine's Laboratory for Surface Science and Technology.

Using the same equipment and techniques employed in making integrated circuits and computer chips, the research team designed and fabricated a microfluidic chip consisting of a labyrinth of tiny culture chambers and interconnecting fluidic channels to generate the same morphogen distributions known to induce spinal cord development.

The research was the topic of a UMaine doctoral dissertation by Christopher Demers, now a postdoctoral research fellow at the Francis Crick Institute in London.

The microfluidic device promises to provide developmental biologists with a powerful new tool with which to study how cells make differentiation decisions during embryonic development.

The microdevice also has potential for studying limb and organ regeneration, diagnostics and therapeutics for neuromuscular diseases, such as amyotrophic lateral sclerosis (Lou Gehrig's disease), spina bifida and anencephaly, as well as drug discovery and personalized medicine.

USING DIATOMS TO REFINE ARCTIC CLIMATE HISTORY

JUST ABOVE the Arctic Circle, a University of Maine-led research team conducted a large-scale experiment to test the role of lakes' thermal structure on *Discostella stelligera*, a species of diatom whose abundance is often used as an indicator of warming-induced changes in lakes throughout the northern hemisphere.

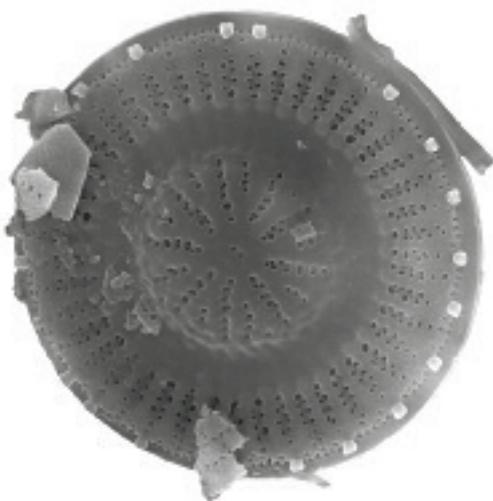
UMaine researchers are studying the effects of a changing climate on lakes by looking at a species of single-celled algae that leave microscopic silica fossils in lake sediments, creating a paleolimnological record of past environmental conditions that can extend thousands of years.

The team, led by Jasmine Saros, professor of paleoecology and lake ecology in UMaine's School of Biology and Ecology, and the Climate Change Institute, shared the research findings in the journal *Limnology and Oceanography Letters*.

Saros and her team evaluated the abundance of the species in two small arctic lakes near Kangerlussuaq, Greenland. In many arctic lakes during the summer, a warm, less dense layer of water, heated by the sun, forms at the surface and "floats" on the cooler, denser water below. The point at which these two layers meet is known as the mixing depth.

Many climate- and environmental-related factors can influence a lake's thermal structure, including atmospheric temperature, solar radiation, wind strength, changing water chemistry and turbidity.

The researchers confirmed that *D. stelligera* thrive in lakes with shallower mixing depths.



Scanning electron microscope image of *Discostella stelligera* magnified at x7000. The diatom is about 10 micrometers — .00039 inches — wide.



Maine's resilient kelp forests

A HALF-CENTURY of global ocean research indicates that kelp forests are declining in some areas and increasing in others.

Fortunately, kelp forests in Maine have been increasing since the 1990s. The large brown seaweed provides food or habitat for a number of species, including fish, sea urchins and lobster, says Robert Steneck, a University of Maine oceanographer and one of 37 scientists on the international project to study kelp around the globe. Lead author Kira Krumhansl from Simon Fraser University says understanding regional environments is central to maintaining the dense underwater forests. The research, published in the *Proceedings of the National Academy of Sciences*, is the largest study of kelp forests ever produced. Scientists found that while kelp in 38 percent of the analyzed regions showed clear declines, there were others where kelp has increased (27 percent) and others where no net change was observed (35 percent). While global factors associated with climate change affect kelp forests, regional effects vary depending on the species, local environmental conditions and other stressors, including the combination of fishing and climate change.

“

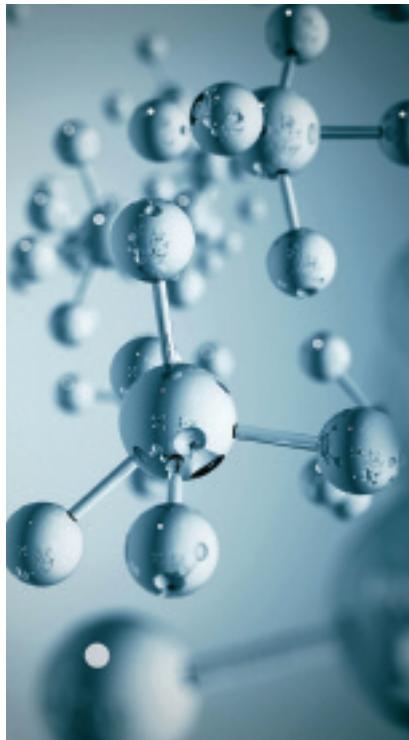
(Lobsters) typically don't like hanging out on a bare ledge that's like a parking lot with nowhere to hide. Kelp is a great habitat for lobster, so keeping track of kelp abundance is important.

Fortunately, the coast of Maine is holding its own.”

Robert Steneck

“
As a new investigator, I am poised to approach the complex field of glycoscience in innovative ways that will **aid in the diagnosis and treatment of human diseases.”**

Matthew Brichacek



DELVING INTO DISORDERS

UNIVERSITY OF Maine research to provide molecular-level understanding of glycan-associated disorders, such as inflammation, pathogen infection and cancer, has been awarded a \$1.2 million grant from the National Institutes of Health.

Matthew Brichacek, UMaine assistant professor of chemistry, leads the research to develop methods to synthesize glycans — a family of carbohydrates — that can attach to a wide variety of biological molecules. Ultimately, the glycans produced by Brichacek and his team would enable investigations of numerous glycan-binding proteins in glycan-associated disorders.

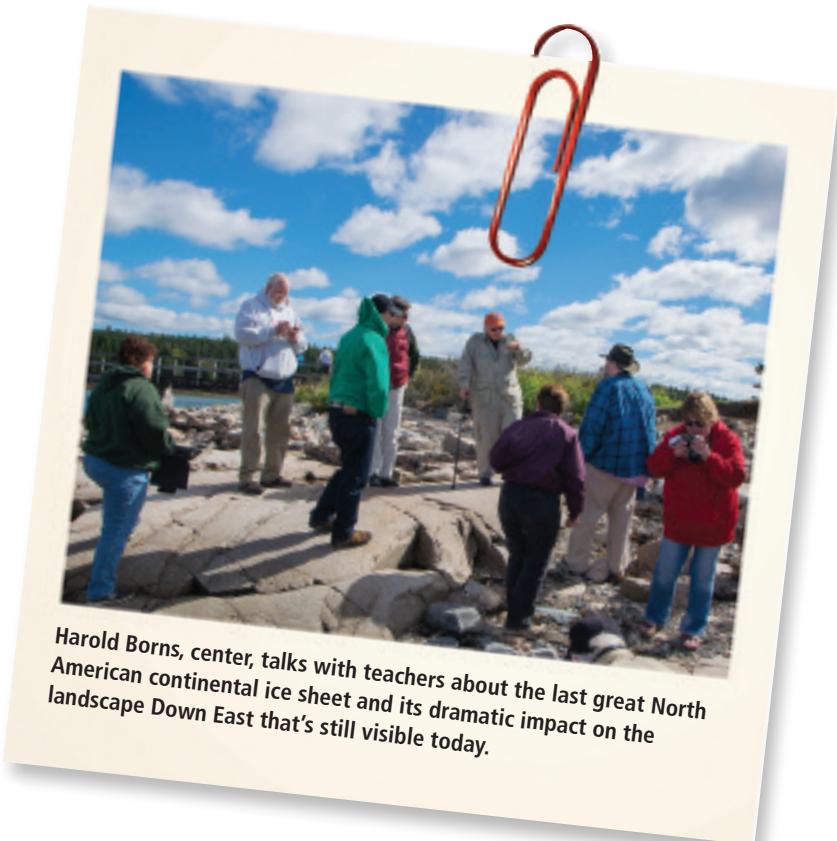
Glycans play an integral role in cell signaling, immune response and modulation of protein activity. Though researchers have long understood the importance of glycans in biological processes, the ability to study such structures has been inhibited by the complexity of the molecules, and by available tools and technologies.

Brichacek aims to develop tools for studying carbohydrates that will enable researchers in all biomedical fields to dramatically advance their understanding of the roles these complex molecules play in health and disease.

The technology would enable scientists from a wide variety of disciplines interested in carbohydrates to acquire the desired molecules inexpensively and without highly specialized training.

STEM education in the ice age

THIRTY MAINE middle and high school teachers were at the Schoodic Institute in September to learn more about the state's ice age history and evidence across the landscape, and how they could make Earth science lessons come alive. The teachers were joined by researchers from the Maine Center for Research in STEM Education (RiSE Center), based at the University of Maine, and glacial geologist Harold Borns. *Maine Ice Age Trail: Down East, Map and Guide* was developed by Borns, professor emeritus of glacial and Quaternary geology, and founder of UMaine's Climate Change Institute. Participants visited nine sites on the Maine Ice Age Trail and took part in student-centered learning activities. Based on these experiences, teacher teams began developing place-relevant science lessons for Maine middle and high school students.





In the CORE learning cycle, students will develop analogical reasoning skills in a sequence that **mirrors the process of experimentation and discovery**.

CHEMISTRY'S CORE

SCIENTISTS AND science educators have emphasized the vital role that reasoning with analogies plays in innovation, making new discoveries and advancing science. Fostering college students' use of analogical reasoning in constructing scientific arguments in chemistry laboratory work is the focus of a more than \$278,000 grant to UMaine from the National Science Foundation.

Mitchell Bruce and Alice Bruce, UMaine associate professors of chemistry, will lead the three-year research project to establish the basis of a new learning cycle developed at UMaine called CORE — Chemical Observations Representation Experimentation.

Chemists are adept at using analogical reasoning to make connections between observations that can be made with the senses (macroscopic level), the behavior of submicroscopic particles such as atoms and molecules, and the various representations used in chemistry.

However, many chemistry students struggle with making these connections in college courses, which creates a barrier to learning. The development of strong analogical reasoning skills can foster the connections.

NORWAY SPRUCE MAKES THE GRADE

NORWAY SPRUCE, a species extensively tested at the Advanced Structures and Composites Center at the University of Maine, has been approved for use as construction-grade dimensional lumber.

Based on the testing at UMaine, the American Lumber Standard Committee (ALSC) approved the inclusion of Norway spruce in the Spruce-Pine-Fir South grouping of wood species for home construction and industrial applications.

Introducing Norway spruce into the market marks a nearly once-in-a-lifetime occasion, says Jeff Easterling, president of the Northeastern Lumber Manufacturers Association (NELMA).

"This is a momentous occasion for the building industry," he says. "The addition of a new species hasn't happened in almost a century, and it's been a very exciting year as we've worked to shepherd it through testing and bring it into the mainstream."

Landowners, loggers and lumber mills are expected to benefit from being able to utilize lumber from some of the millions of Norway spruce trees, many of which the Civilian Conservation Corps planted in the United States during the Great Depression.

From October 2015 to February 2016, a team of staff and students at the UMaine Composites Center, led by Russell Edgar, wood composites manager, and Jon Hill, wood composites technician, tested 1,320 pieces of lumber milled from Norway spruce grown in Maine, Vermont, four regions of New York and Wisconsin.

The team then derived allowable design values (including bending, tension, shear and compression) for the species and wrote the final report that NELMA submitted to ALSC.

"The university is really important in its support of the forest products industry. We combine with industry, we combine with the federal government, we combine with the state government to be able to answer some of those questions that aren't proprietary for a single mill or single company — they're more industrywide," says Stephen Shaler, associate director of the Composites Center and director of the School of Forest Resources.



— **100 million** Norway spruce seedlings were planted by the Civilian Conservation Corps in the 1930s

— **2 billion** board feet of standing saw timber is in Wisconsin, Michigan and the Northeast, according to U.S. Forest Service estimates

— **10th member species** in Spruce-Pine-Fir South grouping



Valuing Maine seafood

75%
willing to pay more for sustainably harvested food

30%
willing to pay extra for seafood from Maine.

Survey of more than 1,000 Maine residents

MAINE CONSUMERS would be willing to pay more for food that is sustainably harvested and some may even be willing to spend extra for seafood harvested in Maine waters, according to a recent survey conducted by researchers in the University of Maine School of Economics and the School of Marine Sciences.

The issue, according to researchers, is that information about the source and sustainable practices of food production isn't always available.

In a survey of more than 1,000 Maine residents, 75 percent of respondents indicated they were willing to pay more for sustainably harvested food, and 30 percent believed Maine people are willing to pay extra for seafood from Maine.

Caroline Noblet, a UMaine assistant professor of economics who collaborates on the research with Teresa Johnson, associate professor of marine policy, says people do care where their food comes from and they might have preferences. But when information is incomplete or unavailable, especially in restaurants, customers' choices may be impacted.

Maine restaurant owners told UMaine researcher Brianne Suldovsky, a former Ph.D. student, that tourists — not Maine residents — were far more likely to ask about seafood origins.

The survey is part of a Maine Sea Grant research project called Seafood Links that is studying consumer perceptions of seafood and how Maine businesses source their seafood. Ongoing research focuses on issues of sustainability and willingness to purchase seafood.

ISLAND LIFE

THIRTEEN STUDENTS and two professors from the University of Maine spent the final week of May on Swan's Island doing community service projects, and taking in the natural and cultural attractions as part of a travel-study course, "Maine Island Culture and Community Engagement."

"We've gone there on field trips for the multicultural education and multicultural counseling classes," says Annette Nelligan, a lecturer in counselor education, who co-taught the class with Laura Cowan, chair of the English Department. "It's a good way to show students that Maine has many different cultures, and not just the obvious cultures of race and ethnicity, but that there can be a culture to a community."

Located six miles south of Mount Desert Island, Swan's Island is home to about 350 year-round residents. In the summer, the population swells to more than a thousand as seasonal residents and tourists inhabit the island.

A ferry shuttles people and vehicles between the community and Bass Harbor up to seven times a day — a trip that takes about 40 minutes each way, depending on the weather.

The main industry on the island is lobster fishing, but Nelligan says many residents also have creative economy jobs.

"In a place like Swan's Island, you can't extricate the culture from the natural world, because the natural world is so closely tied to everything that people do," Cowan says.

Students in the Swan's Island course renovated the island's historic lighthouse keeper's house or did volunteer work at the local school, library and historical society. Some also worked at Saturn Press, a local shop that makes greeting cards using antique printing presses.





A legend leaves a legacy

RICHARD C. "DICK" HILL was professor emeritus of mechanical engineering and director emeritus of the Department of Industrial Cooperation at the University of Maine, where he taught for 46 years. He passed away in July 2016. Hill epitomized the life of a professor who wove himself into the fabric of a university community, so much so that he chose to leave a legacy to benefit UMaine. For more information about creating your personal legacy, please contact the University of Maine Foundation.

“

Dick was a special person. **His faith in the future of UMaine continues** with gifts that benefit several departments. Like others who have worked with our staff to create a legacy, he chose several different mechanisms, customized to carry out his personal wishes, and we are truly grateful for his foresight and generosity.”

Jeffery N. Mills '82, Ph.D.
President/CEO, University of Maine Foundation

UNIVERSITY of MAINE
FOUNDATION

umainefoundation.org

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

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



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