UMaine Today

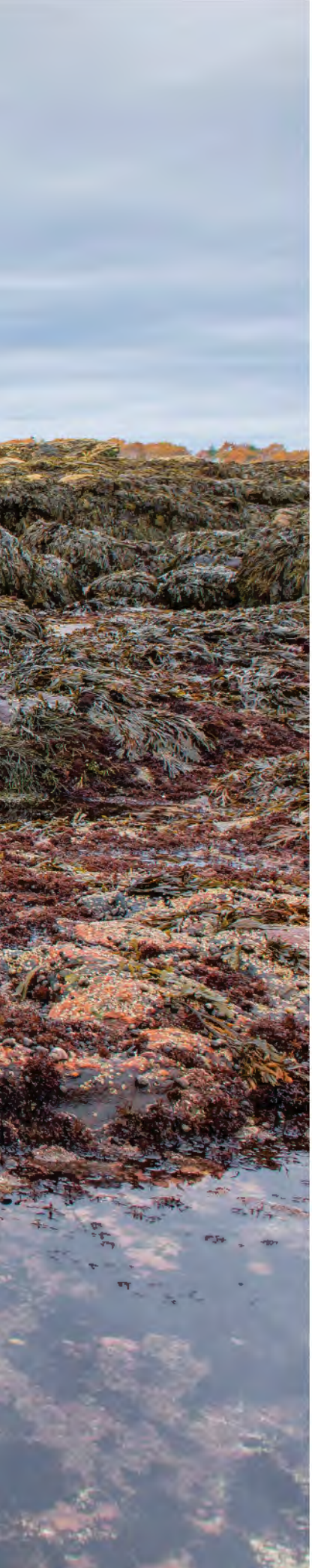
CREATIVITY AND ACHIEVEMENT AT THE UNIVERSITY OF MAINE

SPRING/SUMMER 2017

Out for blood

How do we stem the growing threat of ticks in Maine?


MAINE
SIGNATURE AREA



COLLABORATING FOR the common good is rewarding and empowering. There is real value in working together with shared vision, understanding that there is strength in numbers, that leadership takes many forms and that no single person can think of everything.

As Maine's public research university with a statewide mission, we've always been in the role of problem solving, helping discover what's next and communicating evidence-based knowledge to meet needs. UMaine partnerships are forged among scholars and researchers in different disciplines, and with community groups and organizations to benefit the people we serve. And throughout these efforts, students can gain real-world experience and be engaged in public service.

Take the multiple UMaine research and outreach efforts to help the state address its growing human and animal health issues related to tick-borne illnesses. UMaine Cooperative Extension has long been on the front lines of tick identification. In the ongoing search for answers, UMaine faculty, staff and students are involved in research in varied fields, and in partnership with agencies such as the Maine Department of Inland Fisheries and Wildlife. And with the help of a 2014 bond approved by Maine voters, the state will soon have a new laboratory administered by UMaine Extension to improve the protection of our human health, food and natural resource-based economy.

That forward thinking is key to advancing Maine. We do it with — and for — the people of the state.

Susan J. Hunter, Ph.D.
President

The University of Maine's Signature Area of Excellence in Marine Sciences includes multidisciplinary research to improve understanding of the physical, biological and socioeconomic processes that shape the ocean. Goals include being a reliable, deeply engaged partner with policymakers, fisheries stakeholders, marine industries and coastal communities. UMaine is dedicated to helping develop solutions for issues associated with Maine's marine resources while providing high-quality, interdisciplinary undergraduate and graduate education, outreach and research for the Gulf of Maine. Photo by Holland Haverkamp

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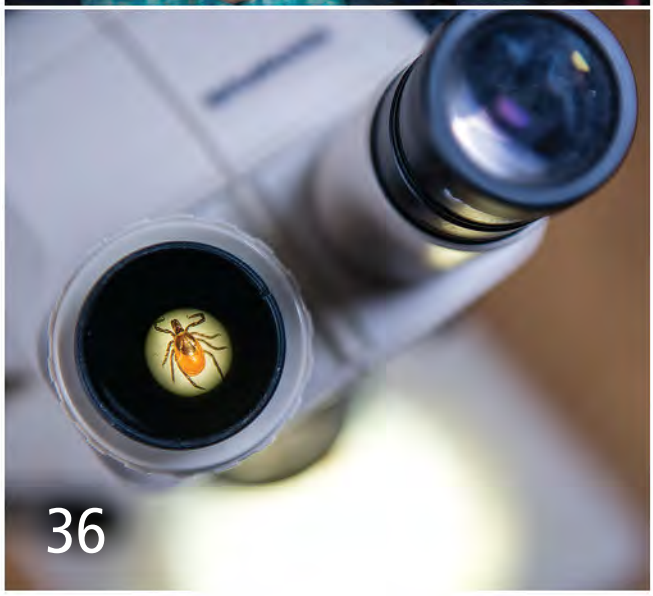

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On the cover

In 2016, the state had 1,485 probable and confirmed cases of Lyme disease, according to the Maine Center for Disease Control and Prevention, but experts note the incidence could be nearly 10 times higher. University of Maine Cooperative Extension's new Plant, Animal and Insect Laboratory will expand researchers' capabilities to screen for blood-borne pathogens, including tick-borne diseases.

Photo by Mariusz Potocki

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Volume 17 Issue 1

Knowing a lobster's age is important for scientists and fishery managers seeking to measure the **health of the fishery** and **sustainability of the stock.**

Age **bands**

RESEARCH PROFESSOR Rick Wahle and graduate student Carl Huntsberger are testing a technique at the University of Maine Darling Marine Center to determine the age of lobsters.

Unlike fish, mollusks and trees, Wahle says lobsters and other crustaceans molt — or cast off their skeletons, thereby discarding external signs of growth. That means a lobster's age is estimated on size, but it's a rough determination because ocean conditions affect the crustacean's growth rate.

Knowing a lobster's age is important for scientists and fishery managers seeking to measure the health of the fishery and sustainability of the stock.

Recent research by Dr. Raouf Kilada of the University of New Brunswick revealed that lobsters and other crustaceans have internal structures that exhibit growth patterns similar to tree rings. Kilada found tree-ring-like microscopic bands, only a fraction of a millimeter thick, within a lobster or crab's gastric mill — a part of the stomach that grinds food.

Kilada recently visited the Darling Marine Center to share his technique with Wahle and Huntsberger.

The growth bands are located in the ossicles, which are tiny, bony, plate-like structures. To process a sample, ossicles are embedded in epoxy and cut into 150-micron sections. The number of bands can be counted using a microscope. (For reference, the thickness of a human hair is about 75 microns.)

Huntsberger, who is processing samples as part of a project funded by the Maine Department of Marine Resources and Maine Sea Grant, says preliminary data indicate the bands do show annual growth patterns. ■

THE KANGERLUSSUAQ region of southwest Greenland is a 3,728-square-mile corridor stretching from the ice sheet to the Labrador Sea. In this area near the top of the world, flora and fauna range from microbes in the ice sheet to large herbivores — caribou and musk oxen — living on the tundra, and aquatic plants and animals in the diverse bodies of water, including silt-filled rivers, ponds, lakes and mountain streams.

The varied terrestrial and aquatic ecosystems in this, the country's largest ice-free region, receive water, geological material, organic carbon and nutrients from the glacier surface — an integrated system that has been undergoing substantial change since 2000 due to rapid regional warming.

In a recent article in the journal *BioScience*, "The Arctic in the 21st Century: Changing Biogeochemical Linkages Across a Paraglacial Landscape of Greenland," researchers from seven countries, including a University of Maine team led by Jasmine Saros, associate director of the UMaine Climate Change Institute, detail the ecosystems in southwest Greenland and explore how rapidly changing environmental conditions may alter this landscape, including the flow of water, carbon and nutrients. N. John Anderson at Loughborough University is the lead author.

The research collaboration, the outgrowth of a 2015 international workshop in the U.K., highlights the importance of looking across landscape ecosystems and time periods — including the paleoecological record — to understand the interrelated, dynamic processes affecting areas such as the Arctic that are expected to continue to warm. Saros is one of seven UMaine professors conducting research in the Arctic in recent years.

Based on how the Arctic's diverse geomorphic and ecological systems have responded to the current warming trend, shifting temperature and precipitation levels have the potential to change such aspects as mammal size and abundance, vegetation cover and type, and carbon and nutrient flows. ■

Altered **Arctic**

IN THE last two decades, the Arctic has seen some of the most rapid environmental changes on Earth. Synthesizing two decades of multidisciplinary research in the Kangerlussuaq region — focused on changes in water, carbon, nutrients and other elements, and anthropologic influences such as atmospheric pollution — highlights the complex linkages among glacial, aquatic and terrestrial systems in the deglaciated landscape, according to the researchers.

Photo by Carl Tugend

Hemlock **at high risk**

A UNIVERSITY of Maine-led research team predicts that eastern hemlock will face increasing decline as winters warm. The results of the study, which also involved researchers from the University of Vermont and LandVest Inc., in Portland, Maine, were published in the journal *Biological Invasions*.

LAND MANAGERS in New England and eastern New York have a new tool to help identify eastern hemlock stands at greatest risk for rapid growth decline by evaluating stresses on the trees, including response to the hemlock woolly adelgid and changes resulting from a warming climate.

Today, an estimated 26 percent of the region's hemlock stands are at high risk. As winters get warmer, the decline will increase, with 43 percent of stands expected to be at high risk, according to a research team led by William Livingston, University of Maine associate professor of forest resources.

To prioritize management efforts, the researchers' comprehensive landscape model maps the varied response to the invasive Asian insect across the Northeast, and identifies the site characteristics of stands with the highest potential for tolerance and recovery.

Eastern hemlock is a towering foundational species in North American forests from southern Canada to Alabama and as far west as Minnesota. But since the mid-20th century, eastern hemlock that can live more than 500 years have been increasingly threatened by the hemlock woolly adelgid that can kill a tree within four years by feeding on its needles and branches, preventing new growth.

After being introduced in Virginia in the 1950s, the Asian insect has spread northward and has now infected hemlock along the Maine coast. As winters warm, an inward spread to more hemlock is likely.

By measuring changes in tree ring widths — basal area increment (BAI) measurement — in mature hemlock, the researchers quantified annual growth decline in 41 hemlock stands across New England representing a range of infestation density and duration, and species vigor. The model also was applied to 15 hemlock sites in Massachusetts.

Among the findings of the research team using the growth decline metric: Eastern hemlock sited on steeper slopes with increased exposure to solar radiation and warmer January minimum temperatures have a greater probability of experiencing rapid decline. ■

Baby **breaths**

FOUR UNIVERSITY of Maine bioengineering students have developed a new method of simulating pediatric respiratory distress in medical training manikins to better prepare health care professionals. For their bioengineering senior capstone design project, the students were tasked with creating a pediatric breathing simulator capable of displaying realistic lung and diaphragm movements.

Most current manikins don't have the ability to simulate lung and abdominal breathing independently. The UMaine model more accurately simulates the breathing of children in critical conditions, including respiratory distress, when they typically only use diaphragm or abdominal breathing patterns.

Manikins designed to show different rates of breathing could potentially allow training doctors and nurses to make a diagnosis based on the breathing pattern, according to bioengineering professor Caitlin Howell, who, along with UMaine bioengineering professor Karissa Tilbury, advised students Banton Heithoff of Oldwick, New Jersey; William Breeding of East Granby, Connecticut; Amber Boutiette of Skowhegan, Maine; and Madeline Mazjanis of Portland, Maine.

The students worked in collaboration with alumnus Dr. Denham Ward and Dr. J. Randy Darby of the Hannaford Center for Safety, Innovation and Simulation at Maine Medical Center in Portland.

The students are pursuing a patent for the pediatric respiratory simulation prototype. The team won one of two Innovation Awards at UMaine's 2017 Student Symposium, an annual showcase of undergraduate and graduate student research and creative activity. ■

AT THE start of their project, the students were given a full-size training manikin by the UMaine School of Nursing to better understand how to build one. With a $500 budget, the students used widely available materials — stretchable plastics, tubing, fittings and an air compressor — to design a system that can accurately replicate four types of children's breathing patterns in the lungs and diaphragm.

Scaling **up**

A PILOT plant capable of processing up to 1 ton of woody biomass per day into chemicals that can be used to manufacture bioproducts, including biofuels, biochemicals and advanced materials, was demonstrated in 100 hours of continuous operation beginning May 1 at the University of Maine's Technology Research Center (TRC) in Old Town.

Chemicals made from biomass could one day be an important revenue source for the forest economy. Organic acid platform chemicals, as they are known in the industry, have multiple uses, including the production of plastics and other specialty chemicals.

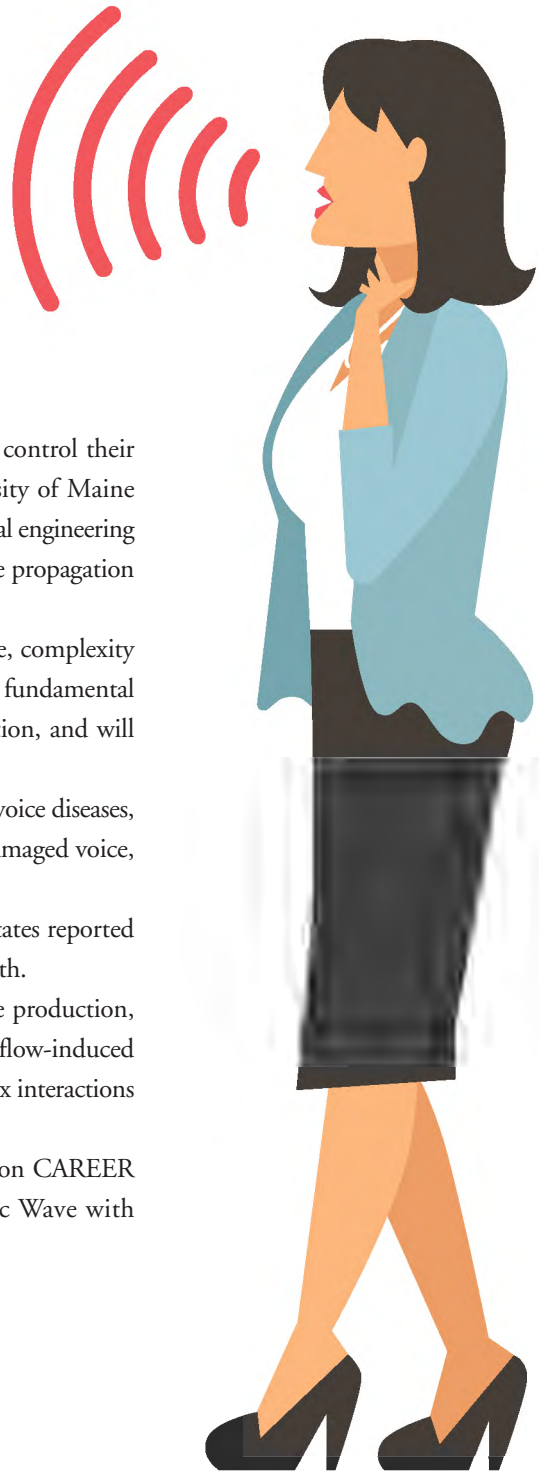
At UMaine, these "green" chemical intermediates are critical in the university's patented conversion technology to produce diesel and jet fuel from woody biomass, developed by the Forest Bioproducts Research Institute (FBRI).

Installation of the new Biomass to Bioproducts Pilot Plant was made possible by a partnership between UMaine and Biofine Technology, based in Massachusetts.

The Biomass to Bioproducts Pilot Plant occupying 10,000 square feet in TRC is the first step in scaling up UMaine's jet fuel technology, which is still in bench-scale production. FBRI researchers hope to add another pilot plant that would use the platform chemicals to create larger quantities of biofuel — prototyping for commercialization. The two pilot plants would fully demonstrate the potential of creating diesel and jet fuels — and the chemical ingredients — entirely from biomass. ■

THE 100 hours of continuous operation is providing reliable engineering data for companies considering such development, including the first commercial plant in Maine. The Biomass to Bioproducts Pilot Plant is the newest addition to UMaine's research facilities that are dedicated to prototyping, and demonstrating technologies and new products to benefit commercialization of the emerging bioeconomy sector. UMaine's other pilot plants focus on pulp and paper, food and nanocellulose.

Flowing **voice**



CREATING A better understanding of how humans use and control their voice is the focus of a five-year study being led by University of Maine researcher Xudong Zheng. The assistant professor of mechanical engineering will use computer models to look at the role of mucosal wave propagation in sound production during phonation.

The goal is to understand the mechanism responsible for the range, complexity and uniqueness of the human voice. The research will contribute to the fundamental understanding of flow-induced sound through flow-structure interaction, and will advance the knowledge of voice production.

Researchers will develop diagnosis metrics for mucosal wave-related voice diseases, determine the adjustments to the vocal folds to restore or improve a damaged voice, and predict the outcome of the adjustment.

In the past year, an estimated 17.9 million people in the United States reported problems with their voice, according to the National Institutes of Health.

The research also could be applied to flow problems beyond voice production, such as the detection and diagnosis of heart murmurs generated by the flow-induced motion of heart valves, and the reduction of noise due to the blade-vortex interactions in wind turbines.

Zheng received a more than $513,000 National Science Foundation CAREER award for his project, "Sound Production by Flow Induced Elastic Wave with Application to Human Phonation." ■

In addition to **improving diagnosis and surgical procedures,** the research could help people who use their voices extensively — teachers, performers, broadcasters — by providing knowledge for how to **efficiently use and control their voices.**

Cold context

Internationally recognized climate scientist Paul Mayewski documents the past to ensure the future

By Beth Staples

Cold context

Paul Mayewski
Photo by Joan Meyers

SOME DAYS, Paul Mayewski's commute to work is a 75-minute drive.

Other days, it involves traversing a glacier on the planet's coldest continent or making land on South Georgia after sailing the inhospitable Southern Ocean. On these days after work, Mayewski stands atop glaciers, gazes at thousands of stars and, in the near absolute silence that's only possible in the Earth's most isolated reaches, hears the pulsing of his heart.

From a multitude of remote high-altitude vantage points, the man dubbed the "Indiana Jones of climate research" also has admired the curvature of the Earth, witnessed flashes of nighttime gunfire during Soviet-Afghan skirmishes

and been jolted awake in his tent by an 8.8 magnitude earthquake.

For decades — including on birthdays and holidays — the planet's peaks and poles have been homes away from home for Mayewski, and teams of students and colleagues.

The extended expeditions that have yielded groundbreaking discoveries about the climate also have provided Mayewski with opportunities to better understand himself.

"I've been very fortunate," says the director of the world-renowned Climate Change Institute (CCI) at the University of Maine. "I get to see what the world was like hundreds of years ago and to be in situations that allow me to be in tune with the natural surroundings."

Mayewski and CCI colleagues seek to know what happened from one second ago to a hundred thousand years and even more than a million years ago.

Opening photo: A well-lit tent and hundreds of stars illuminate a UMaine campsite at an altitude of about 18,000 feet on Tupungatito — a volcanic crater. The summer 2012 night was calm and about zero degrees F. The high-elevation crater is a good spot to monitor atmospheric circulation patterns in South America. Tupungatito and surrounding Andean glaciers are water sources for major population centers, including Santiago, Chile.

Below: Paul Mayewski, Gino Casassa and Jeff Auger traverse Murray Snowfield on the way down from the Esmark Glacier to Possession Bay on South Georgia. In 2015, a UMaine team conducted field reconnaissance for a potential future site to drill deep ice cores. Photos by Mariusz Potocki

To find out, they often go great distances, and to great heights and depths. Their discoveries about the past have illuminated possible future scenarios.

MAYEWSKI'S JOURNEY began in Edinburgh, Scotland, where he loved the barren landscape of the Highlands. When he moved with his parents to New York City, he was riveted by dioramas at the American Museum of Natural History. The Boy Scout pored over *National Geographic* magazines and dreamed of expeditions to remote regions.

He was a sophomore at the State University of New York at Buffalo when a professor showed him photographs of Antarctica. Mayewski was transfixed by the site of 90 percent of the ice on Earth.

He asked to accompany the professor on his next research trek to the continent, where the lowest temperature on Earth — a staggering minus 129.3 degrees F — had been recorded.

"I kept asking and taking courses. I really wanted to go," says Mayewski, who was a field assistant on that expedition in 1968. "It was a dream come true."

In the more than four decades since, Mayewski has led 55-plus expeditions, many to Antarctica. There, he's said to be the first human to step foot in a number of locales.

It's commonly held that he's traversed more land miles on the continent than anyone else.

The Advisory Committee on Antarctic Names dubbed one summit in the Saint Johns Range of Antarctica "Mayewski Peak" to honor his glaciological and geological work there.

Mayewski has explored dozens of areas, including the Arctic, Canada, Central Andes, Chile, China, Greenland, Iceland, India, Nepal, New Zealand, Peru, South Georgia and Tibet (Mount Everest).

For Mayewski, it's a rush flying over the ocean toward Antarctica. The air becomes noticeably colder. Icebergs appear, spectacular mountain ranges come into view. Inland, there are the vast — approximately 5 million square miles — human- and animal-free reaches of the Antarctic Plateau.

"It changes your perspective and your life," he says.

In that frigid desert, researchers need to be independent and self-sufficient. "There's no escaping," he says. "You can't just leave for the weekend."

Due to logistics and high costs in the 1970s, researchers traveling to the fifth-largest continent were encouraged to stay as long as feasible.

"You'd get dropped off, traverse across the ice sheet on foot, skis and snowmobiles, and then get picked up three to four months later," he recalls.

MAYEWSKI SAYS it generally takes a couple weeks to adjust to the extreme conditions — the cold, snow and wind — and sleeping in unheated tents. Plus, there's the oxygen deprivation. There's just 50 percent of the oxygen available at the altitudes Mayewski works — including the Himalayas and Andes — as there is at sea level.

Challenges come with the territory — from aggressive baboons in the jungle to being holed up 17 days in a tent

Paul Mayewski stands atop Nun Kun Plateau in the Himalayas.
Photo courtesy of Paul Mayewski

due to snow and winds of 115 mph, when Mayewski and his team had to be vigilant about shoveling to keep from being buried.

On an early-career trip, a cooking stove flared, catching his tent on fire. Mayewski dove outside, taking time to snag a field notebook containing several months of data.

He also has pulled one of his teeth, stitched colleagues' gashes and carried people with altitude sickness off mountains. During a particularly challenging trek getting to the Himalayas, Mayewski lost 35 pounds in 17 days.

On another excursion in the Indian Himalayas, he and colleagues went in one direction while their food supply went in another. For three days until they caught up with the food, the team subsisted on Mayewski's birthday cake.

During the 1989 Tiananmen Square protest, Mayewski was conducting research in northwest China. And in 2010, when a magnitude 8.8 earthquake that killed hundreds and displaced 800,000 struck at 3:30 a.m. off the coast of Chile, he was sleeping in a tent in the Central Andes.

While boulders crashed down around them, he and his teammates were safe on a plateau where they were camping.

One Christmas Eve in the mid-1970s in Antarctica, he

At a site 100 miles from the South Pole, Paul Mayewski and his research team found the first evidence of Chernobyl in the Southern Hemisphere and a demonstration that the modern Antarctic ozone hole is much larger than those that are part of natural variability. Photo by Paul Mayewski

and his assistant were caught in a blizzard away from the team camp. For several days, their clothes, sleeping bags and tent were drenched. Battling hypothermia, Mayewski and his colleague ultimately got the snowmobile started and made it back to the camp in blinding snow.

Less than a month later, he was at the University of New Hampshire for his first teaching appointment.

TO TRAIN for excursions, Mayewski skis or walks up an inclined field while pulling an 80-pound sled. While physical training has been a constant during his decades of exploration, attitudes and technology have changed considerably. Communication, for the most part, was once confined to those in the research party. Today, with satellite technology, explorers can connect with people on other continents, including with schoolchildren learning about their research.

Snowmobiles are far more powerful now and dogs are no longer allowed on Antarctic expeditions because they're not indigenous. (There aren't indigenous people there either, reminds Mayewski.)

In the '60s, the attitude that humans should strive to conquer nature was pervasive. And many people, scientists

In fall 2015, Paul Mayewski and UMaine graduate students — Mariusz Potocki, Jeff Auger and Ben Burpee — traveled 1,600 miles round-trip aboard the 73-foot sailboat Pelagic Australis in the Southern Ocean. Here, the Pelagic Australis takes shelter in the relatively calm Sunset Fjord of South Georgia after the team collected ice cores on Esmark Glacier. Photo by Mariusz Potocki

included, thought the planet was so enormous that humans couldn't permanently alter it, no matter what they did.

Antarctica, in particular, was believed to be timeless.

"At the beginning of my career, the thought was we couldn't do anything to Mother Earth — but we've done a lot and we've done it fast," Mayewski says. "And the ramifications of those things are unbelievable."

By the late 1970s and '80s, his team and many other scientists realized that glaciers were shrinking and climate that should have been naturally cooling was warming.

Researchers also recognized that human activity could — and was — impacting the planet. As examples, Mayewski cites the burning of fossil fuels that resulted in acid rain, as well as emission regulations that resulted in the subsequent reduction of acid rain, lead and other toxic substances.

Climate science has evolved and so has Mayewski.

"I started more for the adventure and travel, and I was driven by the opportunity to go to remote places," says the Distinguished Professor in the School of Earth and Climate Sciences, School of Marine Sciences, School of Policy and International Affairs, and Maine Business School.

"Not until several years after I earned a Ph.D. would I consider myself a scientist."

Others consider him a pioneer. *Maine* magazine hailed him one of the state's 50 Bold Visionaries.

The European Geosciences Union awarded him the Hans Oeschger Medal for his ice core and climate research. And the World Ocean Observatory hailed him as a Citizen of the Ocean for his inspiring contributions to ocean knowledge and advocacy.

The International Glaciological Society gave Mayewski its highest honor — the Seligman Crystal — for his contributions to glaciology. The Scientific Committee on Antarctic Research awarded him the first Medal for Excellence in Antarctic Research.

And the Explorers Club presented him with the Lowell Thomas Award.

> "At the beginning of my career, the thought was we couldn't do anything to Mother Earth – but **we've done a lot and we've done it fast. And the ramifications of those things are unbelievable."**
>
> Paul Mayewski

THREE OF his discoveries have been critical in advancing climate science. One was that wind systems, or atmospheric circulation patterns, can change patterns very quickly.

Wind transports heat, moisture, precipitation and pollutants, and affects sea surface currents and sea temperature. Rapid change in wind patterns can result in temperature changes of 10 degrees F in less than two years, he says.

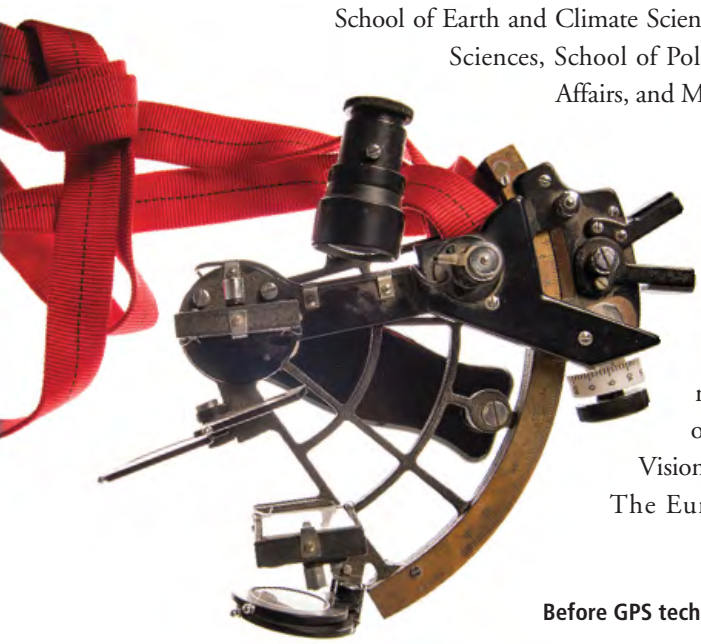
Rapid changes in atmospheric circulation also can result in changes in frequency of storms and amount of precipitation. And these shifts can remain in place for decades, if not centuries, Mayewski says.

This paradigm shift is tied to a second game-changing discovery — abrupt climate change.

The climate system, says Mayewski, doesn't operate in a slow or linear way. Abrupt climate change can happen faster than a political cycle and can lead to considerable challenges for communities or the collapse of civilizations.

Mayewski points to the eastern Arctic, where the temperature has risen 8 degrees F in the last five years. It is as big a change in climate, and as fast, as the change that occurred during the remnants of the last ice age, he says.

The Inuits who live, fish, trap and hunt in the Canadian Arctic are experiencing climate change firsthand. The results



Before GPS technology, Paul Mayewski used this sextant to navigate during expeditions.

Photo by Holland Haverkamp

Mariusz "Mario" Potocki speaks Polish, Russian, English and Spanish, but he finds that photographs express a universal language. He loves the sound of the camera shutter clicking, and sharing the beauty of Earth with those who may not have opportunities to ski on glaciers, interact with seals and explore caves. "I like to show the world's beauty in my photos so people may understand that it's worth caring for and saving for future generations," he says.

Photographing a 'world worth saving'

COMPOSITION IS key to Mariusz "Mario" Potocki. As it relates to chemicals and to photography.

The glaciochemist drills ice cores to obtain timelines of climate history. For example, a 700-foot-deep core reveals atmospheric conditions dating back about 1,000 years.

Ice core data also provide a base from which to anticipate future climate changes, says the University of Maine doctoral candidate.

Potocki's recent analysis of an ice core from the Antarctic Peninsula revealed that the region has been — and is being — polluted by uranium mining 6,000 nautical miles away in Australia.

During breaks on research expeditions — whether ice coring, traversing a glacier or observing marine wildlife — the Climate Change Institute research assistant takes photographs of his surroundings.

National Geographic-quality photographs.

His photograph of king penguins on the Falkland Islands was one of 30 chosen from 9,000 entries to National Geographic for an online June 2016 collection titled "Pristine Seas."

During his initial research excursions, Potocki took pictures of landscapes and inhabitants — including seals, penguins, sea turtles, elephants, monkeys — to share with family and friends.

Now he also shares them on Instagram and his website for people worldwide to enjoy. Including his close-up encounter with curious crabeater seals during a frigid underwater photo shoot. The seals, which can grow to nearly 900 pounds, had periodically popped up through air holes on the frozen Admiralty Bay while following Potocki and other environmental marine observers off King George Island.

The adventure-seeker cherishes traveling, meeting and forging relationships with people, and experiencing various cultures.

Potocki's childhood vacations involved outdoor adventures. And today, his academic and adventure pursuits — spelunking, mountaineering and underwater diving — are intertwined.

The Poland native earned an undergraduate degree in geography and a master's in physical geography at the University of Warsaw.

Those pursuits, in addition to his doctoral education at UMaine, have landed him on every continent except Australia; he's been to numerous locales several times.

In the vast Sahara, Potocki explored how groundwater levels affect the speed at which sand dunes move.

He's since spent considerable time in colder climates, including ice coring on the Detroit Plateau on the northern Antarctic Peninsula, which he describes as one of the most rapidly changing regions on Earth.

Using state-of-the-art high-resolution technology, Potocki discovered that a significant increase in uranium concentration in the Antarctic ice core coincided with open pit mining in the Southern Hemisphere.

Understanding airborne distribution of uranium is important because exposure to the radioactive element can result in cancer, mental development challenges, kidney toxicity and genetic mutations.

Until World War II, Potocki says most atmospheric uranium was from natural sources, such as rock, soil and seawater. But since 1945, increases in Southern Hemisphere uranium levels are from industrial sources, including uranium mining in Australia, South Africa and Namibia. Uranium ice core concentrations increased as much as 100-fold between the 1980s and 2000s, he says.

Potocki came to UMaine to pursue his doctorate after what he calls a fortuitous meeting with Paul Mayewski in 2007 in Antarctica.

Potocki was working as a meteorologist, glaciologist, environmental marine observer and guide at the Polish Antarctic Station on King George Island when the director of the UMaine Climate Change Institute arrived with a "60 Minutes" crew to do a story.

Mayewski now is Potocki's adviser and the two have collaborated on several expeditions.

Gathering as many ice cores as possible is vital, says Potocki, because of the rapid rate at which glaciers are melting.

of rapid warming there are significantly altering the way they've lived for centuries.

Thirdly, through ice core analysis, Mayewski and colleagues have made numerous contributions to understanding the change in the chemistry of the atmosphere.

In the last half-century, Mayewski says human-produced toxic metals, radioactive materials and greenhouse gases have dramatically changed the chemistry of the atmosphere.

Ice core data indicate that "this is not the way the natural world works," he says.

What will happen, he asks, to the already-troubling rates of asthma, autism, cancers and neurological diseases if we don't stop putting pollutants into the atmosphere?

"If you had abundant clean air and water, there would be much less disease," he says. "The human toll as a consequence of these things, of course, is tremendous. Even if you just want to think about it like a business person, the cost is phenomenal."

> "The age of climate decision is here, and **our actions will define the course of civilization, our health and the health of our planet."**
>
> Paul Mayewski

MAYEWSKI RECENTLY has been involved in a project with Michael McCormick, a Harvard University professor of history who's creating a historical and scientific database of Europe's climate from about 800 to 1500 AD.

McCormick and colleague Alex More have assimilated and analyzed an extensive collection of detailed written records and diaries that contain information about wars, weather events and food shortages in Europe.

Their analysis includes the approximate five-year period beginning in 1347, during which the bacteria *Yersinia pestis* — Black Death — killed about 25 million people.

For that same time period, Mayewski and his CCI team have analyzed an ice core from the Colle Gnifetti glacier high in the Alps near the Swiss-Italian border.

The state-of-the-art W.M. Keck Laser Ice Facility at the Climate Change Institute allows for a season-by-season, even storm-by-storm, analysis of the core. Ice cores, Mayewski says, are the most robust way of understanding past environment. And McCormick and More are interested in how environments impact human societies.

The researchers learned after matching the written records and ice core records that soon after the Black Death arrived in Europe, due to death and sickness, industrial mining temporarily and abruptly ended. Lead, arsenic and copper levels in the atmosphere dropped to nearly zero.

"Sadly, if you kill off half the population of Europe, everything stops," Mayewski. "It's tremendously important because it shows the impact of an abrupt disease event."

About five years later when the plague subsided and mining resumed, levels of lead and other toxic metals in the atmosphere increased substantially. The findings are troublesome, Mayewski says.

Before this project, he says the natural level of lead in the atmosphere had not been documented.

Scientists had assumed that since environmental regulations had been instituted that the lead level in the atmosphere was about 100 times higher than the natural level. But the level of lead in ice cores over the last nearly 2,000 years — with the exception of during the Black Death — has been considerably higher than that.

What, Mayewski asks, are the health ramifications to this long-term high exposure?

THE PROJECT with Harvard University reflects how the Climate Change Institute has broadened.

"Change is our middle name. We embrace it," he says.

Researchers in archaeology, evolutionary ecology, forest soils, glaciology, marine ecology, paleoecology, renewable energy, volcanology and other fields contribute to the "understanding of the variability of Earth's climate, the complex interconnections between climate, humans and the natural

Photo by Holland Haverkamp

Jill Pelto says she uses data in her art to tell stories of environmental change literally. She combines the intellectual information of graphs with emotional imagery to communicate climate change issues with a broader audience.

Communicating science through art

UNIVERSITY OF Maine graduate student Jill Pelto is passionate about communicating science in an easily understandable and visually appealing way. To raise awareness of climate change, Pelto creates watercolors of landscapes and animals that incorporate scientific data in the form of graphs.

"As a scientist, I am able to learn about and conduct studies on both past and present climate change," Pelto says. "I see data every day that communicates research so effectively, but only to a particular audience. My goal is to share this important and interesting information with a broader audience by creating pieces that raise awareness about environmental topics, and eventually inspire people to take action."

In the past year, reports on Pelto have been published by local and national news organizations, including Climate Central, Public Radio International and PBS NewsHour. Actor Leonardo DiCaprio also shared Pelto's art on his official Instagram account, which focuses on climate issues. In summer 2016, Pelto was featured in *National Geographic* as part of the series, "20 Under 30: The Next Generation of National Park Leaders."

Her art also has been featured in several publications, including on the front and back of the *State of the Climate* in 2015, an international, peer-reviewed publication released each summer as a supplement to the *Bulletin of the American Meteorological Society.*

The front cover features Pelto's piece, "Landscape of Change," which uses data about sea level rise, glacier volume decline, higher global temperatures and the increasing use of fossil fuels. The data lines compose a landscape shaped by the changing climate, "a world in which we are now living," according to Pelto.

Art on the back of the report, "Salmon Population Decline," uses population data about the Coho species in the Puget Sound to depict the struggle as spawning habitat declines.

Pelto, an honors student who graduated from UMaine in December 2015 with a double major in Earth science and studio art, is pursuing a master's degree in the School of Earth and Climate Sciences.

In December 2016 and January 2017, Pelto spent four weeks in the field with her adviser, glacial geology professor Brenda Hall, reconstructing the deglacial history of the Antarctic Ice Sheet. The team focused on the Amundsen Glacier, an outlet glacier of the East Antarctic Ice Sheet.

To reconstruct the retreat history of this glacier from its maximum extent during the last glaciation to its present location, the researchers are mapping landforms and dating deposits on ice-free peaks alongside the glacier.

Pelto and Hall collected ancient algae several centimeters below the sediment and mapped glacial geologic features in two field locations — Robinson Bluff and Witalis Peak.

When the Antarctic Ice Sheet was larger, outlet glaciers such as Amundsen extended into these now ice-free valleys. As the glacier retreated, it exposed rocky peaks and valleys; ice tongues in these valleys dammed ice-marginal ponds, where algae grew, Pelto says. As the glacier continued to move down in elevation, these ponds followed the ice front; the previous location of the pond was then preserved by the algae, which researchers can locate and date. Given that the ice had to have been thick enough to at least dam these ponds, this also provides a minimum glacier elevation.

After Antarctica, Pelto traveled to New Zealand to work with another group of UMaine researchers looking at the glacial history of the Southern Alps.

For the eighth consecutive year, she also spent part of the summer working with the North Cascade Glacier Climate Project, which monitors glaciers in the North Cascades in Washington state. The program is led by her father, Mauri Pelto, a professor of environmental science at Nichols College in Massachusetts. He started the project in the 1980s while pursuing a Ph.D. at UMaine.

world, and the unique challenge of abrupt climate change."

Their discoveries, according to the CCI website, "contribute to evidence-based solutions for pressing environmental problems and provide the basis for partnerships with diverse stakeholders to create pathways to a climate-resilient future."

And they continue to push the boundaries of exploration with new initiatives, such as "Climate Futures" — a new way to predict climate.

Mayewski regularly shares his research, findings and projections. Mainers can frequently find him presenting in a library or hear him being interviewed on Maine Public.

CCI also hosted a recent forum for community planners to learn how to access and utilize online tools developed by UMaine researcher and state climatologist Sean Birkel.

City leaders considering building a cooling center can review projections for heat wave frequency. Medical professionals can assess the potential increases in Lyme disease, and community planners replacing stormwater drains can examine projected precipitation.

Mayewski also frequently reaches larger audiences.

He has been published in more than 425 scientific journals and wrote *The Ice Chronicles* with Frank White and *Journey Into Climate: Adventure, Exploration, and the Unmasking of Human Innocence* with Michael Morrison.

He has been featured in media ranging from several appearances on CBS' "60 Minutes" to the BBC. And he was highlighted in the Emmy Award-winning Showtime series "Years of Living Dangerously," produced starting in 2014 to showcase the impacts of climate change on people and the planet. Mayewski was filmed while collecting ice cores 20,000 feet atop a glacier.

SINCE 2001, Earth has experienced 16 of the 17 warmest years on record, resulting, in part, in drought, the spread of diseases, worsening wildfires, water shortages, species extinctions and climate refugees.

"The age of climate decision is here, and our actions will define the course of civilization, our health and the health of our planet," Mayewski has often said.

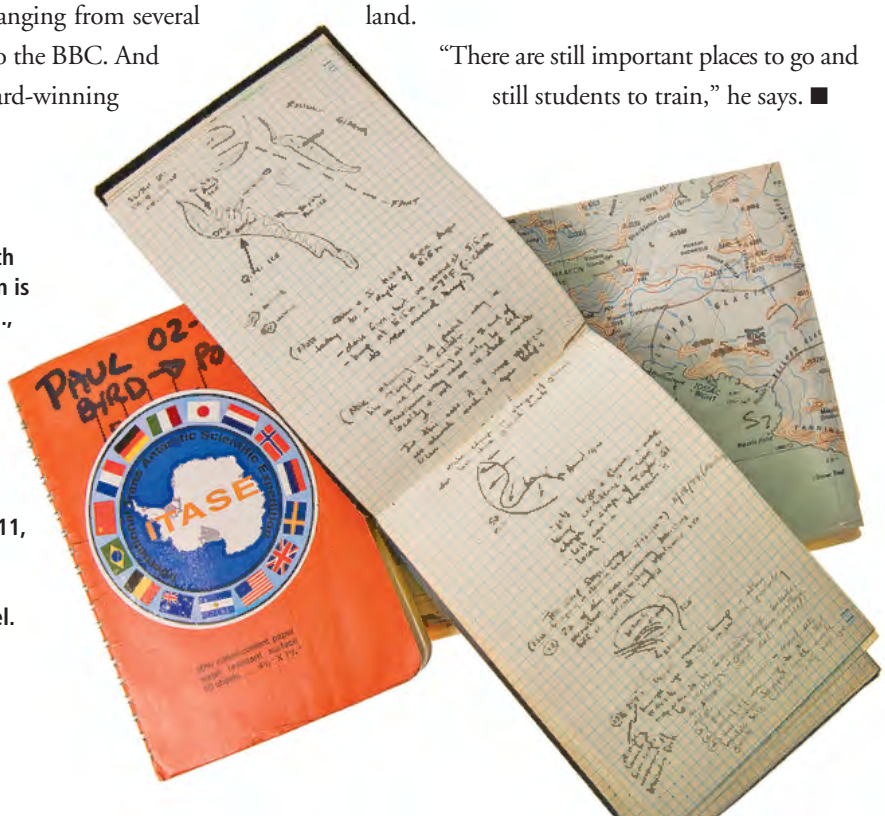
In court, cases are decided on evidence and facts. The same, Mayewski says, should be true with regard to climate policy. Facts, he says, are not political. Health and the planet aren't either.

"We can do without just about everything, except for water and air," Mayewski says.

This fall, Mayewski and several students will again sail a portion of a route in the Southern Ocean that polar explorer Sir Ernest Shackleton made famous in 1914–16. On the 1,600-mile excursion, they'll disembark on a remote South Atlantic island and retrieve more ice cores.

Then there will be expeditions to the Andes and Greenland.

"There are still important places to go and still students to train," he says. ■



The first entry in Paul Mayewski's hardcover black geology field book is dated Oct. 29, 1974 and begins, "Flew into North Fork of Wright Valley ..." One of the last entries of the season is dated Jan. 3, 1975 and includes, "Weather clears by 2:00 p.m., first meal in 2 days, dry gear." Inside his orange 2002–03 International Trans Antarctic Scientific Expedition logbook is an email from Julie Palais, glaciology program manager with the National Science Foundation. Jan. 3, 2003, she congratulated Mayewski and his team for being the first Americans in 40 years to reach the South Pole by ground travel. She intentionally closely replicated wording in a Jan. 11, 1961 note that Admiral David Tyree sent to Major Havola, leader of the Byrd-Pole Task Group, when it became the first American party to ever reach the South Pole by ground travel.

Photo by Holland Haverkamp

Kimberley Rain Miner is acutely aware that humanity's impact on the planet can't be ignored. She strives to make a difference by contributing to the development of plans aimed at safeguarding the planet's air, water, health and security. "If there's the slightest risk, it's worth planning for," she says.

Security matters

GROWING UP in Boulder, Colorado, Kimberley Rain Miner has long been at home immersed in nature, including while rock climbing and teaching children to grow food.

When she was pursuing a bachelor's degree in environmental science and ecology at the University of California, Santa Cruz, she sometimes lived in a hollowed-out portion of an ancient redwood perched along a river.

Today, she's a Ph.D. candidate in Earth and climate sciences at the University of Maine.

The IGERT (Integrative Graduate Education and Research Trainee) at the Climate Change Institute has explored six continents. And she says it has been difficult to locate places where people's impacts aren't tangible — even on pristine-appearing glaciers.

For her doctorate, Miner is developing a framework to assess the threat of pesticides — including DDT — that for years have been trapped in glacial ice and now are entering watersheds as the glaciers melt. She seeks to quantify effects of pollutants downstream.

During her research, Miner says she has benefited from CCI professor and adviser Karl Kreutz's support, and from UMaine's exploration culture and student-first mentality.

"Individuals make the difference in the long run. There's always something we can do to make a situation better, our lives better and the health of the ecosystem stronger," she says.

Miner, a firefighter and first responder, says personal acts — including planting pollinator flowers and delivering drinking water after a hurricane — make a difference.

In October 2012, when Superstorm Sandy made landfall along the Jersey Shore, Miner was pursuing an MPA in environmental science and policy at Columbia University.

While her graduate student apartment didn't lose power, Miner remembers feeling powerless watching TV coverage about the devastation occurring just a few blocks away.

Soon after, she became involved in several projects, including mapping ADA-accessible shelters in New York City that planners believe will be safe from flooding in a 100-year storm.

Miner became interested in the intersection of nature, weather-related disasters and emergency preparedness, and she worked with scientists at Lamont-Doherty Earth Observatory and emergency managers at the New York City Office of Emergency Management.

Now, she's a Department of Defense Scholar and a volunteer research fellow at the Center for Climate and Security in Washington, D.C.

Her funding is through the American Society for Engineering Education SMART (Science, Mathematics And Research for Transformation) program. The U.S. Army Engineer Research and Development Center's Geospatial Research Laboratory in Virginia is Miner's sponsoring agency and supports her doctoral education.

She anticipates working at the Geospatial Research Laboratory this summer and for two years after she earns her doctorate in 2018. Her responsibilities will include using geospatial technology to ensure mission security of U.S. troops.

It's encouraging, Miner says, that federal agencies in the United States — from the Department of Energy and Department of Homeland Security to the Department of Agriculture and NASA — have collaborated to strategically identify priorities, exchange data and build environmental resilience.

Worldwide, 194 countries are planning and preparing, too. As a Switzer Foundation Fellow and Fulbright awardee, Miner is gaining a global perspective.

In December 2016, she attended the Planetary Security Conference in the Netherlands. There, worldwide experts on climate change and security collaboratively addressed emerging environmental challenges and safety concerns.

And in February 2017 at Yale University, Miner was part of a panel that discussed planning for worst-case scenarios at the New Directions in Environmental Law Conference.


1B
Flour
Canned
Coffee & Tea
Pasta

Jason Bolton is one of University of Maine Cooperative Extension's go-to resource people. The research and expertise he shares makes the difference in new product development, food companies' growth and homemakers' peace of mind. In the past seven years, he has worked with more than 200 food companies in all 16 counties to help grow Maine's food industry.

Market value

For Maine entrepreneurs, food safety expert Jason Bolton is part of their recipe for success

By Walter Beckwith / Photographs by Adam Küykendall

JASON BOLTON'S phone begins to ring at 7:30 a.m.

The first call is from a local butcher requesting information about a two-day course offered by University of Maine Cooperative Extension covering new federal food safety regulations.

The next is from the manager of one of the state's thriving craft breweries, seeking advice on the design for a new facility and equipment needed to keep up with rising demand.

Then a community member calls to ask whether it's safe to eat homemade pickles that have been hidden in a pantry for over a decade. (Spoiler alert: It's not.)

Bolton, UMaine Extension food safety specialist and associate professor, never knows what query the next call will bring — from a question about what to do with cheese someone "finally found," to a request for laboratory analysis of a new hot sauce created by a Maine-based company.

He also isn't sure what the next office visit will bring, like the day someone stopped by with a container of glowing shrimp covered in bioluminescent bacteria.

In Prospect Harbor, Jason Bolton and Maine Fair Trade Lobster production manager Bill Jackson touch on a range of topics — from plant expansion and the upcoming processing season to cooking validation and the placement of a summer food safety intern from UMaine.

When he's not fielding calls and visits, Bolton is on the road, traveling statewide to work one-on-one with food and beverage entrepreneurs — both home-based business owners and managers of multimillion-dollar seafood facilities. As part of UMaine Extension's three-member food safety team, he consults on issues ranging from facility expansion plans and best food safety practices to product development and regulatory compliance.

He also organizes professional industry courses, teaches UMaine's popular Brewing with Food Science class and a graduate-level food safety course; and advises food science graduate student researchers.

Bolton is one of UMaine Extension's go-to resource people. The research and expertise he shares makes the difference in new product development, food companies' growth and homemakers' peace of mind.

"Every day is different. A new opportunity to learn and meet new and exciting food entrepreneurs," says Bolton, whose position is funded in part by the Maine Economic Improvement Fund, established by the Maine legislature in 1997 and funded through an annual state appropriation to leverage economic development through targeted investment in university-based research and development.

"I do it," he says, "because I have knowledge that can help others be successful."

THERE CAN be many hurdles to clear before a new food idea makes it to market, says Bolton, and depending on the product, some can be intense. The same goes for starting or expanding a food-related business.

First are regulatory and legal concerns, which entail getting the necessary permits and licenses. For some industries, this process can be lengthy, complex and expensive.

Next is the facility. Both small commercial kitchens and multimillion-dollar processing plants must be designed to meet federal food safety specifications. Specialized equipment needs to be installed, processes reviewed and validated, and some products need to be lab tested before they can be sold.

Once the food product is ready, there's the implementation of food safety controls and employee training, establishment of ingredient supply chains, packaging, labeling, storage, shipping and distribution. Business owners also need marketing and business plans, and knowledge of the day-to-day operation.

In the past seven years, Bolton has worked with more than 200 food companies in all 16 counties to help grow Maine's food industry.

"It's one of the few growing non-health care industries in the state," says Bolton. "All of the industries that support these new businesses are growing and being brought up by them.

"When I started seven years ago, we only had a few lobster processors in the state. Now we have an additional four, and I've worked or continue to work with most of them. These are large processors, processing at least 25,000 pounds a day during the peak season."

And of all the promising Maine-made products — pickles, sauces, ice cream, tofu, jams and jellies — one is particularly effervescent. Beer.

As of January 2017, Maine was home to 89 licensed breweries, 25 of which opened since 2015. The industry added $228 million to Maine's economy in 2016 and its growth has outpaced the national average for five of the last six years.

"There is something that is said when you produce a Maine-made product: quality, safety, hard work, a

Jason Bolton and Maine Craft Distillery owner Luke Davidson discuss product and process efficiencies and control as the Portland-based company prepares to move a few blocks up the street to its new location — a site nearly five times larger. Lining the walls are Maine-made barrels in which the various spirits — whiskey, rum and gin — are aging. Among them is Blueshine, made with Maine-grown barley, wild blueberries and maple syrup.

A new filling line at Gelato Fiasco Flavor Foundry was part of the 2016 expansion of the Brunswick-based company. Jason Bolton provided expertise on sanitary design, product flow and operation.

strong sense of community. Things that define the state as a whole," Bolton says.

ON A rainy morning in Prospect Harbor, Maine, Bolton tours the Maine Fair Trade Lobster facility with Bill Jackson, the production manager. The plant is quiet, with large segments of the processing line disassembled for maintenance in preparation for the start of another busy season.

When the operation is in full swing, the brightly lit and sparkling clean factory will hum as more than 150 employees handle hundreds of thousands of lobsters from one end of the production line to the other.

Bolton knows this facility. Years ago as a UMaine undergraduate, he visited what was then Stinson Seafood Cannery, one of the last canneries in the country, and watched a team of older women deftly pack tins of sardines. The next time he saw the facility was in 2010, when the new owners, Live Lobster Co., wanted help retooling the century-old cannery into a state-of-the art processing plant.

Bolton came in on the ground floor.

By the time East Coast Seafood and Garbo Lobster purchased the plant and started MFTL three years later, Bolton knew the place inside out and offered MFTL recommendations on equipment, safety training for employees, meeting state and federal regulations, and more.

In the years since, MFTL has produced upward of 8 million pounds of

lobster annually with a value of over $36 million, says Tad Pawlowski, a quality control director. The lobsters are harvested by local fishermen from the Gulf of Maine and Atlantic Canada. The frozen lobster products are shipped worldwide.

Jackson says Bolton's food safety experience, expertise and advice have been incredibly helpful.

"We aim to be leaders in terms of processing excellence and quality assurance. His input has been invaluable as we continue to grow and provide meaningful employment to the state of Maine," says Jackson.

BOLTON IS no stranger to the state's most iconic sea-bug. His uncle, Robert Bayer, directs the Lobster Institute at UMaine and inspired Bolton to move to Maine from Arizona to study food science.

In 2006, Bolton earned a bachelor's degree in food science and human nutrition at UMaine.

"Coming from Arizona, Maine was a new place and a new culture, but the opportunities at UMaine gave me a huge leg up in my overall confidence and abilities," says Bolton, who as an undergraduate was a teaching assistant in both biology and chemistry, and collaborated on research projects with faculty and staff. He also was a National Science Foundation Teaching Fellow, leading STEM classes at local elementary schools.

For his undergraduate thesis in food science, Bolton quantified the heavy metal content in lobster meat and tomalley, the liver-like organ that is a delicacy in some brave Maine circles.

Bolton stayed at UMaine for a master's and Ph.D. in food science and human nutrition. He developed a non-invasive, handheld device to analyze optical properties of the protein hemocyanin, or lobster blood, which is correlated with lobster health and vitality. The sensor informs distributors about the health of a live lobster prior to shipping and its ability to survive long-term storage.

> "There is something that is said when you produce a **Maine-made product: quality, safety, hard work, a strong sense of community.** Things that define the state as a whole." Jason Bolton

Bolton continued the development of the sensor as he began his Ph.D. as the principal investigator of a $98,000 National Science Foundation grant.

For his doctoral research, Bolton designed analytical methods to rapidly identify, quantify, isolate and extract small molecules in foods — proteins in lobster blood, polysaccharides in aloe and potent antioxidants in peppers — that could be used in nutraceuticals or biotech research.

Two years into his program, he joined UMaine Extension. Committed to the engaged student experience he had, Bolton advocates for internships, plugging undergraduates into food businesses. That includes three food safety interns at MFLT.

"I fully believe in the Extension mission to bring UMaine research and information to the public," says Bolton. "In my case it is to help grow food companies and ensure they are properly educated to manufacture safe foods."

AT THE Gelato Fiasco Flavor Foundry in Brunswick, Maine, freshly filled pints of Madagascar Vanilla Bean advance along a conveyor belt. On the lid of each hand-packed container, a sticker highlights the 10th anniversary of the award-winning gelato.

In the last decade, the company has created over 1,500 flavors of gelato and sorbetto, most of which are only available at the company's stores in Brunswick and Portland. These pints of vanilla, however, are destined for grocery store freezers nationwide.

Bolton began working with Gelato Fiasco in 2015 during a period of major growth for the company.

"When we first reached out to him, we had virtually no mechanization on the production line. We were in a stage where we needed to start producing a lot more gelato quickly to fill customer orders," says Lila Wilmerding, Gelato Fiasco's quality control director.

Bolton helped the growing company design its new plant and build its food safety plan. With the expansion, the gelato company shifted from producing about 2,400 pints a day to nearly 12,000.

Amid the clatter of empty containers and lids feeding into the production line, Molly Delan, Gelato Fiasco's plant manager, and Joshua Davis, co-founder and CEO, talk with Bolton about the implementation of the new Food Safety Modernization Act (FSMA).

FSMA represents a massive change in commercial food processing regulations, says Bolton, who is the lead in FSMA education and programming for the state. Under the new regulations, all food producers will be required to have specific practices and controls in place to prevent food safety issues.

"Cooperative Extension is providing the required education for these companies to meet these new mandates," says Bolton, who also teaches courses and works with Maine companies, like Gelato Fiasco, to help them get ready for compliance.

Bolton placed UMaine food science student Olivia Conrad as an intern with Gelato Fiasco, and she helped the company start to compile required FSMA documentation.

"She exceeded all of our expectations," Delan says.

Many companies want an intern with experience in food safety, says Bolton. The interns often bring valuable knowledge and become essential team members during their experience.

Gelato Fiasco hopes to hire Conrad when she graduates in 2018.

THIRTY MILES south of Brunswick in Portland's East Bayside neighborhood, Luke Davidson, chief distiller and owner of Maine Craft Distilling, is in the middle of moving the business to a larger facility.

> "I fully believe in the Extension mission **to bring UMaine research and information to the public.** In my case, it is to **help grow food companies** and ensure they are properly educated **to manufacture safe foods."** Jason Bolton

Maine Craft Distilling locally sources many of the ingredients it uses to make spirits. Even its whiskey is aged on peat and seaweed from Washington County in Maine-made barrels built from Maine-grown oak.

After five years, the approximately 1,500-square-foot "farm-to-flask" distillery is bursting at the seams. Barrels full of finishing spirits and open-topped fermenters line the walls. And at the center of it all is the still, engineered by Davidson, dubbed "Frankenstill."

In 2012, Maine Craft Distilling approached Bolton and UMaine Extension with questions about regulations, licensing and distillation technology.

"I was able to use less of my food safety background and use more of my food science background to help them with flavors, packaging and a few other things," says Bolton.

Over the years, Bolton has assisted Maine Craft Distilling with its development of a few flavors, including Blueshine, a potent spirit flavored with Maine blueberries and maple syrup.

"The Maine wild blueberry is a mystical creature," says Davidson, holding a bottle of the dark indigo fluid up to the light. "They (the blueberries) are more of an experience, and they aren't what people normally expect."

Bolton provided Davidson with expertise to distill, bottle and capture that unexpected experience — right down to the color.

"The Blueshine is a unique Maine product," says Bolton. "It's been fun to see how all of (Davidson's) products have evolved over the years."

CHRIS KINKADE, beekeeper and founder of Green Bee Soda, began making all-natural sodas in five-gallon batches at his home in 2010. Now in a ground-floor suite in Brunswick's Fort Andross Mill Complex, Kinkade's honey-sweetened beverages are made in two 1,000 gallon-stainless steel tanks.

As the company began scaling up production in 2012, Kinkade contacted

UMaine Extension to come up with a way to ensure consistency and develop quality-control procedures.

Bolton worked with Kinkade to validate a new production process for the sodas. He also provided training to test each batch for potential microbiological contaminants.

Over the clinking of glass and the rhythmic hiss-snap-click of the automated bottle labeler, a two-person crew packs cases with Blueberry Dream soda. Kinkade shows Bolton where new production machinery will be installed. The new equipment will allow Green Bee Soda to significantly increase daily production and further ensure the quality of the product.

Recently, Green Bee Soda partnered with Luke's Lobster to create an exclusive Maine Blueberry Lemonade soda for the restaurants. Bolton connected the two after working with the restaurant's affiliated company, lobster processor Cape Seafood in Saco, Maine.

Luke's Blueberry Lemonade will be sold at Luke's Lobster restaurants nationwide and in Japan.

Watching Maine's food community grow, and seeing companies he's built relationships with succeed and share what they've learned with others starting out is a rewarding experience, he says.

A rising tide lifts all ships.

"I try to make connections between Maine's food companies as often as I can," says Bolton. "I think as they grow, they can often bring others with them." ■

At Green Bee Craft Beverages in Brunswick, owner Chris Kinkade, right, discusses the company's pasteurization process with Jason Bolton. The full line of Green Bee Craft Beverages includes a Maine Blueberry Lemonade, made exclusively for Luke's Lobster restaurants throughout the United States and in Japan.

A click away

Speech-language teletherapy breaks the bounds of isolation

By Erin Miller

BY THE time most people reach kindergarten, speaking is second nature. But for some children in Maine, verbal communication does not come easily. That's also true for a growing population of older adults in the state.

Unable to verbalize needs or to greet loved ones as they enter the room, people with aphasia, an impairment of language frequently caused by a stroke, often live in a secluded world. Maine's rural geography can compound this social isolation, and many small communities have limited treatment options, requiring caregivers and patients to travel long distances, or do without.

As part of their clinical training, UMaine graduate students in the Department of Communication Sciences and Disorders provide speech therapy telepractice services to children and adults throughout Maine.

To help overcome these challenges, the Speech Therapy Telepractice Program was established in 2012 at the University of Maine's Madelyn E. and Albert D. Conley Speech, Language and Hearing Center in collaboration with colleagues at Waldo County General Hospital in Belfast.

Using a secure web-hosted video conferencing system, graduate student clinicians provide speech therapy services to clients anywhere in the state through computers or other devices connected by high-speed internet. Instead of traveling to a speech and hearing center, clients are able to receive speech therapy while sitting at their computers in their homes, schools or any other setting.

"In a predominantly rural state, telepractice is an efficient, cost-effective way to provide speech therapy services that are beneficial to children and adults with communication disorders," says Judy Walker, an associate professor in UMaine's Department of Communication Sciences and Disorders, who developed the program.

> "In a predominantly rural state, **telepractice is an efficient, cost-effective way to provide speech therapy services** that are beneficial to children and adults with communication disorders." Judy Walker

THE UMAINE Speech Therapy Telepractice Program was one of the first of its kind in the nation to offer speech therapy telepractice training for graduate students and serves as a model for other academic institutions worldwide.

As part of their clinical training, graduate student clinicians provide speech therapy telepractice services to 36 children and adults from York to Aroostook counties. A client and his or her eHelper — the person who is assisting — log onto a password-protected site for the telepractice therapy session. Clients converse with graduate student clinicians through an interactive monitor, where they can jot their lessons on the computer screen so the therapist responds to what they are doing in real time. Family members from other remote locations and collaborators who assist and encourage the client between therapy sessions also can "attend" the session.

On the other side of the globe, four children with disabilities at the International School Suva in Fiji also are receiving speech therapy through UMaine's telepractice program. The tropical archipelago does not have speech therapists, and like some children in Maine's rural schools, without telepractice they would not receive consistent speech therapy.

In Maine, Buckfield Junior-Senior High School started using UMaine's speech therapy telepractice services following the retirement of its speech pathologist almost two years ago. Principal George Reuter says the school adopted the new model to benefit students.

"For me and my position as principal, we really want a quality level of service provided on a consistent basis, and without telepractice, I don't know that we would be able to provide such a consistent level of service," Reuter says.

Special education technician Tina Hicks says the UMaine team is "accommodating and flexible with our schedule, and takes a lot of what we do daily and incorporate that into their lessons."

"The kids love it. I think they prefer this," Hicks says. "I never have any of them not want to go. The kids are really engaged and we have seen improvement."

Telepractice also created new opportunities to improve the quality of clients' lives, including helping senior citizens stay in their homes. Walker recently completed a research project that focused on reducing social isolation of people with aphasia through participation in a telepractice communication group.

Bob and Kathy Jackson of South Gardiner, Maine joined the group to connect with other people.

"It was great just having somebody new to talk to," Kathy says.

Kathy lost the ability to speak following a stroke four

years ago. Thanks, in part, to individual speech treatment through telepractice, she regained her speech.

Phone conversations, though, can still be a challenge, making it difficult to keep in touch with family and friends out of state. Following individual therapy, Kathy has participated in two telepractice aphasia communication groups.

"This support group helps make connections and friendships that you lose because people don't know how to deal with you," Bob says.

"I look forward to it," says Kathy.

"They can talk together because they all understand each other," says Bob.

FOLLOWING THE success of the telepractice aphasia communication groups, Walker also is focused on building telepractice caregiver support groups in future research projects.

In addition to the telepractice program, the Conley Center has expanded to meet the growing demands for speech therapy and audiology services, along with serving as the on-site training facility for graduate and undergraduate students.

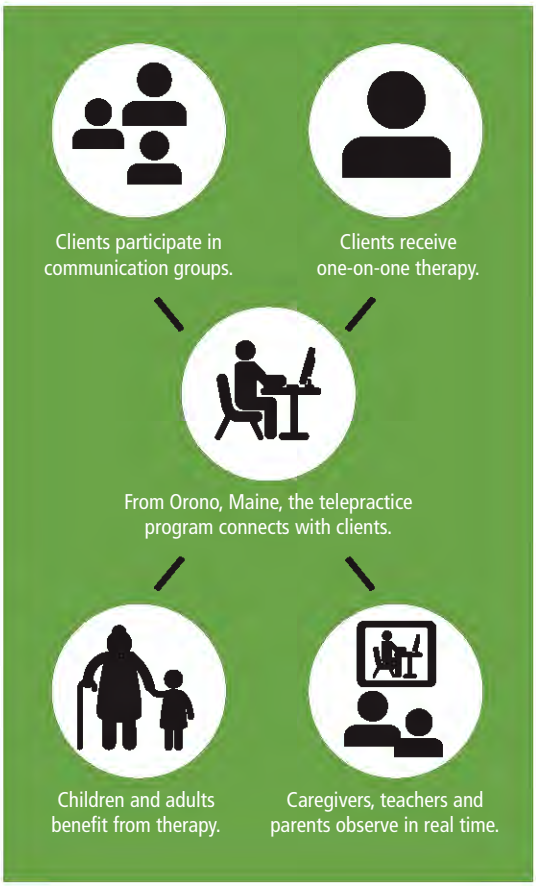
UMaine's Audiology Clinic and Speech-Language Clinic offer services for people across the lifespan. The Speech-Language Clinic includes comprehensive speech and language diagnostic evaluations, family-based approach to therapeutic services, and support services for children and adults who stutter.

"We have over 50 clients in our on-campus center — from 18 months to 93 years — all working with our students," says Judith Stickles, the center's director.

From 2014–24, the U.S. Bureau of Labor Statistics anticipates the speech pathology field will grow 21 percent — three times the national average for job growth overall.

In states with rapidly aging populations like Maine, the demand may become even more critical. Maine is the oldest state in the nation, with the population of citizens 65 years of age or older on track to increase by almost 90 percent over the next 15 years.

UMaine is home to the state's only undergraduate major in speech-language pathology and Maine's only accredited master's program that leads to national certification in speech-language pathology.



"Our workforce development is critical for meeting current and future demands for speech-language pathologists, and the telepractice service delivery model will enhance the ability to reach those in need of services," says Nancy Hall, chair of UMaine's Department of Communication Sciences and Disorders.

Experience with telepractice was essential for Anastasia Valcourt, a graduate of the communication sciences and disorders master's program, when she entered the workforce.

"UMaine is one of the few universities in the country that offers the telepractice program. From day one, we had opportunities to practice our skills working with a range of different age groups, from preschool to adult-age clients," Valcourt says.

She now works for Mark R. Hammond Associates, Inc. in Portland, Maine, where she trains other speech language pathologists on telepractice.

For families like the Jacksons, more telepractice-savvy speech pathologists is great news.

"The whole telepractice program was a godsend for us," Bob says. ■

Summers in the lab

Physics, electrical engineering major a Goldwater Scholar

GRAHAM VAN Goffrier, a physics and electrical engineering major at the University of Maine, has been named a 2017–18 Goldwater Scholar by the Barry Goldwater Scholarship and Excellence in Education Foundation. The Norwell, Massachusetts native was awarded one of 240 scholarships to outstanding undergraduate sophomores and juniors nationwide who are studying mathematics, natural sciences and engineering.

SUMMER RESEARCH: Van Goffrier, who also is pursuing minors in nanotechnology and mathematics, has spent past summers involved in UMaine research in the Maine Software Agents and Artificial Intelligence Laboratory, Biophysics Research Group, and Laboratory for Surface Science and Technology. This summer, he will participate in the University of Michigan's Research Experience for Undergraduates Program at the European Organization for Nuclear Research.

BEYOND ACADEMICS: Van Goffrier has been involved in various extracurricular activities, including ice skating and theatre. He also launched a Rubik's Cube club. He has worked as a teaching assistant and has been active in professional associations, including the student chapters of the Society of Physics Students, IEEE and Tau Beta Pi. Van Goffrier plans to pursue doctoral research in theoretical physics. He credits his UMaine professors and staff for much of his success. ■

Tick check

Multiple initiatives focus on stemming a growing threat in Maine

By Elyse Catalina / Photographs by Adam Küykendall

IN MAINE, the threat is growing.

Fourteen tick species have been found in the state. Of those species, two pose significant health threats — one to humans and another to one of Maine's most iconic animals.

Researchers at the University of Maine — in the College of Natural Sciences, Forestry, and Agriculture; Climate Change Institute; and University of Maine Cooperative Extension — are studying the arachnids and the diseases they spread in an attempt to better protect the health of people, animals and the environment.

The deer tick or blacklegged tick *(Ixodes scapularis)* is responsible for the majority of tick-borne illnesses affecting humans and domestic animals in Maine. The winter tick or moose tick *(Dermacentor albipictus)* prefers ungulate hosts, including moose, whose population is under attack as a result of the blood-sucking pests that latch on by the tens of thousands to a single animal.

Cases of Lyme disease, the most common tick-borne disease, reached a high

Maine is home to 14 tick species, two of which pose significant health threats. According to the Maine Center for Disease Control and Prevention, cases of Lyme disease, the most common tick-borne disease, reached a high of 1,485 in 2016, which researchers believe is a small fraction of the actual incidence.

of 1,485 in 2016, according to preliminary data from the Maine Center for Disease Control and Prevention (CDC).

"Those reported cases are believed to be only a small fraction of the actual cases," according to Griffin Dill, an integrated pest management specialist with UMaine Extension. "It's thought that it's a tenfold difference, so 1,000 cases is actually more like 10,000 cases."

The disease is caused by a bacterium *(Borrelia burgdorferi)* transmitted by the bite of an infected deer tick. Ticks don't hatch carrying the disease, but contract it in the larval stage by feeding on an infected rodent, according to Dill. The ticks then transmit the disease to animals and humans during the nymphal and adult stages.

Early Lyme disease symptoms can include a bull's-eye rash, fever, headache, joint and muscle pain, and fatigue.

> "Those reported cases are believed to be **only a small fraction** of the actual cases. It's thought that it's a **tenfold difference,** so 1,000 cases is actually more like 10,000 cases."
>
> Griffin Dill

The disease is easiest to treat with antibiotics in the early stages. If left untreated, it can lead to arthritis; neurological problems, including numbness, pain, facial paralysis and meningitis; memory and concentration difficulties; or heart inflammation. In rare cases, Lyme disease can be fatal, according to the Maine CDC.

Dill says an increase in deer ticks began to appear in southern Maine in the late 1980s and early '90s. Since then, the pests have increased their population in southern Maine, as well as their distribution statewide. Deer ticks have been found in all 16 counties and as far north as Madawaska, according to Dill.

EVEN THOUGH ecologists predicted the dry conditions of 2016 would reduce Maine's tick population, the overall incidence of Lyme disease hit a record high. According to the UMaine report "Maine's Climate Future: 2015 Update," the spread of Lyme disease has been linked to temperatures that make habitat more suitable for deer ticks and their hosts.

Other tick-borne diseases, including anaplasmosis and babesiosis, also have been increasing in the state. Preliminary

At University of Maine Cooperative Extension's Insect and Plant Disease Diagnostic Lab, integrated pest management specialist Griffin Dill and other team members offer diagnostic services, including plant disease identification, plant nutritional and cultural problem assessment, and insect identification. Dill, who runs UMaine Extension's tick identification program, is pursuing a Ph.D. in ecology and environmental sciences. His research is concentrated in the ecology of ticks, particularly the relationships among tick densities, habitats and small mammal hosts, including mice.

Maine CDC data for 2016 reported 373 confirmed and probable cases of anaplasmosis, up from 186 in 2015; 83 cases of babesiosis, up from 56.

Anaplasmosis is a bacterial disease that can infect white blood cells. Symptoms of anaplasmosis include fever, headache, malaise and body aches. Babesiosis is a potentially severe disease that can infect red blood cells. Signs of babesiosis usually range from no symptoms at all to extreme fatigue, aches, fever, chills, sweating and anemia, according to the Maine CDC.

UMaine Extension operates the only tick identification program in the state. John Rebar, UMaine Extension executive director, says the free service is a more affordable, faster option that gives people peace of mind sooner than if they sent a tick out of state. The program also adds to UMaine Extension's surveillance and research efforts.

For 25 years, tick identification in the state was provided by Maine Medical Center Research Institute's Vector-borne Disease Lab in Scarborough. In 2014, the center eliminated its program due to funding concerns and turned it over to UMaine Extension.

"We thought it was a very important service to offer," says Dill, who has taken on coordination and expansion of the UMaine Extension tick identification program.

Since UMaine's program began, it has averaged about 275 tick identifications per year, Dill says. UMaine Extension staff can identify the type of tick submitted, as well as the common hosts and diseases that species can carry. Currently, the lab does not test for disease-causing organisms.

UMAINE'S NEW Plant, Animal and Insect Laboratory, slated to open by early 2018, will include a Biosafety Level 3 (BSL-3) area that will allow for safe screening of blood-borne pathogens, such as tick-borne diseases. UMaine Extension hopes to offer pathogen testing for Lyme, anaplasmosis and babesiosis at a cheaper rate than out-of-state services, which can cost around $50, according to Dill.

The BSL-3 area will be a biocontained environment, according to Anne Lichtenwalner, a UMaine professor, veterinarian and director of the Animal Health Laboratory, which also will be relocating to the new facility.

One of Lichtenwalner's major research initiatives is monitoring the health of Maine's moose. For about seven years, the Animal Health Lab has been working with the Maine Department of Inland Fisheries and Wildlife (IF&W) to study moose survival rates and mortality sources.

The lab is part of a multiyear study assessing the health of the animal in Maine, New Hampshire and Vermont. Since 2014, IF&W has fitted 286 Maine moose with GPS collars, which enable biologists to track movement, as well as receive messages if a moose dies, according to Lee Kantar, state moose biologist.

When the moose are collared in January and February, IF&W biologists collect fecal, hair and blood samples; count parasite loads; and do a general assessment. Researchers at the UMaine Animal Health Lab then process, analyze and store the samples.

"It's IF&W's procedure; we provide the service and help interpret the results," Lichtenwalner says.

When a radio-collared moose dies, IF&W biologists conduct a necropsy in the field. They bring back samples, including the lungs and brain, which Lichtenwalner and her students test for diseases and parasites. Many of the moose samples the lab has analyzed have been infected with winter ticks, lungworms and lung cysts.

> "We need to be **thinking ahead** when we're managing our yards, our communities, our state. We need to be thinking about **how to reduce our risk of infectious disease."**
>
> Susan Elias

In late March and early April, the biologists usually see a surge in deaths.

"This is when the winter ticks are taking their biggest blood meal. The weather is changing, and the moose have used up a lot of their metabolic stores for the winter, and we're a little early for new growth they may be browsing on. That's when we tend to lose moose," says Lichtenwalner, who affectionately refers to the animals as "charismatic megafauna."

A single moose can carry tens of thousands of winter ticks. University of New Hampshire researchers estimated one moose in the study carried more than 60,000, with the average being around 47,000, Kantar says. A mature winter tick can expand to the size of a grape and fill itself with up to four milliliters of blood, according to the researchers.

An infested moose can become anemic, and essentially be drained of its blood. Calves are more likely to die because their smaller bodies are sometimes unable to handle the blood loss.

University of Maine researchers in multiple disciplines are conducting research on ticks and the diseases they spread in an attempt to better protect the health of people, animals and the environment. In the Animal Health Lab, pictured far left, UMaine veterinarian Anne Lichtenwalner, left, partners with Maine Department of Inland Fisheries and Wildlife biologists to study moose survival rates and mortality sources. UMaine Climate Change Institute doctoral student Susan Elias, pictured near left, a vector ecologist with Maine Medical Center Research Institute, conducts research on the eco-epidemiology of tick-borne disease in an era of abrupt climate change.

Deer and other animals have the ability to groom ticks from their bodies.

"Moose tend to rely on rubbing, but the ticks oftentimes can survive the rubbing. (The moose) end up losing their hair, but not the ticks," Lichtenwalner says. Infested adults are often referred to as "ghost moose" because of their patchy and pale appearance caused by their attempts to rid themselves of the pests.

The IF&W study began in western Maine in 2014. That year, 73 percent of the collared calves died, followed by 60 percent the next year. In 2016, 26 of 35 collared calves in the western Maine study area did not survive, as well as 17 of 36 in the newly added northern Maine area, Kantar says.

Lichtenwalner says the data from the IF&W study can be used to help predict moose populations and inform decisions related to forest management and hunting permits. The number of moose permits issued in Maine fell from 4,110 in 2013 to 2,140 last year — largely because of concerns about survival rates due to winter tick infestation. State wildlife biologists are proposing to reduce moose permits to 2,080 for the 2017 season to meet population goals, Kantar says.

RESEARCHERS BELIEVE tick survival may be increased by warming temperatures and shorter winters. In the fall, ticks wait in vegetation to attach themselves to passing animals. The later winter starts, the more time the ticks have to find an animal to grab onto to escape the cold and snowy weather.

"What we're experiencing in Maine now is compression of winter," says Susan Elias, a doctoral student in the Climate Change Institute. "It's become a shorter season, so that means adult deer ticks can quest longer into the late fall and start earlier in the spring. That improves their probability of finding a blood meal, and once that female deer tick is fed, then she can overwinter and lay eggs in the spring."

One adult female deer tick lays between 1,000 and 2,000 eggs that result in larvae the following August, according to Elias, who is researching the factors that affect the spread of deer ticks in Maine, as well as the diseases they carry.

Elias has a master's degree in wildlife science and is a research associate at the Maine Medical Center Research Institute's Vector-borne Disease Lab (VBDL). She also is part of the Adaptation to Abrupt Climate Change (A2C2) Integrated Graduate Education and Research Traineeship (IGERT) at the Climate Change Institute (CCI). The program provides funding to

Ph.D. students for interdisciplinary research projects aimed at improving climate change adaption strategies.

In collaboration with CCI, Elias says VBDL predicts climate change will increase the risk of vector-borne illness to humans in Maine. Tentative conclusions are that milder winters and adequate moisture in summers, as well as higher daily temperatures, will allow the deer tick to complete its life cycle statewide, according to Elias.

In addition to climate change, Elias is looking into other variables thought to affect the spread of deer ticks.

"Certainly one driver is climate. That's one piece of the puzzle, but it's not the whole puzzle," she says, citing other factors, such as deer and small mammal host density, and changes to tick habitat, including land use and invasive plants.

With help from other UMaine climate scientists, Elias is creating models that better integrate the variables by using existing data sets and software that simultaneously take into account several factors and indicate the relative importance of each.

In 2016, Elias conducted a survey of Maine's island residents to better understand the attitudes and beliefs people have toward ticks, as well as what they're doing to protect themselves.

"We're seeing fairly high tick densities out on the islands and fairly high infections. There seems to be a high entomological risk out on these islands," says Elias, who cites high deer densities and invasive plants, such as Japanese barberry and oriental bittersweet, as possible reasons for the increased risk.

Tick removal spoon

The main reproductive host for the deer tick is the white-tailed deer. Some small island communities that don't have a history of a regular firearm season have an overabundance of the animal, Elias says.

Thirteen of Maine's 15 unbridged islands with year-round residents have deer herds that carry ticks. Matinicus never had a deer population, and Monhegan eliminated its herd in the 1990s after contacting VBDL about its increasing number of Lyme disease cases.

The lab continues to be contacted by island residents who are concerned about the prevalence of ticks and Lyme disease, says Elias, who hopes the survey can be the first step in developing a response to the increasing problem.

"Our approach to finding out what people are thinking and feeling is to better understand the community and, upon invitation, go in and consult, and then help streamline this quasi-political process to try to grapple with tick control," she says.

Tick management works best as a community effort, Elias says. In communities that are split on how to handle deer overabundance, she recommends tick control committees look into ways to tackle a less polarizing issue, such as eliminating invasive plant species, which can create a dense microhabitat and protective environment for ticks.

Elias says understanding the spread of Lyme disease is important because it speaks to the larger issue of the eco-epidemiology of infectious disease.

"Tick-borne disease is just one; other diseases could spread northward and we need to be prepared," she says. "We need to be thinking ahead when we're managing our yards, our communities, our state.

"We need to be thinking about how to reduce our risk of infectious disease."

ALLISON GARDNER, an assistant professor of arthropod vector biology in the School of Biology and Ecology, also is looking into the ecological processes that facilitate the expansion of vector-borne diseases.

The three tick-borne diseases in Maine that are currently undergoing substantial geographic range expansions — Lyme disease, anaplasmosis and babesiosis — are spreading at different rates and spatial patterns, Gardner says.

"Lyme has spread the farthest north and the fastest at this point," she says.

"Babesiosis is the most geographically confined; currently substantial human cases only are being seen in the southern part of the state."

Gardner's research will look at whether land use and/or climate change is responsible for the state's emergence and distribution of tick-borne disease.

All land use changes — increased residential development, forestry practices and terrestrial plant invasions — result in reduced complexity of habitat, Gardner says. As habitats become more simplified, many large mammals leave. These animals include predators of mice — the primary reservoir hosts of Lyme disease.

In the case of climate change, Gardner says one possibility for the spread of Lyme disease is that the deer tick has been transported north by animals capable of moving long distances, such as birds or deer. However, they haven't been able to survive the winter to form a reproductive population until now.

Trying to assess the relationship between climate change and vector-borne disease is a complex problem, according to Gardner and Elias, because of the many components to transmission, including the vector, pathogen and hosts.

"The Lyme disease ecological model is one of the most complex models of disease out there," Elias says. "Working out this puzzle is fascinating. We need people from so many disciplines to get this figured out."

Before coming to UMaine in 2016, Gardner's research primarily focused on diseases transmitted by mosquitoes. Now her focus has shifted to tick-borne disease because it is of more concern in the region.

Gardner says the primary defense Maine residents have against tick-borne disease is awareness.

"People need to take steps to protect themselves by wearing appropriate clothing and being aware of times of year that are particularly high risk for tick-borne disease," she says.

The most important personal protection technique, according to Elias, is the tick check.

Also essential, Gardner says, is being better informed to make land use decisions that can either drive or inhibit the transmission of vector-borne disease.

Dill, who runs UMaine Extension's tick identification program, is pursuing a Ph.D. in ecology and environmental sciences. His tick ecology research focuses on their relationship to their hosts.

In summer 2016, he conducted a pilot project at farms statewide. At each, he live-trapped small mammals, removed any ticks and took an ear snip to test for tick-borne disease. While his initial study looked at farms and potential risks for workers, Dill plans to expand his research to look into the relationships among tick densities, habitats and small mammal hosts. He will do that at the new Plant, Animal and Insect Laboratory.

"There's a lot of fear and disinformation related to ticks out there, so it's incredibly important to have a facility like this where we can conduct research, but also (operate) as a hub for disseminating information directly to the public," Dill says. ■

Personal Protection Tips

from UMaine Cooperative Extension

Avoid direct contact

- Avoid areas that may be infested with ticks, including wooded and brushy spots with tall grass and leaf litter.
- If unavoidable, plan activities involving tick habitat for the hottest, driest part of the day. In general, ticks tend to be found in wooded areas, tall grass or brush, edges where woods and lawn meet, and leaf litter; and around stone walls and woodpiles where small mammals live.
- Walk in the center of mowed or cleared trails to avoid brushing against vegetation.

Dress appropriately

- Wear light-colored clothing for easier tick detection.
- Wear long pants tucked into socks or boots, and tuck your shirt into your pants to keep ticks on the outside of your clothes.
- Do not wear open-toed shoes or sandals.

Use repellents

- Repellents that contain up to 30 percent DEET can effectively repel ticks from exposed skin and clothing for several hours.
- Use products that contain permethrin to treat clothing and gear; do not apply permethrin directly to your skin.
- Other tick repellents recommended by the Centers for Disease Control and Prevention include picaridin, lemon eucalyptus oil and IR3535.

Perform checks

- After being outdoors, conduct a full-body check. Ticks may be found anywhere on the body, particularly under the arms, behind the knees, between the legs, in and around the ears, in the belly button and in hair.
- Examine gear and pets before returning indoors to ensure no ticks are carried inside.
- Tumble clothing in a dryer on high heat for one hour to kill any ticks.

Safely remove ticks

- Remove an attached tick using tweezers or a tick removal spoon.
- Thoroughly clean the bite area, your hands and the tick removal tool with rubbing alcohol, an iodine scrub, or soap and water.
- If you experience a rash, headaches, fever and flu-like symptoms after a bite, see a physician.

A focus on Maine plants, animals and insects

IN NOVEMBER 2014, Maine voters approved an $8 million bond referendum to support state agriculture, facilitate economic growth in natural resource-based industries, and monitor human health threats related to ticks, mosquitoes and bedbugs through the creation of a Plant, Animal and Insect Laboratory, administered by University of Maine Cooperative Extension.

The new facility, expected to open by early 2018, will house UMaine's Animal Health Laboratory and Extension's Insect and Plant Disease Diagnostic Laboratory.

The lab will bring together scientists researching mammals, agriculture, insects and plants under one roof, according to John Rebar, executive director of UMaine Extension. The unique combination of researchers will provide many teaching opportunities for students, as well as premier research and outreach facilities.

By allowing for research contributions to agriculture, public health, communities and wildlife, the lab will benefit Maine in a variety of ways, including protecting the natural resource- and food-based economies, adding to food safety and human health, and providing unique diagnostic and testing services to farmers, homeowners and the public.

The need for new facilities dates back about 20 years, Rebar says. Both the Insect and Plant Disease Diagnostic Lab on College Avenue, and the Animal Health Lab in Hitchner Hall were in danger of becoming obsolete.

The original plan called for constructing a facility off College Avenue. But when a mostly vacant, 28,000-square-foot commercial laboratory building became available for sale in Orono a few miles from campus, it was clear that buying and renovating would offer more options for the budget, according to Rebar.

"It went from good to great to unbelievable," he says of lab plans.

The building on Godfrey Drive across the river from campus was built about 15 years ago and already contained lab and office spaces. About 3,500 square feet of space in the facility is, and will continue to be, leased to an office of the National Oceanic and Atmospheric Administration.

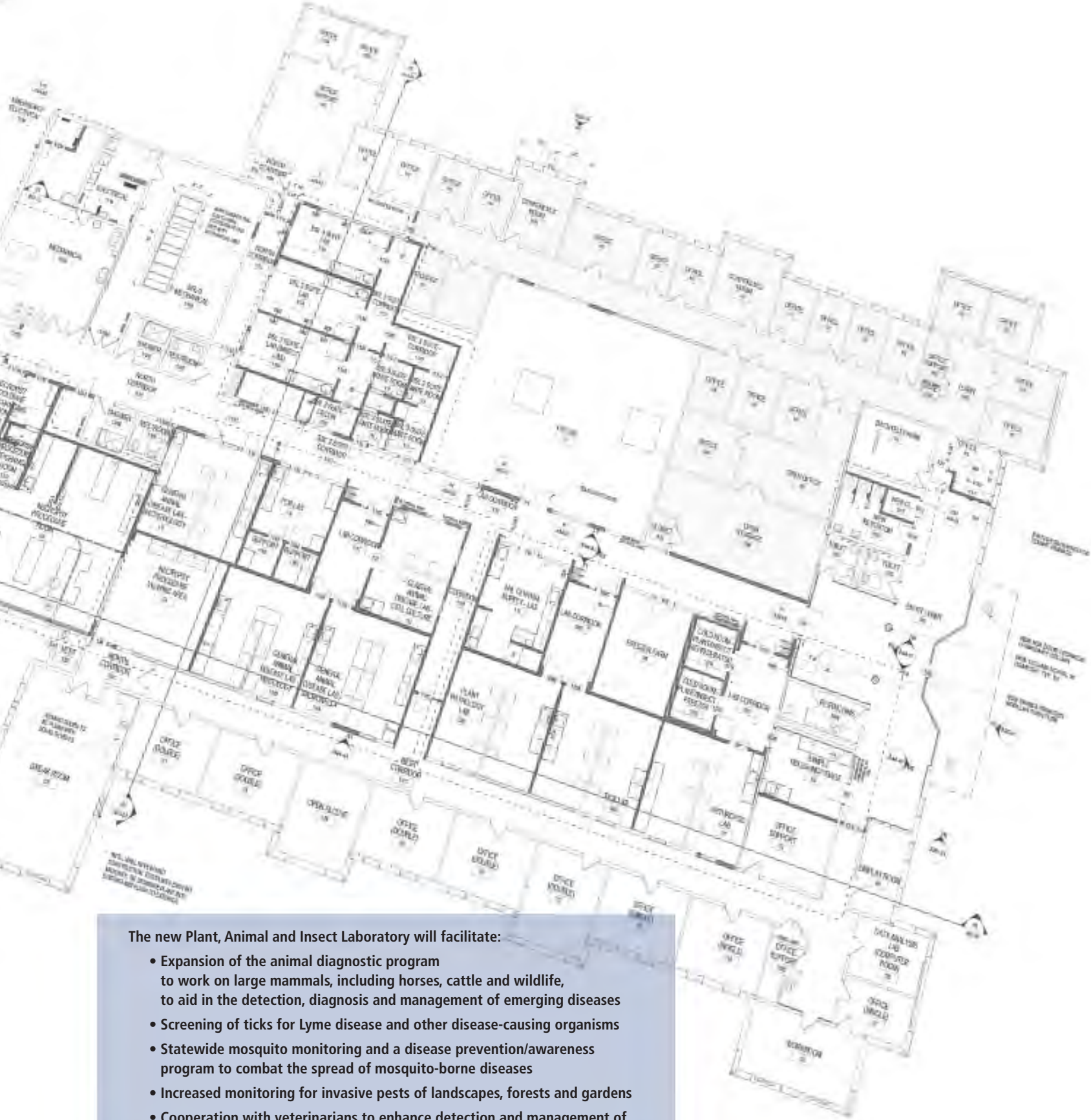
The building is a prime location for bringing in large animals to be autopsied. It also sits on a six-acre site with room for expansion.

The new Plant, Animal and Insect Laboratory will include a Biosafety Level 3 (BSL-3) area that will allow for screening of blood-borne pathogens, such as tick-borne diseases. According to the Centers for Disease Control and Prevention, BSL-3 requires primary barriers and personal protective equipment, as well as secondary barriers in the form of lab facilities.

More information is online: extension.umaine.edu/newlab

The area will be a biocontrolled environment, according to Anne Lichtenwalner, a UMaine professor, veterinarian and director of the Animal Health Lab. Researchers will be required to take extra precautions, such as wearing lab-specific clothing, showering and sterilizing all materials coming out of the facility. The section also will have its own air-handling system to keep pathogens from escaping, she says.

Other improvements to the Animal Health Lab's necropsy space include a glassed-in viewing area for students and livestock owners, as well as a private drop-off at the back of the building, complete with a monorail system, to more easily transport large mammals, such as moose or cows.



The new Plant, Animal and Insect Laboratory will facilitate:

- **Expansion of the animal diagnostic program to work on large mammals, including horses, cattle and wildlife, to aid in the detection, diagnosis and management of emerging diseases**
- **Screening of ticks for Lyme disease and other disease-causing organisms**
- **Statewide mosquito monitoring and a disease prevention/awareness program to combat the spread of mosquito-borne diseases**
- **Increased monitoring for invasive pests of landscapes, forests and gardens**
- **Cooperation with veterinarians to enhance detection and management of preventable diseases in domestic animals**

The company we keep

Research focuses on the role and value of friendship in the lives of youngsters and adolescents

By Walter Beckwith / Photographs by Adam Küykendall / Illustrations by Rylie Bonin and Lucy Küykendall

ON A car ride home, Douglas Nangle's 12-year-old daughter and her friend were sitting in the backseat, their noses glued to their smartphones as they chatted about the "likes" they'd received on the cat photos posted to their social media profiles.

Left unsaid: the mutual understanding of the meaning behind each of those likes.

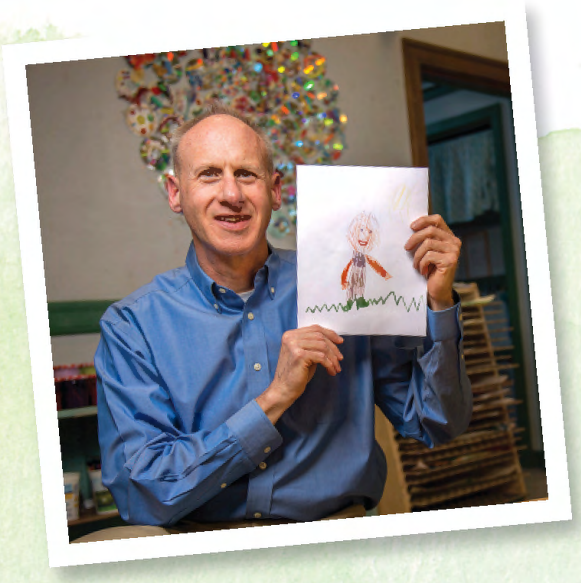
"I've only got five likes on this one, but one is from Sarah."

"Oh really? You got one from Sarah?"

For a researcher like Nangle, who has been studying the interactions of children for over two decades, the exchange is particularly fascinating.

"They are not only analyzing how many likes they got, but also who sent them," says Nangle, a University of Maine professor of psychology and director of the doctoral Clinical Training Program. "It was a whole conversation that seems pretty silly on the surface, but they were processing the information at an incredibly detailed level, balancing the number of likes and the relative social standing of the senders and what that said about them."

In the 20-plus years since Nangle and Cynthia Erdley, a UMaine psychology professor, began studying the science of children's friendships, much has changed in the understanding of how these early relationships help — and, in some cases, hinder — social adjustment. Through their seminal research, Nangle and Erdley have been major contributors to the understanding of the core functions of early



Relationship challenges

RELATIONSHIPS ARE fundamental to how people experience the world around them, says Douglas Nangle, professor of psychology, director of the UMaine Clinical Training Program and recipient of UMaine's 2011 UMaine Presidential Outstanding Teaching Award.

Since joining the university in 1994, Nangle's research has focused on child and adolescent peer relations, and social skills assessment and treatment. He has examined how the friendships in children and adolescents impact, and are impacted by, internalizing symptoms, like depression and social anxiety. His work also explores how friendships and other peer experiences help shape the development of early romantic relationships.

In many ways, friendships are important training grounds for future relationships, says Nangle.

Early friendships provide opportunities to learn skills in communication, empathy and intimacy. Inhibition and withdrawal associated with social anxiety can create challenges for early friendship formation and impede development of relationship-building skills. Without them, or exposure to broader social networks that good friendships offer, adolescents' romantic relationships may suffer.

Nangle's research has identified a path connecting social anxiety to friendship and romantic relationship impairments in adolescence. He also has found evidence linking social anxiety and dating aggression in college-age romantic relationships.

Most recently, Nangle has explored this link between social anxiety and forms of aggression. Rather than physical or overt aggression, he and other researchers have begun to identify more indirect forms of aggression in peer relationships.

peer relationships, and the implications of the game-changers through the years, including the rapid rise of technology and social media. Together, they have collaborated on numerous publications, including two books — one on the role of friendship in psychological adjustment and another on the clinical assessment of social skills.

Two years ago, the UMaine psychologists were joined by assistant professor Rebecca Schwartz-Mette, whose research also focuses on peer relationships. Together, the scientist-practitioners are working to develop crucial social intervention programs to help youngsters and youths build more positive friendships in a world that is more complex than ever.

The three have published a practitioner's guide to understanding depression in childhood and adolescence. They are now working on a book that will explore how social behaviors and skills impact adjustment through childhood and adulthood, as well as their role in certain psychological and developmental disorders, like depression, aggression or anxiety. The volume will highlight the intervention programs that have been developed to help aid in these social challenges.

"For a long time, there was a focus on trying to change kids' social behavior to get them liked by more of their peers in general," says Nangle. "But changing social status at the group level is difficult and these programs did not always have as much success as people had hoped for. Now, instead of trying to get a kid liked by everyone in their class, some are trying to help them become better participants in the friendships they do have."

A FRIENDSHIP, as defined by peer relationship researchers, is a dyadic relationship distinguished by "reciprocated positive nominations." Put simply, two individuals are friends if they like one another and identify each other as a friend. Equality and mutuality are the relationship's defining characteristics, Nangle says.

Childhood friends are important because they help shape the way we think, the way we see the world and the behaviors we engage in. In many ways, we are the company we keep — the good and the bad.

Friendships provide children with something they can-

not get from the other important relationships in their lives, such as parental bonds, because their friends are often on equal footing. As children grow older, their friends become an important source of social and emotional support.

Early research into children's relationships focused on peer group acceptance — how popular a child was among peers — rather than the more nuanced one-on-one relationships.

In the '70s and '80s, it was generally understood that positive peer group acceptance predicted more positive behavioral outcomes. That is, the popular kids tend to be friendlier, more generous, cooperative and empathetic, while youngsters rejected from the social group tend to be more aggressive, disruptive or hostile. They also are lonelier and have more depressive symptoms, according to Erdley.

But as social researchers began to look closer at interactions between individual children in the 1990s, a more complex picture surfaced. Among those researchers were Nangle and Erdley, who focused on the "protective role" of children's friendships.

Peer group acceptance and friendship are related. Children and adolescents who are more accepted are more likely to have more friends. But friendships, in their own right, are distinct, meaningful, and have a direct relationship to feelings of loneliness and, in turn, depressive symptoms.

"We ended up finding out that friendship more strongly predicts to adjustment than peer group acceptance does," Erdley says. It's probably uncommon to find somebody who is depressed and not lonely.

Having just one friend is often all it takes to reap these protective qualities.

"One is the magic number. One friend makes the difference. You don't seem to be any better off with three or five or more friends, but there is a huge difference between zero and one," Erdley says. "We know that children who don't have friends are more likely to be bullied by peers."

While youngsters with friends can be victims of bullying, the risk for negative outcomes, including low self-esteem, depression and anxiety, decrease if a child or adolescent has a friend — someone to turn to for comfort, support and, most importantly, validation.

Being accepted by a group of peers provides feelings of inclusion and community, says Nangle, but friendships provide more. With friendship comes a mutual expectation of support.

Some of the core functions of a friendship include companionship, help, loyalty, nurturance, validation, affection and intimacy. Early friends are often the first sources of these social and emotional qualities outside of immediate families.

"Friends help us learn positive social skills," Erdley says.

In many ways, the friendships children forge on the playgrounds and neighborhoods become important training grounds for relationships later in life. Skills such as communication, conflict resolution and intimacy are learned and honed in early friendships.

For example, disagreements are a part of every relationship, but youngsters and adolescents with friends tend to be better at conflict resolution, which becomes crucial in adulthood, not only in interactions with family members and friends, but co-workers and other people in our lives.

"When friends fight, they care about the relationship and they want to preserve it," says Erdley. "Skills like negotiation and communication become important."

Early friendships also can be important predictors for romantic relationships later in life.

"We know there is a continuity between high-quality friendships as a young kid and high-quality dating interactions as a young adult. And if you have high-quality friendship and dating interactions, you're more likely to have high-quality interactions in your marriage," Nangle says.

Friendships are an important source of support during life's many transitions. In the case of schoolchildren, peer relationships also can have an impact on students' academic, social and emotional success in school.

While studying the transition of adolescents into middle school, Erdley and her colleagues discovered that both the quantity and quality of a student's friendships during elementary school predicted loneliness, self-esteem and academic performance when entering middle school.

Others' research has shown similar results. Kindergarten children who had more friends or who were able to make new friends at the beginning of the transition into school developed a more positive outlook and showed greater academic gains throughout the year. Additionally, academic success and extracurricular involvement of older students can be predicted by the same qualities in their friends.

> **One is the magic number.**
> One friend makes the difference."
> Cynthia Erdley

"I think that peer relationship research has uncovered what humans have probably known for generations about the social provisions we get from friendships," Schwartz-Mette says. "It all boils down to the simple fact that having a friend scratches that very basic human itch we all have — needing to be accepted and to have a connection with other people."

Meaningful friendships equip people with the social armor that protects against deeply seated fears of not being accepted and provides tangible proof that one is OK — and loved.

"Having a friend, even just one friend, unconsciously communicates that you are connected and you are worth

it," says Schwartz-Mette. "You are part of the fabric and you're not on the outs."

While friends and friendships may change dramatically throughout a lifetime, those social provisions of friendship — companionship, validation and greater self-esteem — are important no matter the stage of life. While they are particularly crucial when coming into one's own during childhood and adolescence, they also are important during crossroads in later life, says Erdley.

"In a time when you're losing some of your roles — perhaps you are retiring, your kids have moved on or maybe your spouse is no longer with you — you're still looking for that connection with somebody," says Erdley. "You're still trying to enhance that feeling of, 'Wow, this person wants to be with me, this person enjoys being with me, I must be somebody good.'"

UNDERSTANDING THE dynamics of children's friendships is just as important when it comes to helping youth deal with the downside of early relationship building.

"In the early 2000s, people were really looking at friendships as an all-good thing," says Nangle. "We used to think that if you did all the things that the socially competent kids did, then other kids would like you. However, (we) found that that was not necessarily true."

Children and youth who are less popular don't necessarily admire the most socially competent kids. Rather, they gravitate toward those more like themselves, with common behaviors, attitudes, interests and ethical principles.

And once a bond is formed, pairs of friends tend to grow more similar to each other over time; for better or for worse.

In recent years, peer relationship research has begun to look into the less-than-positive qualities of friendship. In this "dark side" of friendship, children who form close relationships with those who exhibit delinquent behaviors or depressive symptoms are more at risk of developing the same problems.

"You can feel really close to someone and feel supported by them, but their engagement in certain risk behaviors confers a risk for you to also develop those behaviors," Schwartz-Mette says.

Virtual friendships

CYNTHIA ERDLEY can trace her interest in the science of peer relationships to her days as a babysitter in high school when she was fascinated by the way children interacted.

Since joining UMaine in 1992, her research has focused broadly on understanding the relationship between children's friendships and social and emotional adjustment. She's explored how having a friend can impact both internalizing problems, like loneliness, anxiety or depression, as well as externalizing problems, like aggression. Her research has also shown how quality friendships predict both academic performance and success in social transitions, like moving to a new school. For Erdley, seeing how friendships have changed and evolved throughout her career is particularly exciting.

Some of Erdley's most recent research has been on the use of social media and its impact on the friendships of adolescents. Social media has been a game-changer in terms of the amount of contact peers can have with one another. Adolescence used to be the stage when older youth began to spend more time with their friends and gained more control over their social lives. Now, though, due to the omnipresence of social media, that stage occurs as early as late elementary school.

Social media has certainly provided an avenue for bullying or other types of negative interaction, but in general, Erdley sees it as a mostly positive thing.

When used appropriately, the online social lives of children and adolescents in many respects mimic their face-to-face friend networks, says Erdley. It has allowed children and adolescents to greatly expand their friendship networks, and has provided the tools to support and maintain ties with peers from all over.

Emotional adjustment

REBECCA SCHWARTZ-METTE has always been fascinated by the nuances of human nature and understanding why people do what they do. Now, drawing inspiration from her experiences and social interactions, the assistant professor of psychology is looking into the complex mechanics — the microsocial processes — of the peer relationships of children and adolescents.

Schwartz-Mette came to UMaine in 2015. Her research broadly focuses on the ways psychological problems and health-risk behaviors are influenced by interpersonal context — the needs, values or personality a person brings to an interaction.

In adolescence, friendships become very important. At the same time, youth are at increased risk for unhealthy behaviors, like self-injury or suicide. Schwartz-Mette is interested in understanding how constructs like contagion and co-rumination in friendships relate to these adjustment issues.

Schwartz-Mette has developed a community outreach program that works with local school districts and community organizations. The program provides training for teachers and school counselors, and consultations with school guidance departments. There also are presentations for students on a variety of issues.

From this outreach, her lab is gaining information about the unique needs of the state's children. She hopes the research will give these schools a better sense of how their students are doing and, perhaps, will inform policy.

This year in her lab, Schwartz-Mette is testing school-based prevention and intervention programs, which help students develop stronger social skills and potentially prevent emotional adjustment problems.

Depressive symptoms can be contagious and can pass from one friend to another.

"The risk for depression in childhood is roughly equal for boys and girls," Schwartz-Mette says. "At adolescence, that risk increases, but for girls it increases much more sharply."

This disparity continues into adulthood. A female's risk of developing depressive symptoms is twice that of males, and women are more likely to experience one or more periods of depression in their lives.

A social mechanism called co-rumination may in part explain the contagious and gendered nature of depression. Co-rumination is the excessive discussion of problems between a set of friends, and it encompasses both positive and negative traits of friendship. All people share problems with their friends on some level. It's a natural part of building trust and intimacy in a relationship, but can have some unintended and serious consequences.

"It's a process that makes friends feel pretty close to one another, but it also, unfortunately, increases emotional adjustment problems like depression," says Schwartz-Mette.

Research by Erdley and other psychologists has shown that girls' friendships are generally characterized by a greater exchange in emotional provisions. They tend to place more emphasis on intimacy, disclosure and emotional support in friendships. For girls, friendships are a greater source of self-definition, according to Erdley. Co-rumination also is much more frequent in girls' friendships.

Girls who engage in a lot of co-rumination report having high-quality, intimate friendships, but at the price of greater feelings of depression, says Erdley.

"What we found was that co-rumination was sort of a missing piece of the puzzle in understanding why girls, adolescent girls in particular, are at an especially high risk of depression," says Schwartz-Mette.

Boys who co-ruminate appear to experience increased feelings of intimacy and connection, but don't seem to have the negative trade-off of being more depressed.

"We might have uncovered a hidden strength of boys' friendships," Schwartz-Mette says. "They seem much more focused on solving rather than internalizing the problems."

In some respects, the gender differences in valuing rela-

Being accepted by a group of peers provides feelings of inclusion and community, but **friendships provide more.** With friendship comes a **mutual expectation of support.**

tionships, disclosure and co-rumination can be attributable to the ways in which young girls and boys are socialized, says Schwartz-Mette.

Typically, girls are encouraged to share and label their emotions more so than boys. Relationships are emphasized and connectedness to others is explicitly valued. Society sometimes sends the message to boys that displays of emotion should be avoided and that ideal masculine traits include being strong, stoic and independent.

"Of course we know that being emotional and strong aren't mutually exclusive, but in a society where we like things in neat boxes, these gender stereotypes persist," says Schwartz-Mette.

Schwartz-Mette thinks research into co-rumination has a lot to offer in helping explain the gender differences in depression. It also can help researchers understand the contagion effect of depression, self-harm and suicide.

"If you spend a lot of time talking about it, maybe it raises the level of importance and it starts to impact behavior," she says.

This is a particularly important issue for a rural state like Maine, where access to mental health care is limited and the risk of depression and suicide in youth is higher than the national average, according to Schwartz-Mette.

"Wouldn't it be great if we could understand the unique needs of this population? To figure out what we can do for the schools, and provide good evidence-based services for the kids who really need it," Schwartz-Mette says. ■

Watching for eyes

Reproduction endocrinology research could improve survival rates of Atlantic salmon embryos

By Jay Field / Photographs by Holland Haverkamp

IT'S A mystery that has puzzled University of Maine assistant professor of marine biology and aquaculture Heather Hamlin and the salmon farming industry in New England: the decline in egg survival.

The survival rate of fertilized salmon eggs had been as high as 80 percent. But beginning in 2000, salmon embryos began dying in large numbers and the average survival rate fell to around 50 percent.

Previous studies have shown that a range of factors can negatively impact egg quality and production, including nutrition, stress, temperature and the endocrine status of the female. Until recently, businesses such as New Brunswick-based Cooke Aquaculture, which runs farming operations at several sites in Maine, knew little about why some of its eggs were dying and others were surviving, despite having come from same-strain females, cultured under similar conditions.

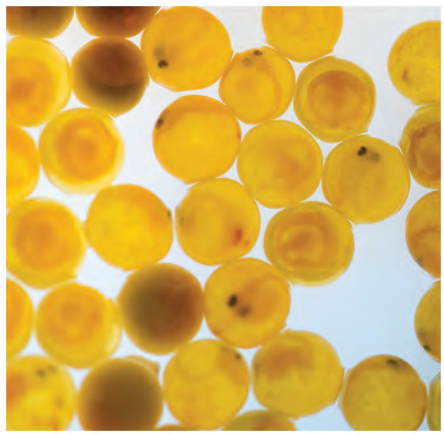
Now a UMaine study has found that two hormones may play significant roles in achieving an 80 percent embryo survival rate. Hamlin and LeeAnne Thayer, a UMaine Ph.D. candidate in marine sciences, wrote about their findings in the journal *Aquaculture Research*.

For the past five years, Hamlin and Thayer have been taking tissue samples from Atlantic salmon ages 2–4 at three Maine sites: the National Cold Water Marine Aquaculture Center of the U.S. Department of Agriculture at UMaine's Center for Cooperative Aquaculture Research in Franklin; and two owned by Cooke Aquaculture — a freshwater breeding site in Bingham and a sea cage site in Eastport.

Hamlin and Thayer incubated fertilized eggs and monitored their development. What they watched for was the development of the embryos' eyes in the bright orange eggs — a good indication that the egg will ultimately hatch.

For Hamlin and Thayer, a major focus of their research has been the endocrine

> "How do I use what I've done in the past to **address problems that are important to Maine?** It's a really important part of our scholarship and research."
>
> Heather Hamlin



LeeAnne Thayer, a Ph.D. candidate in marine sciences, monitors Atlantic salmon development by looking for the embryos' eyes — a good indication that the incubated fertilized eggs will ultimately hatch.

system, which includes hormones, the tissues that produce them and the genes that regulate them. Because hormones regulate much of reproduction and embryonic development and many other systems, the researchers wanted to determine if there was a difference in the hormone profiles of the females producing batches of eggs with high and low survival rates.

Hamlin and Thayer found that female Atlantic salmon with the highest levels of 11-Ketotestosterone, an androgen, and 17-beta estradiol, an estrogen, were more likely to produce embryos with an 80 percent survival rate.

Beginning in 2000, Atlantic salmon embryos began dying in large numbers and the average survival rate fell to around 50 percent. UMaine researchers wanted to determine if there was a difference in the hormone profiles of the females producing batches of eggs with high and low survival rates.

THE PROJECT was a natural next step in Hamlin's research career focused on the intersection of endocrinology and reproductive health. The Hampden, Maine native received her bachelor's and master's degrees from UMaine. She was an assistant professor in the Department of Obstetrics and Gynecology at the Medical University of South Carolina before returning to her alma mater in 2011.

"How do I use what I've done in the past to address problems that are important to Maine?" she asks. "It's a really important part of our scholarship and research. It has less utility, in my opinion, if it can't benefit the people of Maine."

Hamlin found the research project that would allow her to fulfill this goal a few months before beginning her job in Orono. That spring, she was invited to a salmon hatchery roundtable in Bangor. Commercial aquaculture producers, marine scientists, and state and federal officials gather biannually to discuss challenges facing hatcheries in New England. At the meeting, Hamlin learned about declining embryo survival rates in farmed Atlantic salmon.

Hamlin's Ph.D. research at the University of Florida examined how pesticides, nitrates and chemicals in plastics affected the reproductive health of alligators, sharks, chickens, Siberian sturgeon and turtles. In South Carolina, the reproductive endocrinologist worked at the Hollings Marine Laboratory, where she did research on marine animals in an effort to learn more about problems impacting maternal fetal health.

In the declining survival rates of salmon embryos in New England, Hamlin saw an opportunity to use her expertise in endocrinology and reproduction to help solve a major problem facing an industry vital to Maine's economy.

Student researchers sort the live salmon embryos to determine the percentage that have reached the eyed stage.

Cooke Aquaculture operates salmon farming operations in New Brunswick, Nova Scotia, Newfoundland, Chile, Scotland, Maine and Washington, and sea bass and sea bream farming operations in Spain. Cooke representatives were among the industry officials at the salmon hatchery roundtable in Bangor. Hamlin introduced herself after hearing about the salmon embryo survival problem, and proposed working together to solve the issue.

The declining embryo survival rate creates unpredictability, which means the company must produce more eggs than needed to ensure a consistent supply of salmon for the marketplace.

Hamlin will now turn her attention to hormonal processes related to egg assembly, ovulation or postovulatory aging. In the next phase of her research, Hamlin plans to analyze arrays of mRNA transcripts, or transcriptomes, in the tissues of farmed Atlantic salmon to see which systems in the fish are the most stressed.

"That could really help us sort of identify that needle in the haystack," says Hamlin. "We can start to identify very specific pathways that might be affected. Then we might be able to definitively identify causes. That's a relatively new area of research." ■

Peter Neptune, left and Sabattis Tomah at Peter Dana Point, Indian Township, Maine.

Photo courtesy of Donald Soctomah, Passamaquoddy Tribe

The Sabattis Tomah Project

Micah Pawling will work with the Passamaquoddy tribe to finish transcribing and annotating the notes of ethnographer Nicholas N. Smith, which will be part of an exhibit in Indian Township.

MICAH PAWLING, an assistant professor of history and Native American studies at the University of Maine, is one of eight humanities scholars nationwide to be awarded a 2017 Public Engagement Fellowship from the Whiting Foundation.

The eight were selected from more than 80 scholars nominated from over 50 institutions.

The fellowship supports scholars as they engage the public in humanities-focused projects that encourage community building and cultural literacy.

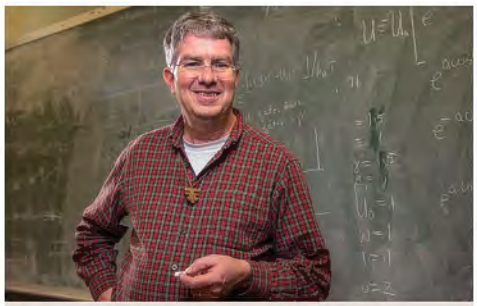
Pawling's initiative, "The Sabattis Tomah Project: Making History in the Community," focuses on the significance of Passamaquoddy cultural leader Sabattis Tomah of Peter Dana Point in Indian Township, an isolated community in Down East Maine. Tomah (1873–1954) was an important keeper of ceremonial songs, plant medicine, traditional stories and intimate knowledge of Passamaquoddy homeland.

Weekly conversations took place in the early 1950s between Tomah and ethnographer Nicholas N. Smith. As part of Pawling's community engagement project beginning in spring 2018, Smith's ethnographic field journals, transcribed stories and original photographs will be "brought home" to the Passamaquoddy community for the first time in over half a century.

Pawling and Passamaquoddy historian Donald Soctomah will lead intergenerational workshops to help young members of the Passamaquoddy tribe interview their elders in an effort to preserve traditions and tribal stories, including memories of Tomah.

GLOBAL SPAN

ADVANCED INFRASTRUCTURE Technologies, a University of Maine Advanced Structures and Composites Center spinoff company, has signed an exclusive distribution and marketing agreement for North America with Terre Armee Group/Reinforced Earth Company. The agreement will help grow adoption of UMaine's patented composite arch bridge technology in North America, with the intent to expand into global markets. The innovative composite bridge system lowers construction costs, extends structural life span up to 100 years and is an alternative to traditional construction.



AAAS FELLOW

R. DEAN ASTUMIAN, University of Maine professor of physics, has been named a fellow of the American Association for the Advancement of Science (AAAS). His selection brings the number of full-time UMaine faculty members named AAAS Fellows to 10. Astumian was cited for significant contributions to the field of biological and synthetic molecular motors; particularly, for clarifying the role of microscopic reversibility in governing molecular machines. His work was cited in the scientific background for the 2016 chemistry Nobel prize on synthetic molecular machines.

WHAT'S NOW — AND NEXT

THE UNIVERSITY of Maine College of Education and Human Development, Riverside Adult Education Partnership and Literacy Volunteers of Bangor have teamed up to provide much-needed educational opportunities for female inmates at Penobscot County Jail.

In the pilot program called "What Now? What's Next?," women choose from a menu of services, ranging from help with completing high school and preparing for college, to child development and parenting classes, to one-on-one tutoring in reading and writing.

"A more literate community is one that is stronger, safer and more vibrant," says Mary Marin Lyon, executive director of Literacy Volunteers of Bangor, which has a longstanding working relationship with the college. With a high percentage of state prison inmates lacking a high school diploma or classified as low literate, "we know that this work is another way we can have a positive effect on our community," she says.

One of the services offered through "What Now? What's Next?" is a writing group, led by UMaine literacy professors William Nichols and Susan Bennett-Armistead. To date, about 30 women have participated in the group, which, in addition to teaching writing skills, provides opportunities to tell personal stories.

Other services offered by the UMaine team include child development and parenting classes provided by Associate Professor of Education Sid Mitchell and doctoral student Janet Nichols. Rachel Sirois, a junior pursuing a teaching degree, also is working on the project, which will be a focus of her honors thesis.

CLAM CAM

BRIDIE MCGREAVY grew up in Brownfield, Maine, but until coming to the University of Maine in 2010, she hadn't been on a clam flat.

Walking on exposed intertidal mud for the first time, she says, was like entering a "world that was so foreign, so beautiful."

Soon, thanks to the Clam Cam — which opens a window into the lives of Maine clam harvesters — others will be able to experience that world, too.

McGreavy is an assistant professor in the Department of Communication and Journalism. She's collaborating on the project with Tyler Quiring, a Ph.D. student in communication from Kelowna, British Columbia, and Carter Hathaway, a 2017 UMaine graduate in journalism from Turner, Maine.

A goal, says McGreavy, is to share the unique way of life and some of the pressing challenges of people who harvest clams for a living on the coast of Maine.

The team uses ethnographic methods (detailed, in-depth descriptions of people's daily life and practices) and digital media in its research to help foster communities' resiliency and sustainability.

After a harvester suggested the public could learn about his livelihood by vicariously digging clams, McGreavy's team supplied GoPros for harvesters — from Freeport to Roque Bluffs — to strap to their chests.

The videos depict what harvesters see — including sunrises, thick fog and mud. They also show the tools of the trade — rakes, buckets, hods, mesh bags and gloves, as well as various digging or pulling techniques. And more mud.

McGreavy says the Clam Cam captures the hard physical labor that goes into securing even a few pounds of fresh local clams for dinner.

The researchers have a website (nest.maine.edu/clamcam) showcasing the project's videos, interviews, information and data. The goal is to educate the public about people who are essential to this vital Maine industry, and the environmental, economical and social challenges they face.

A National Science Foundation award to the Senator George J. Mitchell Center for Sustainability Solutions and a grant from the University of Maine Humanities Center are supporting the project.

> "The clammers have a **substantial, embodied role in shaping how their industry is depicted.** This variation on traditional data generation supports **engaged and ethically mindful research."** Tyler Quiring

THE 'RURAL SCHOOL PROBLEM'

> **Rural schools have always had a hard time attracting teachers,** and then the teachers they do attract have to do a wide variety of things and teach a wide variety of subjects, which they wouldn't necessarily have to do in a more specialized urban environment."
>
> Catharine Biddle

WHAT CAN you learn by studying 100 years of academic writing about rural education in the United States? For Catharine Biddle, assistant professor of educational leadership at the University of Maine, it's this: The more things change, the more they stay the same.

"A lot of literature at the turn of the century focused on the things that rural schools lack, and there's a tendency to still do that today. That's kind of the echo forward of the 'rural school problem,'" says Biddle, who co-wrote an article in the *Review of Research in Education* titled "Constructing and Reconstructing the 'Rural School Problem': A Century of Rural Education Research."

Biddle and co-author Amy Price Azano, an assistant professor of adolescent literacy at Virginia Tech, trace the origins of the "rural school problem" to the progressive education reformers of the early 20th century. They examined nearly 150 academic articles published between 1910 and 2015 and focused on rural teacher recruitment, retention and training.

A long view of this critical topic shows that rural schools continue to have a difficult time attracting and keeping teachers.

An aspect that has changed, Biddle says, is that rural America has lost population since the early 20th century. That's had a negative impact on the political capital of rural communities and, in turn, rural schools, she says.

Biddle and Azano conclude their article by cautioning researchers against seeing rurality itself as a cause of the problems facing rural schools. They recommend education researchers take a more holistic look at issues of place.

A BETTER LOOK AT THE BASE OF THE MARINE FOOD WEB

TO GAIN greater understanding of the annual cycles of free-floating, life-sustaining ocean phytoplankton in the Arctic and Antarctic, University of Maine oceanographer Emmanuel Boss and colleagues from around the country utilized NASA's Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) instrument.

Lidar is an active sensor that emits a pulse of light and measures, as a function of time, the return signal due to interaction with matter along the light path. Return signals from the ocean measured by CALIOP have only recently been found to provide a good predictor of particle concentration in the upper ocean, Boss says.

With this technology, the team examined a decade of uninterrupted growth-decay cycles of polar phytoplankton biomass (microscopic algae), including when no light was available during polar winters.

Boss said the project yielded several important takeaways. One is that, if NASA optimizes lidar technology for ocean measurements (CALIOP was designed for atmospheric measurements), quantifying phytoplankton vertical distribution on a global scale will be possible.

Boss and his colleagues also concluded the annual cycle of plankton biomass can be explained as a slight imbalance in herbivore-phytoplankton dynamics.

And the team learned that in the last 10 years, ice cover changes dominated the variability in Antarctic phytoplankton stocks and ecological processes — light, nutrients and grazing — predominantly drove changes in Arctic phytoplankton.

Whittling Fog Photography

SHE'S THE EXPERT

THIS YEAR'S annual Maine Science Festival in Bangor, Maine included a taping of "You're the Expert," a live show featuring a panel of comedians who "try to get to the bottom of what a distinguished scientist studies all day." The goal of the program is to "make academic research more accessible and exciting" to the public. Kristy Townsend, UMaine alumna and assistant professor of neurobiology, joined host Chris Duffy and the other comedians — Roy Wood Jr., Michelle Buteau and Charlie Hankin — for the raucous game show segments focused on ferreting out her research field. In the lab, Townsend works to unravel the mysteries of the nervous system and how the brain regulates energy balance. The Bangor show is expected to air early this fall, and a podcast will be available.

Dawn of a new geological epoch

THERE ARE roughly 5,200 officially recognized minerals on Earth, according to the International Mineralogical Association (IMA), two of which — edgrewite and hydroxyledgrewite — are named after University of Maine mineralogist and petrologist Edward Grew.

Grew, a research professor in the School of Earth and Climate Sciences, has studied and helped discover new minerals from five continents — from Antarctica to Australia to Europe — particularly those containing the elements boron and beryllium.

Most recently, he helped identify and catalog, for the first time, a group of 208 mineral species that formed either principally or exclusively through human activities.

The research, a collaboration led by Robert Hazen of the Carnegie Institution for Science, suggests that humans have done more to increase the diversity of minerals on Earth than any other agent since the Great Oxidation Event impacted the planet over 2.2 billion years ago.

Many of the 208 minerals are attributed to human activities related to mining. Others are attributed to industrial environments. A few were even found in association with archaeological materials.

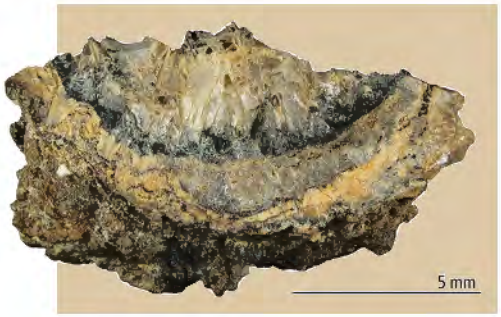
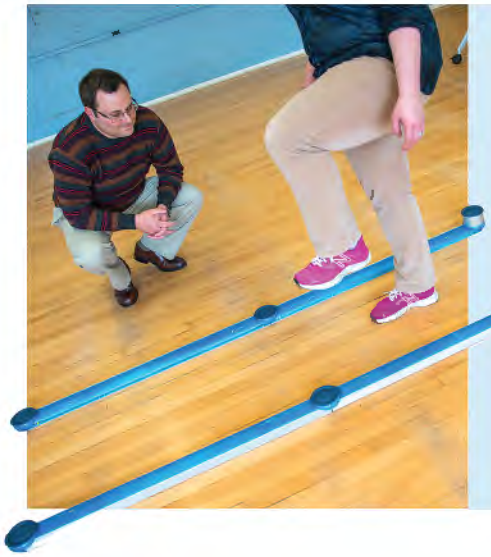


Photo courtesy of the RRUFF project

People did not directly create these human-mediated minerals, but rather helped shape the environments and conditions under which they were formed.

5,200
officially recognized minerals on Earth

208 **mineral species that formed either principally or exclusively through human activities**



A MATTER OF BALANCE

CONCUSSIONS ARE in the news these days as numerous professional and amateur sports leagues look for ways to ensure the long-term health and safety of players who sustain head injuries. A team led by researchers from the University of Maine and Logan University recently conducted a pilot study that might lead to a new method of monitoring people who sustain concussions. Using a device called OptoGait, which evaluates how a person walks, they are developing measures of balance that could indicate when a person has sufficiently recovered from a concussion to resume physical activity. Since loss of balance can be an indicator of a concussion, OptoGait may give athletic trainers and medical professionals additional information about a patient's symptoms. OptoGait could be a tool for understanding variations in balance that could indicate long-term concussion effects, says Christopher Nightingale, UMaine assistant professor of athletic training and physical education.

SPRING BREAK GETAWAYS

SPRING BREAK 2017 for some members of the University of Maine community involved a variety of engagement activities. Among them: Fifteen students and a faculty member from the School of Nursing were in Costa Rica on a medical mission trip. For the 19th year, UMaine's Alternative Breaks program sent volunteers into communities to undertake service projects, this time at sites in Virginia and New York state. Eighteen students majoring in anthropology, zoology, wildlife ecology, and ecology and environmental sciences were in Tanzania for a field studies course in ecology led by two faculty members. And four engineering majors traveled to Florida to work on a Habitat for Humanity project.

HUNGRY 100K

MAY 3, members of the University of Maine community set a meal-packing record. During The Hungry 100K: Maine Day Meal Pack-out at the Memorial Gym on campus, UMaine set a record for the most meals packed in one event by a university. UMaine is now ranked in the top 10 of all pack-outs held in 18 states. More than 250 volunteers helped the UMaine Honors College and Bodwell Center for Service and Volunteerism exceed their goal by packing 107,562 meals — about 5.5 tons of food — that were sent to food banks and shelters around the state. The pack-out was one of more than 70 volunteer projects undertaken by over 1,500 students, faculty, staff, alumni and community members on UMaine's annual day of service.

ONE OF THE BEST BATTALIONS

BLACK BEAR Battalion, the University of Maine's Army ROTC unit, has won the prestigious MacArthur Award, which recognizes the top eight schools, selected from among the 275 senior Army Reserve Officers Training Corps (ROTC) programs nationwide. The award, presented by Cadet Command and the Gen. Douglas MacArthur Foundation, recognizes the ideals of "duty, honor and country." It is based on achievement of the school's commissioning mission, its cadets' performance and standing on the command's National Order of Merit List, and its cadet retention rate. Cadet Command and the MacArthur Foundation have given the annual awards since 1989. Black Bear Battalion won top honors for 2nd Brigade, whose 42 schools include MIT, Northeastern, Boston University and Rutgers. It's the first time Cadet Command has selected UMaine Army ROTC for the award.

PLANTS IN THE PITS

FOR TENS of thousands of years, the warm, sticky natural asphalt that occasionally bubbled to the Earth's surface in the area now called Los Angeles was a death sentence for some ice age animals.

Woolly mammoths, camels, rabbits, horses, bison, sloths, rodents, snails, turtles, birds and saber-toothed cats perished after becoming mired in the liquid asphalt — sometimes referred to as tar pits.

For Jacquelyn Gill, the fossils, twigs and plants encased in this sticky petroleum at the La Brea Tar Pits and Museum in downtown Los Angeles provide opportunities to examine the climate and flora and fauna of the past, and observe evolutionary changes.

The University of Maine paleoecologist's findings will be added to the broader mosaic of what's already known about the very large animals of that era.

Gill and other scientists involved with Project 23, as it's called, intend to reconstruct the food web — from mastodons and bison to rodents and plants — during 2,000- to 5,000-year snapshots across an approximate 50,000-year period.

"Many of these are ice age survivors," Gill says of the animals and plants trapped in the oil seeps. "What made them so resilient to climate change and extinction?"

By reconstructing the food web, Gill and the team of researchers will learn how various species were connected for extended periods of time when they were not under climate stress.

Understanding those connections could help protect today's biodiversity in a changing climate, she says.

"We can see how species relied on each other, and use those relationships to predict extinction risk based on food web connections," says Gill. "It's a useful model to apply to our modern ecosystems."

Fossils in the tar pit tombs were unearthed recently when the Los Angeles County Museum of Art, which is adjacent to La Brea Tar Pits and Museum, excavated a site to build an underground parking garage.

Retirement saving

NEW RESEARCH by the University of Maine commissioned by AARP Maine reveals the fiscal impact of inadequate retirement savings in the state.

"The Fiscal Implications of Inadequate Saving for Retirement" report shows that an aging Maine workforce moving into retirement is increasingly reliant on public assistance, signaling a trend that could have important fiscal implications for the state, according to AARP Maine.

The study was led by Philip Trostel, an economics and public policy professor at the UMaine School of Economics and Margaret Chase Smith Policy Center.

"This report can serve as a catalyst for change," Trostel says. "Helping workers save during their career will reduce government spending for retiree benefits. It is important for the state of Maine to consider options that will create more vehicles for workers to save toward retirement through their workplace."

AGE-FRIENDLY LIVING

WHEN AARP announced last summer that Bangor would be named the 100th community in the country to earn "age-friendly" status, leaders in Maine's third-largest city had to make a big commitment. To receive this distinction, a city must agree to devise a comprehensive strategy to become more livable for its oldest residents.

AARP had already done one survey on how well Bangor currently meets the needs of its seniors. But city leaders, including Patty Hamilton, director of health and community services, felt they needed to dig deeper.

Bangor partnered with the University of Maine's Center on Aging to hold seven community forums last fall to gather feedback from seniors on how well Bangor is complying with the eight domains of livable communities, as defined by the World Health Organization: outdoor spaces and buildings, transportation, housing, social participation, respect and social inclusion, civic participation and employment, communication and information, and community and health services. Attendees also were asked to fill out voluntary demographic forms.

The Center on Aging research team found that Bangor has already made significant progress living up to its age-friendly status, says Lenard Kaye, Center on Aging director.

"We're not starting from scratch here," he says. "Bangor has pretty good grades on all counts."

Kaye says the Center on Aging is committed to working with Bangor officials and residents to figure out how to prioritize suggestions — from improving sidewalks to the need for housing and expanding bus service.

The older adults living in Bangor who attended the community forums and responded to the Center on Aging's survey also noted that they want an intergenerational community that they can benefit from, where they can interact with folks of all ages.

> "We remain the only campus in the system that has a Center on Aging that's **devoted to the research of issues of aging.** This is what we do." Lenard Kaye

WALK BANGOR

LAST FALL, a group of UMaine students gave a presentation on what could be gained by Bangor becoming a more walkable city, as well as the steps needed to get there. The students outlined the potential benefits and costs of two scenarios: creating about 5 miles of new bike lanes, and launching a "Walk Bangor" campaign by placing 30 signs citywide. Their analysis found that taking these two steps could save residents money, bring local businesses more customers, improve home values by attracting more people to the city, increase social activities and make Bangor greener and less car dependent.

Acadia's small critters

ALESSIO MORTELLITI, an assistant professor of wildlife habitat conservation at the University of Maine, is one of three scientists who have been awarded fellowships to conduct research in Acadia National Park.

The fellowships were awarded as part of Second Century Stewardship, an initiative of the National Park Service, Schoodic Institute at Acadia National Park, and the American Association for the Advancement of Science (AAAS).

Second Century Stewardship launched in 2016 during the centennial of the National Park Service to provide top-quality science research for park stewardship, build public appreciation for science, and pursue solutions to critical issues for parks and society.

The collaboration is initially focused at Acadia National Park, with plans to partner with national parks across the country over time, according to the Schoodic Institute.

The fellowship will fund Mortelliti's research on how small mammals may affect the expansion of plants due to climate change in Acadia National Park.

The results of the field experiments will allow managers to predict how local forest communities might change in the coming years and take the appropriate actions, Mortelliti says.

LESSONS IN STORYTELLING

THIS SPRING, 11 undergraduates in a class on adult development and aging in the College of Education and Human Development participated in a project called Legacy Storytellers through the Alzheimer's Association of Maine. They interviewed elders with early to middle-stage Alzheimer's or another form of dementia about their life and wrote narratives to give to their families.

The students worked from a list of questions covering different parts of a person's life: childhood and early adolescence, adolescence, young adulthood, adulthood and parenthood, and, finally, life's wisdom.

Ian Cameron, a lecturer in human development and family studies, teaches the course that examines the misconceptions, myths and stereotypes about the aging process and the elderly, with a focus on social, physical, cognitive, economic and demographic issues. Cameron wants students to understand that as humans live longer, rates of Alzheimer's and other forms of dementia increase.

The Legacy Storytellers program came to UMaine through a partnership with the Alzheimer's Association, Eastern Area Agency on Aging, and the UMaine Center for Community Inclusion and Disability Studies.

Cameron says the primary goal for the students was to produce a story about the residents' lives. A secondary goal was to have the students form a personal relationship with someone living with Alzheimer's.

ONLINE *SPIRE*

THE INAUGURAL issue of *Spire,* an online journal of conservation and sustainability at the University of Maine, launched in May. The student-produced journal promotes "awareness-raising dialogue" to unite Maine communities to affect positive environmental change. The first issue (umaine.edu/spire) features photos and original artwork, and articles from the fields of biology and ecology, folklore, climate science, English, graphic design, nursing and forest resources. Kaitlyn Abrams, a graduate student in English, founded the journal and is editor-in-chief.

Illustration by Colby Fogg

Home is where the heart is

Celebrating 15 Years! 2002 2017
BUCHANAN
ALUMNI HOUSE

FIFTEEN YEARS ago, alumni and friends celebrated the opening of the Robert D. Buchanan '44 Alumni House. After years of planning and hard work by University of Maine alumni leaders, reunion classes and friends, the dream of having "A Place to Call Home" became a reality. With more than 13,000 alumni taking part, the campaign to construct Buchanan Alumni House was the largest in UMaine's history. Built and maintained entirely through private monies, Buchanan Alumni House is home for more than 100,000 alumni and friends of the university. Since opening, the house has hosted 9,000 events, with over 275,000 attendees and countless numbers of visitors, including Dr. Buchanan this spring to celebrate his recent 95th birthday.

"**The University of Maine is home to some of the most loyal and caring donors** I have worked with in my career. They provide a level of excellence at UMaine that would not otherwise be possible. This building is one example of that generosity."

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

Please contact the University of Maine Foundation if you would like to discuss making a gift to benefit the University of Maine.

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