UMaine Today

CREATIVITY AND ACHIEVEMENT AT THE UNIVERSITY OF MAINE

FALL/WINTER 2017

Field days

Maine regenerates its storied grain culture

STEM education is a Signature Area of Excellence at the University of Maine, supporting expanded and improved teaching and learning from preschool through graduate school. For six years, the UMaine Department of Physics and Astronomy has offered weeklong science summer camps, where up to 80 children in grades K–8 learn about astronomy, space and energy, and math and art. The wonder of science was evident this day as UMaine graduate students helped Surya Vel and the other youngsters in the K–2 camp make "lava lamps."

Photo by Adam Küykendall

As A public research university, the University of Maine is committed to turning knowledge into solutions to help meet Maine's needs. It also is a go-to resource in the state and far beyond. World-class faculty, staff and graduate students lead those initiatives, and involve undergraduates — tomorrow's leaders in these efforts.

There are so many examples of the difference made by this mission — and mind-set. Take Maine-grown grain. A quarter-century ago when the state's dairy and potato farmers needed to diversify, and a Maine-based business was looking for locally grown grain, UMaine experts helped connect the dots. University researchers have partnered with Maine producers and businesses, contributing to the state's economic development and culture.

And while rooted in Maine, this state grain movement has international dimensions, as well.

In this issue of *UMaine Today* magazine, you'll read about important scientific and scholarly research that makes a difference in Maine and has brought the world to our door to tap the expertise of our exceptional faculty.

UMaine mycologist Joyce Longcore's research has helped us understand a pathogen responsible for decimating frog and other amphibian populations across the globe. This fall, she received a 2017 Golden Goose Award from AAAS for her pioneering work. Across campus, for a number of years UMaine biologist Harold Dowse collaborated on circadian rhythm research with now Nobel Prize winner Jeffrey Hall. And for decades, when the international community has sought the wisdom of a Gandhi scholar, it has turned to UMaine philosopher Douglas Allen, just as the United Nations did in October.

That's the breadth, depth and caliber of the contributions of Maine's public research university.

Susan J. Hunter, Ph.D.
President

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At the University of Maine, Ellen Mallory, an Extension specialist and associate professor of sustainable agriculture in the School of Food and Agriculture, is at the center of grain-related research and outreach efforts. She oversees plot trials of several varieties of wheat, rye and barley at UMaine's Rogers Farm in Old Town.

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NEXT TIME there's a total solar eclipse in the United States — April 8, 2024 — the UMaine High Altitude Ballooning group won't have far to travel. The path of totality includes northern Maine.

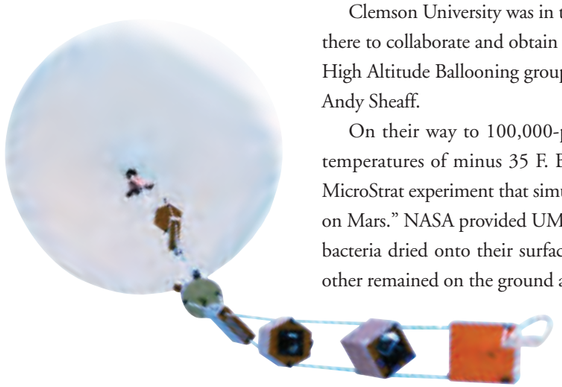
Courtesy of Clemson University

Eclipse mission

FOR THE Aug. 21 eclipse, a team of 18 University of Maine electrical and computer engineering students packed up their high-altitude balloons and headed to Clemson, South Carolina to participate in the first-ever NASA "Great American Eclipse" project. The mission entailed students from 55 teams nationwide launching unpiloted high-altitude balloons to live stream aerial footage of the total solar eclipse from the edge of space to NASA's website. UMaine's balloons were among the last to go airborne after 1 p.m.

Clemson University was in the 70-mile-wide path of totality, so the UMaine team traveled there to collaborate and obtain the best view of the eclipse from the balloons. The university's High Altitude Ballooning group is led by professor Rick Eason and engineering staff member Andy Sheaff.

On their way to 100,000-plus feet, the balloons and their payloads were subjected to temperatures of minus 35 F. Because of that, NASA used one of UMaine's balloons for a MicroStrat experiment that simulated "life's ability to survive beyond Earth — and maybe even on Mars." NASA provided UMaine with two small metal cards with environmentally resilient bacteria dried onto their surfaces. One card was part of a UMaine balloon payload and the other remained on the ground as a control.



Nobel research

THE 2017 Nobel Prize in Physiology or Medicine was jointly awarded Oct. 2 to Jeffrey C. Hall, Michael Rosbash and Michael W. Young for their discoveries of molecular mechanisms controlling the circadian rhythm, the internal biological clock. Hall joined the faculty at Brandeis University in 1974. From 2004–12, he was an adjunct professor at UMaine, and was a Libra Professor of Neurogenetics from 2008–10.

Rosbash is from Brandeis University; Young from Rockefeller University.

At UMaine, Hall collaborated with Harold "Dusty" Dowse, a professor of biological sciences, whose early work also involved circadian rhythm in the common fruit fly, *Drosophila melanogaster.* Dowse used the insect's modeling of fundamental mammalian biology to seek clues to human disease and development.

Hall and Dowse were frequent co-authors on leading journal articles. One of their first was with UMaine biologist John Ringo in 1987 in the journal *Behavior Genetics.* Hall and Dowse also were among the co-authors of articles related to *Drosophila* circadian rhythm in *Nature* and *Science* in 2001 and 2002, respectively.

Dowse also focused on heart movements in the fruit fly to understand the cardiac pacemaker and mutations that affect ion channels, cellular gatekeepers critical to an organism's nervous and muscular systems. Dowse and his colleagues identified two ion channels that constitute the core of the *Drosophila* pacemaker.

Mutations in two genes originally discovered in fruit flies were proven to underlie cardiac disorders in humans. Recently, Dowse and a co-worker showed that melatonin substantially increases heartbeat regularity in the fly.

At the time of their collaboration at UMaine, Hall and Dowse were studying the complex *Drosophila* courtship songs, with a focus on the cacophony mutation. Male fruit flies with the mutation have a harsh mating song, as well as an ion channel defect that affects heartbeat frequency and regularity.

THE NOBEL Laureates used fruit flies as a model organism to isolate a gene that controls the biological clock that helps living organisms, including humans, "anticipate and adapt to the regular rhythm of the day." The discoveries of the three researchers "explain how plants, animals and humans adapt their biological rhythm so that it is synchronized with the Earth's revolutions," according to the Nobel Assembly at Karolinska Institutet in its announcement.

ONE OF the study's most important findings is the two-year lag between economic stress and the eventual rise in suicide rates. According to the authors, the delay accounts for the time it takes economic hardships, such as job loss and home foreclosure, to affect individuals' mental health to such an extent that they take their own or others' lives. This lag, however, opens a "window of opportunity" for support systems to be put into place to help prevent these unfortunate acts.

Human costs

GLOBAL FINANCIAL crises and the severe economic hardships they impose on millions of people worldwide can sometimes lead to violent and fatal outcomes, according to a new study from the University of Maine. The research, which links periods of economic turmoil to increased rates of suicide and murder-suicide, illuminates the often overlooked and understudied loss of human life as a direct consequence of market instability.

The results of the study, which included an analysis of data from the Centers for Disease Control and Prevention (CDC) and Bureau of Labor Statistics, find that the rates of suicide and murder-suicide can be predicted by shocks to the national economy, like the recent Great Recession.

However, according to the study's lead author Pankaj Agrrawal, these tragic outcomes, termed "direct human fallout," lag behind the economic events that trigger them by two years — an important finding that identifies a crucial window for proactive government or public health policies or interventions to help prevent irreparable loss of life and human capital.

The paper, "Suicides as a response to adverse market sentiment (1980–2016)," co-authored with Doug Waggle, professor of accounting and finance at the University of West Florida, and Daniel Sandweiss, UMaine professor of anthropology and climate change, was published in the journal *PLOS ONE.* Agrrawal, an associate professor of finance in the Maine Business School, spent nine years evaluating the records of more than 2.5 million non-natural deaths reported by the CDC.

As economic systems struggle, so do the people who rely on them. The collapse of the housing market, which began at the end of 2006, set off what would become the most severe global financial crisis since the Great Depression. Between 2007 and 2010, it is estimated that U.S. families lost nearly $6 trillion of personal wealth — a sum equivalent to 39 percent of the U.S. national gross domestic product (GDP).

The **King Chair**

A SHAKESPEARE SCHOLAR whose public talks focus on the Bard in popular culture has been selected to hold the inaugural Stephen E. King Chair in Literature at the University of Maine. Caroline Bicks joined the UMaine English Department faculty in September from Boston College, where she was an associate professor of English.

In addition to Shakespeare, Bicks' other areas of specialization include women and gender in early modern literature and culture, early modern drama, the history of science, and girlhood studies.

The Stephen E. King Chair in Literature was established in the University of Maine Foundation with a $1 million gift from the Harold Alfond Foundation in honor of the UMaine alumnus' substantial body of work and his creative impact. Its goal is to advance excellence in the creation, study and appreciation of literature and the humanities. In addition to recruiting and retaining a top scholar, the endowed fund supports the creation of innovative learning opportunities for students, and activities that advance creative writing, literature and the humanities on campus and in the community.

Bicks received a Ph.D. from Stanford University in 1997, and spent a year there as a postdoctoral fellow. She is a New York City native who grew up spending her summers in Castine.

Bicks is the author of *Midwiving Subjects in Shakespeare's England* and co-editor of *The History of British Women's Writing, 1500–1610,* which received the Society for the Study of Early Modern Women Collaborative Research Award. Most recently, she co-authored an irreverent Bard-meets-life cocktail book, *Shakespeare, Not Stirred: Cocktails for Your Everyday Dramas.*

Her current book project challenges conventional views of the adolescent female brain in early modern England, arguing that girls were seen as inventive and culturally influential — inquiring and retentive minds that, in turn, captured the imaginations of early modern playwrights who frequently featured the brainwork of these teenage heroines.

Bicks' public lectures across the country focus on Shakespeare's relevance and vibrancy today, including echoes of the Bard in popular culture. For Bicks, that can even include the parallels between Shakespeare's Juliet and Stephen King's Carrie.

"I'm always seeking to bring the humanities out of the ivory tower and, in turn, to ensure that the academic spaces I'm privileged to create reflect the diversity of human experience that my students bring with them," Bicks says.

"I remember reading every Stephen King book they had at the Castine public library. **It's an enormous privilege to be holding this chair in King's honor."**

Caroline Bicks

Flu in muscle cells

THIS TIME of year, doctors often recommend flu shots for people who are young, old, pregnant or immunocompromised. Michelle Goody suggests adding people with muscular dystrophy to the list. After the University of Maine research assistant professor injected the flu virus into the bloodstreams of zebrafish with Duchenne muscular dystrophy (DMD), damage to their muscles was greatly exacerbated.

DMD is the most common type of muscular dystrophy and is characterized by progressive muscle degeneration and weakness. The genetic disease is caused by the absence of dystrophin, a protein that helps muscle cells remain intact. People with DMD — almost all males — have difficulty standing up and walking, and may have heart and lung problems.

Goody first injected human Influenza A virus (IAV) into the bloodstream of 2-day-old healthy zebrafish. Within 24 hours, they exhibited symptoms of an influenza infection — their hearts were swollen, their mobility was reduced and they were shaking.

The data, says Goody, indicate IAV can enter and infect live zebrafish muscle cells, and that "muscle degeneration, pain and weakness may be, at least in part, due to direct infection of muscle cells by IAV."

Muscle complications with viral infections also could be due to collateral damage by an activated immune system, she says.

Goody, the first person to discover that the flu virus can enter and infect muscle cells in a live animal, then injected the same dose of the flu virus into the bloodstream of zebrafish with muscular dystrophy. These zebrafish soon displayed severe muscle damage. This suggests "that muscle damage caused by Dystrophin-deficiency and IAV infection is synergistic," wrote Goody in *PLOS Currents: Muscular Dystrophy.*

MICHELLE GOODY, left, research assistant professor, earned her Ph.D. in biomedical science at UMaine. She conducts her research in the UMaine zebrafish facility and the labs of Carol Kim, professor of microbiology and associate vice chancellor for academic innovation and partnerships at the University of Maine System; and Clarissa Henry, right, her adviser and associate professor of biological sciences.

PORPHYRA UMBILICALIS (laver) attains high biomass despite the high levels of stress in its habitat in the upper intertidal zone of the North Atlantic, such as low tide at Sand Beach, Acadia National Park, Maine. Laver is a human food, and is being developed as an aquaculture crop by marine sciences professor Susan Brawley and her team at the University of Maine. The completed genome provides insights to its nutritional value, especially to its content of minerals, such as iron and vitamin C; vitamin E; and B vitamins, including B_{12}.

Story of **survival**

SEQUENCING OF the nuclear genome of *Porphyra umbilicalis* — laver or Atlantic nori — has revealed insights into how the bangiophyte red algae have thrived for over a billion years in the harshest environmental conditions — the pounding waves, baking sun and drying winds of the intertidal zone.

An international research team of 50 scientists led by Susan Brawley, professor of marine sciences at the University of Maine, discovered ancestral mechanisms of cell wall formation, an array of ultraviolet/high light and thermal protection strategies, and a wealth of nutrient transporters encoded by the *P. umbilicalis* genome.

The analysis of the *Porphyra* genome and the team's comparative analysis to available nuclear genomes of other red algae revealed novel features, including a reduced complement of motor proteins, unique signaling molecules and augmented stress tolerance mechanisms. The unexpected findings, published in the *Proceedings of the National Academy of Sciences,* offer a potential explanation for why the red algae are constrained to small stature relative to other multicellular lineages. Researchers discovered that the cytoskeleton that is so central to growth, development and ability to respond to environmental signals in most organisms has a strikingly small number of elements in *Porphyra* and other red algae.

Major support for the sequencing was provided by a contract from the Joint Genome Institute of the U.S. Department of Energy and by grants from the National Science Foundation.

Field days

Maine's successful grain movement is powered by farmers, products and research

By Elyse Catalina

Photographs by Holland Haverkamp

Joseph Cannon, farm facilities and field coordinator at the University of Maine's Rogers Farm in Old Town, Maine, harvests fields of grain in August. UMaine researchers study topics related to boosting the state's organic grain production, including fertility, weed management, and disease identification and control.

IN THE 1990s, Matt Williams was a University of Maine Cooperative Extension educator working with the state's dairy and potato industries. A focus was crop diversification to improve soil health and bring in additional revenues.

At the same time, Jim Amaral was building his Maine-based business. Borealis Breads specializes in sourdough and crusty loaves made in the European tradition of using local grains to create a unique, regional flavor. His challenge: a shortage of high-quality, locally produced grain.

"If you want to make a truly Maine-grown loaf, you need to use Maine grains," Amaral says.

That's why Amaral attended a meeting of Maine organic dairy farmers, hoping to convince them to grow grain for human consumption.

Williams also was there.

"The dairy farmers thought I was crazy," Amaral says, "but Matt was like, 'We can do this.'"

To prove his point, Williams piloted a 30-acre plot of wheat on his organic farm in Linneus, Maine, implementing the research-based knowledge that Cooperative Extension in Maine and nationwide uses to help address issues and needs. Amaral shipped the wheat from Aroostook County to Canada for milling. Four years later, in 2001, Williams also set up a milling operation on his farm.

With Maine's growing interest in local foods, "it was the natural thing to do," says Williams, who retired from UMaine Extension in 2006 to manage his farm full time.

Fittingly named Aurora Mills and Farm is now 300 acres and the main grain producer for Borealis Breads, which expects to use 80,000 pounds of Maine grains in 2017, with plans to double the amount in the next few years.

It is one of two local flour mills in the state and among 25–30 farms growing an estimated 1,000 acres of grain per year to process into flour at those mills. But grain being grown for flour is just one small part of the Maine grain economy. Other categories include food grains going to markets out of state, as well as grains being used for malting and distilling, organic and nonorganic animal feed, and seed markets. All told, Maine farmers are growing an average of 40,000–50,000 acres of oats, barley and common wheat annually, according to the United States Department of Agriculture's most recent figures.

"The fresher the grains are, the better the flavor is," says Amaral, who gets grains milled from Aurora Mills every two to three weeks. "It allows for a much higher quality where I have a lot more input. Our sourdough is only made with four ingredients — flour, water, salt and sourdough starter — so the quality of those ingredients is critical."

Jim Amaral, owner of Maine-based Borealis Breads, follows the European tradition of using local grains to create a unique, regional flavor.

MAINE HAS a long, storied history of growing grain, says Tristan Noyes, executive director of the Maine Grain Alliance.

"If you went back to the mid-1800s, we had many acres of grain being grown for human-grade consumption and we had thousands of small mills that dotted the countryside. Over time, we lost a lot of that culture that was associated with grain growing," says Noyes, a sixth-generation potato farmer.

He cites Williams and Amaral as two of the pioneers who were at the beginning of the movement to bring back Maine-grown grains.

The modern perception among grain producers was that food-grade grain couldn't be grown in the Northeast, according to Williams.

"We introduced malting barley, and now Maine is recognized as one of the premier sources of malting barley in the world. Prior to that, no one believed you could grow malting barley east of the Mississippi. Sometimes we have to break those paradigms," Williams says.

Maine's cool evenings help create a grain that has a different profile than grain grown in the Midwest, Noyes says.

While grains have traditionally played a supporting role to Maine's more lucrative potatoes, new markets and an increasing demand for locally grown products are moving the crop to the main stage.

To preserve and promote grain traditions, the Maine Grain Alliance formed in 2010. The nonprofit organization hosts the annual Kneading Conference and Artisan Bread Fair each summer in Skowhegan.

The conference brings together professional and home bakers, chefs, cooks, farmers, grain researchers, maltsters, food entrepreneurs, and wood-fired oven enthusiasts to learn about the science of baking, milling and growing grains using traditional methods, according to the alliance.

This year, more than 250 people from around the world — 22 states, three provinces and seven countries — attended the conference, which featured 50 workshops, panels and hands-on exercises, according to Noyes.

The event culminates in the Artisan Bread Fair, which is free and open to the public, and offers wood-fired oven

Weather models

BROGAN TOOLEY, a graduate student in the Plant, Soil, and Environmental Sciences program at the University of Maine, is using a computer simulation model to assess climate adaptation strategies for potato and grain systems.

The objective of the project is to address the effects of weather variability on crop yield by looking for new management strategies to increase crop resilience and mitigate potential detrimental impact of variable weather on year-to-year yield stability.

This past summer, Tooley conducted fieldwork to calibrate the model for varieties and weather conditions in Maine.

"Once calibrated, the model gives us the freedom to adjust parameters and investigate 'what if' questions," says Tooley, of Camden, Maine. "We can then virtually increase irrigation, change planting dates or even increase soil health to experiment with outcomes and look for sustainable management practices to strengthen agricultural systems under potential climate pressures."

Tooley is using the Decision Support System for Agrotechnology Transfer, a software program that comprises crop simulation models. Using a crop model gives the researchers statistical power to simulate for a range of variables multiple times under the impacts of long-term trends, such as weather variability.

demonstrations, artisan bread samples, and opportunities to talk with professional bakers. About 3,500 people attended the 2017 "celebration of all things real bread," Noyes says.

The successful development of the local bread wheat market inspired other uses of locally grown grain, such as growing oats, rye and spelt for cereals and flours; barley and rye for malting and distilling; as well as a continual and increasing demand for organic animal feed, according to Ellen Mallory, a UMaine Extension specialist and associate professor of sustainable agriculture.

"The Kneading Conference and Artisan Bread Fair have really played the role of increasing excitement and demand for local breads," says Mallory, who is a Maine Grain Alliance board member. "The university's role has been more of, 'If there is this demand, how do we help farmers meet it?'"

In 2008, when Mallory began working at UMaine Extension, the state had about 500 acres of wheat that was mainly grown for salmon feed.

"Then the demand for local wheat increased significantly, not just in the state, but in the region. For instance, a couple of mills in Canada started buying Maine-grown wheat. By 2012, we had almost 2,500 acres of wheat," she says.

Grain production is not new to Maine farmers, according to Mallory. They have grown 40,000–50,000 acres of oats and barley per year for the last two decades, but grains are typically considered a necessary rotation crop for potatoes, paid little attention, and sold at relatively low prices into the commodity feed market.

Grains are harvested at UMaine's Rogers Farm, left, and milled into flour at Aurora Mills and Farm in Linneus, Maine. Aurora Mills is one of two flour mills in the state and among 25–30 farms growing an estimated 1,000 acres of grain per year to process at those mills. In addition to flour, Maine grains also are being used for malting and distilling, organic and nonorganic animal feed, and seed markets.

In the 1990s, with the help of Williams, Maine farmers increased their grain value by growing barley for a large Canadian malthouse, with acreage peaking in the mid-2000s at 8,000–10,000 acres, Mallory says.

Maine is home to more than 80 craft breweries and two malthouses. A study released by the Maine Brewers' Guild and conducted by the UMaine School of Economics found Maine breweries added $228 million to the state's economy in 2016 and employed 2,177 people. The figures include multiplier effects from related businesses.

Portland-based Allagash Brewing Co., which anticipates using 115,000 pounds of local grains in 2017, recently pledged to use 1 million pounds of Maine-grown grains annually by 2021.

"Allagash's announcement provides a key piece to building the whole system," Mallory says. "People have really identified Maine craft brews as a quality product, so maybe Maine malt should be in that same class."

AT UMAINE, Mallory is at the center of grain-related research and outreach efforts.

"UMaine Extension's role in the grain industry has primarily been to help farmers understand the production practices that will help them meet the quality that's needed," says Mallory, who adds this is done by generating and providing information through research, and creating networks of farmers, buyers and producers.

In 2009, Mallory; Eric Gallandt, a UMaine professor of weed ecology and management; Heather Darby, an agronomic and soils specialist for the University of Vermont Extension; and other colleagues were awarded $1.3 million from the USDA to increase farmers' capacity to produce high-quality organic bread wheat. The team partnered with local farmers, millers and bakers in the four-year project.

Wheat grain sold for bread flour can garner up to twice the price as grain sold for livestock feed in New England, but the grain must meet higher quality standards, according to the researchers.

The team's research focused on production issues farmers

Common grains grown in New England

Oats *(Avena sativa)*

Grown on 24,000–30,000 acres per year in Maine

Used for rolled oats, malting/brewing/distilling, livestock feed, and cover crop seed.

Barley *(Hordeum vulgare L.)*

Grown on 12,000–15,000 acres per year in Maine

Used for malting/brewing/distilling, and livestock feed. Pearl barley, which is processed to remove the hull and bran, can be prepared and eaten like rice.

Common wheat *(Triticum aestivum)*

Grown on 500–2,000 acres per year in Maine

Farmers in Maine grow both spring and winter types. Winter types are planted in the fall and harvested the next summer. Used for bread flour, malting/brewing/distilling, and salmon feed. Can be used as a livestock feed, but is less common than oats or barley.

Durum wheat *(Triticum durum)*

Used for pasta.

Rye *(Secale cereale)*

Used for bread flour, cover crop seed, animal fodder, and less commonly, for malting/brewing/distilling.

Spelt *(Triticum spelta)*

Used for bread flour and feed.

Triticale (hybrid of *Triticum* and *Secale*)

Used for feed and less commonly, bread flour.

Emmer *(Triticum dicoccon)*

Also known as farro or hulled wheat.
Used for flour or cooked like rice.

Compiled by Ellen Mallory. Acreage information comes from the USDA National Agricultural Statistics Service 2010–16, and is only available for oats, barley and common wheat.

face. They worked to identify spring and winter wheat varieties suited for organic production in the region, develop fertility strategies for high-protein grain, and evaluate innovative weed management systems. They also initiated the Maine Grain Conference, held each year in early spring.

"The university was critical in terms of getting a movement that was starting and providing the technical information that really allowed it to thrive," Amaral says.

The researchers also evaluated baking quality by subjecting the varieties to tests conducted by professional bakers, including Amaral and others at King Arthur Flour in Vermont. Results showed that good to excellent artisanal breads can be baked using organic winter wheat grown in northern New England. The bakers determined nine of the 15 varieties were suitable for making bread.

"I see the industry as a three-legged stool," Amaral says. "Farmers are one leg, those creating products are another, and the third leg is research at the university, which is supporting the other two to really drive economic gains for the industry."

Another focus of the project was to share the research through online resources, workshops and field days, and to create a regional network for those in the grain industry.

"It's really helpful to have a supportive university and Cooperative Extension-based resource alongside what's happening on the market-development side of things," says Amber Lambke, co-founder of the Maine Grain Alliance. "Farmers need more resources. People sometimes refer to the knowledge it takes to grow these crops successfully as being part of the lost infrastructure, and I think the university plays a really important role in helping farmers feel confident, help them troubleshoot problems, and also help them determine whether it works on their farm and how to create a whole system that's economically viable."

Realizing the need to quickly develop that knowledge infrastructure, Mallory and her colleague at the University of Vermont led trips for farmers, millers and bakers to Quebec in 2009 and Denmark in 2010. Mallory had learned about Denmark's local grain economy and made connections with grain researchers in 2006 while living in the country

Plot trials at UMaine's Rogers Farm, above, include varieties of wheat, rye and barley. The researchers are interested in helping farmers meet the increased demand for local grains that has been boosted by the Maine Grain Alliance's annual Kneading Conference and Artisan Bread Fair in Skowhegan, right, which attracts more than 3,000 people.

In the weeds

AFTER EARNING a bachelor's degree in sustainable agriculture from the University of Maine in 2015, Margaret McCollough of Hampden, Maine went on to own and operate an organic, diversified vegetable farm in southern Maine.

McCollough now is pursuing a master's degree in ecology and environmental sciences at UMaine. Her research is focused on identifying improved weed management strategies for organic grain growers in the Northeast.

"My experience as a farmer has instilled in me a practical understanding of those challenges facing organic growers when it comes to managing on-farm weed problems," says McCollough, who adds weeds are one of the most common production problems facing organic grain farmers.

To identify ways in which growers can better manage weeds, McCollough's research compares sowing strategies that alter the spatial arrangement of the crop, as well as cultivation strategies, including killing weeds by uprooting, severing or burying them.

One cropping strategy McCollough is particularly interested in is band sowing, where the crop is planted in wide bands instead of typical single-file rows.

on sabbatical for a year. She knew they had a lot to offer in terms of experience growing, processing, using and marketing local organic grains.

"They were about 10 years ahead of where Maine was," Lambke says of farms in Denmark.

At Maine's first Kneading Conference in 2007, Lambke realized there was no infrastructure left in the central and southern parts of the state for grain processing.

"If farmers in this area were going to grow grains, that infrastructure needed to be revived," says Lambke, who was on the UMaine Extension-led trip to Denmark in 2010.

She returned to Denmark before the 2012 launch of Maine Grains, which manufactures locally grown, stone-milled grains at Somerset Grist Mill in Skowhegan, Maine.

"I made some great connections that ended up being people I have stayed in touch with over the years for technical support and resources in running my mill," Lambke says.

Mallory also has maintained her connections. In 2015, she was contacted by a Danish food company seeking help to develop a Maine supply of two heritage grain varieties grown in Denmark for their new New York City restaurant.

To evaluate whether the varieties — Øland spring wheat and Svedje winter rye — would grow well in Maine, plot trials were planted at UMaine's Rogers Farm in Old Town. Both varieties had high yields and good grain quality. UMaine Extension identified farmers who could successfully grow the grain and networked them with the buyer.

In 2016, Maine growers produced over 80 tons of Øland spring wheat and 5 tons of Svedje rye for the restaurant. The price growers are receiving for the specialty wheat is up to five times the typical price for spring wheat.

"We are definitely growing in leaps and bounds," Lambke says. "We now have a food-grade market in Maine. We now have a malting-grade market in Maine. We have a feed-grade market in Maine."

Mallory and her colleagues were awarded an additional $1 million USDA grant in 2015 to continue efforts in boosting organic grain production in northern New England.

Mallory's research focus is on fertility, Gallandt's is on weed management, and Darby's is on disease identification and control. Tom Molloy, a research associate in sustainable agriculture with UMaine Extension, also is a critical member of the team, overseeing the field trials in Maine.

With this grant and other funding, the team continues to offer workshops, conferences and farm tours, often in collaboration with key partners at the Maine Potato Board, Maine Grain Alliance, and Maine Organic Farmers and Gardeners Association (MOFGA), which UMaine Extension helped form in the 1970s.

This past summer, Mallory partnered with Joel Alex of Blue Ox Malthouse in Lisbon Falls, Maine to offer a malt and barley workshop at Rogers Farm, and with John Chartier of MOFGA to offer "cross-border" farm tours in Aroostook County and New Brunswick.

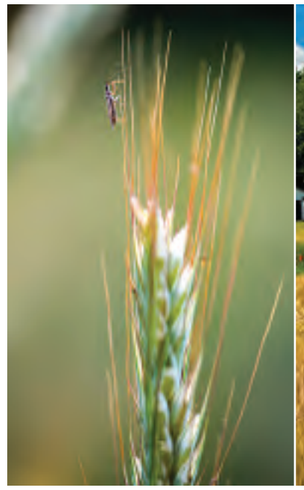
The farm tours were part of a new initiative with the Atlantic Canadian Organic Regional Network (ACORN) to expand the community of organic grain farmers and researchers. The Northeastern U.S. and Eastern Canada Organic Grain Network (NEEOGrain) kicked off last year with Maine and Vermont farmers.

"Vermont has growers and millers they network with in Quebec, and we have the same in New Brunswick and Prince Edward Island," says Mallory, adding she wants to create a network of northern Maine and Canadian grain growers because they have similar concerns.

For the past three summers, Mallory and Molloy have conducted trials of spring malting varieties for craft brewing. The trials, with 25 varieties each year, are being conducted in collaboration with 10 other institutions as part of the Eastern U.S. Spring Malting Barley Evaluation project, organized by North Dakota State University and funded by the Brewers Association.

In Maine, the trials are conducted at Rogers and the Aroostook Research Farm in Presque Isle. Agronomic and basic grain quality data are collected by UMaine researchers, and grain samples are submitted to North Dakota State University for comprehensive grain and malt quality analysis.

Maine is home to more than 80 craft breweries and two malthouses. For the past three summers, spring malting variety trials have been conducted at UMaine's Rogers Farm as part of the Eastern U.S. Spring Malting Barley Evaluation project. Portland-based Allagash Brewing Co., which anticipates using 115,000 pounds of local grains in 2017, recently pledged to use 1 million pounds of Maine-grown grains annually by 2021.



Nourishing nitrogen

MARGARET PICKOFF, a graduate student in the Plant, Soil, and Environmental Sciences program at the University of Maine, is evaluating different methods of terminating legume-based green manures to optimize soil cover over the winter and nutrient availability to a subsequent grain crop.

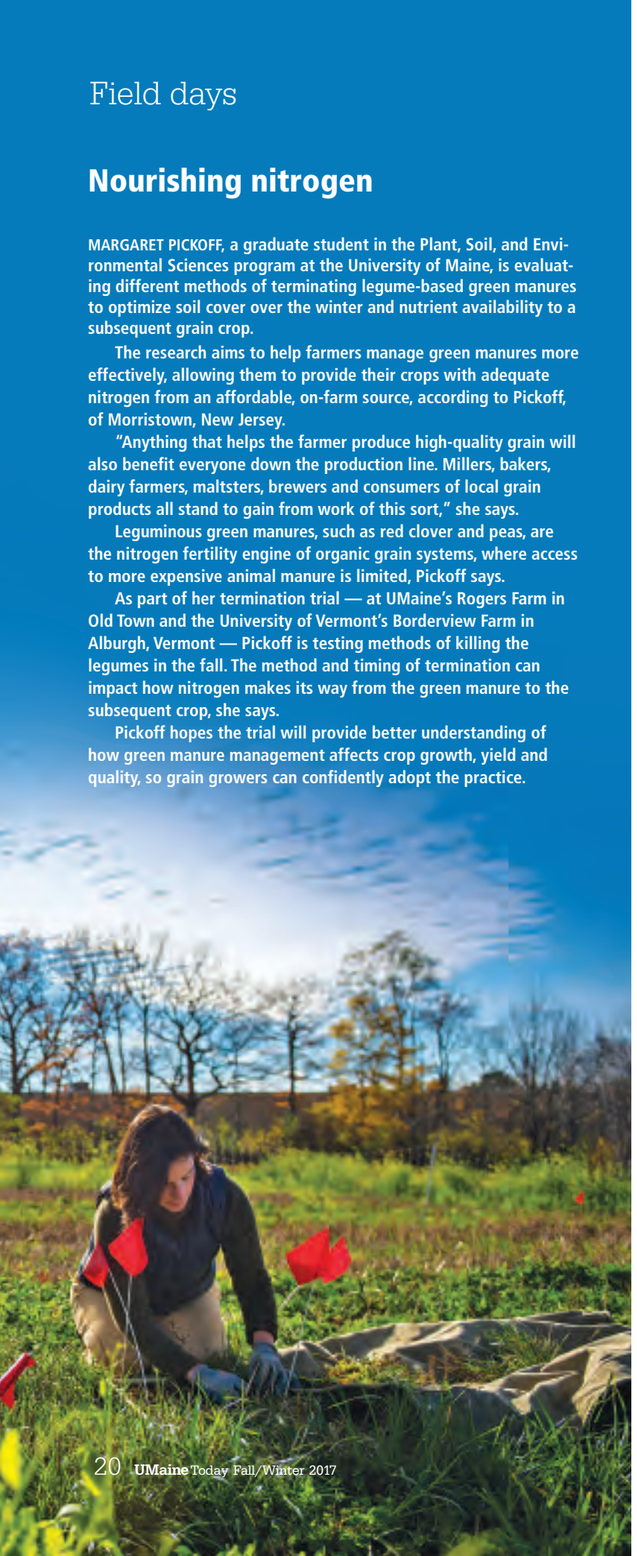
The research aims to help farmers manage green manures more effectively, allowing them to provide their crops with adequate nitrogen from an affordable, on-farm source, according to Pickoff, of Morristown, New Jersey.

"Anything that helps the farmer produce high-quality grain will also benefit everyone down the production line. Millers, bakers, dairy farmers, maltsters, brewers and consumers of local grain products all stand to gain from work of this sort," she says.

Leguminous green manures, such as red clover and peas, are the nitrogen fertility engine of organic grain systems, where access to more expensive animal manure is limited, Pickoff says.

As part of her termination trial — at UMaine's Rogers Farm in Old Town and the University of Vermont's Borderview Farm in Alburgh, Vermont — Pickoff is testing methods of killing the legumes in the fall. The method and timing of termination can impact how nitrogen makes its way from the green manure to the subsequent crop, she says.

Pickoff hopes the trial will provide better understanding of how green manure management affects crop growth, yield and quality, so grain growers can confidently adopt the practice.



"We all have humid growing conditions that can be challenging for growing barley and wheat," Mallory says of the participating institutions from across the Northeast, as well as in North Dakota and Indiana. "We're particularly interested in varieties that are less susceptible to the diseases that can grow in these conditions, and that have the agronomic characteristics farmers would like; the quality and grain characteristics that maltsters would like; and the malting characteristics that brewers would like."

Amaral credits Mallory and Molloy with developing the technical know-how for Maine farmers looking to increase the value and quality of the grain they grow.

"When I first started working with farmers in Aroostook County, they didn't have the knowledge base to ask older generations, because it had been so long since wheat had been grown for commercial purposes for human consumption. We had to recreate that whole knowledge base, and that's where the university made a huge difference," he says.

Amaral adds the researchers have developed and disseminated important information that enables farmers to see and contribute to the market, which is "critical to keep the ball rolling." Related UMaine graduate student research focuses on topics including weed management, soil health and green manure utilization.

"From day one, the challenge has been to grow the market, grow the supply, but don't let one get too far ahead of the other; that will be the challenge going forward," Amaral says. "Allagash's pledge to use 1 million pounds of Maine-grown grains a year is a big step up for farms. That's the kind of problem you want to have."

SARA FLEWELLING, grower and co-owner of Aurora Mills and Farm, graduated from UMaine in 2005 with a landscape horticulture degree. She worked in the Washington, D.C. area doing landscape design for eight years before coming back to help Williams — her father — in 2013.

The farm produces several organic stone-ground flours, including spelt, rye, hard red spring and winter wheat; wheat for brewers; and organic rolled oats. In addition to providing grain to Borealis Breads, Aurora Mills also sells to Allagash, where its rolled oats have been used in two national releases; provides oats to several major universities in New England; and distributes to natural food stores.

"I know that every day I'm making a difference," Flewelling says. "We're making a quality product that makes people healthier, and that's great."

Although the farm has more than quadrupled in size since Flewelling's return, the family hopes it will continue to expand. Flewelling says the long-term goal is to grow from 300 to 1,000 acres.

"You need scale with grain, it's hard to do that on a small scale," she says, estimating grain output averages 1 ton per acre.

Aurora Mills now is working with a group of farmers to develop food-grade Japanese buckwheat production in Maine to make soba noodles, according to Williams, who says they are always looking for ways to make the whole grain system more valuable. He does this — in part — by staying in touch with his former colleagues.

"They're carrying on doing the research and I benefit from that, so I'm certainly going to help them as much as I can," he says.

Flewelling cites Mallory and Molloy as great resources for the farm and the entire grain community.

Over the past decade, Mallory says she has seen the market diversify and gain value. Markets and consumer demand for New England-grown grains are continuing to grow in Maine, as well as outside the region, according to Amaral, who sees opportunities for expanding the market.

Maine Grains owner Lambke agrees, noting that the grain ecosystem in Maine is beginning to flourish.

"It's been a lot of hard work, but 10 years is a relatively short time to be seeing a lot of resurgence happening, and I think that's really encouraging," Lambke says. "Industry leaders are starting to realize the impact they can have by participating in the grain ecosystem, and I think that will continue to develop over the next 10 years. I think we're still in growth mode, and that's exciting." ■

Ellen Mallory, a UMaine Extension specialist and associate professor of sustainable agriculture, partnered with "malt ambassador" Joel Alex of Blue Ox Malthouse in Lisbon Falls, Maine to offer a malt and barley workshop for farmers, malt producers and brewers at Rogers Farm.

Identifying a killer

Joyce Longcore's international research is recognized with prestigious AAAS Golden Goose Award

By Walter Beckwith / Photographs by Adam Küykendall

JOYCE LONGCORE had all but given up on the flask containing a mysterious microscopic fungus from a frog leg sent to her by pathologists at the Smithsonian's National Zoo in Washington, D.C.

For days, the mycologist had been trying to culture the fungus her colleagues thought was responsible for a mass die-off of the zoo's young poison dart frogs. But in her lab, the fungus, from a group called *Chytridiomycota* (chytrids), was not cooperating.

The organisms she was attempting to isolate into pure culture refused to form the zoospores necessary for reproduction. She was convinced the early growth was going to die, leaving many unanswered questions.

Then, something in the flask changed. Overnight, the fluid containing the floating fungus sample, which had been extracted from the skin of a dead blue poison dart frog, went from clear to a kind of opalescent.

> **"You never know when something that is found will become important.** I was content to study a group nobody had much interest in." Joyce Longcore

Either the sample was contaminated by bacteria or the mysterious little chytrids had begun to grow.

Looking at a drop of the solution on a microscope slide, Longcore realized that she had isolated a pure culture of a worldwide killer.

The zoospores, rhizoids, thalli, and other structures and life stages of the chytrid were the first glimpse of the fungus in isolation and the cause of a new disease in amphibians. Until then, no species of chytrids had been known to be a pathogen of vertebrates.

The day of the internationally important discovery: Oct. 13, 1997. Longcore's birthday.

"I knew that I had this organism that killed amphibians in pure culture, and that this made research on the disease organism possible," says Longcore, who, along with her Smithsonian colleagues, was the recipient of a 2017 Golden Goose Award from the American Association for the Advancement of Science (AAAS).

The Golden Goose Award recognizes the people and stories of unexpected scientific breakthroughs that are outgrowths of federally funded research — research that, at the surface, may have seemed odd or obscure, but has gone on to have serious benefits for society.

In 2012, Longcore was elected as an AAAS Fellow for her groundbreaking chytrid research.

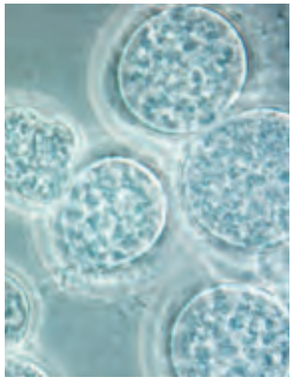
Longcore and her Smithsonian collaborators, Don Nichols, Allan Pessier and Elaine Lamirande, were honored at the sixth annual Golden Goose Award Ceremony at the Library of Congress in Washington, D.C. this past September.

LONGCORE HAS studied chytrids for more than 30 years. Until the discovery of the lethal chytrid, her research had flown largely under the radar. Chytrids simply had not garnered much attention from anyone, let alone the scientific community.

The discovery of the frog-killing chytrid and its role in the mass die-offs of frog populations worldwide thrust her research into the spotlight.

Longcore and her colleagues from the Smithsonian's National Zoo named the chytrid *Batrachochytrium dendrobatidis* (Bd). And researchers simultaneously found that it was ravaging frog populations around the world — from Australia to Central America — and has already driven dozens of species to extinction.

Since the discovery of Bd, Longcore has collected hundreds of different strains of the pathogen from around



Microscopic images of the chytrid *Batrachochytrium dendrobatidis (Bd).*

> I love a group of organisms called chytrids, much in the same way birdwatchers love birds. **They're beautiful** and not a lot of people know what they are." Joyce Longcore

the world — including Maine. Bd can be found nearly everywhere that amphibians live and it seems to have spread rapidly, largely assisted by human movement and the global trade of amphibians, some of which are silent carriers of the disease.

Bd now has been joined by a second chytrid species that can harm and kill amphibians. The recently described species, *Batrachochytrium salamandrivorans* (Bsal), is similar to Bd with the exception that it seems to infect only salamanders and newts, rather than all amphibians. Native to East Asia, Bsal arrived in Europe with imported amphibians and was discovered when researchers began investigating a large decline in Netherlands' fire salamanders.

According to Longcore, the U.S. Southeast is a hotspot for salamander biodiversity and if North American salamanders are susceptible to the disease, an outbreak of Bsal could be catastrophic.

LONGCORE'S RESEARCH didn't stop with the description of Bd. She has isolated Bd from many places and collaborates with scientists all over the world. She sends them samples for a variety of research purposes, including molecular phylogenics, which, according to Longcore, is the next frontier in understanding the origin and distribution of Bd.

She also consults with algae aquaculturists who are interested in aquatic fungal pathogens that attack their crops.

At her UMaine lab, hundreds of different types of chytrids, Bd and otherwise, are cryogenically preserved in liquid nitrogen; her collection has been growing for decades.

"I love a group of organisms and they're called chytrids," says Longcore, "much in the same way birdwatchers love birds. They're beautiful and not a lot of people know what they are.

"You never know when something that is found will become important. I was content to study a group nobody had much interest in," she says. "I still am content to do that work." ■

A high note

Kaitlin Young named 2018 Maine Teacher of the Year

KAITLIN YOUNG, the 2018 Maine Teacher of the Year, graduated from the University of Maine with a degree in music education in 2010. She teaches general and choral music to elementary and middle school students in Dover-Foxcroft. As the Maine Teacher of the Year, Young will travel throughout the state and country collaborating with other educators to support efforts to prepare students for college, work and civic life. "I am hopeful that this opportunity will allow me to share stories of many of the incredible music and arts educators across our state." **IMPORTANCE OF MUSIC AND ART:** Young says she would love to see schools invest more in music and arts programming. "Students need to experience — not just have access to — quality arts education, the same way that they need to experience quality math, science and social studies. The more you learn and experience, the more connections you make. These connections allow for a greater perspective that help you to think creatively, flexibly and empathetically," Young says. **PART OF A SUPPORTIVE COMMUNITY:** Young, who recently earned her master's degree in music education from the Hartt School, part of the University of Hartford in Connecticut, credits UMaine with helping shape who she is. "It truly helped me experience the joy of growing up, learning and being a part of something bigger than yourself," she says. Today, Young says she is happy to be part of a supportive community. "The students and colleagues that I have the privilege of working with each day always motivate me. We all benefit from continuing to learn together." ■

Christopher White directs the soundtrack linking generations of Black Bear fans

By Elyse Catalina / Photographs by Adam Küykendall

IN 1993, during Christopher White's first year as head of University of Maine sports bands, the men's ice hockey team advanced to the Frozen Four.

A day before the team and pep band flew to Milwaukee to take on the University of Michigan in the National Collegiate Athletic Association Men's Division I Ice Hockey Tournament, White received a query from a Wisconsin college sports representative.

Could the pep band play Wisconsin's fight song during the UMaine game against Michigan, Wisconsin's arch rival? It would mean a lot to the many fans who wouldn't be seeing their home team compete.

During the flight, White talked to then-UMaine head coach Shawn Walsh about the bizarre phone call.

"You have to do that," was Walsh's unequivocal response.

Sheet music was faxed to the band's hotel, where the manager offered free use of the ballroom to practice.

"At some point in the game, we'll play this and see what happens," White told the band during the impromptu rehearsal.

Come game time, both teams were welcomed onto the ice with their fight songs, followed by alternating performances by the UMaine and Michigan pep bands to a raucous arena of about 17,000 spectators.

At one point, White told the band, "Let's try this *On, Wisconsin* thing."

"You heard the arena get a little bit quiet, and then probably 10,000 people, all wearing red-and-white shirts, stood up and cheered. It intimidated the band," White recalls. "You could see all their eyes get big — they almost stopped playing — they didn't know what was going on. It went really well, much to our surprise."

The UMaine hockey team won 4–3 in overtime, advancing to the championship game against Lake Superior State. The Black Bears won 5–4 to earn the national title.

"Does having 10,000 people all of a sudden swing to your side and cheer make a difference in the game? Obviously we're not on the ice, we don't know. But that was my first thought, that maybe it does make a difference.

The University of Maine's Screamin' Black Bear Pep Band performs at men's ice hockey games, as well as men's and women's basketball games. The group's objectives are to provide a representative group for the university, team spirit and a musical outlet. The fourth unwritten rule: Get on TV.

The man behind Maine music

"We certainly are not the event where we play, but we do try to make the event better," White says. "That's what we do. We go out and entertain."

AT THE University of Maine, White leads several music ensembles, as well as a summer program for Maine youth. But it is as director of UMaine's Pride of Maine Black Bear Marching Band — 120 students strong this year — and the high-energy Screamin' Black Bear Pep Band that his influence is most far-reaching.

These groups provide the UMaine soundtrack that successfully links generations of students, alumni and fans — near and far — under the direction of one of the country's top "50 directors who make a difference," according to *School Band and Orchestra* magazine.

"Chris' stewardship of the university's memorable fight song is an important part of his job, but he also has built a catalog of songs with the athletic bands that have become traditional for many generations of students here," says Beth Wiemann, a professor of music who chairs UMaine's Music Division.

"He has to balance this aspect of musical tradition for the students alongside newer songs for the general audience, so he is always looking at both sides of the band repertoire," she says.

The pep band plays the same four songs before every home men's ice hockey game. When White changed the lineup once, he received emails from fans demanding the traditional songs.

"*The Stein Song* has a tremendous amount of history to it," White says of UMaine's school song made famous by Rudy Vallee in 1930. "It's important for us to play it because it represents the University of Maine in song form.

"When people hear that, they associate the song with the university. Especially (for) alumni, it triggers all the memories of being on campus and the reasons why they loved the university when they were here. It provides a connection back to the university."

WHITE BEGAN leading the pep and marching bands as a graduate student in 1992 while pursuing a master's degree in conducting. His assistantship was to run the sports bands, as well as conduct the concert band. He was offered the opportunity by Curvin Farnham, a UMaine music professor, whom White met while he was the band director and district music supervisor of MSAD 11 in Gardiner, Maine.

In fall 1994, White served as interim director for a year before getting the permanent job. Today, he continues to lead the Pride of Maine Black Bear Marching Band and Screamin' Black Bear Pep Band, as well as the Symphonic Band, UMaine's highest-level audition group.

"They all fulfill something I do," White says. "I couldn't do just the sports bands without the challenge of the Symphonic Band. It balances me out pretty well."

White also teaches advanced conducting and percussion methods for music education majors, and leads Maine Summer Youth Music (MSYM) camp, a 45-year tradition that attracts about 325 of the state's most talented middle and high school musicians annually.

Weeklong camps, offered by UMaine's School of Performing Arts, feature instruction by educators from the university and across the country. Camp activities include jazz and string ensembles, symphonic and concert bands, chorus, and musical theatre.

This past summer marked White's seventh year as MSYM director and 27th year working at the camp, which encourages youth to hone their musical abilities.

LIKE SO many of the young performing artists he and the other MSYM faculty mentor, White was surrounded by music at an early age. Growing up in Durham, Maine, he was inspired by his grandfather, a professional musician.

In the last five years, the Pride of Maine Black Bear Marching Band has grown from an average of 75 members to 120. The group meets for a week of band camp before the fall semester begins to perfect pregame and halftime shows.

UMaine bands under Christopher White's direction average 70 public performances per year. In addition to performing at football games, the Pride of Maine Black Bear Marching Band also participates in local parades and events, including the American Folk Festival on the Bangor Waterfront. Photo by Ron Lisnet

"Around age 10, I thought it would be nice to play an instrument, so I started playing the drums," White says. "My grandfather bought me my first drum, and my parents were very supportive. Shortly after that, I decided I wanted to be a band director, and I followed that path."

In the absence of a school music program, White took private lessons, and marched in a drum and bugle corps before joining his high school band.

"When I went to college, all I was looking for (were) music schools," says White, who earned a bachelor's degree in music education from Ithaca College in 1988 and a master's at UMaine in 1994.

WHEN IT comes to performing, White expects the best from his musicians. His conducting style is firm without being strict; compliments are just as frequent as his critiques.

Jay Baines of Hampden, Maine first met White through MSYM. Now, Baines is a drummer in the sports bands, as well as one of three drum majors, or student conductors, for the marching band.

"I'd describe his teaching style as very regimented and organized," Baines says. "It's pretty simple: Show up on time, follow the system and everything else will fall into place."

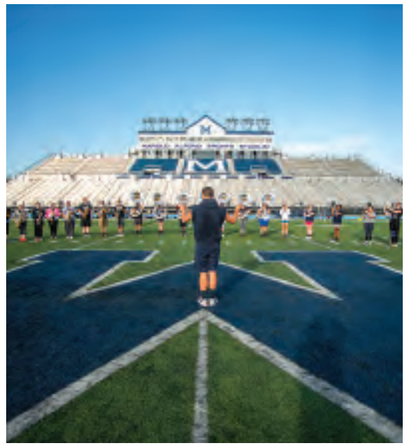
White's attitude sparks a drive that inspires musicians to do their best — not only for themselves, the group and university, but also to possibly get their reserved leader to crack a smile — a sign that a piece is coming together or a performance is going well.

Drum major Jessica Oriente, a civil engineering major in the Honors College, says White recognizes the need for student involvement.

"No one is forced to be in band. We're all here because we choose to," says Oriente of Jamison, Pennsylvania. "He looks to his students, whether drum majors or section leaders, to aid in everything the band does — from recruitment to show design. That involvement allows his students to develop leadership skills early on that extend far beyond just being able to lead a band."

Baines says White has taught him the importance of punctuality. White also helped him and the other band members understand the value of pertinent and timely communication, as well as what to do when you make an error, such as hitting the wrong note or taking the wrong turn while marching in front of hundreds.

"When making a mistake, make it big and sell it. No one learns from a tentative mistake. Keep performing and convince everyone else that you're right," Baines says.



Jay Baines of Hampden, Maine, is one of three drum majors, or student conductors, for the marching band.

UMAINE BANDS under White's direction average 70 public performances per year. The marching band mainly performs during home football games in addition to local parades and events, while the pep band holds court at men's and women's basketball, as well as men's ice hockey games.

"We're very much the soundtrack when we're present," Baines says of the sports bands. "It's ingrained in people's minds, it's an expectation."

In the last five years, the marching band has grown from an average of 75 members to 120. Pep band has 132 members this year, with about half of the students playing in both groups.

The pep band's objectives are to provide a representative group for the university, team spirit and a musical outlet.

"The fourth unwritten rule is you gotta get on TV," White says. "You don't get on TV by just sitting there. I encourage the choreography, and I let them come up with the moves."

The marching band involves more planning, including a week of band camp before the fall semester begins. The camp itinerary reads, "To be early is to be on time, to be on time is to be late. Everyone is important."

During camp, band members, dancers and majorettes strive to perfect pregame and halftime shows.

"The pregame show is not part of the game, but it's part of the show," White says. "Probably 250–300 people are just there to see their kids in the band. That's OK, they're still coming to the game, they're part of it."

Music for pep and marching band includes a range of pop hits, ranging from those popular today to those as far back as the 1960s.

"We have a very specific audience," White says, talking

The beat goes on

EVERY HOMECOMING, the Pride of Maine Black Bear Marching Band is joined by former members who perform before and during the football game.

The University of Maine Alumni Band started in the 1970s, but it wasn't until 1981 that the band began gathering for Homecoming, according to Courtney Evans, president of the group.

Evans works with Pat Munson, director of the alumni band, to prepare music selections, instrumentation and logistics for the Homecoming performance.

Alumni band appearances include 20 to more than 100 members every year, with turnout often weather dependent, Evans says.

The band frequently consists of alumni from classes as far back as the 1950s up to the most recent graduates, according to Christopher White, director of the Pride of Maine Black Bear Marching Band.

"We have many individuals who return year after year," says Evans, who plays trombone. "I'm one that hasn't missed a Homecoming since I graduated with my bachelor's in 2004."

Evans, who was a drum major during her senior year, says performing with and organizing Alumni Band reminds her of her time at UMaine. The opportunity to see friends and catch up in person keeps her coming back.

The group typically arrives the Friday before Homecoming and gathers at Pat's Pizza in Orono. The next morning, the band begins rehearsing at 8. Practice includes joining the marching band on the field.

During the football game, the Alumni Band sits next to the marching band in the stands,.

"My favorite part of being involved in the Alumni Band is that I get to see alumni come together and bond over their love of music, share eternal friendship and show such pride in being alumni of UMaine," Evans says.

Jeff Ferrell, past president of the group, has missed only two Homecoming games since earning his bachelor's degree in history 24 years ago.

"One of the reasons that all band folk have such strong ties to other band folks is that we all worked together, suffered together, played together and grew close together," says Ferrell, who, like many former Pride of Maine Black Bear Marching Band members, met his spouse while in the group.

"It's my one chance a year to blow the dust out of my tuba and see if I still have the chops to play."

Photo by Kathy Rice

The Pride of Maine Black Bear Marching Band performs rain or shine, left. The UMaine Dance Team, center, joins the sports bands for basketball and football games, including halftime performances. Christopher White and a local dance teacher started the team, in lieu of a color guard, about 16 years ago. As part of the marching band, White oversees the group.

about the pep and marching bands. "They're not there to listen to Beethoven; we're not going to play that. We try to be relevant, we try to find stuff that's catchy and that people in the band can move to."

The 15 student band leaders selected at the end of marching season meet in the spring to build the next season's two halftime shows, which often revolve around a theme. This year's shows were "Musicals that have been on TV," and a '60s, '70s and '80s decades show that included songs by Styx, Lionel Richie, The B-52's and The Beatles.

"I tell the students on the first day of band camp to look around because your best friends in college are sitting in the room. That's rewarding to know that there's something we're doing here that allows people to make and carry on those relationships," White says.

"Those connections are wonderful, and they tie people to the university. They'll come back 20 years from now and remember those days."

Every Homecoming, former Pride of Maine Black Bear Marching Band members return to perform as part of the Alumni Band.

THE UMAINE Dance Team joins the bands for basketball and football games, including halftime performances. White and a local dance teacher started the team, in lieu of a color guard, about 16 years ago.

As part of the marching band, White oversees the group, but is quick to add he does not take responsibility for choreography, because if he did, "it would just be the lawn mower and sprinkler."

The team typically has 35–40 men and women audition every year for the 20 slots.

"It adds visually to what we do," White says. "It gives the university another performing group, and it's another creative outlet for students."

The Symphonic Band has 45 auditioned members representing the best wind and percussion players on campus. The smaller, select group tours a region of the state for several days each spring, performing concerts at schools and community centers, usually with local bands.

"It's wonderful to get that group into the schools so they can see and hear what we have for ensembles," says White, noting that each year, two or three students from a high school the group visited audition to be music majors.

Although Symphonic Band exists primarily for music students to have a high-level ensemble to perform in, over a third of the group's members are not music majors.

"What determines if you get in is your ability on your instrument," he says.

In March 2018, White will represent the Symphonic Band at the College Band Directors National Association 2018 Eastern Division Conference in New Haven, Connecticut. He was selected to present a recording of the group during the small band showcase.

"IT'S NOT magic what we do; it does take work. And most of our students come here with eight years of training on their instrument," White says.

"These are phenomenally dedicated students. They all work super hard," White says of their rehearsals several hours a week, including evenings, and weekend performances. "Without any one of them, we wouldn't be who we are."

Some students go beyond the normal requirements, White says, volunteering to help with tasks such as organizing

Left to right: Christopher White leads Maine Summer Youth Music (MSYM) camp; the sports bands, dance team and majorettes; and the 45-member Symphonic Band, UMaine's highest-level audition group. "They all fulfill something I do," White says. "I couldn't do just the sports bands without the challenge of the Symphonic Band."

and handing out music, keeping track of uniforms and performing instrument maintenance.

"Many of these students have chosen music as their primary area of interest and give everything they can," he says. "It's wonderful to work with them. They're there because they want to be, so it makes my life really easy. I just have to give them what they need to be successful."

MUSIC IS important for many reasons, according to White.

"We're spending a tremendous amount of time educating in science and math, and getting those technical skills, but music and the arts educates our emotional side. We have to have that balance of arts because it allows us to see the world in a different way; it allows us to give things life," he says.

In addition to MSYM and Symphonic Band concerts, White's outreach efforts include conducting at music festivals and visiting schools to work with the next generation of musicians.

In March, UMaine will host the second annual Festival of Winds, which brings bands to campus to work with wind and percussion faculty.

The sports bands also offer days when high school bands and dance teams statewide are invited to perform with them during a game.

"We do anything to get students here and get them involved," White says. "If you survey our band students, they'll say the band they are in was an influencing factor in them choosing UMaine."

Baines, a civil engineering major, says the thought of being a UMaine student and not being part of the band program had never crossed his mind. He vividly recalls his first memory of the marching band 20 years ago.

"A beautiful fall Saturday in Orono in October 1997, a triple overtime win over Connecticut, and a large group of people with instruments and matching blue uniforms will forever stay ingrained in a wide-eyed 2-year-old's mind," Baines says.

White has taught the students to have pride in every performance, because you never know when that will be someone's first or last impression of the university, according to Oriente.

"Whatever my last impression of the band may be, it'll be hard to top the memory that inspired me to join the group in the first place," Baines says.

There are always obstacles with keeping students interested in music, according to White, as well as educating why the arts are important.

"There are challenges every day, but the rewards outweigh the challenges, which is why I still do this," White says.

White enjoys interacting with students, making music, engaging in a creative process, teaching students the university's traditions, and sharing parts of the university with those outside the campus community.

"Seeing students smile when they get done playing an event, that's nice," he says. "You're providing an outlet for them where they are letting part of their expressive self be shown; that's satisfying." ■

A new look next year

CHRISTOPHER WHITE, director of the Pride of Maine Black Bear Marching Band, says an anonymous donation to the University of Maine Foundation in support of UMaine's Division of Music will allow the band to outfit students in uniforms that are younger than they are.

The 150 new uniforms — 145 regular band member uniforms and five drum major uniforms — replace jackets and pants that were 23 and 34 years old, respectively. The band will debut the new uniforms next fall.

The donation also allowed for a design update.

"We have kept elements of the past in the design with some improvements for practicality in the new pants and tops to eliminate extra parts," White says.

The new uniforms do not have shoulder cords, and have coats that close completely, eliminating the need for a dickey. Fewer uniform pieces also saves on cleaning costs, White says.

Gandhi in today's world

The United Nations taps Douglas Allen's internationally recognized scholarship

By Margaret Nagle / Photo by Holland Haverkamp

THE UNITED Nations' International Day of Non-Violence was celebrated Oct. 2, the birth date of Mahatma Gandhi, who was one of the most admired and influential proponents of nonviolence in the modern world.

As part of the observance, University of Maine professor of philosophy Douglas Allen was invited to address the United Nations on "Mahatma Gandhi on Violence and Nonviolence: Common Misconceptions and Gandhi's Significance Today."

The UN observance occurred a day after the deadliest mass shooting in modern American history that left 58 people dead and hundreds injured after a gunman opened fire in Las Vegas.

Allen is one of the world's leading scholars of Gandhi's philosophy and practice of nonviolence. Throughout his career, he has conducted research and lectured extensively in India.

In 2015–16, for five months of his sabbatical he was based at the Indian Institute of Technology Madras, and began work on his next Gandhi-inspired book. And for a month, Allen was the first Visiting Chair Professor in Gandhian Philosophy at the Indian Institute of Technology Bombay in Mumbai.

At UMaine, Allen teaches courses in Marxism, Hinduism and Buddhism. He received UMaine's 1998 Presidential Research and Creative Achievement Award, and is the 2000 Distinguished Maine Professor. Allen has been a member of the UMaine community since 1974.

At the UN event, Allen spoke after brief presentations by Ambassador Syed Akbaruddin, the permanent representative of India; António Guterres, secretary general of the United Nations; and Miroslav Lajčák, the president of the UN General Assembly.

Professor of philosophy Douglas Allen has written and edited 15 books, including *The Philosophy of Mahatma Gandhi for the Twenty-First Century;* and *Comparative Philosophy and Religion in Times of Terror.*

Following his remarks, Allen was asked how he thought Gandhi would have viewed terrorism in the world today.

"Gandhi says there are extreme rare cases where intervening physically and even maybe having to use violence is the most nonviolent thing we can do," Allen said. "But never glorify the violence. What we do is tragic. It's a sign of human failure. And we have to do everything in our power then to change the conditions — economic, social, political — that gave rise to that violence.

"I think almost all of us can usually agree about the violence of a certain extreme terrorism," Allen said. "But I think we should also think about the kind of structural terrorism — corporate terrorism, state terrorism, environmental terrorism — that's part of our systemic, structural approaches that we often don't even recognize as violent, and in which not hundreds or thousands, but tens of millions of human beings suffer and die unnecessarily, and live under terror every day.

"There is so much we can do to overcome that terrorism if we are determined and dedicated enough to change those conditions."

"Mahatma Gandhi on Violence and Nonviolence: Common Misconceptions and Gandhi's Significance Today"

Remarks by University of Maine professor of philosophy Douglas Allen to the United Nations, Oct. 2, 2017, as part of the International Day of Non-Violence

WITH SO much political violence, economic violence, violent language, hate and psychological violence, war and violent conflicts, terrorism, cultural and religious violence, and environmental violence, it is of the greatest urgency and with great hope that the United Nations celebrates the UN International Day of Non-Violence today. What makes this International Day of Non-Violence especially meaningful is that Oct. 2 marks the birthday of Mohandas Karamchand Gandhi, better known as Mahatma Gandhi.

Although Mahatma Gandhi is usually considered the most admired and most influential proponent of nonviolence of the modern world, there are many misconceptions about his approach to violence and nonviolence. Admirers usually invoke simple inspirational Gandhi slogans, the kinds that appear frequently on posters or greeting cards, such as, "Be the change you want to see in the world"; "There is enough in the world to meet everyone's need, but not enough for anyone's or everyone's greed"; "An eye for an eye makes the whole world blind"; and "In the midst of death life persists, in the midst of untruth truth persists, in the midst of darkness light persists."

On many holidays and on occasions such as Oct. 2, we often rather ritualistically repeat such inspirational slogans and sayings, wish everyone a good day, and then return to our violent world with little or no difference.

That is not Gandhi.

Many Gandhi admirers present an oversimplified and misinterpreted Mahatma as having the nonviolent blueprint and all of the answers for dealing with violence. They often sadly conclude that the idealized Mahatma Gandhi may be too good for our violent world.

That is not Gandhi.

Critics invoke the same kind of simple stereotypical Gandhi, but they then dismiss him as naïve and irrelevant for dealing with our complex world of so much violence.

That is not Gandhi.

Gandhi certainly upholds his absolute ideals and truths of nonviolence rather than violence, peace rather than war, love and kindness rather than hatred and cruelty, compassion rather than selfishness, and morality rather than immorality. But the real Gandhi maintains that we are imperfect human beings living in an imperfect world, and we must struggle to figure out ways to apply our nonviolent ideals to difficult, complex, local, national and international contexts of violence.

Even when he was 77 and 78 years old, engaged in heroic nonviolent struggles in India and what is now Bangladesh, Gandhi recognizes that he has not been successful in overcoming problems of Hindu-Muslim and other communal violence, gender violence, untouchability and caste violence, exploitation, poverty and economic violence.

As a practical idealist, upholding values of nonviolence and preventative practices resisting and transforming relations of violence, Gandhi leaves us with a practical and hopeful message. According to Gandhi, perhaps 99 percent of our economic, political, religious, and other violence is humanly caused and conditioned. Therefore, if we are sufficiently concerned, truthful and dedicated, we can engage in changing those humanly caused violent conditions and causes to nonviolent ones.

We can find nonviolent solutions to violent personal, national and international crises. Sometimes we cannot at present prevent or nonviolently remove some violence, such as the shooter killing innocent civilians in Las Vegas last night, rapists raping victims, or millions of innocent victims of brutal violence every day that are never covered by the mass media. In responding, we must never glorify our violence, instead viewing it as a tragic human failure, and doing everything we can to transform violent causes and conditions into nonviolent human relations.

> "As Gandhi would have emphasized today, **what is most significantly and urgently needed is for us now to change priorities, renew our dedication and work cooperatively** to bring about a world of much greater nonviolence."
>
> Douglas Allen

Gandhi leaves us with a legacy of hope for transforming ourselves and our world toward greater nonviolence. The Sanskrit term "ahimsa" literally means not harming, not injuring, including not being violent, and most have interpreted this as a rather passive attempt at refraining from doing harm.

That is not Gandhi.

He correctly tells us that nonviolence is more than a passive attempt at refraining from being violent. Nonviolence, loving kindness, and justice are the most active powerful moral, political, cultural and spiritual forces.

In the most action-oriented and practical terms, Gandhi focuses our attention to the multidimensionality of violence: physical, psychological, political, military, cultural, religious and other dimensions of violence. And Gandhi focuses our attention to the structural violence of the status quo, business as usual, our economic, political, environmental, and other dominant models and approaches that are structurally violent.

Gandhi tells us that in our violent lives and violent world, we are driven by ego-attachments to maximizing material consumption, dominating and exploiting others and nature, constructing ego defense mechanisms that fuel fear, insecurity, hatred and violence, and block our human potential.

Nonviolence, loving kindness and justice are powerful moral, spiritual, social, and political forces that give meaning and purpose to our projects and actions, develop our human potential by serving the needs of others, provide us with untapped human energy, and give us hope for a world of nonviolence that is possible and urgently needed for human and global survival and flourishing. Such active nonviolence provides us with desperately needed approaches to the threat of nuclear holocaust, growing economic inequality and widespread poverty, genocide, health care, and environmental crises, and other issues that must define the UN's major priorities. Such active nonviolence is what brings us all together in meaningful interconnected relations and what expresses human development at its highest.

The United Nations is to be congratulated for recognizing this International Day of Non-Violence. As Gandhi would have emphasized today, what is most significantly and urgently needed is for us now to change priorities, renew our dedication and work cooperatively to bring about a world of much greater nonviolence. ■

Line of sight

Anne Knowles uses technology to reconstruct and re-examine the past

By Beth Staples / Photo by Adam Küykendall

One German came by, a(n) officer said, 'You Jews are supposed to go to Palestine.'… But … nobody had any idea what they had in mind to do.

Holocaust survivor Jacob Brodman, born April 24, 1920 in Nowy Sącz, Poland. Brodman was in law school when Germany invaded Poland in 1939. He was interviewed April 13, 1989 in Sarasota, Florida. His testimony, excerpts of which are interspersed in this story, is part of the United States Holocaust Memorial Museum collection.

HISTORY IS not dusty or dead, says Anne Knowles. It seems settled and forever, but it's being remade all the time. Stories are never over.

Knowles knows that well. The historical geographer has pioneered the use of technology to re-examine past events, including the Holocaust.

For a decade, the co-founder of the Holocaust Geographies Collaborative has used geographic information systems (GIS) to reconstruct landscapes of the genocide.

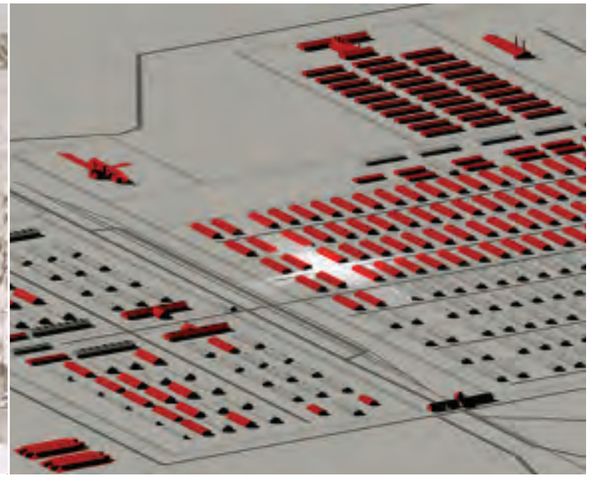
Place is important for Knowles, who views the Holocaust as fundamentally a geographical phenomenon. Location matters.

She asks where and when to learn how and why the Nazi regime's annihilation of 6 million Jews could have happened.

Images left to right: Women in the barracks of the newly liberated Auschwitz concentration camp. Liberation of Auschwitz began Jan. 27, 1945.

Inmates haul cartloads of soil for the construction of the "Russian Camp" at Mauthausen, Austria, 1942.
Both images from United States Holocaust Memorial Museum, courtesy of National Archives and Records Administration, College Park

This approximate, partial representation shows buildings undergoing construction or repair (in red) at Auschwitz-Birkenau between May 1943 and May 1944. Nazi architectural plans were rational, but Anne Knowles says construction at Birkenau was nearly constant and sometimes chaotic.
Map by Chester Harvey



Using GIS, she can map any information that has an attached location, including births and deaths.

By layering or combining various pieces of information — in which location is the key variable — trends and relationships over space and time become visible.

Illustrating such data can advance and broaden perspectives, Knowles says.

Because the Holocaust was large and complex, technology is key to teasing it apart for greater understanding. Trying new ways to examine the past results in aha moments, and new questions, says Knowles.

The Colonel James C. McBride Distinguished Professor of History at the University of Maine anticipates the discoveries will continue for decades.

Researchers with the Holocaust Geographies Collaborative have mapped where Jewish women, men and children were captured, assaulted and killed. They have mapped death marches, SS concentration camps, Jewish ghettos and other aspects of the genocide.

So I looked out and see 10 people walking in one row towards the park and between them my late father … . And they (the Nazis) start shooting … one after the other. My late father was the third man ... he said, 'I will give you everything … whatever you want from the city, let the people live.' Then Haman … laughed and said, 'I will take it myself' and shot him in the stomach first and then shot him in the head.

In 2005, Knowles was sitting at her desk at Middlebury College when she got a call from Michael Haley Goldman, then a staff member of the research arm of the United States Holocaust Memorial Museum in Washington, D.C.

"He talked so fast," Knowles remembers. "He knew of GIS and wanted to learn more about its potential for Holocaust scholarship. I had chills and visions of what could be done."

Knowles had edited *Past Time, Past Place: GIS for History* and she was in the midst of a 16-year project that would result in her book *Mastering Iron: The Struggle to Modernize an American Industry, 1800–1868.*

Goldman's call led to an invitation for Knowles to help organize a two-week summer research workshop, "Geographies of the Holocaust" at the museum.

She and a group of eight geographers and Holocaust historians discussed possible benefits of applying geographic methods, including spatial analysis and visualization, to the study of the Holocaust.

The atmosphere was electric and the attendees had great chemistry, says Knowles. The scholars applied for and received National Science Foundation funding to examine the Holocaust from many geographical perspectives.

The first members of the Holocaust Geographies Collaborative included Alberto Giordano of Texas State University; Tim Cole of Bristol University; Paul Jaskot, then with DePaul University, now at Duke University; Simone Gigliotti, then with Victoria University, now at Royal Holloway, University of London; Waitman Wade Beorn, then with University of Nebraska Omaha, now at University of Virginia; Anna Holian of Arizona State University; Marc J. Masurovsky, consultant historian at the United States Holocaust Memorial Museum; and Erik Steiner of Stanford University.

In recent years, the team has grown to include scholars with expertise in Eastern Europe and additional research methods.

In the fall, it was already cold, they shipped us to Auschwitz. We are traveling three days to Auschwitz in cattle cars. Same story, no food, no water, no nothing. People breaking out from the trains. ... They jump from the trains and broke their hands … and their legs … . We came to Auschwitz on the railroad tracks. Mengele came around … . He was asking if you're twins (for experiments). We got to Birkenau … . People from Auschwitz built the chimneys … built their own crematorium.

At Middlebury, Knowles' students used GIS to make static and animated maps of the Jäger Report, a chilling record kept by Karl Jäger, a commander of an infamous attack squad called Einsatzkommando 3 (EK 3).

In five months, from July 2 to Dec. 1 1941, Jäger's mobile killing squad murdered 137,346 civilians, mostly Jews, via a "holocaust by bullets."

Jäger's detailed account of the executions included dates, locations with the number of people killed, and whether victims were adults or children, male or female.

He concluded in his report: "Today I can confirm that our objective, to solve the Jewish problem for Lithuania, has been achieved by EK 3. In Lithuania there are no more Jews, apart from Jewish workers and their families.

"The still available Work Jews and female Work Jews are urgently required and I can foresee that post-Winter, this manpower will still be most urgently required. I am of the view that sterilization of the male Work Jews should begin immediately to prevent reproduction. Should a Jewess nonetheless become pregnant, she is to be liquidated."

One of the collaboration's visualizations illustrates that

in Lithuania during the last week of August 1941, the task force's killings became full-blown genocide — the systematic destruction of a certain group of people based on their race, religion or citizenship.

That week, in addition to murdering Jewish men, EK 3 began exterminating Jewish women and children.

Knowles' highly visual approach to history is evident in the collaborative's 2014 book *Geographies of the Holocaust.* The 260-page illustrated hardcover explores Holocaust geographies at every scale of human experience, from continental to individual.

Co-written and co-edited by Knowles, the book contains six case studies: "Mapping the SS Concentration Camps"; "Retracing the 'Hunt for Jews'"; "Killing on the Ground and in the Mind"; "Bringing the Ghetto to the Jew"; "Visualizing the Archive: Building at Auschwitz as a Geographic Problem"; and "From the Camp to the Road: Representing Evacuations from Auschwitz." The book drew rave reviews.

But Knowles says that she and her colleagues were uneasy because their case studies so strongly reflected the perpetrators' perspective, and lacked humanity and Holocaust victims.

Today, the collaborators are working on projects that integrate experiences of survivors and Nazi perpetrators. It's important for historians to tell emotional truths, she says.

"Scholarship needs more passion," Knowles says. "We should move people."

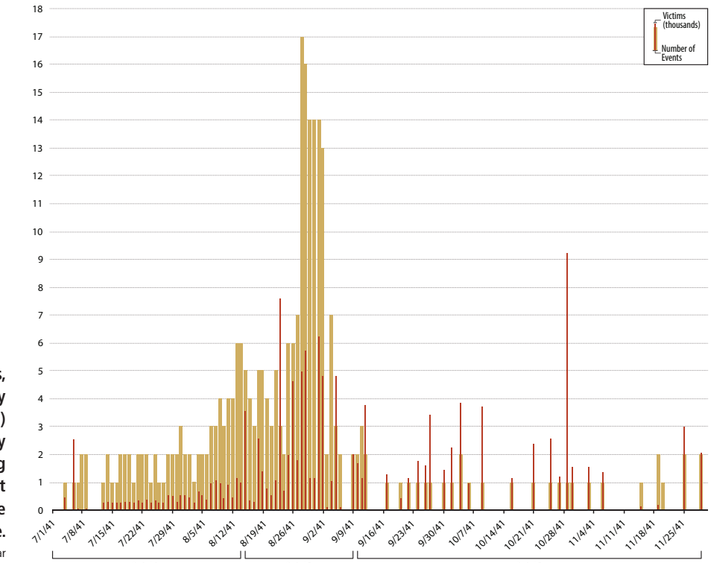
Jan. 18, they ordered us all to march. That was a death march … . Two feet of snow ... we had to walk ... . And the guns were popping. Who couldn't walk got killed. So you make yourself walk … doesn't matter how. You crawled and you walked. The whole night we walked.

The collaborative utilizes corpus linguistics to reveal emotional truths contained in spoken and written testimonies of 800 Holocaust survivors. Corpus linguistics is the use of computers to analyze large collections of text.

A method called geoparsing attaches geographic coordinates to place names in text. Knowles and colleagues hope to use geoparsing to map places in testimonies and eventually map movements of victims throughout the Holocaust.

Analysis of the testimonies also will include semantic tags to give researchers insight into survivors' emotions and attitudes.

Images left to right: In 1944, Jews from Subcarpathian Rus, then part of Hungary, await selection on the ramp at Auschwitz-Birkenau. A Jewish woman carrying a baby walks toward the gas chambers with three young children. They had just undergone the selection process in May 1944 on the ramp at Auschwitz-Birkenau. United States Holocaust Memorial Museum, courtesy of Yad Vashem



A total of 137,346 civilians, mostly Jews, were killed by Einsatzkommando 3 (EK 3) in Lithuania between July and December 1941. During the last week of August 1941, the killings became full-blown genocide. Graph by Benjamin Perry Blackshear

The collaborative has many questions, says Knowles. Mining the material will answer some and spark others: How were people's experiences affected by the country where they lived? How did trauma affect awareness of place and ability to describe experiences? Did women perceive and remember experiences differently than men?

Knowles, who was awarded a prestigious Guggenheim Fellowship in 2015, imagines using animations and geovisual storytelling to narrate the trajectories of people during the Holocaust.

In her book, tentatively titled *Telling the Spatial Story of the Holocaust,* Knowles wants to capture the immediacy of lived experiences and the spaces of intimate interactions, uncertainty and fear.

They loaded us up (in January) in open (railroad) cars … . People froze to death in these cars. Used to huddle together to keep warm, or we sat down on the dead people … . It took us eight days to go to Buchenwald … . And sometimes you were lucky, the Czechoslovakian people were very nice, used to stay on the bridges from the railroad and throwing in the rolls and the bread to the open cars.

"My goal is to convey the spatial restructuring of Europe during the Holocaust while interweaving personal stories that illuminate moments when individuals encountered the force of Nazi power," Knowles wrote in her proposal.

Survivors who faced extreme trauma, deprivation, dislocation and isolation sometimes struggle to find the language to express moments and experiences, she says.

The messages might be stark and simple: "I was cold." "The mud stuck on my boots." Some interviews contain long silences; some survivors return repeatedly to one topic.

The book will demonstrate the enormous range of Holocaust experience in place. Knowles also hopes to bring together Nazi control of space with victim experiences.

Listening to and reading survivor testimonies can be difficult and demands intense focus, she says.

"We're confirming the worst in humanity so (society) can't pretend it doesn't exist," says Knowles. ■

Standing (digitally) in Robert E. Lee's boots

BRUSHING HER teeth one morning, Anne Knowles wondered what Confederate Gen. Robert E. Lee saw July 3, 1863 at Gettysburg before ordering an attack on Union troops.

That tactical decision cost the South the Battle of Gettysburg and was the turning point in the Civil War.

To find out what Lee observed that morning through binoculars at the top of the United Lutheran Seminary, Knowles digitally placed herself in the boots of the 5-foot-10-inch general. She even took into account the thickness of his heels.

For the project, Knowles began with a 12-foot-by-13-foot map from the Treasure Vault inside the U.S. National Archives.

She traced the map's 4-foot contours from a poster-size compilation published in 1868, and she and her students at Middlebury College brought the redrawn contours into GIS to create a digital terrain.

Then, using viewshed analysis — which Knowles describes as looking at the landscape through 3-D glasses — she acquired the perspective that Lee had more than 150 years ago.

Knowles saw what Lee saw.

More importantly, she saw what Lee didn't see prior to ordering 18,000 soldiers in the Confederate Army to attack what he incorrectly thought was a vulnerable position of the Union Army.

Knowles' research suggests that when Lee ordered Pickett's Charge, he couldn't see nearly a third of the Union troops.

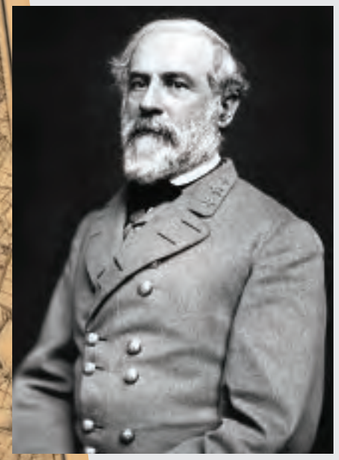
"Without full knowledge, he set his men up for a dreadful defeat," says Knowles in her nine-minute TED-Ed talk titled, "A digital reimagining of Gettysburg."

Lee's line of sight had been a missing part in the discussion of the Battle of Gettysburg, says Knowles in the talk, which has been viewed online nearly 75,000 times.

And now, she says, seeing is believing.

Contour lines are depicted for each change of 4 feet in elevation in this *Battle Field of Gettysburg* map produced by the Office of the Chief of Engineers. Anne Knowles used this map to create a 3-D rendering of the battlefield.

Library of Congress Prints and Photographs Division, Washington, D.C.



Gen. Robert E. Lee

Photo by Julian Vannerson, Library of Congress Prints and Photographs Division, Washington, D.C.

Charting her course

ANNE KNOWLES' fascination with maps began during her childhood.

She and her siblings eagerly gathered around the family's dining room table in Kalamazoo, Michigan as their father read aloud passages from American Heritage books.

"I was often the last one (left) at the table," says Knowles, who was enthralled by the beautifully written volumes packed with photographs and maps.

During summers, the family piled into the station wagon for highly organized trips to beautiful lands and historical sites, including Gettysburg, the Black Hills and Boston.

Exploring places she had heard about, read about and examined on maps was powerful, and gave history context and a sense of place. At Duke University, Knowles majored in English, worked at the student newspaper, started *Tobacco Row* magazine and took up modern dance.

After graduation, she continued to dance and edited books for publishing companies in New York, then Chicago. For her first developmental editing job, Michael Conzen designed 110 full-color maps to distinguish *America's History* from other U.S. history textbooks.

Knowles says her nine-month crash course in cartography with the enthusiastic historical geographer and gifted pen-and-ink mapmaker was a transformative experience.

"Seeing history through maps made it real, it grounded me. I didn't know there was such a thing as historical geography."

Then it became her calling.

Knowles earned her master's and doctorate in geography at the University of Wisconsin–Madison, then taught — mainly in Welsh — at the Institute of Earth Studies at Aberystwyth University in Wales.

She returned to the U.S. for a postdoctoral fellowship at Wellesley College. But after three years, her geography position, like many others up and down the East Coast, wasn't funded.

Knowles felt desperate and angry, but says the experience showed her life was possible without an academic job. For two years in Washington, D.C., she focused on the potential of using GIS in historical research and teaching.

She edited *Past Time, Past Place: GIS for History*, which used GIS to analyze past events, including the Salem witch trials and the Dust Bowl. As it turned out, reimagining history refocused her academic career.

Several weeks after 9/11, Knowles left a church service with renewed passion and purpose to again pursue teaching. She soon was offered a post in the Geography Department at Middlebury College, where she worked for 13 years.

In 2012, *Smithsonian* magazine heralded Knowles' innovation, presenting her with a Smithsonian American Ingenuity Award for historical scholarship for pioneering "the combined use of mapmaking and databases in historical research."

Knowles is married to Stephen Hornsby, director of the University of Maine Canadian-American Center, and professor of geography and Canadian studies. She joined UMaine's Department of History in 2015.

UMaine doctoral student Justus Hillebrand says that when Knowles, his adviser, welcomed him to work with the Holocaust Geographies Collaborative, she told him the researchers leave their egos at the door and focus on the project at hand.

"That was the most surprising, refreshing and truly helpful sentiment I have experienced in academia," says Hillebrand.

Now seven

Three more NSF Graduate Research Fellows named

By Beth Staples

EARLIER THIS year, three University of Maine students — Melissa Jankowski, Elisabeth Kilroy and Anne "Ani" St. Amand — were awarded National Science Graduate Research Fellowships for their demonstrated potential for significant achievement in STEM fields.

UMaine now has seven students who are or recently have been NSF Graduate Research Fellows.

The fellowships are highly competitive, three-year awards to promote innovation and transformative scientific breakthroughs that will have a broad scientific impact at the state, national and international levels. Some of the most notable researchers in the United States began their careers as NSF graduate research fellows.

JANKOWSKI, OF Cassville, Missouri, is pursuing a Ph.D. in clinical psychology (developmental-clinical track). She expects to earn her doctorate in 2021.

Her research focuses on peer relationships, and their connection to risk and resilience in adolescence. Specifically, Jankowski investigates the interpersonal mechanisms of risk for, and influence of, contagious suicide and self-harm behaviors in adolescents.

After her mother died of cancer, Jankowski lived with friends during her last two years of high school. She became interested in how particular health-risk behaviors emerged within the social context of families and other peer relationships.

Jankowski studied psychology to formally explore risk and resilience in interpersonal contexts. She earned a bachelor's degree in psychology at the University of Missouri.

Jankowski plans to be a clinical psychology faculty member at a research institution.

KILROY, FROM Brewer, Maine and Charleston, South Carolina, is pursuing a doctorate in biomedical science. She expects to obtain her Ph.D. in 2020.

Kilroy's research focuses on developing effective therapies for muscular dystrophy — a neuromuscular disease characterized by a loss in muscle mass that results in progressive muscle weakness.

She's revisiting the premise of whether strength training is beneficial or detrimental to individuals with the disease, using the zebrafish model for muscular dystrophy.

For people with muscular dystrophy, a protein needed to build and maintain healthy muscle is missing or doesn't function properly, which results in the muscle's inability to contract properly. Muscles also tire more easily and individual muscle fibers atrophy.

Kilroy's father and brother are battling a yet-to-be identified type of muscular dystrophy and medical professionals don't know what's causing their muscles to waste.

Kilroy plans to be a university professor.

ST. AMAND, of Deer Isle, Maine, is pursuing a Quaternary and climate sciences master's degree, and an interdisciplinary doctorate. She expects to earn her doctorate in 2021.

St. Amand explores intersections between climate change and human behavior over the last 12,000 years. She uses geoarchaeological methods, spatial analysis and geophysical modeling to understand how past climates and environments have impacted human settlements, infrastructure and resource acquisition.

She also uses remote sensing to create land cover classification models to identify new archaeological sites. Doing this, she says, expands the archaeological record and provides new proxy evidence to enhance and refine climate reconstructions.

St. Amand earned a bachelor's degree in geography/anthropology from the University of Southern Maine.

Her career goals include conducting research that expands knowledge of dynamic Earth systems. She also seeks to increase communities' capacities to adapt to rapidly changing climates. ■

UMaine's newest NSF Graduate Research Fellows are, left to right, Elisabeth Kilroy, Ani St. Amand and Melissa Jankowski. Photo by Holland Haverkamp

Lost to the sea

Researchers are surveying the state's fragile shell middens to preserve the ancient history of the archaeological sites

By Walter Beckwith / Photographs by Holland Haverkamp

Graduate research assistant Jacque Miller, center, collects ground penetrating radar data at a shell midden on the coast of Maine, working in the field with Joseph and Alice Kelley. The method gives the researchers a rapid and cost-effective way to document many of the state's at-risk midden sites without the need for traditional archaeological excavation.

Lost to the sea

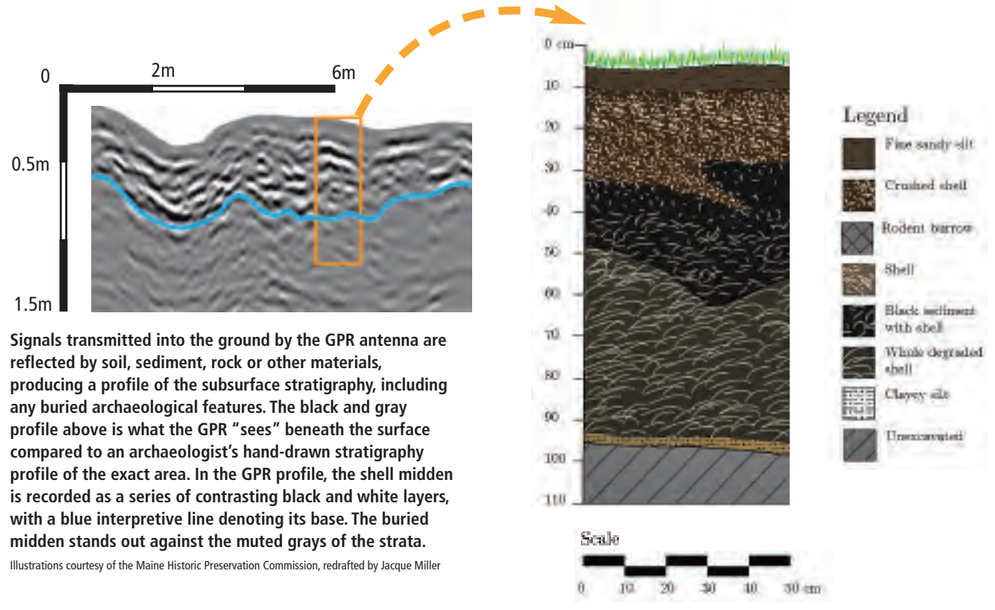
AT THE foot of a rolling hillside on the coast of Maine, beneath the meadow of tall grass and lupine, lies a patch of bleached white and broken clam shells. The chalky remnants protruding from the dark soil are the only visible sign of an ancient shell midden — an important archaeological site that can tell a thousands-of-years-long tale about coastal inhabitants and environments.

Just a few meters away, some timeworn shells spill from the eroding beachside embankment and into the tide. Each passing year, more and more of this site is lost to the sea.

This trend is likely to continue — even accelerate — in the face of increased storm intensity and sea level rise due to changing global climate.

Maine's coastline is dotted with more than 2,000 archaeologically documented shell middens and virtually all of them are eroding into the ocean. Some quite rapidly, which is putting valuable records of cultural and environmental history at risk, says Alice Kelley, a geoarchaeologist at the University of Maine.

Ground penetrating radar (GPR) uses short radar pulses to discover and identify features beneath the ground surface.



Signals transmitted into the ground by the GPR antenna are reflected by soil, sediment, rock or other materials, producing a profile of the subsurface stratigraphy, including any buried archaeological features. The black and gray profile above is what the GPR "sees" beneath the surface compared to an archaeologist's hand-drawn stratigraphy profile of the exact area. In the GPR profile, the shell midden is recorded as a series of contrasting black and white layers, with a blue interpretive line denoting its base. The buried midden stands out against the muted grays of the strata.

Illustrations courtesy of the Maine Historic Preservation Commission, redrafted by Jacque Miller

Kelley, an assistant research professor in the Climate Change Institute, is working with a team of archaeologists and geologists from UMaine and the Maine Historic Preservation Commission to survey these fragile archaeological sites using ground penetrating radar (GPR).

The goal of the Maine Sea Grant-funded project is to better understand the current state of Maine's many shell midden sites — to document what is there and has the potential to be lost, and the rates at which erosion is happening. It is the first concerted use of GPR technology on the Maine coast to rapidly assess the state's middens, many of which, due to time and budget constraints, have not been visited by archaeologists since the 1970s or '80s.

The information will help land and cultural resource managers triage the most at-risk sites for preservation or conservation. Or emergency archaeological excavation.

Shell middens in Maine are ancient heaps made up largely of discarded clam or oyster shells. They also contain many other cultural artifacts associated with daily life, such as pottery, stone and bone tools, and even other types of organic remains, says Kelley.

"For a long time, it was thought that these sites were merely garbage dumps and not worth anything," she says, "but we're finding that's not the case."

FOR THOUSANDS of years, the ancestors of the Wabanaki people called the Maine coastline home. Native families lived, fished and hunted in these coastal environments. Not only in the summer, but also in winter months when other food resources became unavailable, people turned to the surrounding mudflats and harvested the abundant bivalves.

People continued to come and go to the sites. Perhaps just for a few years. Perhaps for centuries. Sometimes they settled on top of the shell deposits and, season by season, discarded shells and cultural refuse accumulated, slowly becoming incorporated into the geological stratigraphy.

While the sites are often rife with cultural objects that paint a picture of the lifeways of coastal residents in the landscape that became Maine, they also are unique in their abundance of environmental and ecological information.

"The faunal remains. The fish bones, the bird bones, the mammal bones, the fish ear bones, all of those sorts of things tell us what was in the Gulf of Maine at that time," long before the pressures of industrialized fishing, says Kelley.

The calcium carbonate from the layers of densely packed shells effectively buffers against Maine's acidic soil and creates ideal conditions for organic preservation. As a result, organic materials, such as the bones of animals, and the archaeologically rare tools made from them, can be found, whereas at other sites they are quickly lost to decay.

"The (middens) allow us to examine the local environment through the animals Native people were using," says Arthur Spiess, the senior archaeologist with the Maine Historic Preservation Commission and co-investigator on the project.

The bones of land and sea mammals, including moose, deer, bear, beaver, seals and porpoise can be found alongside copious fish and bird bones, all intermixed and preserved amid the shells. They are the only places where the remains of some now-extinct native species, such as the sea mink and the great auk, can be found.

Spiess, who has investigated dozens of Maine's shell middens throughout his 40-year career, says the ancient environmental records interred in the middens can inform current fish and wildlife experts with a perspective spanning the past 5,000 years. Official Inland Fisheries and Wildlife and Marine Resources records have been kept for 50 to 100 years.

"Just at the time we're coming to appreciate what these middens can offer us, sea level rise is accelerating and endangering the middens," says Kelley.

The team members use GPR to survey each of the sites they visit. The technology allows the researchers to identify hidden underground features without having to dig.

Traditional archeological excavation is expensive in terms of cost, time and labor. As a result, few shell midden sites are excavated each year — and often only a few square meters of each site can be investigated.

Furthermore, archaeological excavation is an inherently destructive process because it removes artifacts and other material from its original context.

"We want to put our emphasis where we can recover the most data without disturbing or destroying (the site) too much," says Joseph Kelley, professor of marine geology and co-investigator on the project.

What lies beneath

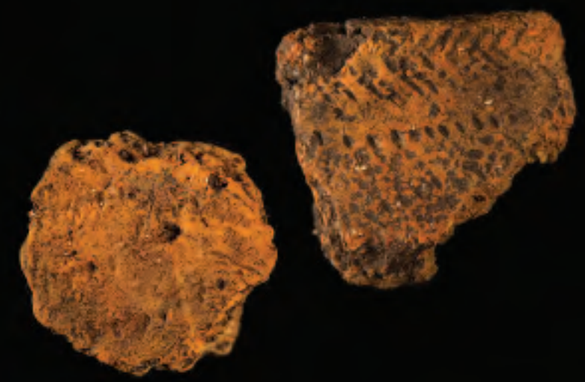
MAINE SHELL middens are full of artifacts — stone and bone tools, pottery, remains of fish and animals, and even shells that can enrich archaeologists' understanding of the site's cultural and environmental history. Alone, these artifacts can be of great interest and beauty; however, their context (where they were found) and association (what they were found with) are far more important. An artifact without these elements loses its ability to inform the past. This is why archaeologists go to great lengths to record meticulous details about where each was found and try to dissuade artifact collectors from disturbing shell middens. Once a site has been dug and the items removed, it can never be excavated again.

STONE AND BONE TOOLS
Three chipped-stone bifaces, left, clockwise: Kineo rhyolite, Moosehead Lake region; chert, unknown source; Munsungan chert, northern Maine (1000 BCE–500 CE Woodland/Ceramic Period)
Right: bone awl (1000–500 CE Late Woodland Period)

Stone tools and the discarded materials from their manufacture (debitage) are commonly found in middens. The function and design of the tools can suggest a site's age or the culture and activities of the people who left them behind. Also, the types of stones can shed light on where the site's occupants came from or whom they interacted or traded with. Often, the stone material is from nearby sources; however, stones from as far away as Ohio or northern Labrador, Canada are occasionally found in Maine middens. Items made from bone are quite rare due to their perishable nature and often are only found in shell middens. Bone tools include barbed harpoons, projectile points, fishing hooks, and even beads, jewelry and musical instruments.

NATIVE CERAMICS
Left to right: Cord-wrapped stick (CP4 (600–1000 CE late Middle Woodland/Ceramic); CP2 rocker dentate (200 BCE–300 CE early Middle Woodland/Ceramic Period)

Native people in the Northeast began making ceramics nearly 3,000 years ago. While archaeologists have never found a fully intact vessel in Maine, their fragments (potsherds) are quite common in middens. The styles and patterns of decoration — imprints using animal teeth, fabric or sticks wrapped in cord — can be used to determine the age of a site. In some cases, what was cooked or stored in the pots can be determined by chemically analyzing the ancient residues.



SHELLS
Softshell clam *(Mya arenaria)*
(1000 BCE–500 CE Woodland/Ceramic Period)

Clam and oyster shells that make up the bulk of a midden contain important records of ancient climate and environmental conditions in the Gulf of Maine. Oxygen isotopes, which became incorporated into the bivalve shells when they were alive, can be analyzed to determine past sea temperatures and salinity, the season in which they were harvested and the time of year the sites were occupied.

FAUNAL REMAINS
Left to right: Grey seal *(Halichoerus grypus)* temporal auditory bulla; sea mink *(Neovison macrodon)* maxilla and teeth (1000 BCE—500 CE Woodland/Ceramic Period)

Discarded bones of fish, birds, reptiles and mammals often found in middens are representative of which animals lived and were hunted in and around the Gulf of Maine. Some animals, like the now-extinct sea mink, are only known through remains preserved in shell middens. The skeletal elements present also can hint at deeper cultural meanings. At one site, the left auditory bulla (ear bone) of the grey seal was found in greater abundance than any other part of the animal, suggesting those bones in particular had specific cultural significance.

JOSEPH KELLEY, a specialist in coastal erosion and remote-sensing technology, is working with Alice Kelley to document the sites. The two, who are married, have collaborated on similar interdisciplinary field research using GPR worldwide, including in northern Peru and the Shetland Islands.

With GPR, hundreds of square meters can be surveyed by the team, noninvasively and nondestructively, in as little as a day. And if excavation is necessary, the GPR data can greatly inform where archaeologists should focus their efforts.

GPR uses short electromagnetic pulses transmitted from a radio frequency antenna into the ground. The signals are reflected by different underground features — types of soil or sediment, disturbances, voids, rocks and other materials — back to a receiver on the surface.

Changes in the underground layers result in different electrical properties of the returned signal. The time it takes for the signal to return to the receiver is used to determine a feature's depth below the surface of the ground. As the antenna and receiver trace along the surface, a profile of the underlying stratigraphy is generated.

To date, the team has used GPR to survey more than five sites along Maine's coast — from the southern shores to Down East.

"We can use the GPR to essentially survey what we think is the entire site," says Jacque Miller, a UMaine graduate research assistant in Earth and climate sciences.

Miller notes that some of the surveyed sites are much more expansive than previously thought.

The project combines coastal geology with archaeology, and draws attention to sea level rise and climate change, and how they are impacting Maine's cultural heritage, says Miller, who was recently awarded the Richard Hay Award from the Archaeological Geology Division of the Geological Society of America. The GPR data they are collecting will be the core of Miller's master's thesis.

According to Spiess, who maintains the state's official archaeological records, research of this type and scope has never been done on the coast of Maine.

While the project represents the first formal collaboration between the Kelleys and Spiess as co-directors, they have worked together for decades. During this time, Spiess says, the Kelleys have made major contributions in Maine archaeology.

The two-day Lost to the Sea Conference, hosted by the Darling Marine Center in August, included a field trip to the Whaleback Shell Midden State Historic Park in Damariscotta, Maine. Project collaborator Arthur Spiess, foreground, senior archaeologist with the Maine Historic Preservation Commission, shared the archaeological and historic significance of the site with participants.

"Their combined work on sea level rise, erosion and archaeological sites made me realize that a lot of the wonderful sites on the coast won't be there in 50 to 100 years. This project deserved my support," Spiess says. "It feels great to be able to help with the issue."

However, some of the sites have already been erased by the tide.

"Some (sites) are lost. We've gone back to them and they're simply not there," says Joseph Kelley. "In 20 years, they've disappeared."

However, it's not just the rising tide that endangers these unique sites. Historically, Maine's ancient shell deposits have been mined for fertilizer and chicken feed, used for local road fill or bulldozed for coastal development.

They also are a common target for possibly well-intentioned, but highly destructive artifact collectors, which is why many archaeologists and land managers must be so tight-lipped about each site's location.

"Educating the public is a multifaceted and complicated challenge," says Spiess, who's been doing public outreach in archaeology in the state throughout his career. He hopes that key people and organizations, including municipal planning commissions and land trusts, will get involved.

With the right players in the game, he says, there is a chance that some of the sites can be protected.

THE RESEARCHERS hope to build a network of citizen scientists who understand the importance of the sites and the ethics involved in protecting them — a group that could monitor sites and report increased erosion or disturbances.

To facilitate this, the researchers organized a two-day conference for stakeholders who own or manage coastal properties to intersect with archaeologists, learn about the sites and discuss potential conservation strategies.

Among the attendees was Joan Ray, the land protection and stewardship director for the Medomak Valley Land Trust.

The trust manages over 4,000 acres of land in and around the Medomak River and Muscongus Bay. To the best of her knowledge, Ray says there are several dozen shell midden sites in her management area.

"We knew the middens existed, but we didn't pay any attention to them. Not many land trusts in the state recognize these features," she says.

Ray attended the conference knowing little about Maine's shell middens. But after learning of their significance and their rapid rate of erosion, she now sees their protection as a major concern for the land trust.

That public awareness is key, says Kelley.

"These sites are disappearing and I have a sense that, if we can get this message out, if we can get people interested, it could really make a difference in how we look at cultural resources," says Alice Kelley. "Not just as something that you'd look at and walk by, but that there is something really important here. To have people appreciate what they are and perhaps take some interest in monitoring or preserving them.

"When people become involved with things, they tend to protect them, and that would be a great outcome." ■

Global exploration

ALICE AND Joseph Kelley are no strangers to interdisciplinary collaboration. Alice is a geoarchaeologist, Joseph is a marine geologist. With their varied areas of expertise, the wife-and-husband team make use of a number of geological and geophysical concepts and tools, and apply them to answer archaeological questions. Together, they have collaborated on archaeological and geological research projects worldwide.

On the north coast of Peru, the two used GPR to identify architectural elements more than 5,000 years old, buried within a large sandy mound at the site of Los Morteros.

They also have used GPR in Scotland's Shetland Islands to locate the ruins of a small coastal community that was abandoned and buried by encroaching sand dunes during the Middle Ages.

Back in Maine, the two have used a variety of oceanographic methods, including side scan sonar and seismic reflection profiling, to explore underwater areas in the Gulf of Maine that were once dry landscapes where people likely lived when sea levels were much lower at the end of the last ice age.

Recognition and management of small natural features can be **an effective way to conserve biodiversity and ecosystem services.** Malcolm Hunter

Big roles of small natural features

ECOLOGISTS AND conservationists have long recognized that keystone species have major ecological importance disproportionate to their abundance or size. Think beavers, sea stars and prairie dogs — species that keep an ecosystem balanced.

Similarly across landscapes, the keystone concept of disproportionate importance extends to other ecological elements, such as salt marshes in estuaries.

Now an international group of researchers is exploring the disproportionate ecological importance of small natural features — unique environmental elements that provide significant ecological and economic impacts.

Desert springs. Caves harboring bat colonies. Rocky outcrops. Strips of natural vegetation edging agricultural fields. Riparian zones. Small coral heads. Tiny islands. Large old trees.

These small natural features are often overlooked, relatively vulnerable yet environmentally mighty in their ecosystem. They also are at the opposite end of the spatial scale from the Earth's large conservation superstars — the Serengeti, Yellowstone and the Great Barrier Reef.

Small natural features have big ecological roles, according to the 37 researchers from 11 countries writing in a special issue of *Biological Conservation*. Sometimes they can provide resources that limit key populations or processes that influence a much larger area. Sometimes they support unusual diversity, abundance or productivity.

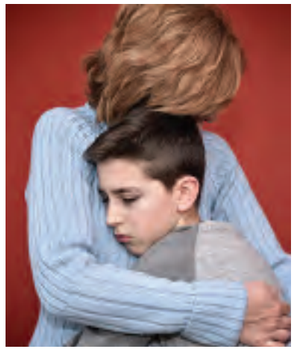
They also are small enough to efficiently maintain or restore, while traditional land-use activities, such as forestry, fishing and grazing, continue in close proximity.

"Small natural features are an example of what can be termed 'The Frodo Effect,'" writes Malcolm Hunter, University of Maine professor of wildlife resources and Libra Professor of Conservation Biology, in the introduction to the issue.

"In *The Lord of the Rings,* the small and unassuming hobbit Frodo has more strength than any of his larger peers and saves Middle Earth with his brave actions," says Hunter. "Gandalf and the rest of the fellowship of the ring go to great ends to protect him, because they know this."

50 THINGS

THIS PAST spring, 23 University of Maine seniors in a communication course collaborated on a capstone project to create a useful resource for UMaine and its students for years to come. The project, "50 Things to Do Before You Graduate from the University of Maine," is a UMaine bucket list for students by students. It was developed by associate professor of communication and journalism Claire Sullivan in collaboration with UMaine's Division of Marketing and Communications. The list is online: umaine.edu/50things.



BARRIERS THEY FACE

IN A study of self-identified mothers of violent children with mental illness to better understand their experiences when seeking help, researchers from the University of Maine and Niagara University identified three barriers that make it difficult to find effective assistance. The barriers are denial of the mental illness and the severity of violence by treatment providers, extended family, and nonfamily members; limited access to quality treatment and supports; and a recurring cycle of optimism and hopelessness.

The mothers who participated describe an ongoing struggle to increase awareness of — and belief — that they and their children need help, according to UMaine sociology professor Karyn Sporer and her co-author Dana Radatz, a criminal justice professor at Niagara University.

The researchers note that the barriers faced by these mothers and their violent children parallel those experienced by survivors of intimate partner violence. The hope is that greater understanding of the similarities can inform policy and social services, including the programs for survivors that have been effective in helping provide an informed support system and access to positive, helpful and supportive care.

Currently, say the researchers in the *Journal of Family Violence*, "the mental health system seems incapable of providing adequate support to persons with mental illness and their family caregivers," raising questions about societal priorities.

Longer summers

SUMMER IS coming to the Gulf of Maine — warmer than ever and as much as two months longer than just three decades ago, according to a research team led by Andrew Thomas of the University of Maine School of Marine Sciences. Their study, published in the journal *Elementa*, examined the seasonality of sea surface temperature trends along the northeast coast of the United States.

For all but a small region immediately north of Cape Hatteras at the southern edge of their study area, the researchers confirmed that surface water temperatures shows an increasing trend over the last three decades, with the Gulf of Maine warming at about 0.4 degrees Celsius per decade. The new analysis both mapped the geographic pattern of these trends and showed that the increase is actually much stronger than this in the summer and early fall months, from June to October, and weaker in the winter months. The impact of these seasonal differences was an increasing duration of the summer period — strongest in the Gulf of Maine, which had a trend of over two days per year.

The research builds on previous work by Thomas and his colleagues, including Andrew Pershing and Katherine Mills of Gulf of Maine Research Institute, and others from Bigelow Laboratory, Stony Brook University and NOAA. In a widely cited 2015 paper in *Science*, these authors analyzed sea surface temperature data showing that the Gulf of Maine region exceeded the global average rate of warming over the last 30 years, and noted that over the past decade the Gulf of Maine warmed faster than 99.9 percent of the global ocean. Looking at details behind these trends was a logical next step. They were motivated by several questions: Do overall warming trends occur equally throughout the year, or do they occur primarily in a particular season? Which regions are the most susceptible or resilient to changes in sea surface temperature?

With funding from the National Science Foundation and NASA, they took a higher resolution version of the same set of data — 33 years of satellite measurements — and zoomed in on the northeastern North American continental shelf region. Then they separated the data into months, so they could quantify and map seasonal trends. Their results showed patterns in space and over the seasonal cycle that were not evident in earlier studies.

Evidence is mounting that pollinators, particularly honeybees, are declining nationwide and globally, having decreased by more than 40 percent since 1980.

MAPPING BUSY BEES

UNIVERSITY OF Maine researchers have developed a tool called "BeeMapper" that will allow blueberry growers to assess the predicted wild bee abundance in the landscape surrounding their crop fields.

"Having a better understanding of the predicted wild bee abundance in the landscape surrounding crop fields is important when making pollination management decisions," says UMaine doctoral candidate Brianne Du Clos, who led the development of BeeMapper with funding from the university's Senator George J. Mitchell Center for Sustainability Solutions.

For example, knowing the numbers and types of wild bees in the surrounding landscape will help growers budget how many honeybee hives to rent and help determine if they could take more action to enhance wild pollinator populations in their fields.

BeeMapper is part of a pollinator toolbox developed at UMaine that includes wild bee identification and monitoring tools, guidelines on installing pollinator plantings, and a budgetary tool to explore financial feasibility of pollination management decisions. Together, these tools will help growers attract more wild bees to their farms. BeeMapper is online: umaine.edu/beemapper.

"The tool will give growers better information on **what the wild bee habitat is and where the bees that are pollinating their crop come from.**"

Brianne Du Clos

Sturgeon sojourn

ATLANTIC STURGEON that summer in Maine's Penobscot River estuary can be found in the fall and winter in waters as far away as Nova Scotia and New York City, according to a seven-year study of the fish that is one of the planet's oldest living fossils. The study's findings are helping to identify the fish's critical habitats, and inform management decisions concerning the threatened and endangered species.

A University of Maine research team led by School of Marine Sciences associate professor Gayle Zydlewski is working to shed light on the elusive fish by tagging them in the Penobscot River and tracking their travels by using a network of acoustic receivers throughout the Gulf of Maine and beyond.

The scientists found that during the summer months, many of the tagged sturgeon return year after year to a narrow 3-mile stretch of the Penobscot estuary to feed. However, in the fall, they can stray quite far from their summer homes in Maine. Some Penobscot sturgeon were detected as far away as the Bay of Fundy and the Hudson River.

The discovery of extensive migration patterns emphasizes the need for future conservation and management strategies that can span regional subpopulations and international boundaries.

SAVING A SEMINAL SPECIES

A NATIVE fungal pathogen that has increasingly damaged eastern white pine throughout New England in the last three decades has been found to be most severe in stressed, weakened trees, such as those growing in poor soils or in extremely dense, overstocked stands.

Extremes in climate also are predisposing trees to more damage due to drought and record precipitation, according to University of Maine researchers.

The UMaine research team, led by William Livingston, associate director of the UMaine School of Forest Resources, and Kara Costanza, a Ph.D. candidate in forest resources, expects to issue a management plan for eastern white pine in the coming year. It will be based on the findings of their three-year project focused on the health concerns resulting from *Caliciopsis pinea* and its impact on the region's forest products industry. Recommendations will aim to reduce future infestations and limit the amount of damage caused by the pathogen.

Since the late 1990s, forest health specialists have found increasingly significant damage to white pine from the *Caliciopsis* canker — first in central New Hampshire and then elsewhere in New England. In their project, UMaine researchers are collaborating with the U.S. Forest Service, New Hampshire Division of Forests and Lands, Maine Forest Service, Northeastern Lumber Manufacturers Association, and regional foresters and loggers.

DETECTING SCALLOP SPAWNING

SKYLAR BAYER, who graduated last spring from the University of Maine with a Ph.D. in marine biology, has been studying scallops for six years in professor Richard Wahle's lab at the Darling Marine Center. Her research addresses questions about scallop reproduction. Scallops are broadcast spawners, releasing their eggs and sperm separately into the water. Fertilization happens by random encounters.

Bayer knows about scallop spawning events from both laboratory and field experiments. However, even under a microscope, it's difficult to distinguish the eggs, sperm, embryos and larvae of scallops from those of other bivalves.

In research funded by Maine Sea Grant, Bayer is collaborating with microbial ecologist Peter Countway, a senior research scientist at Bigelow Laboratory for Ocean Sciences in East Boothbay, Maine, to detect scallop spawning without having to collect, tag, track, tend, dissect or harvest.

They have developed a technique that uses three pieces of DNA that work together to locate and amplify scallop DNA against the backdrop of millions of other DNA types in the environment. The goal is to determine whether it can detect scallop DNA in a typical seawater sample.

Bayer and Countway successfully used the method to detect spawning scallops in the laboratory. Now they are extracting DNA from ocean water samples to determine if they have captured any spawning events.

There is growing interest in environmental DNA — e-DNA — techniques for assessing biodiversity, detecting the presence of invasive or toxic species, or studying migration patterns. The signatures of life are everywhere, revealing where animals have been and, in the case of spawning scallops, what they're doing.

"Trying to capture spawning events in the field in real-time is risky and requires a lot of time and effort, but the payoff is worth it," says Bayer. "If we can detect spawning events with this method, we could open a whole new door into understanding reproduction and population dynamics in marine animals."

Scallops are one of the most profitable fisheries in Maine, with **a statewide value of nearly $7 million in 2016.** The scallop fishery is also one of the most local, with small "day boats" staying close to shore.

Photo by C. Bartlett/Maine Sea Grant

Colorado potato beetle cannibals get an immediate benefit — **a meal without investing in a lot of search time.**

MANAGING CANNIBALS

COLORADO POTATO beetles can decimate spud crops by devouring the plants' foliage. That's a big problem for farmers in Maine, where the 2016 potato harvest was valued at more than $142 million.

There's more unsettling news: Each female Colorado potato beetle can lay about 600 eggs in a growing season. And the species — *Leptinotarsa decemlineata* — easily develops resistance to pesticides.

What might slow their devastation of potato crops? Perhaps cannibalism, say University of Maine researchers.

UMaine scientists Everett Booth, Andrei Alyokhin and Sarah Pinatti observed that in a laboratory, Colorado potato beetles faced with starvation, crowding and no opportunity to disperse ate beetle eggs, young beetles, injured beetles and other adults.

Even when Colorado potato beetles were given a choice between other adult beetles and mealworms, they ate their own species, says Alyokhin, an entomologist and director of the School of Biology and Ecology.

The UMaine scientists say farmers could try to protect their potato crop by utilizing agricultural practices — including crop rotations and push-pull strategies — to create field conditions that favor Colorado potato beetle cannibalism.

RISING TEMPS, RISING RISK OF MALARIA

INCREASING TEMPERATURES are fostering more favorable conditions for the transmission of malaria into the highlands of Ethiopia, according to a study led by University of Maine associate research professor Bradfield Lyon.

Traditionally, the cooler climate in the highlands has provided a natural buffer against malaria transmission.

But new data indicate rising temperatures over the past 35 years are eroding this natural buffer and allowing conditions more suitable for malaria to climb into highland areas, says Lyon, who is based at the Climate Change Institute, and in the School of Earth and Climate Sciences.

In 2015, the Centers for Disease Control and Prevention estimated 214 million cases of malaria occurred worldwide and 438,000 people died, mostly children in Africa.

The elevation at which the necessary temperature thresholds are met has risen by more than 100 meters since 1981.

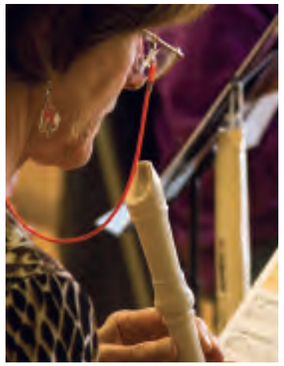
"While a 100-meter increase may appear modest, we estimate that more than 6 million people currently live in areas with statistically significant increases in threshold temperature," he says.

"The necessary temperature conditions for malaria transmission are now being met on an increasingly regular basis at higher elevations in the Ethiopian highlands, where a substantial population lives," says Lyon.

The study, published in the journal *Environmental Research Letters*, utilized a newly developed national temperature data set for Ethiopia, made possible by NOAA's Climate Program Office and Columbia University.

Wild, blue and virtual

TWENTY-THREE students in a digital narrative course led by new media professor Joline Blais are working on a prototype for a virtual wild blueberry museum. They are collaborating with Marie and Dell Emerson, who head Wild Blueberry Land in Columbia Falls, Maine, and are developing a Wild Blueberry Museum for Washington County. For the virtual museum, students interviewed wild blueberry farmers about their personal experiences and memories. The mission of the virtual museum, expected to debut in 2018, is to "tell the 'Great American Story' of the history of the origins and industry" through stories from the family farms, according to the Wild Blueberry Land website.



MINDS AND MUSIC

PSYCHOLOGY PROFESSOR Rebecca MacAulay and music education professor Philip Edelman have partnered on an innovative cognitive research project that teaches older adults to read and play music.

Earlier this year, the Maine Understanding Sensory Integration and Cognition (MUSIC) Project was piloted with two groups of older adults. The participants, many of whom had never had music lessons, spent 12 weeks learning to read and play music on the recorder.

MUSIC partnered with the Heritage and Somerset Place independent living facilities for low-income adults in Brewer, Maine, recruiting older adults who were interested in learning to play music in a social setting.

As part of the project, psychology and music education majors also worked with the elders.

The project stems from MacAulay's research into understanding and improving cognitive development in older adults, and Edelman's work and research with the New Horizons music programs for seniors. In her research, MacAulay has found that one of the greatest challenges in treating cognitive aging processes is to find activities that older adults enjoy doing. Edelman's work with the Roeland Park New Horizons Band showed that older adults seem to enjoy learning and making music together.

WABANAKI YOUTH IN SCIENCE

NATIVE AMERICAN ecological knowledge and western science will be integrated in some University of Maine science courses, with the goal of implementing the methods nationwide.

With a $300,000 National Science Foundation INCLUDES (Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science) grant, tribal and UMaine collaborators will develop science courses that utilize Traditional Ecological Knowledge and western science to increase Native American student participation in college and career STEM fields.

INCLUDES builds on research that suggests complex challenges are best addressed through networked communities focused on finding solutions through common goals and shared resources.

Incorporating culturally relevant educational methods results in Native American long-term participation in sciences, says project leader Darren Ranco, associate professor of anthropology, chair of Native American Programs at UMaine and faculty fellow at the Mitchell Center for Sustainability Solutions.

For the UMaine project, Native Cultural Knowledge Keepers and Elders will come together with university faculty members John Daigle, associate professor of forest recreation management; Mindy Crandall, assistant professor of forest landscape management and economics; and Shaleen Jain, associate professor of civil and environmental engineering.

The project, Wabanaki Youth in Science (WaYS) Program to Bridge Inclusion in Post-Secondary Education Through the Sciences, will develop STEM education methods and practices. It also is UMaine's second NSF INCLUDES grant. The first in 2016 focused on the project, Creating a Diverse STEM Pathway with Community Water Research, led by Mohamad Musavi in the College of Engineering.

Since WaYS began in 2013, **there has been a 15 percent increase** in the number of Native American students enrolled in STEM fields at UMaine.

Photo by Kyle Lolar

MARINE INVESTMENT

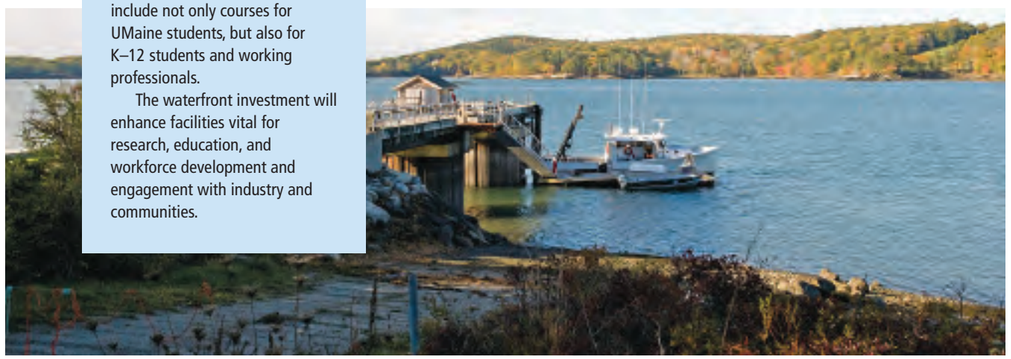
THE U.S. Economic Development Administration (EDA) has awarded $1.5 million to support a major waterfront infrastructure investment at Darling Marine Center (DMC), the University of Maine's marine laboratory in Walpole. The award will benefit marine companies and communities statewide and beyond.

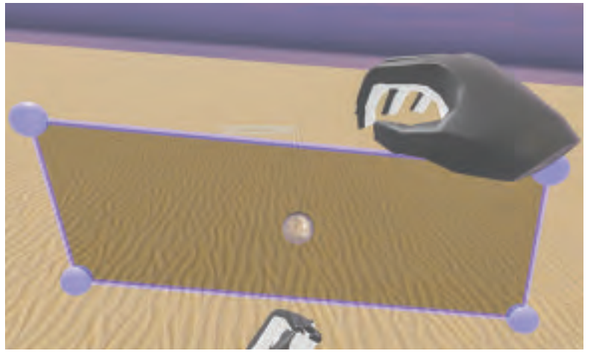
Together with matching funds from UMaine and state marine bond funds, the EDA award will enable DMC to upgrade its flowing seawater system, renovate its oldest seawater laboratory and replace the nearly 50-year-old main pier.

DMC researchers are helping the fisheries and aquaculture sectors adapt and grow in response to changing conditions. Current research includes studies of changing conditions on lobster and shellfish, as well as industry-led efforts with oysters, eels and kelp. DMC scientists also study fundamental ocean ecology, including microbial dynamics.

Students are integral partners in this research. Through Semester By the Sea, students are immersed in a residential marine science experience at DMC. Graduate students are in residence year-round. Education opportunities include not only courses for UMaine students, but also for K–12 students and working professionals.

The waterfront investment will enhance facilities vital for research, education, and workforce development and engagement with industry and communities.





3-D geometry

AS VIRTUAL reality programs grow in popularity, more and more educators are using them to teach students about a variety of subjects, from science to geography to math. A team from the University of Maine recently released a beta version of one such program that allows students to learn geometry in a virtual 3-D space.

The program, called HandWaver, was designed and developed at UMaine's Immersive Mathematics in Rendered Environments (IMRE) Laboratory and was supported in part by the UMaine Faculty Research Funds Program sponsored by the Office of the Vice President for Research.

Justin Dimmel, assistant professor of mathematics education and instructional technology in the College of Education and Human Development and IMRE's director, says the program is designed for users of all ages.

"We wanted to harness the potential of commercially available virtual reality and gesture-tracking technologies to create an environment where anyone would be able to quickly and intuitively build and explore a range of geometric figures," says Dimmel.

Dimmel says HandWaver was designed to be gesture-based to minimize the barriers between the intuitions people might have and the mathematical actions they might take to investigate those intuitions. It's intended as a prototype of the kinds of learning experiences that will be increasingly available to schools as virtual reality technologies become more commonplace.

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