

FALL 2014

UMaine Today

CREATIVITY AND ACHIEVEMENT AT THE UNIVERSITY OF MAINE

Maine migrants
Will they keep
coming?





Photo by William L. Duncan



IN 2015, the University of Maine will celebrate its 150th anniversary as the state's land grant university. We will spend the year reflecting on our past and understanding how that legacy will inform our future.

For 150 years, UMaine has had a leadership role. As Maine's land and sea grant institution, the university has, by definition, a statewide mission of teaching, research and public service. Because

Maine's potential is our purpose, we educate the leaders of tomorrow, help drive the state's economic development, conduct internationally recognized research, and provide outreach in every county in Maine.

Fulfillment of our mission is found at UMaine's Darling Marine Center in Walpole, which is preparing to celebrate 50 years of cutting-edge research in the Gulf of Maine and worldwide. Earlier this year at the other end of the state, UMaine's Aroostook Farm in Presque Isle observed its 100th anniversary as the research center for Maine's potato industry.

And this year, University of Maine Cooperative Extension observed a century of extending knowledge developed at UMaine out to Maine citizens.

In meeting our statewide mission, UMaine promotes teaching that utilizes current practice that is grounded in how people best learn — a process that results in growth in both the student and the teacher. We perform research and scholarship that is critically evaluated within the disciplines. In many fields, it also attracts significant external funding, and national and international recognition.

We also conduct outreach that is connected to and supportive of the people and enterprises of Maine. In doing all this, we insert students in real-world enterprises to inform their academic work and provide incredible growth opportunities. I believe in many cases, it is in these engagement opportunities that passion is discovered.

Just as it did at its founding 150 years ago and every year since, the university contributes to the future of the state. In this issue of *UMaine Today*, we share some of the many stories of the people and programs that fulfill that mission — and the difference it makes.

Susan J. Hunter
President

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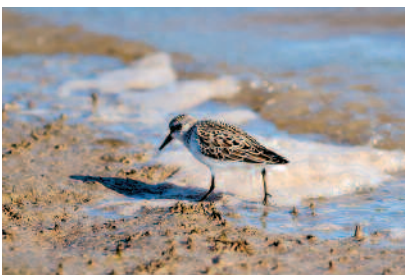
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ON THE COVER: On their migration route, semipalmated sandpipers arrive in Maine and stay for a couple weeks between July and September, resting on offshore islands and feeding in the intertidal zones. A two-year study led by biologists from UMaine and the Department of Inland Fisheries & Wildlife is exploring how the stopover in the state impacts the birds' migration. The data will inform conservation efforts.

Photo by Holland Haverkamp

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UMaine Today Magazine

Managing Editor

Margaret Nagle

Designers

Valerie Ireland
Michael Mardosa
Carol Nichols

Photographers

Holland Haverkamp
Adam Küykendall
Michael Mardosa

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The Center for Cooperative Aquaculture Research in Franklin, Maine conducts advanced research and development benefiting industry partners. The facility will have a key role in SEANET.

Future farming

EPSCoR IS a federal program directed at states that have historically received less federal research and development funding. The program provides states with financial support to develop partnerships between their higher education institutions, industry, government and others to affect lasting improvements in their research and development infrastructure, capacity and national academic competitiveness. Maine EPSCoR at the University of Maine is responsible for administering and implementing the NSF EPSCoR program for the state.

A SUSTAINABLE Ecological Aquaculture Network (SEANET) program will be established in Maine with the help of a \$20 million National Science Foundation EPSCoR (Experimental Program to Stimulate Competitive Research) grant. Maine EPSCoR at the University of Maine will use the grant to mobilize the collective capacity of Maine's coastal science resources to establish the research network focused on sustainable ecological aquaculture. SEANET will take a multi-institutional, transdisciplinary research approach to gain a comprehensive understanding of how sustainable ecological aquaculture can interact with coastal communities and ecosystems.

The public-private partnership led by UMaine, in collaboration with the University of New England and other institutions in Maine, will use the state's 3,500-mile coastline as a living laboratory to study physical oceanography, biophysical, biogeochemical, socioeconomic and policy interactions that have local, bioregional, national and global implications.

Ocean views

Phytoplankton largely drive the functioning of ocean ecosystems. Understanding phytoplankton **vertical distribution and productivity** will allow NASA to **improve satellite-based estimates** of atmospheric carbon dioxide absorbed by the ocean.

UNIVERSITY OF Maine oceanographer Ivona Cetinić is participating in a NASA project to advance space-based capabilities for monitoring microscopic plants that form the base of the marine food chain. Phytoplankton — tiny ocean plants that absorb carbon dioxide and deliver oxygen to Earth’s atmosphere — are key to the planet’s health. And NASA wants a clear, global view of them.

NASA’s Ship-Aircraft Bio-Optical Research (SABOR) mission brings together marine and atmospheric scientists to tackle optical issues associated with satellite observations of phytoplankton.

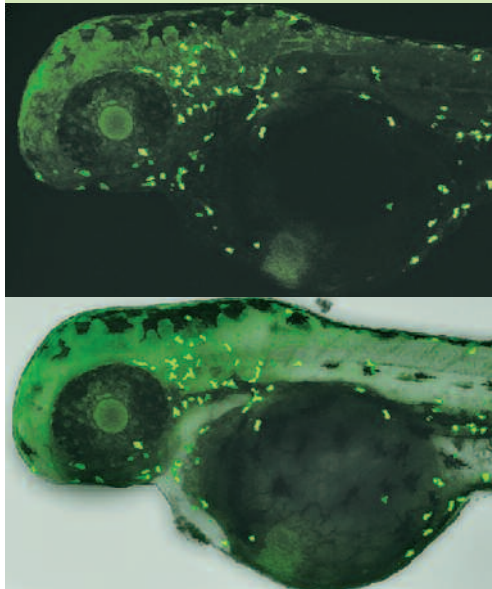
The goal is to better understand marine ecology and phytoplankton’s major role in the global cycling of atmospheric carbon between the ocean and the atmosphere.

“Teams involved in this project are working together to develop next-generation tools that will change forever how we study oceans,” says Cetinić, a research associate at UMaine’s Darling Marine Center in Walpole, Maine. “Methods that will be developed during this experiment are something like 3-D glasses. They will allow us to see more details on the surface of the ocean and to see deeper into the ocean, helping us learn more about carbon in the ocean — carbon that is fueling oceanic ecosystems, as well as the fisheries and aquaculture.”

Cetinić received more than \$1 million from NASA’s Ocean Biology and Biogeochemistry program for her part in the three-year project.

This summer, Cetinić was the chief scientist aboard the *RV Endeavor*. She and her crew — including Wayne Slade of Sequoia Scientific Inc., Nicole Poulton of Bigelow Laboratory for Ocean Sciences and UMaine Ph.D. student Alison Chase — analyzed water samples for carbon and measured how ocean particles, including phytoplankton, interact with light.





The transparent zebrafish embryo allows tracking and imaging of the immune response system in vivo.

IN THE ongoing struggle to prevent and manage seasonal flu outbreaks, animal models of influenza infection are essential to gaining better understanding of innate immune response and screening for new drugs. A research team led by University of Maine scientists has shown that two strains of human influenza A virus (IAV) can infect live zebrafish embryos, and that treatment with an anti-influenza compound reduces mortality.

It is the first study establishing the zebrafish as a model for investigating IAV infection.

“A zebrafish model of IAV infection will provide a powerful new tool in the search for new ways to prevent and treat influenza,” according to the researchers, who published their findings in the journal *Disease Models & Mechanisms*.

The research team is led by professor Carol Kim and graduate student Kristin Gabor of UMaine’s Graduate School of Biomedical Science and Engineering, and includes four other UMaine researchers and one from Ghent University.

Most studies of viral pathogens that can infect zebrafish have been limited to fish-specific viruses. However, in recent years, four human viral illnesses have been reported to be modeled in zebrafish — herpes simplex, hepatitis C, chikungunya and now influenza A.

For studies of flu virus infection, the researchers focused on specific sialic acids and cytokines comparable in zebrafish embryos and humans. For these studies the zebrafish embryos also were kept in a temperature range comparable to the human respiratory tract (77 to 91.4 degrees F).

“The transparent zebrafish embryo allows researchers to visualize, track and image fluorescently labeled components of the immune response system in vivo, making it ideal for immunological research,” wrote Kim, a UMaine microbiologist and vice president for research and graduate school dean, earlier this year in the journal *Developmental and Comparative Immunology*.

In this study, visualization of a fluorescent reporter strain of IAV in vivo demonstrated that IAV infects cell lining surfaces of the zebrafish swimbladder, as it does in the human lungs.

In addition, the antiviral drug Zanamivir, known for being effective in treating influenza A and B in humans, was tested in vivo and was found to reduce IAV infection.

Flu-fighting tool

A **zebrafish** model of IAV infection will aid the search for new ways **to prevent and treat influenza.**

Sea trials

VolturnUS PAVES the way for a larger 6 MW floating turbine. The project brought together more than 30 organizations as part of the DeepCwind Consortium, led by UMaine and funded through a competitive DOE grant and industry contributions.

THE UNIVERSITY of Maine’s one-eighth scale floating wind turbine has been successfully operating and collecting data related to design capabilities for more than a year, including throughout a Maine winter. VolturnUS, the 6 MW wind turbine featuring floating concrete hull technology, is equipped with more than 50 sensors. Among the year-long data highlights: VolturnUS successfully withstood 18 severe storms equivalent to 50-year storms, and one 500-year storm, and the maximum tower inclination angle measured was less than 7 degrees.

Earlier this year, UMaine signed a \$3.97 million cooperative research agreement with the U.S. Department of Energy (DOE), of which \$3 million is DOE funding and \$970,000 is cost share, to continue the design and engineering work of the full-scale VolturnUS floating hull.

The full-scale version of the VolturnUS floating hull is a patent-pending technology developed by the University of Maine Advanced Structures and Composites Center. In June 2013, it became the first grid-connected offshore wind turbine deployed in the Americas, and the first floating turbine in the world to be designed using a concrete hull and a composites material tower.

VolturnUS deployed off the coast near Castine. Photo courtesy of Dave Cleaveland

\$3.97M

cooperative research agreement with the DOE to **continue the design of the full-scale floating hull.**





The Pucuncho Basin sites in the southern Andes of Peru suggest that Pleistocene humans lived successfully at extreme altitudes.

Photo courtesy of Kurt Rademaker

Extreme living

THE PUCUNCHO archaeological site included 260 formal tools, such as projectile points, bifaces and unifacial scrapers up to 12,800 years old.

Cuncaicha rockshelter, featuring two alcoves at 4,480 meters above sea level, contains a “robust, well-preserved and well-dated occupation sequence” up to 12,400 years old. The rockshelter, with views of wetlands and grasslands, features sooted ceilings and rock art, and was likely a base camp. Pucuncho Basin was a high-altitude oasis for specialized hunting, particularly of vicuña, and later, the herding of alpacas and llamas.

IN THE Southern Peruvian Andes, an archaeological team led by researchers at the University of Maine has documented the highest altitude ice age human occupation anywhere in the world — nearly 4,500 meters above sea level. The discoveries date high-altitude human habitation nearly a millennium earlier than previously documented.

Despite cold temperatures, high solar radiation and low oxygen conditions at that altitude, hunter-gatherers colonized the remote, treeless landscapes about 12,000 years ago during the terminal Pleistocene — within 2,000 years after humans arrived in South America.

“Study of human adaptation to extreme environments is important in understanding our cultural and genetic capacity for survival,” according to the research team, led by Kurt Rademaker, a UMaine visiting assistant professor in anthropology, writing in the journal *Science*. Rademaker, who received his Ph.D. from UMaine in 2012, is now a postdoctoral researcher at the University of Tübingen.

It is unclear whether the high-altitude human settlement required genetic or environmental adaptations, but the implication is that there may have been more moderate late-glacial Andean environments and greater physiological capabilities for Pleistocene humans.

Lifesaving

THE CDC views violent death as a public health problem, says Marcella Sorg. This project at the interface of public health and safety provides a promising opportunity for intervention and prevention. In Maine, 12 of the 25 homicides in 2013 were categorized as domestic homicides and 11 of the 25 homicides in 2012 were characterized as such. Of 21 reviewed cases of homicides that occurred between 2009 and 2013, 17 of the 27 victims were female and 20 of the 21 perpetrators were male, according to *The 10th Report of the Maine Domestic Abuse Homicide Review Panel — Building Bridges Towards Safety and Accountability*, released in April 2014. Victims ranged in age from 6 weeks to 76 years old; perpetrators ranged from ages 17 to 85. Of the 21 perpetrators, 14 exhibited suicidal behavior prior to committing or attempting to commit homicide. Of the 14 who had exhibited suicidal behavior before the crime, seven did kill themselves after attempting to commit or committing the homicide, according to the report.

MAJOR FUNDING from the Centers for Disease Control and Prevention (CDC) will enable Maine and Vermont to participate in the National Violent Death Reporting System. Detailed information about homicides and suicides will be provided to the federal database, and also will be made available to state and local agencies that can tailor intervention efforts to save lives.

Marcella Sorg, a University of Maine research associate professor, and recently retired state of Maine chief medical examiner Margaret Greenwald will spearhead the project, funded by a nearly \$1 million five-year grant from the CDC. They will lead Maine and Vermont's participation in the CDC surveillance system studying circumstances associated with violent deaths. Twenty-nine other states also are participating.

Greenwald and Sorg are particularly interested in looking at domestic violence and its effect on suicides that are not part of a murder/suicide incident.

Maine and Vermont have higher-than-average rates of violent deaths, specifically firearm and poisoning suicides, Sorg says. Although Maine and Vermont officials have goals to reduce violence and injury, they lack surveillance systems that gather and aggregate high-quality circumstantial and incident-based information, and disseminate it to agencies and organizations that might implement appropriate prevention strategies to reduce the rate of death and injury, she says.

An additional technical problem, says Sorg, is rooted in Maine and Vermont's low-density, rural population distribution and the resulting suppression of some vital records statistics, even at the state level, due to small numbers. Combining the two states will boost the totals.

\$1M

five-year grant to study **circumstances leading to violent deaths.**





The come

A close-up photograph of a tree trunk, likely a chestnut, showing a prominent knot hole and the rough, textured bark. The background is a soft, out-of-focus green, suggesting a forest setting.

back

**The American Chestnut Foundation and UMaine
join forces to help the 'redwood of the East'
battle back from the brink**

By Elyse Kahl
Photographs by Adam Küykendall

The comeback





DALTON HERRICK-WAGMAN was a man on a mission. On a sunny June afternoon, the second-year forestry major at the University of Maine rode his bike through Orono to the location of one of the largest American chestnut trees in the state. The sight of the majestic rare hardwood got him wondering whether there might be others in the neighborhood.

He biked along the Stillwater River, searching for glimpses of the tree's canoe-shaped leaves with small hooks along the scalloped edges. He headed toward a recently developed area and walked into the adjacent woods, looking for the tree that was a mainstay in the Appalachian states before a deadly fungus began wiping out the species nationwide in the early 1900s.

No luck. He started to pedal away when something caught his eye. On the ground was a brown, prickly husk a little larger than a golf ball. He recognized it instantly — the remains of last year's green American chestnut bur that protected three edible seeds.

That's when he took another look. He walked the property line of the new housing development and found what he hoped for — a previously undocumented native American chestnut tree. He ventured deeper into the woods and found another, then another, ultimately discovering eight trees of various sizes, the tallest standing more than 40 feet high.

"I believe I was meant to discover those trees," says Herrick-Wagman, of Torrington, Connecticut. "Finding surviving, pure American chestnut trees that still produce chestnuts is incredibly rare. I didn't think I'd ever find one."

That's because locating an American chestnut — the "redwood of the East" — is akin to finding a needle in a haystack. In Maine, there are about 200 documented, large native trees in 136 municipalities, says the Maine chapter of The American Chestnut Foundation (TACF).

It was much easier in 1900, when there were more than 4 billion American chestnut trees from Maine to Florida, and west to Ohio, accounting for a quarter of the hardwood trees in the region. In 1904, *Cryphonectria parasitica* arrived in North America, most likely on blight-resistant Asian nursery stock. It proceeded to decimate the U.S. population of American chestnuts.

At the turn of the century, American chestnut trees accounted for a quarter of the hardwoods from Maine to Florida, and west to Ohio. Then the chestnut blight decimated the population. UMaine forestry major Dalton Herrick-Wagman is involved with the Maine Chapter of The American Chestnut Foundation's effort to restore the tree to its native range. He manages the foundation's breeding orchard in Bradley, Maine.



The comeback



In July 2014, David Sandilands, a forestry graduate student and commercial pilot, and Louis Morin, a forest resources instructor and pilot, completed a flyover. They used information from TACF and maps created by the UMaine Mapping and GIS Student Club that were made in the Barbara Wheatland Geospatial and Remote Sensing Analysis Laboratory. Sandilands and Morin rented the university's Cessna 172S Skyhawk. Along with William "Carter" Stone, Barbara Wheatland Geospatial and Remote Sensing manager, they captured images of documented chestnut trees around the state to serve as a reference for the discovery of unknown native American chestnut trees. The mapping club also plotted the trees discovered by member Dalton Herrick-Wagman in Orono during the summer.

The blight is a fungus that kills the aboveground portion of chestnut trees, according to Brian Roth, associate director of UMaine's Cooperative Forestry Research Unit. The roots remain viable, and while the tree often sprouts new shoots from the stump, it rarely gets big enough to reproduce — making the species functionally extinct.

In 1983, a group of plant scientists founded the nonprofit TACF with the goal of breeding a blight-resistant American chestnut tree and restoring the species to its native forests to benefit the environment, wildlife and society. The group also aims to create a template for restoration of other species.

"It is about restoring an element of our cultural heritage as Americans. It is about restoring balance to nature," says Herrick-Wagman, one of a dozen dedicated undergraduate forestry students who have volunteered for the restoration effort through planting, plotting, mapping and research.

Stephen Shaler, director of the UMaine School of Forest Resources, says undergraduates get the chance every semester to take outdoors what they learn in the classroom.

"The opportunity for students to take the skills they have learned in class in different contexts, such as the reintroduction of chestnut trees, really helps to cement the information in the students' brains," Shaler says.

THE AMERICAN chestnut, which can grow up to 100 feet tall, has been characterized as "the perfect tree," according to Glen Rea, emeritus chair of TACF and board member of the national organization, as well as the Maine chapter of TACF.

Chestnut wood has straight grain and is highly rot-resistant, making it ideal for barns, flooring, utility poles, railroad ties and furniture, Rea says. Chestnuts are sweet and nutritious, a source of food for deer, bears, birds and squirrels. Unlike other nuts, such as acorns, chestnuts are produced abundantly every year, he says.

"It's everything you want in a tree," says Rea, who earned a forest management degree from UMaine in 1981. He said early settlers depended on the trees — using the seeds to feed livestock and make flour, and the wood to build homes, furniture and caskets.

Of the 200 mature trees in Maine, Rea says around 50

are part of the foundation's breeding program, which includes hand pollination with pollen from the foundation's research farm in Virginia, as well as seed collecting.

In the 1980s, TACF began a breeding program to cross Chinese chestnut trees with American chestnut trees to introduce genes resistant to the blight. To end up with a tree with American characteristics — straighter, stronger and taller than Chinese trees — the new trees are then backcrossed to pure American trees for two more generations.

At each stage, young trees are tested for resistance, as well as similarity to American trees, with only the best trees retained for the next generation of breeding. Two more generations of interbreeding produces trees that are fifteen-sixteenths American. Each generation of breeding takes as long as a decade to complete, according to Roth.

Rea approached UMaine in 2005, asking for land to plant, grow and pollinate the hybrids in a breeding orchard to introduce genes from the state population of native trees. The Maine chapter of TACF doesn't own any land, and with all of its money going to the breeding effort, these types of partnerships are critical to the restoration effort's success, Rea says.

TACF manages breeding orchards, where volunteers, including UMaine students, inject the trees with blight to determine which are most resistant. TACF also has seed orchards, where the group will produce seeds with the desired genes to be reintroduced into Maine's forests.

The Maine chapter of TACF maintains breeding and seed orchards at UMaine's Highmoor Farm in Monmouth and on university property in Hartland. UMaine students and other TACF volunteers also helped establish a seed orchard in Stetson on land donated by the Penobscot County Conservation Association, and manage a breeding orchard in the Penobscot Experimental Forest in Bradley.

"The University of Maine has been so good to us. They have gone out of their way to help us out," says Rea, noting that UMaine is the only university in the state working with the foundation.

The blight, which is dispersed by animals or spores in the air or on raindrops, enters a tree through a bark wound. The pathogen spreads through the tree, killing tissues until the flow of nutrients closes and the tree dies, according to TACF. Trees with aggressive strains can die within a year, Rea says, while those with mild forms can fight for years — surviving but not producing viable chestnuts.

Producing seeds and testing them for blight resistance requires about six years for each backcross generation and five years for intercross generations, according to TACF. The Maine chapter is growing fifth-generation hybrids that will produce sixth-generation seeds to be strategically planted in the wild by TACF volunteers starting in 2020.

ROTH, A board member of the Maine chapter of TACF, introduced forestry students — particularly members of the UMaine Mapping and GIS Student Club — to the restoration effort. The club, which began in 2013, was formed to familiarize students with geographic information systems (GIS), according to member Danae Shurn, a second-year forestry major from Machias, Maine. Another focus, she says, is reaching out to organizations and connecting students with volunteer opportunities, as well as others in the industry.

The TACF project was the club's first and continues to be a major effort. In fall 2013, club members, including Shurn and Herrick-Wagman, visited TACF orchards to create maps, returning in the spring to plant seedlings.

"When you map the orchard it helps predict how many more plots of trees you can put in the area. If you did that all with footwork, it's a lot more expensive and time-consuming, versus, if you use ground-plotted GPS markings and satellite imagery, you do it a lot more efficiently and accurately," says Dimitrije Howe-Poteet of Glenburn, Maine, one of 22 active club members.

Using technology available in the School of Forest Resources' Barbara Wheatland Geospatial and Remote



It's about **restoring an element of our cultural heritage as Americans.**"

Dalton Herrick-Wagman

The comeback

Sensing Analysis Laboratory, students show TACF members how to use global positioning systems (GPS) and Google Earth to monitor trees and map plots, says William “Carter” Stone, Barbara Wheatland Geospatial and Remote Sensing manager.

In July, Stone; Louis Morin, a forest resources instructor and pilot; and David Sandilands, a forestry graduate student and commercial pilot, completed a flyover using information from the mapping club and TACF. They rented the university’s donated Cessna 172S Skyhawk to capture images of documented chestnut trees in Maine to serve as a reference for the discovery of undocumented native American chestnut trees.

The aircraft had a camera pod — a box with a window — strapped underneath that held a digital camera that was automatically triggered by Garmin GPS.

“We program where we want photos to be taken, and once we fly over that point, it triggers the camera and everything is sent right to our tablet so we can view it in real time,” Sandilands says.

A modified infrared camera differentiates between hardwoods and softwoods, which isn’t easily done with the naked eye, Sandilands says. A digital aerial camera takes photos that may be processed in stereo using software to create 3-D images, allowing researchers to measure the dimensions of trees and other objects.

THE AMERICAN chestnut is one of a few trees in Maine to bloom in July, producing a canopy of white catkins that make the tree easy to spot from the air. By capturing images when the trees are flowering, the researchers can compare the photos to Google Earth images taken at another time of year to help determine if a tree is a chestnut and document its precise location, Sandilands says.

The team plans to conduct annual flyovers to monitor the health of trees, as well as find new trees. If the researchers think they have discovered a tree, software in the lab can determine latitude and longitude based on the photo, making it easier to find and verify the trees on the ground, Roth says.

Stone says the mapping club and aerial team aim to create a Maine database for TACF, and update it through monitoring efforts on the ground and in the air.

“The interaction forestry students have with The American Chestnut Foundation is a great example of the learning continuum that exists from the classroom, to the laboratory, and finally on the ground — or in the air,” Shaler says.

“Activities such as this also benefit the educational experience by bringing those ‘real world’ experiences back to the classroom in the form of questions and a bigger context,” he says.

Rea says he’s impressed by the enthusiasm and energy of the first- and second-year students doing the fieldwork.



© Great Smoky Mountains National Park

Early settlers depended on the trees, using seeds to feed livestock and make flour, and wood to build everything from homes to caskets.



Chestnut blight was first discovered in America in 1904 at the Bronx Zoo. The fungus (*Cryphonectria parasitica*) most likely arrived on blight-resistant Japanese or Chinese chestnut trees.



Chestnut wood has straight grain and is highly rot-resistant, making it ideal for barns, flooring, utility poles, railroad ties and furniture.



Chestnuts are sweet and nutritious, and a source of food for deer, bears, turkeys, blue jays and squirrels.

“They’re learning a lot and it’s going to be good for them, but it’s especially going to be good for us. We’re going to find more large native trees that are hidden away and no one knows about,” he says.

Knowing where these trees are will provide information about conditions, such as soil and climate, in which the species grows best — valuable information for the upcoming restoration plantings, Roth says.

“We all stopped and agreed we were going to put some energy into this project,” Stone says. “It’s good for the university, it’s good for TACF. We’re showcasing our new technology, we’re using a new mapping club. Everything came together at the right time.”

The Maine chapter of TACF formed after the 1998 ice storm when trees were wounded and susceptible to blight, Rea says.

“We started with people with pieces of paper writing stuff down. Now we have planes flying over — just tremendous technology. For us, this is just fascinating,” Rea says of the resources available through UMaine. “They didn’t have this technology when I was in college, I’m learning this from the students and professors now.”

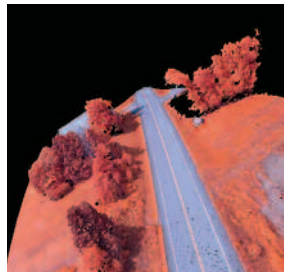
He says the work being done at UMaine is unique.

“Various chapters have tried this technology of using an airplane and camera, and have not been successful. They try and then just sort of back away from it. The University of



Photo courtesy Maine chapter of TACF

The tallest American chestnut tree in its native range is believed to be in Hebron, Maine. It is 95 feet tall and was discovered in 2012. The current state champion for largest chestnut is a tree in Atkinson with a trunk circumference of 111 inches, height of 74 feet and crown of 47 feet.



UMaine researchers use two cameras — a true color and a modified infrared — when taking aerial photos of American chestnut trees. The infrared camera is used to differentiate hardwoods and softwoods; the true color camera takes photos that may be viewed in stereo using software to create 3-D images, allowing researchers to measure tree height.



Forest management in 3-D

THE BARBARA Wheatland Geospatial and Remote Sensing Analysis Laboratory in the University of Maine’s School of Forest Resources opened in January 2013 with a goal of integrating research and teaching to enhance sustainable working forests that contribute to the economic, social and cultural well-being of Maine residents.

The laboratory was made possible by a \$200,000 grant from the Maine Timberlands Charitable Trust in honor of Barbara “Bee” Wheatland, a Massachusetts native who had a passion for the Maine woods and was committed to forestry research that can promote environmental quality and economic development.

The Nutting Hall lab focuses on global positioning systems (GPS), geographic information systems (GIS) and geospatial analysis methods that have revolutionized forest management. It allows UMaine students, local nonprofit organizations and industry professionals to have access to state-of-the-art geospatial technology, according to William “Carter” Stone, Barbara Wheatland Geospatial and Remote Sensing manager.

Geospatial and remote sensing training in the lab has been offered to more than 250 students and 148 others through professional development opportunities. The lab includes 41 computer workstations with the latest hardware and software, including tablets, GPS devices, aerial survey cameras (modified infrared and true color) and aerial remote sensing calibration software.

In an effort to reach out to the community, the lab has become the hub of the UMaine Mapping and GIS Student Club, has provided trail maps for the Orono Land Trust and Bangor Land Trust, and is involved with the Maine chapter of The American Chestnut Foundation (TACF) and its effort to restore the tree to its native range. In working with TACF, the lab is helping build a chestnut tree database for the foundation that will be updated using innovative geospatial applications to detect trees and real-time aerial survey methods for monitoring.

The Barbara Wheatland Geospatial and Remote Sensing Analysis Laboratory is planning for statewide training of basic GIS to forestry professionals working with the Maine Bureau of Parks and Lands, Maine Warden Service, USGS and several private industry entities.



Chestnut fever

Now retired, Glen Rea can devote even more time to restoring the American chestnut tree to its native range. “They’re like my kids,” Rea says of the trees he tends to in orchards around the state. Rea also works with UMaine researchers and students, including Danae Shurn, a second-year forestry major and member of the UMaine Mapping and GIS Student Club.

AT AGE 37, Glen Rea was married with two young children and had been transferred to cities across the country while working as a financial manager for big corporations.

“You’re not happy,” his wife Ann Rea said one day. “What would you really like to do the rest of your life and where would you really like to live?”

“I want to be a Maine forester,” replied Rea, who had vacationed to Maine every summer while working in New York City and had a fascination with trees since childhood.

The family moved to Maine in 1979 and Rea enrolled at the University of Maine. Rea, who already had a bachelor’s degree in economics and an MBA, earned his forest management degree from UMaine in 1981.

After working with Great Northern Paper in Millinocket, Maine, for two years, Rea had difficulties finding a permanent forestry job, so he fell back on his other career of financial management and worked 26 years as a stockbroker in Bangor, Maine, while practicing forestry on weekends.

“You have to follow your passion,” Rea says.

As a birthday present in 2000, Rea’s wife got him a membership to The American Chestnut Foundation (TACF).

“I became hooked. I got chestnut fever real bad,” Rea says. He became active in the Maine Chapter of TACF and was the chapter’s president for eight years starting in 2005. He also was chair of the board of the national organization from 2009–12.



Various chapters have tried this technology of using an airplane and camera, and have not been successful. **Maine is putting it together first and the best.** Glen Rea

Maine is the first one to put it all together,” he says. “Maine is putting it together first and the best.”

During the summer, Herrick-Wagman became the manager of the foundation’s Bradley orchard, where he maintains the property and tends to the trees. This fall he is completing an orchard inventory.

He also is working on an independent study with his adviser Michael Day, an associate research professor of tree physiology and physiological ecology, to document variation in the time of leaf flushing among lines of American chestnut tree hybrids in the Hartland orchard.

“The ideal chestnut tree will break bud after the frost, and then proceed to develop all of its leaves quickly so it can compete with surrounding vegetative species,” he says, adding his study could be vital to successfully reintroducing the tree to its native range.

Other students have participated in a stock comparison field trial, planting trees of different sizes — seeds, potted seedlings and bare-root whips — to determine how best to deploy the soon-to-be available sixth-generation restoration trees in the wild, where they will face competing vegetation and browsing deer.

“There are still many mysteries about the trees. We are learning more every year,” says Herrick-Wagman, who plans to continue restoration efforts after he graduates. He says it’s important to share the often forgotten story of the American chestnut tree with the next generation.

“They call it chestnut fever,” he says. “Once you get involved, you have to continue.

“It is my dream to one day go out into the forest with my children in autumn, and harvest chestnuts together as our great-grandparents once did,” says Herrick-Wagman. “It is also my dream to reinvigorate an economy which once thrived off of the renewable resources that came from the mighty chestnut trees.” ■



A Map of Portland Maine and Some Places Thereabout, 1928. Courtesy of the Osher Map Library, University of Southern Maine

Discovering Maine

New atlas offers a unique perspective on the state's history

By Margaret Nagle

MAINE'S NORTH Woods first called Henry David Thoreau in 1846, when he traveled the West Branch of the Penobscot in a bateau and scaled Mount Katahdin. Over the next 11 years, the philosopher-naturalist made two more expeditions into the Maine woods, both times with Penobscot Native guides. On those journeys, Thoreau discovered the natural wonder of Maine's

wilderness and came to a better understanding of Penobscot culture.

Thoreau died in 1862, five years after his last Maine expedition. His three travel essays, collected posthumously in *The Maine Woods*, put the state on the map, so to speak, and brought the wilderness movement into focus.

In the century and a half that followed, adventure seekers, travel writers, nature enthusiasts, artists and many others have retraced Thoreau's steps. Now an accurate

Discovering Maine

account of those three legendary treks is readily available for those who wish to know and appreciate the Maine woods.

The route of Thoreau's travels in Maine, 1846–57, is handsomely presented on one of 76 two-page plates that comprise the *Historical Atlas of Maine*, a newly completed volume culminating a 15-year scholarly project led by University of Maine researchers and other scholars, published by the University of Maine Press in Orono, a division of UMaine's Raymond H. Fogler Library.

Edited by UMaine geographer Stephen Hornsby and historian Richard Judd, with cartography by Michael Hermann, the folio-size book presents a geographical and historical interpretation of Maine, from the end of the last ice age to the year 2000.

The atlas tells the principal stories of the many people who have lived in Maine over the past 13,000 years — the history of Native peoples, European exploration and settlement, the American Revolution, Maine statehood, agricultural and industrial development, and the rise of tourism and environmental awareness.

To tell these stories, the 208-page atlas presents a rich array of 367 original maps, 112 original charts and 248 other images — historical maps, paintings and photos — in addition to its text. The result is a unique interpretation of Maine, a rich visual record of the state's history, and a major achievement in humanities research.

For Maine, the book is a journey of self-discovery.

"The atlas is beautiful and that's important," says Hermann, founder and lead cartographer of Purple Lizard Maps, who worked on the project for 14 years. "We paid attention to the aesthetic design in a way some other atlases don't, letting the data rise to the surface. A lot of atlases are dry and use a cookie cutter shape of a state throughout. We wanted to get away from that format. People are going to be impressed by the atlas' accessibility. It is scholarly research presented in a beautiful, interesting, readable way that calls you to turn to the next page — and the next."

IN 1997, UMaine Professor of English Burton Hatlen had the idea to compile an historical atlas of Maine that would showcase the mission of a land grant institution and the strength of humanities scholarship. But while Hatlen loved historical atlases and maps, his primary scholarship focused on the poet John Milton and on modernist poetry.

That's when he introduced the idea to Stephen Hornsby.

"I agreed with him that this could be a contribution to Maine and that we could set the bar for other state historical atlases," says Hornsby, director of UMaine's Canadian-American Center. "Maine could set the standard."

Primary funding for the atlas project included \$160,000 in seed money from the Maine Legislature in 1999 and a \$293,500 National Endowment for the Humanities grant in 2003.

Planning for the atlas began with multiple meetings and contacts with scholars — most from UMaine, with others from universities and colleges across the United States and Canada — who focused on those subject areas

important to understanding Maine history. With many of the broad areas identified, preliminary research and compilation of historical information, including archival images, were methodically organized.

With Hatlen's death in 2008, Hornsby and Judd led the final years of the scholarship, largely focused on historical geography, with significant assistance from UMaine graduate students.

Digital files of archival maps of Maine were gathered from archives from Ottawa, Canada, and Washington, D.C., to London, England, and Paris, France. Many important historical maps were made available by the Osher Map Library at the University of Southern Maine.

The two-page, full-color illustrated plates detailing the environmental, economic, social and cultural interactions



The Historical Atlas of Maine is **an articulation of Maine. The book comes from Maine's land grant university and is meant to be a gift returned. It celebrates Maine.** Michael Alpert

that shaped the state and the region represent the extensive scholarship of 33 contributors. The atlas is arranged in four chronological sections, starting with the arrival of hunter-gatherers as the ice sheets retreated more than 10,000 years ago and continuing into European contact in the early 16th century and the colonial period. Part II includes Maine's statehood in 1820, agricultural settlement and the rise of its natural resource-based industries.

With the emergence of industry came urbanization. Part III explores this period of Maine history, including the 1910 federal census that first recorded that a majority of Maine people were living in urban areas. Part IV covers much of the 20th century, with declines in traditional resource-based and manufacturing industries in the state, and the growth of the service economy.

"The *Historical Atlas of Maine* is an articulation of Maine. The book comes from Maine's land grant university and is meant to be a gift returned," says Michael Alpert, director of the University of Maine Press. "It celebrates Maine."

EARLY ON, Hatlen predicted that the *Historical Atlas of Maine* would become "a way of defining the culture and history of the region."

"In school and through the media, we learn to think of Maine as the northeastern-most appendage of the U.S. However, the cultural, ethnographic, economic, and religious links to Canada, particularly Quebec and New Brunswick, are strong. Even the landscapes are similar. Maine is not at the end of the U.S., but rather in the middle of a region. The future of Maine depends on such regional thinking," Hatlen said in a 2003 *UMaine Today* magazine story about the atlas.

Three themes run through the atlas: the importance of Native peoples, Euro-American exploration of Maine, and exploitation of its natural resources and rise of environmen-

tal awareness in the state — including the shift from being a utilitarian, resource-based economy and society to today's paired focus on tourism and environmental protection. While those threads also are found elsewhere in the history of the United States, in Maine these three themes "developed their own unique pattern in the particular geographical context of Maine and continue to shape the state," according to Hornsby and Judd.

The *Historical Atlas of Maine* will change the way people look at Maine history, says Judd, UMaine's Colonel James C. McBride Professor of History, and a nationally recognized scholar and author on environmental history. It reflects international scholarship detailing the influence of French-American culture, starting with settlement of the upper Saint John River, and little-known segments of Maine history, including 19th-century Wabanaki petitions and land treaties.

Even on subjects considered well known, the atlas provides intriguing perspectives.

Take Thoreau's Maine, which Judd says is sure to interest many. Thoreau's three well-known forays into the North Woods are meticulously mapped, complete with the

philosopher's written reflections at points along the way, and the 19th-century images of wilderness promoters and artists who came after him, inspired and intrigued by his views.

The combination gives atlas readers "a good sense of what Thoreau was thinking," Judd says.

"The atlas brings history to life in a truly multidimensional way and will put Maine on the map in more ways than one," Judd says. "This is a pioneering effort in terms of scholarship — a new form of presenting materials, and it will have an impact nationwide." ■



The atlas **brings history to life** in a truly multidimensional way and will **put Maine on the map** in more ways than one. This is a **pioneering effort** in terms of scholarship — a new form of presenting materials." Richard Judd

Early and Middle Archaic Period, 9,500–6,000 BP

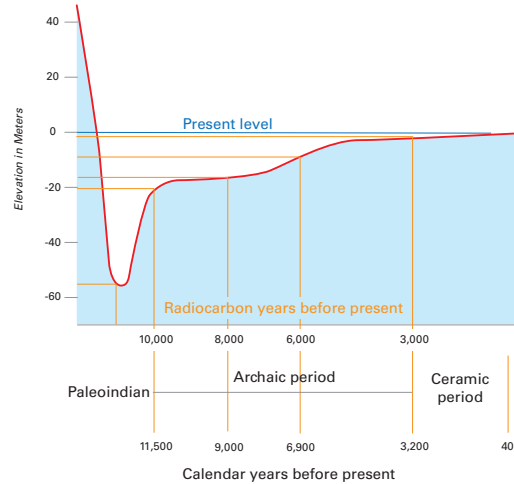
David Sanger, Brian S. Robinson

With the end of glacial times and the beginning of the Holocene epoch, new artifact forms and different lifestyles came to characterize the long-lived Archaic (or pre-Ceramic) period, spanning nearly 7,000 years. During the Early Archaic period (9,500–8,000 radiocarbon years before present) tool kits were dominated by local stones such as quartz, felsite, and slate instead of the more exotic stones that were carried long distances by earlier ice-age people. Spear points made of flaked stone occurred only rarely in the Early Archaic period of Maine. However, finely made ground and polished stone tools of the Gulf of Maine Archaic tradition became common during the latter half of this period, including full-grooved gouges (for woodworking), celts (axes), and slender stone rods (whetstones). Elaborate burial ceremonialism also appeared at this time, with some of the earliest formal cemeteries in North America established in what became New England, creating ritual patterns that expanded greatly in Maine in the Middle and Late Archaic periods.

The end of the ice age marked major changes in both terrestrial and marine habitats. River drainages assumed their modern configurations, but water levels were subject to dramatic change, influencing fish and mammal habitats as well as travel routes. From initial wetter times there was a period of low water in many lakes and ponds between 8,000 to 6,000 BP. The development of marshes and bog lands in eastern Maine provided new resource habitats. Vegetation patterns changed through time, but generally with contrasts in species between western and eastern Maine. These patterns influenced the distribution of large mammals such as deer, moose, and caribou. With the rise in sea level, the coastline assumed its present form, marked by long sandy beaches in western Maine, and rocky shorelines in eastern Maine. The strongly dissected coast of eastern Maine, with its numerous promontories and islands, provided more places for people to settle and collect coastal foods.

The 208-page *Historical Atlas of Maine* includes 76 two-page plates, featuring original maps and charts, and other images — historical maps, paintings and photos — in addition to text.

Sea Level Change



Radical changes in sea level occurred at the end of the ice age, followed by a period of relative stability during the Early and Middle Archaic periods when shorelines were about 15 meters (or 50 feet) lower than at present. The conversion from "radiocarbon years" to "calendar years" for each time period is shown here. For convenience, all dates for the Archaic and Ceramic period plates are reported as radiocarbon ages.

Riverbank Site

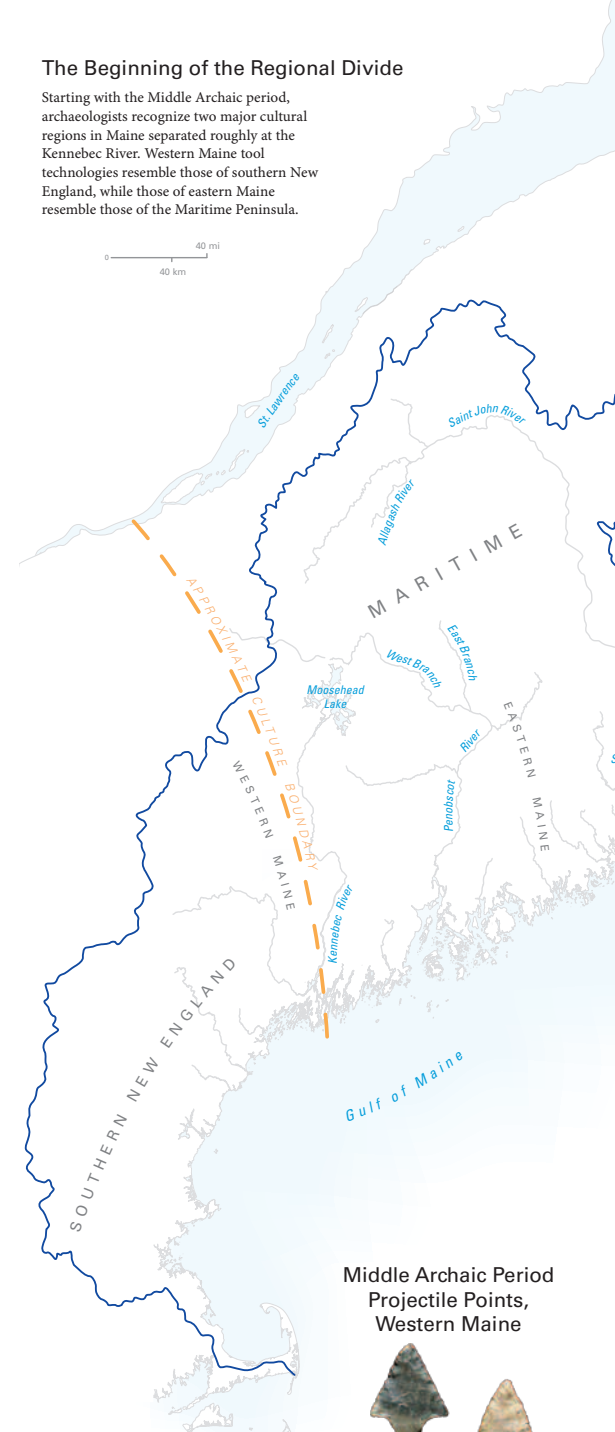
Periodic river floods deposited sandy sediments in valleys, creating ideal camping sites for Native peoples. The sediments also buried and separated each settlement or cultural layer. In this archaeological site on the Piscataquis River near Milo, the white tags identify different sediments and occupation levels spanning 9,000 years.



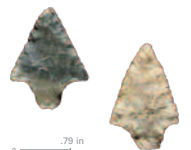
James R. Potoski

The Beginning of the Regional Divide

Starting with the Middle Archaic period, archaeologists recognize two major cultural regions in Maine separated roughly at the Kennebec River. Western Maine tool technologies resemble those of southern New England, while those of eastern Maine resemble those of the Maritime Peninsula.



Middle Archaic Period Projectile Points, Western Maine



Spear points of the Neville-Stark complex are most common in Western Maine.



Nathan D. Hamblin

Middle Archaic Period Ground Stone Tools, Eastern Maine

Diverse stone tools of the Middle Archaic period are typical of eastern Maine, including slate spearheads, stone rods (whetstones), and full-channeled gouges, shaped and sharpened by grinding.



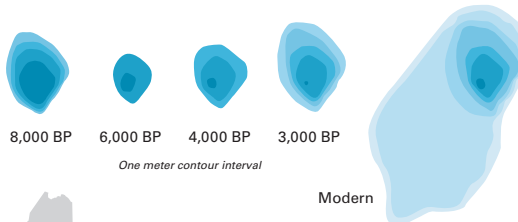
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Stephen Bachiler



Sea-level rebounded from its Pleistocene minimum of 150 feet below the present level, encroaching upon the land at different rates over time. Artifacts recovered from the sea bottom by scallop draggers and marine geology studies are beginning to reveal submerged coastal landscapes and human occupation from the Middle Archaic period, but we still know little about life on the coast before about 5,000 years ago, when sea levels approached modern levels.

During the Middle Archaic period (8,000–6,000 BP), new tool assemblages associated with the Neville and Stark complexes (named after early landowners in Manchester, NH, where the artifacts were first discovered) were introduced west of the Kennebec River. The new tool kits included abundant flaked-stone spearheads along with full-grooved axes and other tool forms resembling those from the mid-Atlantic coast of North America. East of the Kennebec River there were few flaked stone spearheads, but the elaborate ground-stone technology of the Gulf of Maine Archaic tradition persisted from the Early Archaic period. Thus two distinct cultural traditions coexisted on either side of the Kennebec River. This boundary between eastern and western Maine persisted for thousands of years, and some would say still exists today. East of the Kennebec River, tool assemblages and burial ceremonialism had more in common with those of people from what is now Atlantic Canada, representing cultural exchange and interaction as far away as Labrador. Multiple environmental factors influenced subsistence patterns and lifestyles in western and eastern Maine, while the abundant waterways afforded travel routes and communication between the coast and interior.

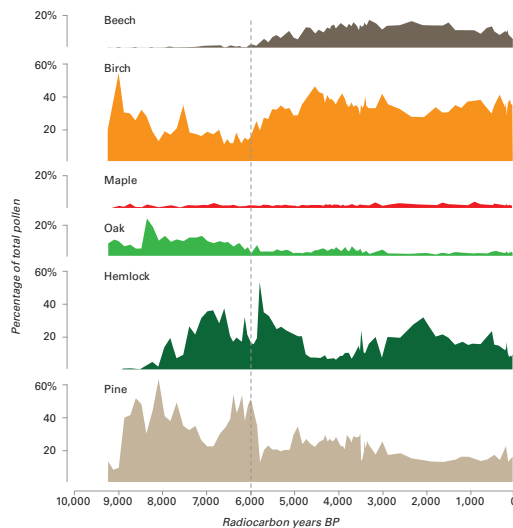
Changing Water Levels at Mansell Pond



Mansell Pond (Alton)

Paleo-ecologists have found that water levels at Mansell Pond rose and fell during wetter and dryer climate phases, as shown by the pond's changing footprint in the soils along the banks of the Penobscot River.

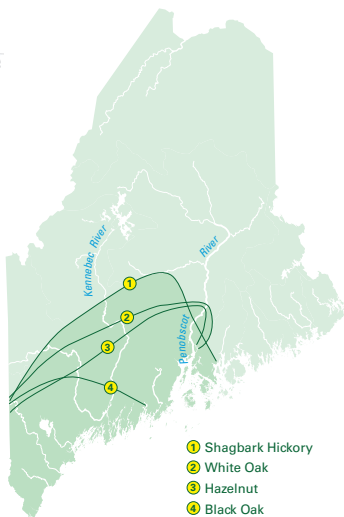
Vegetation Change, Mansell Pond



This pollen profile from Mansell Pond shows changes in percentages of tree pollen and illustrates the fluctuating composition of forests in eastern Maine over 9,000 years. The dramatic changes in species around 6,000 years ago reflected a warmer and wetter climate.

Plant Distribution

The ranges of at least 50 species of woody plants presently reach their northern limits in southern or central Maine. The modern distributions of four nut-bearing trees shown here are among species that provide forage for animals and humans. These and other southern taxa would have had more northerly and easterly distributions during early and middle Holocene warm periods. However, archaeology and pollen analysis suggest that Maine's vegetation likely always had a sharp transition around Penobscot Bay, influenced by cold marine currents, topography, and drainage patterns.



- 1 Shagbark Hickory
- 2 White Oak
- 3 Hazelnut
- 4 Black Oak

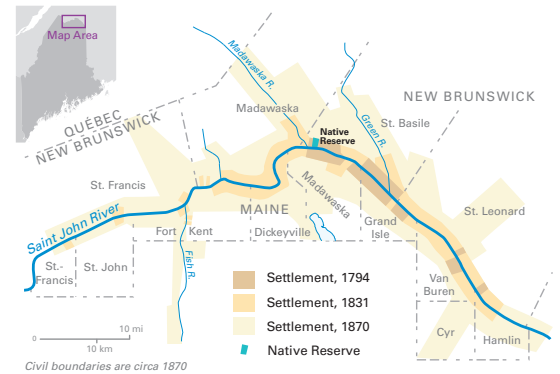
Settling the Upper Saint John

Béatrice Craig

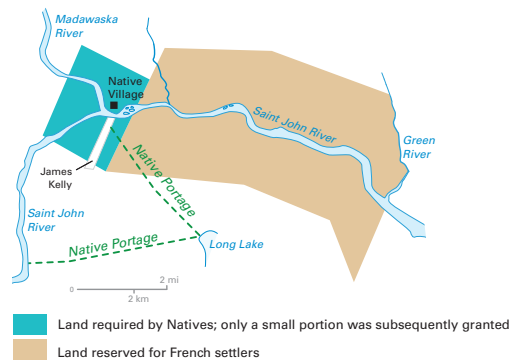
The Upper Saint John River has been the site of a distinctive French-American culture since the late eighteenth century. The French settlement began in 1785. After the American Revolution, the British colonial authorities encouraged French settlers to relocate to the Upper Saint John by promising them generous grants of land. Southern New Brunswick Acadians who had spent the 1755–1767 years on the lower St. Lawrence, Canadian families who had moved to southern New Brunswick during the American Revolution, and soon, Canadians from the Kamouraska region took advantage of the offer. New Brunswick surveyor George Sproule laid out a block of land for French settlers in 1787, and grants were issued in 1790 and 1794 to 74 households (see map “Land surveyed in 1787”). The settlers adopted the long lot system which was standard in Québec; it maximized access to the river, which was the only means of communication, and minimized isolation.

Soon after, the emerging boundary dispute put an end to the granting of land, but not to migrations from the lower St. Lawrence. By 1850, the valley boasted 6,167 inhabitants of Acadian, French Canadian, New England, Native, and Irish descent. By 1870, the population was near 15,000. Intermarriage led to the assimilation of the descendants of the Irish and New Englanders whose grandchildren were often French-speaking Catholics. The settlement was erected into a Roman Catholic parish, Saint Basile, as early as 1792, from which were hived off Saint Bruno, located in what is today Van Buren, in 1838, and Saint Luce in 1842. Most of the priests were from French Canada. In the aftermath of the 1842 treaty, Maine and New Brunswick issued deeds to settlers who could claim six years of occupation.

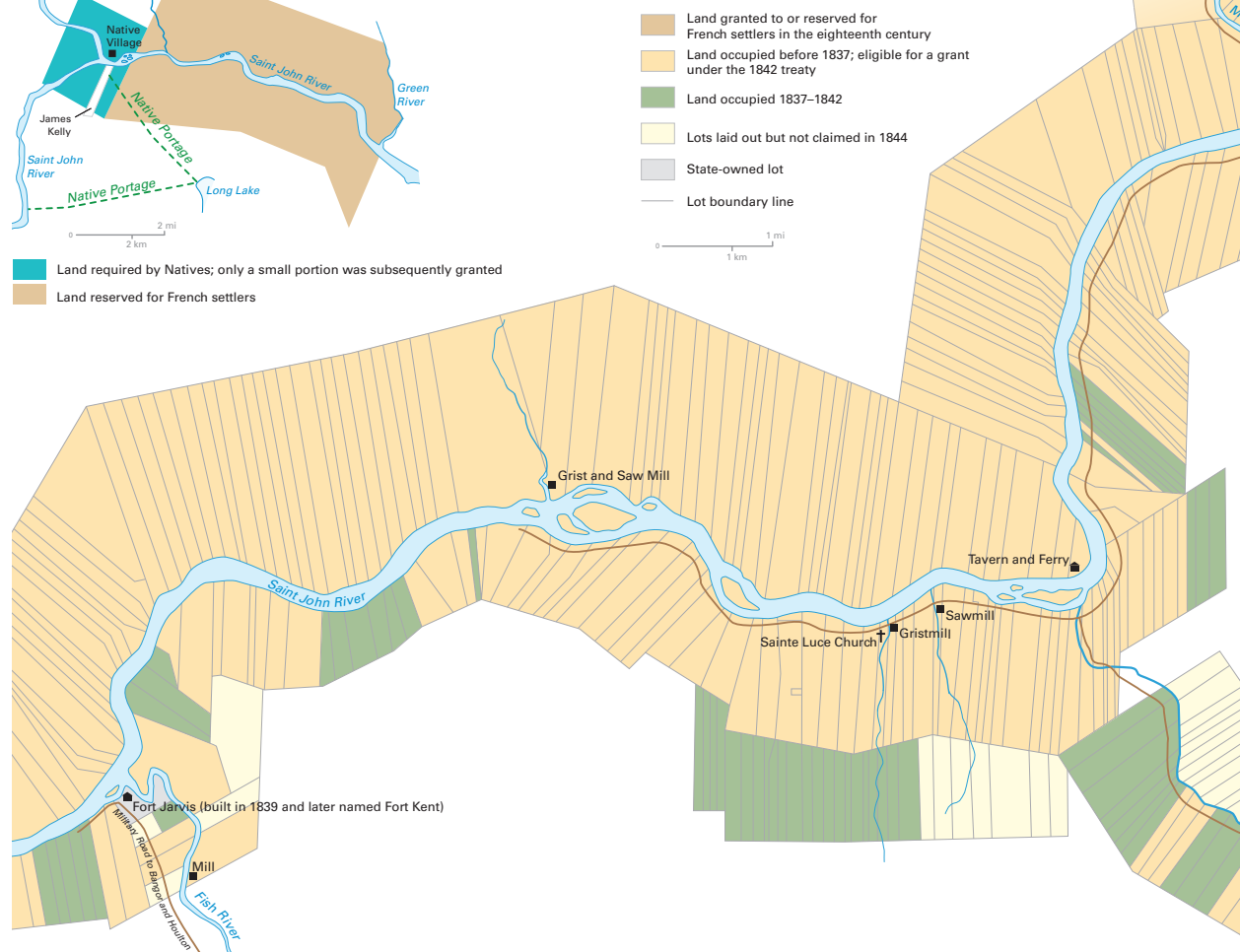
Settlement in the Upper Saint John Valley, 1794–1870



Land Surveyed in 1787



The Saint John Valley in the 1830s and 1840s



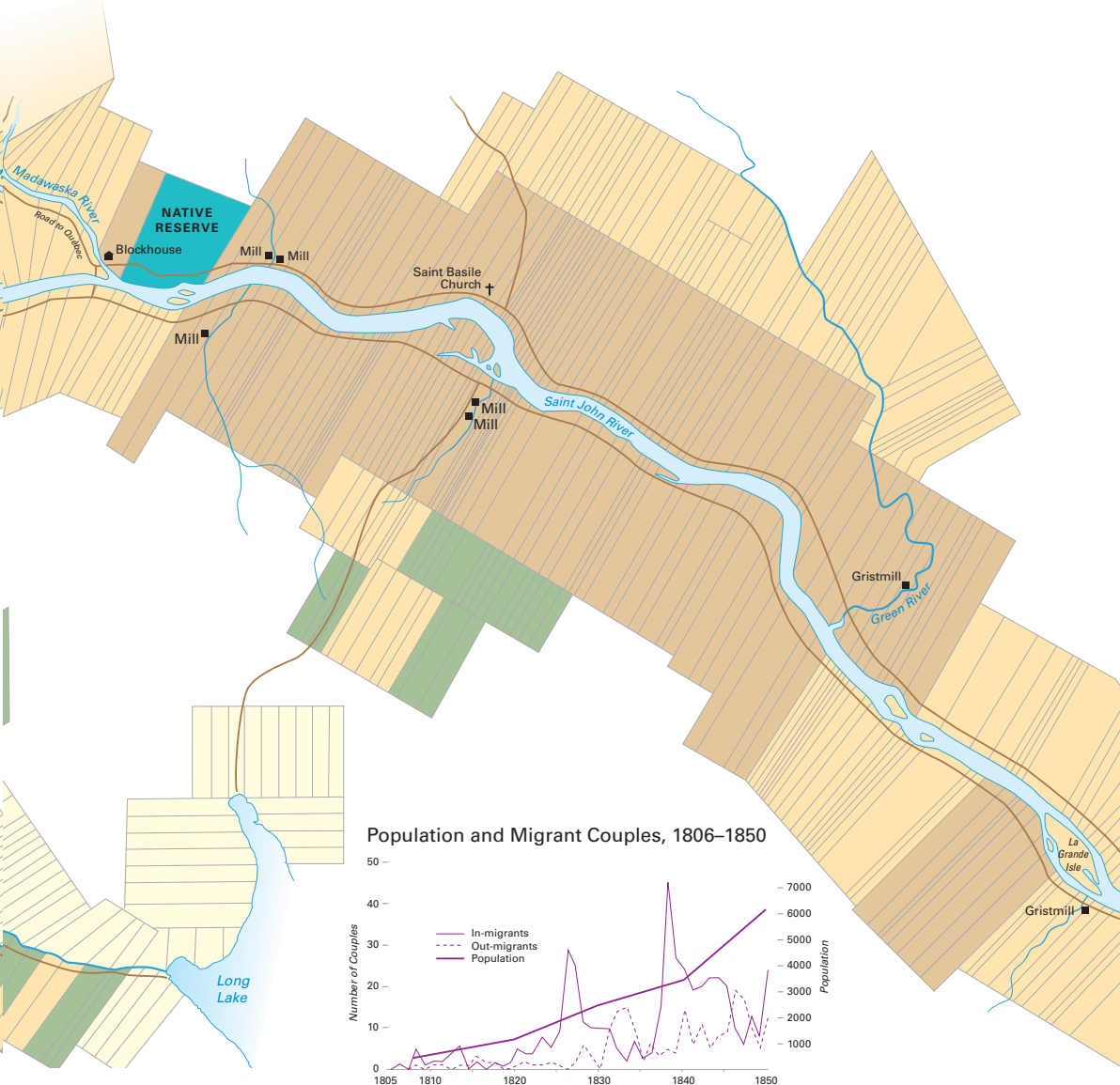
Traveling on the Saint John River, New Brunswick, 1817



A party leaving the Madawaska settlement for Québec City in winter, 1817. In the left foreground is a typical French Canadian one-story log house with bake oven built against the chimney; in the background, stumps from recently cleared land poke through deep snow.

Through the early nineteenth century, the Saint John remained extremely important for transportation, communication, and trade. Major Vidal, a British officer, created a depiction of a group of travelers departing from the territory in the winter of 1817 (see illustration at left). The settlers first made a living from the fur trade (in connection with Québec City merchants) and agriculture. After the War of 1812, Madawaska farmers started growing large amounts of wheat, which was exported to Rivière-du-Loup on the St. Lawrence, milled into flour locally, and shipped down the Saint John to Fredericton, or sold locally to new settlers who had not finished clearing their land.

Numerous immigrants were attracted to the area by the availability of unclaimed land. Lumbering, which began officially during the 1823–24 season and continued illegally during the boundary dispute, made it possible for settlers to survive on wages earned in the lumber camps until farms were established. As the graph shows, the boundary dispute between the United States and Great Britain in the 1820s and 1830s had no effect initially on immigration. The departure of many families in the mid-1830s was caused by a series of bad harvests. Subsequently, farmers switched from wheat growing to producing their own foodstuffs and provisions to sell to lumber camps. Once the dangers of war disappeared, immigration resumed and only slowed with the diminishing supply of good land after 1850. By 1870, all the best land (intervale) had been taken.



Mercantile Portland

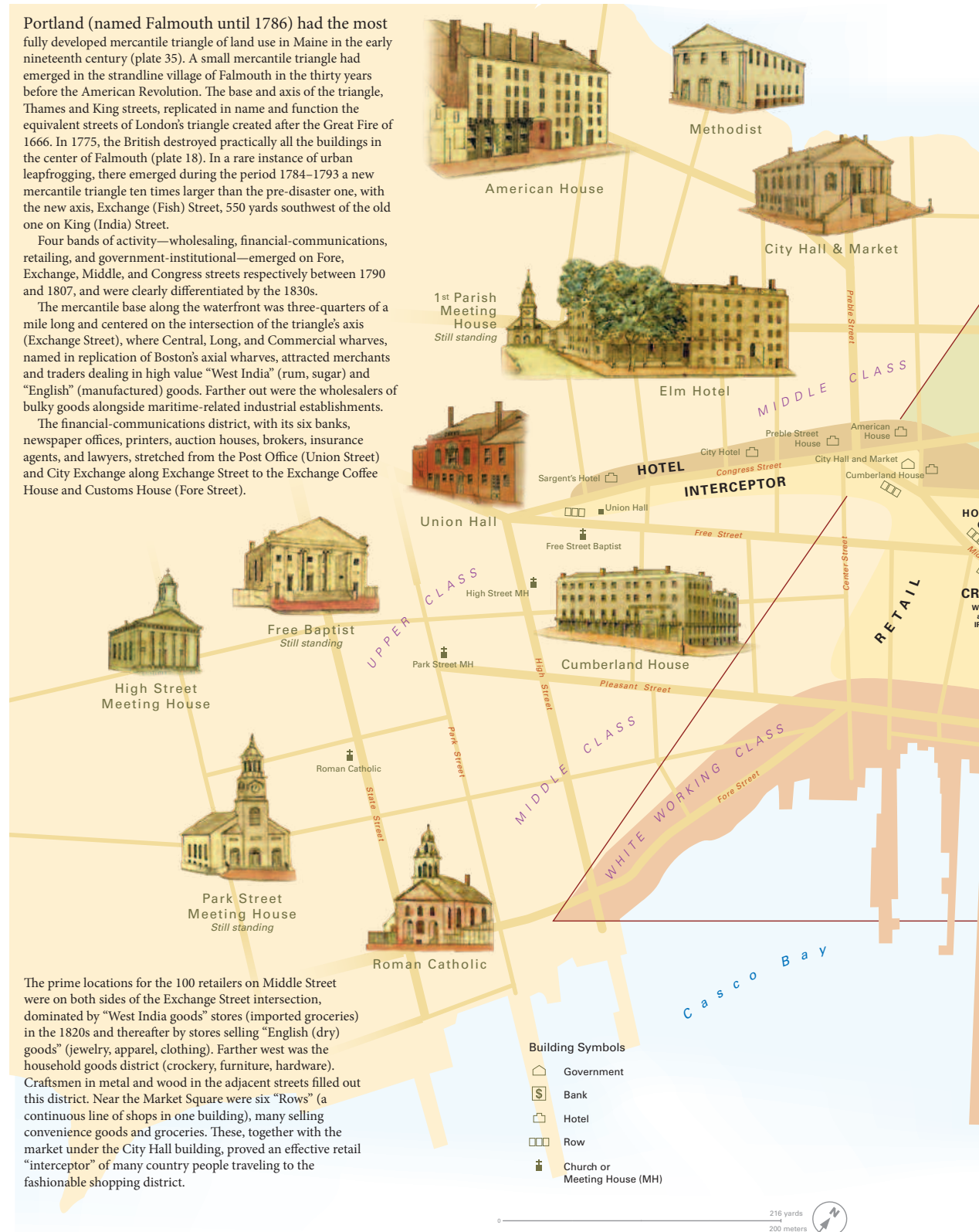
Martyn J. Bowden

Portland (named Falmouth until 1786) had the most fully developed mercantile triangle of land use in Maine in the early nineteenth century (plate 35). A small mercantile triangle had emerged in the strandline village of Falmouth in the thirty years before the American Revolution. The base and axis of the triangle, Thames and King streets, replicated in name and function the equivalent streets of London's triangle created after the Great Fire of 1666. In 1775, the British destroyed practically all the buildings in the center of Falmouth (plate 18). In a rare instance of urban leapfrogging, there emerged during the period 1784–1793 a new mercantile triangle ten times larger than the pre-disaster one, with the new axis, Exchange (Fish) Street, 550 yards southwest of the old one on King (India) Street.

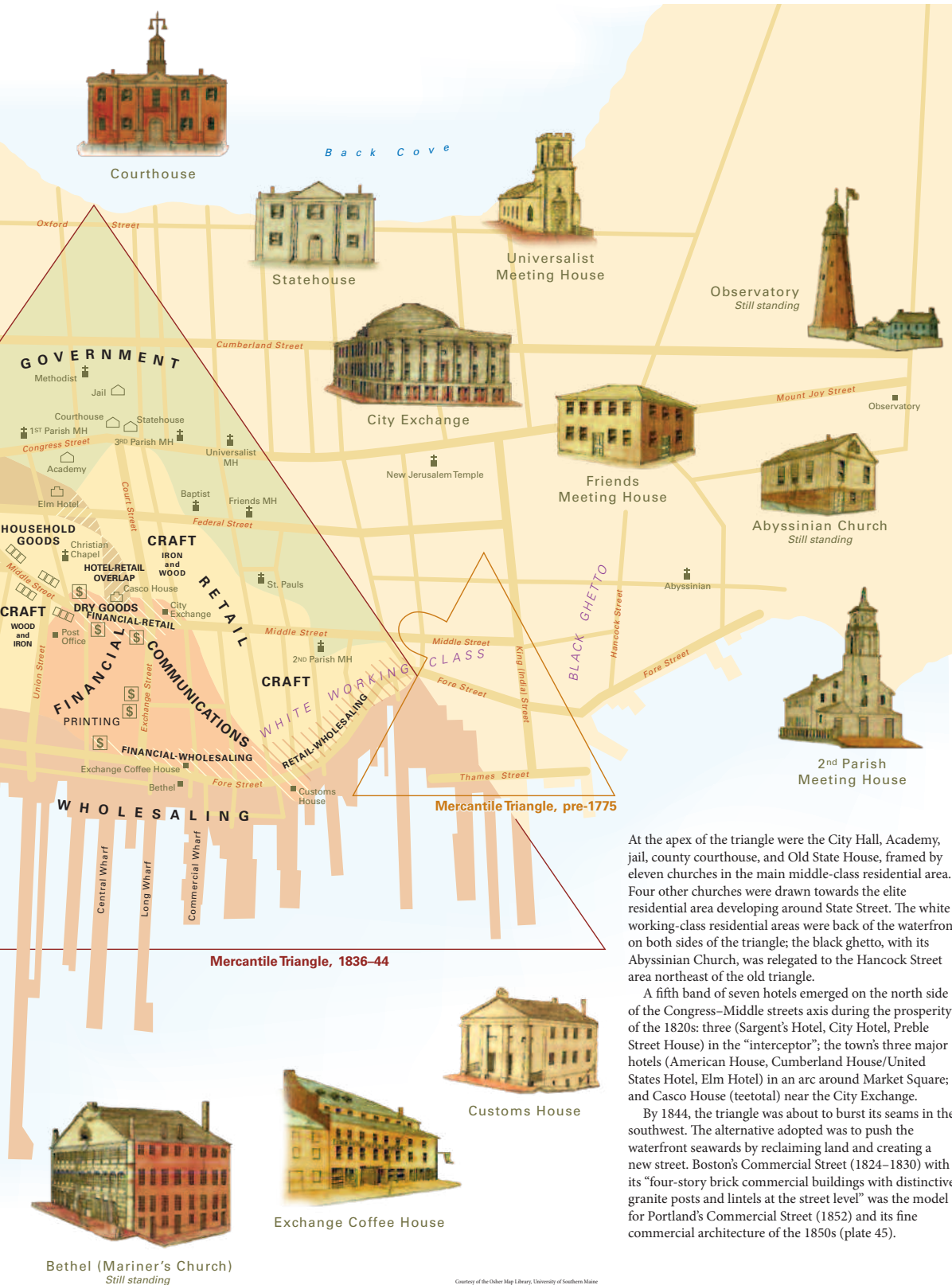
Four bands of activity—wholesaling, financial-communications, retailing, and government-institutional—emerged on Fore, Exchange, Middle, and Congress streets respectively between 1790 and 1807, and were clearly differentiated by the 1830s.

The mercantile base along the waterfront was three-quarters of a mile long and centered on the intersection of the triangle's axis (Exchange Street), where Central, Long, and Commercial wharves, named in replication of Boston's axial wharves, attracted merchants and traders dealing in high value "West India" (rum, sugar) and "English" (manufactured) goods. Farther out were the wholesalers of bulky goods alongside maritime-related industrial establishments.

The financial-communications district, with its six banks, newspaper offices, printers, auction houses, brokers, insurance agents, and lawyers, stretched from the Post Office (Union Street) and City Exchange along Exchange Street to the Exchange Coffee House and Customs House (Fore Street).



The prime locations for the 100 retailers on Middle Street were on both sides of the Exchange Street intersection, dominated by "West India goods" stores (imported groceries) in the 1820s and thereafter by stores selling "English (dry) goods" (jewelry, apparel, clothing). Farther west was the household goods district (crockery, furniture, hardware). Craftsmen in metal and wood in the adjacent streets filled out this district. Near the Market Square were six "Rows" (a continuous line of shops in one building), many selling convenience goods and groceries. These, together with the market under the City Hall building, proved an effective retail "interceptor" of many country people traveling to the fashionable shopping district.



At the apex of the triangle were the City Hall, Academy, jail, county courthouse, and Old State House, framed by eleven churches in the main middle-class residential area. Four other churches were drawn towards the elite residential area developing around State Street. The white working-class residential areas were back of the waterfront on both sides of the triangle; the black ghetto, with its Abyssinian Church, was relegated to the Hancock Street area northeast of the old triangle.

A fifth band of seven hotels emerged on the north side of the Congress–Middle streets axis during the prosperity of the 1820s: three (Sargent's Hotel, City Hotel, Preble Street House) in the "interceptor"; the town's three major hotels (American House, Cumberland House/United States Hotel, Elm Hotel) in an arc around Market Square; and Casco House (teetotal) near the City Exchange.

By 1844, the triangle was about to burst its seams in the southwest. The alternative adopted was to push the waterfront seawards by reclaiming land and creating a new street. Boston's Commercial Street (1824–1830) with its "four-story brick commercial buildings with distinctive granite posts and lintels at the street level" was the model for Portland's Commercial Street (1852) and its fine commercial architecture of the 1850s (plate 45).

Twilight zone

Postdoctoral research in France will focus on marine snow

STUDYING MOVEMENT of carbon dioxide into the deep ocean to improve climate projections and understanding of deep-sea ecosystems will be the focus of a research project by University of Maine marine scientist Nathan Briggs.

Feb. 1, Briggs begins a two-year postdoctoral fellowship in France, funded, in part, by a \$194,000 grant from the National Science Foundation. He will collaborate with Hervé Claustre, a senior scientist at Laboratoire d’Oceanographie de Villefranche on the Mediterranean Sea.

Climate change may alter patterns of carbon movement in the mesopelagic ocean layer (depths from about 300 to 3,000 feet), Briggs says. The change in patterns could result in climate feedbacks (magnification or lessening of the change) and/or threaten deep ecosystems.

The mesopelagic layer — dubbed the twilight zone because light that penetrates to this depth is faint — plays an important role in the long-

term storage of atmospheric carbon dioxide. Carbon dioxide that reaches the bottom of this zone remains trapped in the ocean for hundreds to thousands of years.

Briggs’ research will focus on marine snow — clumps of organic matter that form in the surface ocean and drift through the twilight zone like falling snow, transporting carbon.

The nearly 10-day journey through the twilight zone is a dangerous one for marine snow particles. They are a major food source for giant squid and other creatures in the twilight zone, which is too dark to produce its own food.

The amount of marine snow that makes it through and the amount of carbon dioxide trapped in the deep ocean depend on the sinking speed, its “palatability” and the population of consumers waiting for a meal.

Briggs became interested in marine snow during a 2008 research cruise south of Iceland led by UMaine marine scientist Mary Jane Perry. Researchers deployed low-power underwater robots to explore

Nathan Briggs, whom the National Science Foundation cites as a promising scientist, will conduct the two-year research project with Hervé Claustre, who operates a fleet of more than 50 underwater robots deployed across the North Atlantic Ocean (one is 800 miles off the Maine coast), the Mediterranean Sea and the Southern Ocean that circles Antarctica. Photo by Linda Healy





the twilight zone. The robots carried particle sensors to detect concentrations of microscopic plankton.

The researchers observed a large bloom of microscopic algae at the surface and suddenly the particle sensors in the twilight zone appeared to go haywire, periodically jumping to abnormally high readings, then immediately returning to normal. Perry suspected the abnormal readings were caused by marine snow hundreds of times larger than particles the sensors were designed to measure.

Perry tasked Briggs with further investigation. In 2010, he was awarded a fellowship from NASA and a UMaine doctoral research fellowship to develop and test methods for using underwater robots to measure marine snow.

The work paid off. With Perry and other collaborators at UMaine and the University of Washington, Briggs demonstrated the high particle readings in 2008 were indeed caused by marine snow. And he used the readings to estimate how much carbon the marine snow carried to the deep ocean.

In his new position, Briggs will use the techniques he developed at UMaine to track marine snow on a much larger scale. ■



Extreme *weather*

Researchers look at the effects of a changing environment on Maine's marine waterways, croplands and municipalities

By Beth Staples



Extreme weather

ELDERS sharing childhood stories about growing up in Maine often recount hiking miles uphill in 3 feet of snow to get to school — and home.

Turns out those tales, of Maine winters anyway, might not be all that exaggerated.

In the winter of 1904–05, horses pulled huge saws to cut channels in foot-thick ice on Penobscot Bay so maritime traders could deliver goods. And in the winter of 1918, people walked, skated and rode in horse-drawn sleighs across the frozen bay to Islesboro, according to the Belfast Historical Society and Museum.

That same winter, Albert Gray and his companions drove a vehicle across the frozen-solid brine. According to a Bangor Daily News report, the group made several trips in a Ford Model T between Belfast and Harborside, just south of Castine.

Historical records indicate upper Penobscot Bay froze once or twice a decade during the winter in the 1800s and early 1900s, says Sean Birkel, research assistant professor with the University of Maine Climate Change Institute (CCI).

February 1934 was the last time it occurred.

Climate is different today. For instance, summer — when the mean daily temperature is above freezing — is about 20 days longer now than it was on average in the late 1800s, says Birkel, and spring arrives nearly two weeks earlier than it did a couple of decades ago.

The lakes really do freeze later, and ice out is earlier than it used to be, he says. And computer models predict that in the next 40 years, the average temperature in Maine could rise 3–4 degrees Fahrenheit, with most of the warming occurring in winter.

Understanding **Maine's changing climate** is critical for **informed risk assessment** and cost-effective **adaptation.**

TEMPERATURES HAVE been climbing for some time. According to the National Oceanic and Atmospheric Administration (NOAA), May and June 2014 were the hottest May and June ever recorded. In addition, NOAA notes that people born in 1985 and later have not yet lived through a colder-than-average month.

The number of extreme weather events — like the record-breaking 6.44 inches of rain that flooded Portland, Maine, Aug. 13, 2014 — has spiked in the last 10 years. Birkel says a 50 percent to 100 percent increase in rainfall events with more than 2 inches per day has been recorded at weather stations across the state.

The increase in frequency and

strength of extreme events, including heat and cold waves, is likely tied to the steep decline of Arctic sea ice since about 2000, Birkel says. Studies show rapid warming over the Arctic is changing circulation patterns across the Northern Hemisphere.

In particular, jet stream winds are slowing, which increases the likelihood of blocking events that hold a weather pattern — including heat and cold waves — in place for several days, he says. When blocked patterns finally dissipate, they tend to do so with powerful storm fronts.

Climate change and extreme weather are taking a severe toll on people and the planet, according to scientists.

Worldwide since 1971, 2 million people have died and \$24 trillion in property damage has resulted from weather and climate disasters, according to Climate Central, a nonprofit nonadvocacy organization of scientists and journalists.

In 2012, 11 weather and climate disasters worldwide killed more than 300 people and caused more than \$110 billion in damage, according to NOAA's National Climatic Data Center. The disasters included the largest drought since the 1930s — an event that worsened wildfires that burned more than 9 million acres.

And in October 2012, Hurricane Sandy pummeled the East Coast of the U.S. and the Caribbean. The storm is blamed for approximately 150 deaths and the destruction of about 650,000 homes, according to NOAA.



Extreme weather

A HOST of UMaine marine scientists are participating in a multiagency research project to improve the accuracy of forecasts of extreme weather events — hurricanes, superstorms, blizzards and floods — that endanger people and animals, and destroy property.

UMaine received \$1.5 million of NOAA's \$5.5 million award to increase the precision of predictions of extreme weather events and coastal flooding in the northeastern U.S.

This project will help develop rapid response capability and deploy ocean observing assets before extreme weather events, and use these targeted observations to constrain ocean models and issue timely forecasts for coastal cities and towns in the Northeast United States, says Fei Chai, professor and director of UMaine's School of Marine Sciences, and one of four co-investigators.

The three other UMaine co-investigators from the School of Marine Sciences: Neal Pettigrew, Huijie Xue and Mary Jane Perry, who is interim director of the University of Maine Darling Marine Center.

The UMaine faculty and researchers are among the 39 scientists engaged in the two-year study. The group is building, deploying, garnering and analyzing data from state-of-the-art outfitted floats, gliders and moorings during two winter storms and two summer storms that hit the Gulf of Maine or the area from Cape Cod, Massachusetts to Cape Hatteras, North Carolina.

When a severe storm approaches,

aircraft will deploy 15 miniature, expendable floats along the forecasted storm track and launch four reusable gliders in the middle of the shallow continental shelf. Researchers will also anchor 10 portable buoy moorings near estuary mouths where storm surge causes significant flooding and damage.

Coastal communities need help to **minimize potential hazards** to fisheries, aquaculture, working waterfronts and tourism by implementing **resilient development strategies and practices.**

The floats, gliders and moorings are designed to collect three new levels of ocean observations. The new data will be integrated into computer models that predict currents, sea level and turbulent mixing of cold subsurface water with the surface ocean.

Meteorologists will thus have a more complete picture of sea surface

temperature and upper-ocean heat content, which the scientists say should result in better-informed storm forecasting.

In addition, more targeted ocean surface data (air pressure, air and sea temperature, ocean waves, sea level, etc.) collected by the moorings, in conjunction with current coastal flooding models, should enhance forecasting of flooding.

Esperanza Stancioff, climate change educator with University of Maine Cooperative Extension and Maine Sea Grant, says coastal residents and communities need strategies to address sea-level rise and flooding that will result, in part, due to melting glaciers and polar ice caps.

UMaine Extension and Maine Sea Grant are among the groups working with coastal community leaders to help minimize potential hazards to fisheries, aquaculture, working waterfronts and tourism by implementing resilient development strategies and practices.

Other UMaine researchers with varied areas of expertise also are helping people prepare for the effects of climate change and extreme weather.

Ivan Fernandez, Distinguished Maine Professor in the School of Forest Resources and CCI, says understanding Maine's changing climate is critical for informed risk assessment and cost-effective adaptation.

A warming Gulf of Maine increases the risk of lobster disease, as well as market uncertainty, Fernandez says. He points to summer 2012



Hurricane Sandy storm damage at Ortley Beach, New Jersey in 2012.

when warming ocean water resulted in a glut of lobsters and a subsequent bust in prices. In agriculture, rising temperatures can result in an increase of insects and disease, he says, as well as crop damage and soil erosion due to intense precipitation events.

Opportunities also could result from the changing climate, says Fernandez, including longer growing seasons and emerging shipping lanes in the Arctic Sea due to the receding polar ice sheet.

In September, Damian Brady, assistant research professor at the

Darling Marine Center in Walpole, began examining consequences that longer growing seasons, and the subsequent actions by farmers, have on downstream coastal water systems.

Farmers are planting crops earlier than they did a few decades ago. That results in earlier fertilizer application and planting some crops twice in a growing season, Brady says.

Brady is examining where the fertilizer goes and how changes in farming practices affect estuaries downstream that also are being impacted by other climate-related

factors, including increased frequency of extreme storms and higher temperatures. His research will concentrate on understanding these dynamics in Chesapeake Bay; he says the findings are expected to apply to agricultural watersheds around the world.

Brady also anticipates learning how management policies with different rules and incentives affect farming behavior and, subsequently, impact watershed and estuary health.

He's collaborating with researchers at Johns Hopkins University, Cornell University and the University of

Extreme weather

Maryland Center for Environmental Science.

BIRKEL AND other CCI researchers have developed online tools to assist local community planners prepare for climate changes. The tools — Climate Reanalyzer, 10Green and CLAS Layers — were explained at the Climate Change Adaptation and Sustainability (CLAS) Conference in October at UMaine.

The tools provide users access to station data, climate and weather models, and pollution and health indices.

Paul Mayewski, director of UMaine's CCI, says the CLAS software explains past, present and future changes in climate at the community level and introduces a "planning system that invokes plausible scenarios at the community level where local knowledge can be applied to produce local solutions."

For instance, city leaders considering opening a cooling center for residents can review projections for future frequency of heat waves. Medical care workers can assess the potential for increase in Lyme tick disease. And community planners preparing to replace stormwater drains can examine predicted precipitation in coming decades.

It's important for businesses to prepare for such changes, says conference presenter John F. Mahon, the John M. Murphy Chair of International Business Policy and Strategy and professor of management at UMaine. "Business has to be engaged

with government and other organizations at the local and national level," says Mahon.

"One of the more useful tools for doing this is the use of plausible scenario planning (PSP). In PSP, we try to envision several plausible futures with equal likelihood of happening and develop a set of 'warnings' or 'indicators' that tell us which



When we have a crystal ball, even if the future is bad, **we can create a better situation.** We have no choice but to adapt. Who wouldn't want **a cleaner world,** to spend less money on energy and have better jobs?" Paul Mayewski

one of the several futures we have identified is unfolding so that we can adapt to it in the most efficient, economical and effective manner."

Mayewski says it's imperative to provide tools that enable people to take action to mitigate climate change, as well as adapt to it.

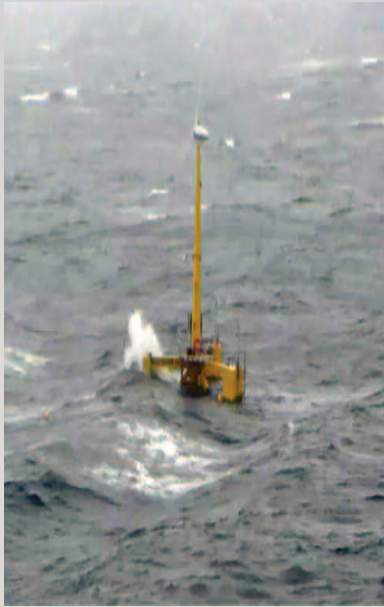
The CLAS framework is being expanded to encompass national and international planning capability, says Mayewski, who was featured in *Years of Living Dangerously*, a nine-part Showtime documentary about climate change that won an Emmy Award for Outstanding Documentary or Nonfiction Series.

Maine is in a good position to take action, Mayewski says, especially with regard to developing offshore wind technology.

"When we have a crystal ball, even if the future is bad, we can create a better situation. We have no choice but to adapt," he says. "Who wouldn't want a cleaner world, to spend less money on energy and have better jobs? We will run out of oil at some point, but the wind won't stop."

On a global scale, climate change is a security issue, as it "impacts human and ecosystem health, the economy; intensifies geopolitical stress; and increases the likelihood of storms, floods, droughts, wildfires and other extreme events," Mayewski says. It's notable that previous civilizations have collapsed in the face of abrupt, extreme changes. And climate change, he says, is far from linear in the way it evolves.

"When you go all over the world, you get a global view," Mayewski says. "By nature, I'm an optimist. That is tempered with this problem. I do believe there will be a groundswell of people, or governments, or some combination so that there will be a better future in store." ■



VolturnUS, UMaine's one-eighth scale floating wind turbine, off the coast of Castine, Maine, winter 2013. W² will further research on how offshore wind can be cost-effectively harnessed.

Storm center

WHAT'S IT like to weather a perfect storm?

Engineers at the University of Maine Advanced Structures and Composites Center soon will have the capability to create one.

Earlier this summer, UMaine broke ground for an \$8 million facility that will house W² — the world's first wind and wave lab to feature a rotating open-jet wind tunnel above a 100-foot-long by 30-foot-wide by 15-foot-deep wave basin.

Waves and wind can be created from different directions converging at a point and creating a perfect storm. The W² facility is an expansion of the UMaine Composites Center to 100,000 square feet.

For nearly 18 years, the existing 83,000-square-foot laboratory has been used to design, fabricate and test large structures under simulated static, fatigue, earthquake, wind and vehicular loads for clients around the world, says Habib Dagher, director of the UMaine Composites Center. The W² facility adds more capabilities to test advanced structures under combined aero-and hydrodynamics loadings.

UMaine faculty, students and partners, including Maine Maritime Academy engineer Rich Kimball and industrial colleagues, will be able to assume the role of nature in the wind-wave generating lab.

Scale models of offshore wind turbines, tidal energy devices, seafaring vessels and oil and gas rigs will be able to be tested under a variety of wind and wave conditions. By directly observing structures' performances, researchers can expect to improve the structures' respective designs.

A wave maker at one end of the basin will be capable of creating waves of varying frequency and as high as 2 feet. The rotating open-wind jet tunnel will produce wind howling up to 22 mph and that can be manipulated to change direction. Scientists also will be able to move the basin's concrete floor up and down to model ocean depths.

A beach at one end of the wave basin will enable coastal engineers to study erosion, seawalls, breakwaters, and the impact of sea-level rise on communities.

W² will allow researchers to physically replicate a myriad of realistic, to-scale ocean conditions anywhere in the world.

"This is a huge opportunity. It's a landmark," says Dagher.

"Wind squall, where winds change direction and intensity rapidly, is an important design condition for many ship-shaped structures producing oil and gas in various parts of the world. We can simulate such an environment in W²," says Krish Thiagarajan, Correll Presidential Chair in Energy and a UMaine professor of mechanical engineering.

For Dagher, Thiagarajan and collaborating engineers in the UMaine Composites Center, including Andrew Goupee and Qingping Zou, W² will be an integral addition to the adjacent University of Maine Offshore Wind Laboratory.





Howard Reiche Jr., with his wife Stevie

The bucket list

UMaine awards a graduate degree started in 1950

SIX YEARS ago, Howard Reiche Jr. started “putting things away” that he felt he could “do without” in order to devote as much time as possible to more pressing family commitments, including caring for his beloved wife, Stevie. Earlier this year, shortly after his 85th birthday, he renewed his focus on some longstanding personal goals, priorities and “unfinished business.”

“I realized I needed a change in my life,” says the Portland, Maine native and long-time resident of Falmouth.

That’s when Reiche got to work on his bucket list. He dusted off his cello that, six years ago, he’d put in the corner of his office, and he started taking lessons. He took up watercolor painting again and started swimming three half-miles every week. He also renewed his 20-year passion of collecting 18th-century autographs of the original signers of the Declaration of Independence (he has 37 of the 55).

And in August, he contacted the University of Maine Graduate School to see if he could finish the master’s degree he started in 1950.

“I have a bucket list of things that I want to accomplish and this was on my list to talk to somebody about,” says Reiche. “I just needed somebody to say it might be worthwhile looking at this.”

After graduating from Bowdoin College, Reiche enrolled at UMaine in 1950 to pursue a master’s degree in zoology and study microbial genetics. He completed the two semesters of coursework, passed his final exams and was set to finish his thesis when he was told that he was supposed to have taken organic chemistry at Bowdoin prior to enrolling in the master’s program at UMaine.

“At the time, I was 21, married, with no money and the draft hanging over my head,” he says. “Spending another year at UMaine to take one undergraduate course was out of the question. But it’s been on my bucket list all this time.”

Reiche left the university to take a temporary teaching position, and then spent three years as a medical services

corps officer in the United States Air Force. When he was discharged, he launched what would become a 32-year career in Maine’s paper industry.

“S.D. Warren Paper Company was looking for nonengineers who had college degrees with an abundance of science and math,” Reiche says. “Four of us were hired, along with engineers from UMaine and Syracuse.”

Through the years at S.D. Warren and then Scott Paper, Reiche worked in product quality control, sales and customer service, and production. Before retiring in 1988, he was mill manager at the Westbrook, Maine mill and a vice president in the global corporation.

He also researched and wrote books, including *Closeness: Memories of Mrs. Munjoy’s Hill* (2002).

It was that body of lifetime workplace experience that UMaine evaluated as prior learning equivalent to the few remaining credits needed to fulfill a nonthesis master’s degree. Oct. 7 in a ceremony in Falmouth, UMaine awarded Reiche a Master of Professional Studies Degree in Biochemistry.

“Mr. Reiche’s career in the fields of medicine, science, engineering and business, coupled with his broad body of unique experiences over a lifetime, stand as a tribute to the man and highlight the importance of maintaining interest, pursuing knowledge and giving 100 percent,” said Carol Kim, UMaine vice president for research and dean of the Graduate School.

With his UMaine degree, Reiche joins a dozen other family members who are University of Maine alumni. Both of his children, Stacey and Ford, graduated with UMaine degrees in 1979 and 1976, respectively. His father and namesake graduated from UMaine with bachelor’s and master’s degrees, both in biology in 1924 and 1936, respectively, and went on to a legendary career in education. The Howard C. Reiche Community School in Portland’s West End is named for his father.

“The University of Maine has always been a part of the family,” says Reich. ■



The **University of Maine** has always been a **part of the family.**”

Howard Reiche Jr.

Maine migrants

State's leading bird biologists are studying the effects of changing habitat on sandpipers during their short stopovers

SEMIPALMATED sandpipers — shorebirds that weigh a whopping 1.4 ounces — give new meaning to the term frequent fliers. During spring and fall migrations, the birds named for the short webs between their toes can

rack up around 9,000 miles. After breeding in the Arctic in late spring, the semipalmated sandpipers fly south, resting and refueling for about two weeks in the United States, including in Down East, Maine, before continuing to South America for the winter.

Researchers with the University of Maine and Maine Department of Inland Fisheries and Wildlife (MDIF&W) are in the midst of a two-year study to see if the Maine coast is a welcoming habitat for these feathered friends.

“When in Maine, they’re our



By Beth Staples
Photos by Holland Haverkamp

responsibility, our birds,” says Lindsay Tudor, an MDIF&W wildlife biologist. “We want to know if the habitat is meeting the birds’ needs.”

Tudor, UMaine wild migratory bird expert Rebecca Holberton and UMaine graduate student Sean Rune are collaborating to find out.

Each of the last two summers, they’ve conducted health assessments and placed “nano tags” — tiny VHF radio transmitters — on about 40 semipalmated sandpipers (*Calidris pusilla*).

Researchers glue the nano tags, which resemble a Tic Tac with a hair-

thin, 6-inch-long antenna, to the birds’ back feathers. Each tag emits a specific frequency signal, and comes off during molt.

“They (nano tags) don’t interfere with their natural behavior or ability to gain weight,” says Tudor of the revolutionary technology.



Maine migrants

Similar to tourists, sandpipers arrive in Maine in throngs and stay for a couple weeks in July, August or September. They rest on offshore islands and furtively feed on intertidal invertebrates, such as worms and amphipods in the mudflats.

Two VHF telemetry receiver towers erected Down East by the researchers pick up specific signals from each nano tag. By tracking individual sandpiper movements while they're in the area, the researchers learn more about the amazing birds and how their stay in Maine impacts the rest of their migration.

Data from the watershed project will inform Rune's graduate thesis. And, similar to data from other bird research projects, it is fed into a repository coordinated by Phil Taylor at Acadia University.

Maine Outdoor Heritage Fund, Eastern Maine Conservation Initiative, Maine Agricultural and Forest Experiment Station and the State Wildlife Grant program of the U.S. Fish & Wildlife Service fund the project that incorporates 50 automated VHF telemetry receiver towers from the Bay of Fundy to Cape Cod, including the two Down East.

“Unless you know the length of stay, you could be double counting (the birds),” says Tudor, a UMaine alumna. “How long do they stay? How much mudflat do they need? How important are the offshore islands? This (data) will improve abundance estimates, determine population trends and conservation efforts.”

IN 2013, the study's first year, Holberton, Tudor and Rune learned that, day and night during the Down East stopover, sandpipers moved between feeding sites along the upper Pleasant

Lindsay Tudor, a wildlife biologist with the Maine Department of Inland Fisheries & Wildlife, left, and UMaine migratory bird biologist Rebecca Holberton lead a two-year study to understand the stopover needs of the semipalmated sandpiper.



and Harrington rivers, and Flat Bay during low tide, and roosted on offshore ledges at high tide.

Hatching-year birds ate and rested an average of 17.5 days in Maine; adults stayed an average of 12.4 days. On average, adult semipalmated sandpipers weighed 5 grams more than hatching-year birds.

The young sandpipers on their first migration may have needed more time to pack on enough weight for the energy reserves required to fly nonstop to their wintering grounds, Holberton says.

Other towers along the East Coast

haven't picked up signals from the migrating birds, which the researchers say indicates that when the sandpipers leave Maine, they fly about 2,400 miles nonstop over the Atlantic Ocean to South America.

Sandpipers can't tolerate cold water and therefore are unable to land in the ocean to rest, says Tudor, which makes the birds' stopover on the Maine coast critical to successfully navigating their long, uninterrupted migratory flight.

Tudor says the endurance exhibited by these "little balls of fluff" is one reason among many to be a fan.



How long do they stay? **How much** mudflat do they need? **How important** are the offshore islands? This (data) **will improve** abundance estimates, and determine population trends and **conservation efforts.**"

Lindsay Tudor



Maine migrants

New mothers leave the Arctic tundra breeding grounds soon after their chicks are hatched and usually before they can fly. No helicopter parenting there.

The fathers head south soon after, which means the new chicks are left to make the nonstop journey from Addison, Maine, to the coast of South America on their own.

“We expect a lot more from life,” Holberton says. “They make things look simple” — including being able to rapidly nearly double their weight.

Tudor, who previously worked with MDIF&W’s black bear management team, said bears have much of the spring, summer and early fall to pack on weight before they den up. Sandpipers have two or three weeks to add enough ounces so they have enough fat reserves to fuel their continuous three-day or so journey over the Atlantic Ocean.

Another of the sandpipers’ many talents — in addition to making their way back to their exact same wintering site each season — is the ability to break down lipids under the skin to both hydrate and fuel their odyssey over the Atlantic Ocean.

When the semipalmated sandpipers have added sufficient weight, they typically fly 8,000 to 10,000 feet above the Maine coastline, head out over the ocean and catch a good tailwind. It generally takes them two to four days to make the nearly 2,400-mile voyage to the coast of South America.

The researchers say the project demonstrates how much more there

is to learn about birds. “You can’t help but be drawn to birds and bird migration,” Rune says. “The more you learn, the more questions that are raised.”

BECAUSE SEMIPALMATED sandpipers feed on intertidal invertebrates at the interface of land and sea, they’re



Keeping track

- Female semipalmated sandpipers generally lay four eggs, one per day, in June or July.
- Both parents incubate eggs for about 20 days.
- Neither parent feeds the chicks. Chicks hatch with open eyes and soon after birth, they peck for insects.
- Females leave the brood about two to eight days after they hatch.
- Semipalmated sandpipers fly at about 14 days of age.
- Adults molt body feathers twice a year.

Source: National Audubon Society

an indicator species for the health of mudflats and sentinels for the natural world in general, Holberton says.

“The Gulf of Maine ecosystem is really facing challenges,” Holberton says. “We (birds and people) share resources and if birds are in trouble,

then so are we. This is another piece of the puzzle.”

Population-wise, the semipalmated sandpipers are in trouble. Despite their amazing abilities, studies indicate that since the 1970s, their numbers have plummeted 80 percent in eastern North America, says Tudor.

The population decline isn’t exclusive to semipalmated sandpipers. Globally, one in eight — more than 1,300 bird species — are threatened with extinction, according to BirdLife International, as reported in National Geographic.

The National Audubon Society’s recently released *Birds and Climate Change* report indicates 314 species of birds in North America are “on the brink” due to climate change.

For years, birds have been messengers — of changing seasons and new days dawning, says the report. The decline of bird populations is another stark and urgent message, Gary Langham, Audubon’s chief scientist, says in a video. If decisive actions aren’t taken to reduce carbon pollution and protect bird habitats, a host of species could become extinct.

In the Maine-based project, the researchers seek to better understand reasons for the nosedive in numbers of semipalmated sandpipers and the most perilous life stages.

Semipalmated sandpipers face a variety of obstacles, Holberton says, in addition to the effects of climate change in the Arctic where they breed. They also face the loss of coastal habitat due to development along the migration route where they

rest and refuel, and they're targeted by hunters where they winter.

Holberton says sometimes the birds, exhausted from their nonstop three- or four-day flight, will arrive on the coast of South America only to be shot by hunters.

LEARNING WHERE and why birds are most at peril can precipitate cooperation between agencies and countries, and help policymakers direct resources where they're most needed.

"It's really critical to build bridges and span geopolitical barriers," Holberton says.

MDIF&W reviews permits for shoreland development and makes recommendations for conservation management plans for habitats of high-value to wildlife. Tudor says it's important to know if these initiatives are working.

Birds have been revered in many cultures around the world for centuries, and are symbols of courage, wisdom, strength, freedom and peace, says Holberton, whose research integrates bird ecology, behavior and physiology.

"I use birds to ask questions," she says "They're on every continent. We need to understand the links between habitat quality and availability, and how well sandpipers survive to the next stage."

Tudor and Holberton are pleased the semipalmated sandpiper project has expanded; this past summer, the U.S. Fish & Wildlife Service conducted similar research at the Rachel Carson National Wildlife Refuge in

Wells. Comparing the data from Down East with data from southern Maine will be interesting and insightful, says Tudor.

Public interest in and appreciation for birds has helped make the project possible, say the researchers.

Prior to the start of the project, Tudor was aboard a lobster boat searching for prime spots Down East to place the towers. She spied a perfect perch between the Harrington and Mill rivers.

The landowners, including Pat Mudge, were at home enjoying coffee when Tudor motored up and asked if she could put a 30-foot tower on the land. Mudge, a retired newspaper columnist for the Greenwich Time newspaper in Connecticut, readily obliged.

On a nearby bluff, so too did John and Anne Marshall, founders of the Pleasant River Wildlife Foundation, a land trust that works to protect wildlife habitat Down East, including wetlands important to waterfowl, wading birds and shorebirds.

And landowner Frank Taylor welcomed the researchers to use his mudflats to set up nets to catch, do health assessments and tag sandpipers.

Members of the public who take part in Christmas Bird Counts and Project FeederWatch also contribute valuable information about fluctuations in bird populations, Holberton says.

Making Maine a more welcoming place can improve the quality of life and chances for success for all feathered frequent fliers passing through. ■

Drawn to globe-trotters

SEAN RUNE is well traveled. Much like the semipalmated sandpipers he studies.

Before coming to the University of Maine, the master's degree zoology student had lived, studied or worked in Israel, Wisconsin, California, New Mexico and St. Thomas, Virgin Islands, to name a few.

His first week in Maine still made quite an impression.

Rune recalled that in August 2013, he boarded a boat in Down East, Maine to capture, measure and tag semipalmated sandpipers roosting on offshore ledges. He watched up close as a thousand shorebirds took flight to evade a falcon.

"It's hard to beat that kind of day," he says. "You can't help but be drawn to birds and bird migration. The more you learn, the more questions that are raised."

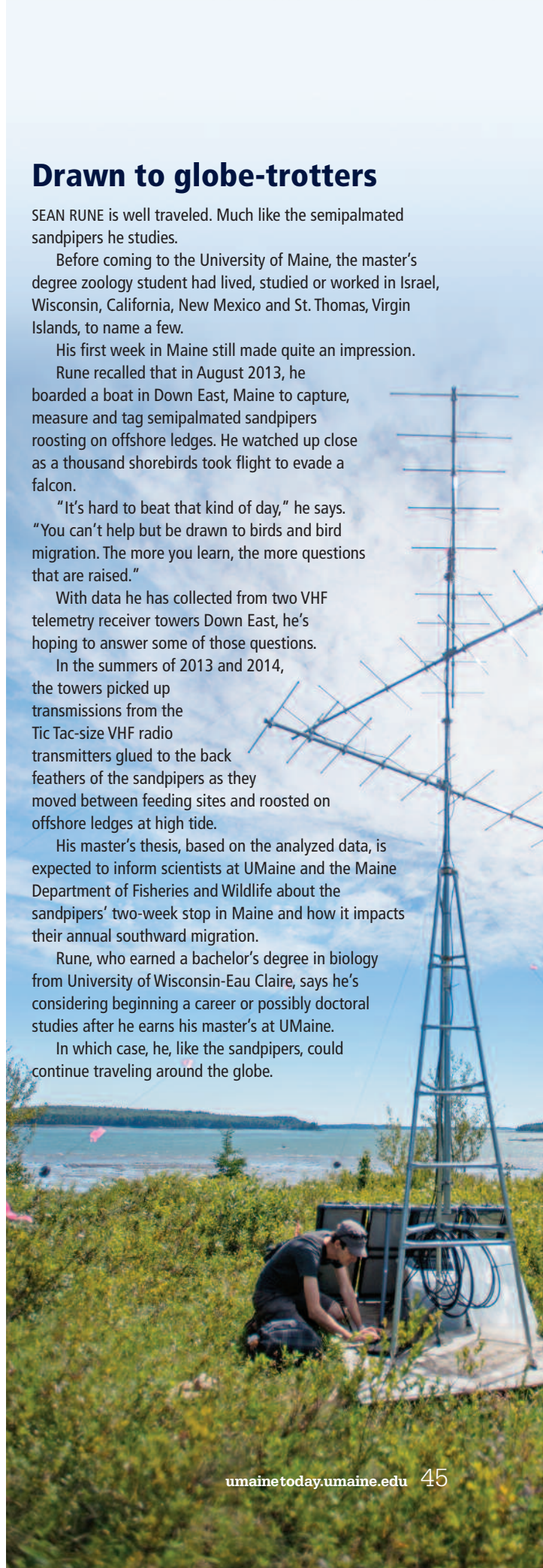
With data he has collected from two VHF telemetry receiver towers Down East, he's hoping to answer some of those questions.

In the summers of 2013 and 2014, the towers picked up transmissions from the Tic Tac-size VHF radio transmitters glued to the back feathers of the sandpipers as they moved between feeding sites and roosted on offshore ledges at high tide.

His master's thesis, based on the analyzed data, is expected to inform scientists at UMaine and the Maine Department of Fisheries and Wildlife about the sandpipers' two-week stop in Maine and how it impacts their annual southward migration.

Rune, who earned a bachelor's degree in biology from University of Wisconsin-Eau Claire, says he's considering beginning a career or possibly doctoral studies after he earns his master's at UMaine.

In which case, he, like the sandpipers, could continue traveling around the globe.



Investing in futures

New lab connects students to Wall Street

IN A scene right out of Wall Street, young men and women discuss investment strategies while scrutinizing real-time electronic trading and commodities data scrolling across numerous screens. The University of Maine students examine global, up-to-the-second energy prices, stocks and bonds, interest rates and supply chain analysis, honing skills they'll be able to employ in financial firms in New York City and around the world.

That's what Gerard S. Cassidy intended with his contribution that, coupled with other donations, helped create the Capital Markets Training Laboratory in the Maine Business School at UMaine.

Cassidy, who graduated from the University of Maine in 1980 with degrees in accounting and finance, knows well the world of capital markets.

He's managing director of equity research at the Portland, Maine-based RBC Capital Markets. At the investment bank with offices in 15 countries, he provides banking and

regional economic research to clients. He's also president of BancAnalysts Association of Boston, Inc., and he created Texas Ratio, a formula investors use to determine the financial health of banks.

The Wall Street Journal, New York Times, Forbes, CNBC, CNN, BNN and National Public Radio utilize him as an expert source about banking, stocks and economic issues.

Cassidy wants other UMaine graduates to be able to have similar opportunities, and he donated a gift to make the state-of-the-art financial education lab possible. In September, the Gerard S. Cassidy '80 Capital Markets Training Laboratory was dedicated in his honor.

"I was fortunate to get a solid foundation in accounting and finance here at UMaine," says Cassidy, who lettered in football and met his wife, Elaine Conley, an education major, at the university. "I hope that this new laboratory will bring a Wall Street environment to UMaine students and that they might benefit from exposure to a part of the business world they might not otherwise experience."

Investment banking wasn't Cassidy's initial career choice. During the spring of his senior year at UMaine, he learned he was a few credits shy of having enough to graduate. He phoned his parents to share the unpleasant news.

To complete his graduation requirements, he returned to UMaine and enrolled in a banking course, which sparked his interest in the field.

"A mistake ended up propelling me toward a career," he says.

The lab bearing his name provides a variety of business educational experiences for the 950 undergraduate and graduate students and 26 faculty members in the Maine Business School, as well as other students and staff members in other disciplines.

It's also an ideal facility in which to conduct portfolio management for the University of Maine Foundation, construct business models for commercializing products and analyze energy pricing for the University of Maine System.

The lab includes two 70-inch monitors for Bloomberg data — "real-time global financial and market

data, pricing, trading, news and communications tools.” Nine leased Bloomberg data feeds supply an instructor’s workstation and eight dual-monitor stations that can be utilized simultaneously by as many as 16 students.

“Upon graduation, many of our students will accept a position where being Bloomberg-savvy on day one is a real plus and is likely to give them an advantage over their contemporaries who have not had this experience,” says Robert Strong, University Foundation Professor of Investment Education, professor of finance and SPIFFY (Student Portfolio Investment Fund) adviser.

One wall-mounted monitor is designated for the SPIFFY portfolio. In the early 1990s, the University of Maine Foundation contributed \$200,000 to start a fund so students could apply financial knowledge learned in the classroom to real-world investing. Today, about 70 SPIFFY students participate in weekly presentations and research, then make trades through a broker. The SPIFFY fund now totals \$2.3 million in value. ■

Professor of Finance Robert Strong is the longtime adviser of the Student Portfolio Investment Fund (SPIFFY), launched in the early 1990s by the University of Maine Foundation with \$200,000. Today, SPIFFY manages a \$2.3 million portfolio and has a dedicated monitor in the new Cassidy Lab.



Safe space



Engineering researchers are helping NASA explore the technology required for living out of this world

By Elyse Kahl and Beth Staples

The self-portrait taken by NASA's Curiosity Mars rover, April–May 2014, using the camera at the end of its arm.

Image courtesy of NASA/JPL-Caltech/MSSS



Research being conducted at the University of Maine has the potential to improve conditions for life on Earth and in space — possibly even on Mars. Grants funded by NASA through the Maine Space Grant Consortium have allowed researchers in Orono to take part in projects with far-reaching impacts, including creating a wireless leak detection system for the International Space Station (ISS), and allowing a spacecraft transporting astronauts and equipment to enter a faraway planet's atmosphere.

THE CURIOSITY Rover took a selfie June 24 to celebrate its one Martian-year anniversary — 687 Earth days — on the Red Planet.

If NASA perfects its hypersonic inflatable aerodynamic decelerator (HIAD), a spacecraft nose-mounted “giant cone of inner tubes” stacked like a ring toy, one day people also may be taking selfies on the fourth planet from the Sun.

The HIAD slows a spacecraft as it enters a planet's atmosphere. The technology, says NASA, is intended to make it possible for a spaceship large enough to carry astronauts and heavy loads of scientific equipment to explore Mars — 34,092,627 miles from Earth — and beyond.

Bill Davids, the John C. Bridge Professor and chair of the Civil and Environmental Engineering Department; Joshua Clapp, a Ph.D. student in civil engineering; Andrew Goupee, Libra Assistant Professor of Mechanical Engineering; and Andrew Young, a Ph.D. student in civil engineering, are working with NASA to accomplish that mission.

The out-of-this world opportunity isn't the first impressive inflatable technology to be worked on at the UMaine Advanced Structures and Composites Center.

First there was the groundbreaking Bridge-in-a-Backpack™, so named because each deflated bridge arch fits into a Black Bear hockey equipment bag.

The award-winning, patented Bridge-in-a-Backpack™ has earned the American Association of State Highway and Transportation Officials' certification. Bridges similar to those in Belfast, North Anson and Pittsfield, Maine, as well as those in Massachusetts and Michigan, can be built around the country and world. One was built in the Caribbean, says Habib Dagher, the Bath Iron Works Professor and founding director of the world-renowned research and development center.

The bridges — stronger than steel and able to be built in a couple weeks — are made of light, portable carbon-fiber tubes that are inflated, formed into arches and infused



UMaine's Advanced Structures and Composites Center is collaborating with NASA to test the hypersonic inflatable aerodynamic decelerator (HIAD), designed to mount on the nose of a spacecraft and aid entry into a planet's atmosphere.



Our role is to **fill in holes in NASA's knowledge**. They have developed the technology; **we help advance it** through testing the structures in the lab.” Bill Davids

with resin. Concrete is poured inside the carbon fiber tubes, which protect the concrete from water and other natural elements, thus extending the bridge's lifespan to double or triple that of a traditional bridge.

Following Bridge-in-a-Backpack™, Davids led a UMaine group that worked on portable, lightweight, rapidly deployable inflatable fabric arch-supported structures for the U.S. Army Natick Soldier Systems Center.

Designed for military forces, the tents supported by inflatable arches also can be used for disaster relief shelters, temporary medical facilities and storage.

The research involving inflatable fabric arch-supported structures caught the attention of NASA scientists several years ago. NASA officials working on HIAD inflatable technology contacted Davids about possible research collaborations.

Ultimately, Davids' research proposal on the structural investigation of the HIAD technology to NASA's Experimental Program to Stimulate Competitive Research (EPSCoR) through the Maine Space Grant Consortium was accepted. UMaine is now about 17 months into the three-year, \$750,000 project funded by NASA and EPSCoR. The Maine Space Grant Consortium administers the funds.

Dagher says it's fascinating how one research discovery gives rise to another idea in a completely different field. “The beauty is you don't know where you're going to end up in the discovery process. One research discovery leads to another. It's a big roller coaster,” he says. UMaine engineers

have weekly telecoms with NASA project officials as they strive to make this promising technology a reality.

“Our role is to fill in holes in NASA's technical knowledge,” says Davids. “They have developed the technology; we help advance it through testing the structures in the lab and analyzing stresses and deformations in the HIADs.”

Davids and Clapp say the HIAD technology is viewed as one of the most, if not the most, feasible options for a successful human spaceflight to Mars and has the potential to allow landing at higher elevations on the planet, carrying more payload, or both.

Payloads that have landed on Mars to date have had a mass less than 1 metric ton; 40–80 metric tons likely will be required for a mission that includes people, says Clapp.

Also, all Mars landings thus far have been below -1.4 kilometer Mars Orbiter Laser Altimeter (MOLA) elevation due to the vertical distance required for deceleration. A number of scientifically interesting sites are at higher elevations, Clapp says.

UMaine researchers are working on a 6-meter diameter HIAD tested at NASA's National Full-Scale Aerodynamics Complex — the largest wind tunnel in the world — in Moffett Field, California.

“The 6-meter HIAD created the most air blockage of anything ever tested in the wind tunnel and pushed the limits of the equipment to the maximum,” Clapp says. “The HIAD diameter needed for a manned mission to Mars is estimated to be on the order of 20 meters. Therefore, we will not be able to conduct aerodynamic testing in

a wind tunnel, which makes a reliable predictive tool — for example, the finite element models that we're all working on — that much more important.”

Neil Cheatwood, principal investigator with the Inflatable Reentry Vehicle Experiment (IRVE-3) — a precursor to HIAD — says in a NASA video that if funding was not a concern, he estimated that by 2020, people could be on Mars, where temperatures range from minus 195 F to 70 F.

Keeping with the space theme, Dagher says with a smile that the Advanced Structures and Composites Center, much like Star Trek's starship Enterprise, allows people to boldly go where no one has gone before.

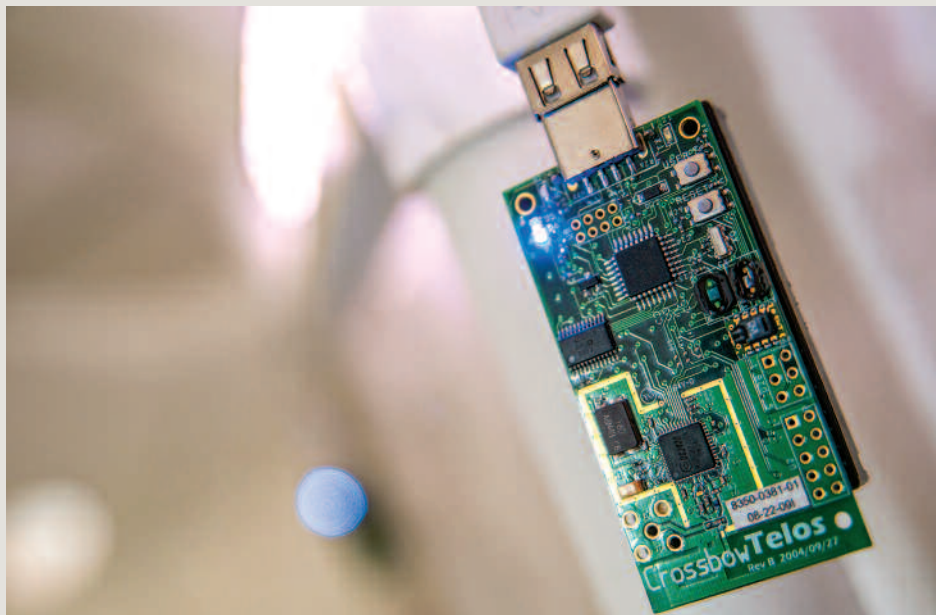
ACROSS CAMPUS in the university's inflatable lunar habitat and Wireless Sensing Laboratory (WiSe-Net Lab), researchers are designing and testing a wireless leak detection system for the International Space Station (ISS) that could lead to increased safety on ISS and other space activities, as well as on Earth in the event of gas and oil leaks at industrial plants.

The project was one of five in the nation to receive funding from NASA-EPSCoR for research and technology development onboard ISS.

Ali Abedi, a UMaine associate professor of electrical and computer engineering, was awarded a three-year, \$100,000 NASA grant through the Maine Space Grant Consortium in Augusta, which consists of higher education institutions and nonprofit research organizations that are actively involved in aerospace-related research and education.

Collaborators on the project include Vince Caccese, a UMaine mechanical engineering professor, and George Nelson, director of the ISS Technology Demonstration Office at the NASA Johnson Space Center.

“We are very excited to be selected among the only five groups in the nation to conduct a flight test on ISS,” Abedi



UMaine graduate students, from left, Casey Clark, Mojtaba Razfar and Lonnie Labonte test wireless sensors in UMaine's inflatable lunar habitat with Ali Abedi, an electrical and computer engineering professor who directs the Wireless Sensing Laboratory (WiSe-Net Lab). The lab conducts research on wireless communications ranging from coding and information theory to wireless sensor networks and space applications.

Safe space

says. “This will be a great training experience for our students to learn how to take a prototype out of the lab, and not only to the field but also to space.”

Leaks causing air and heat loss are a major safety concern for astronauts, according to Abedi. It is important to save the air when it comes to space missions — find the leak and fix it before it’s too late.

Abedi’s project involves the development of a flight-ready wireless sensor system that will be able to quickly detect and localize leaks based on ultrasonic sensor array signals. The proposed system is fast, accurate and capable of detecting multiple leaks and localizing them with a light-weight and low-cost system.

“Our goal is to push the boundaries of hardware and software to design a highly accurate, ultra-low-power and lightweight autonomous leak detection and localization system for ISS,” Abedi says.

The lab prototype was developed by UMaine Ph.D. student Joel Castro and postdoctoral fellow Hossein Roufarshbaf as part of a previous NASA EPSCoR project and was tested on UMaine’s inflatable lunar habitat. With the new funding, researchers are making the system more rugged and revising it for microgravity environment testing at the NASA Johnson Space Center in Houston, Texas, and then onboard ISS in the next two to three years.

The testing and verification of the system in a micro-gravity environment will help determine how well the system performs in space, as well as on Earth.

“Leak detection methods developed for extreme space environments will push the limits of current technology for ground-based leak detection at home and in industrial plants,” says Abedi, who directs the WiSe-Net Lab, which conducts research on wireless communications. ■

Pack your intergalactic bags

In case space travel is in your plans, we asked University of Maine Professor of Physics Neil Comins to list 10 of the top hazards every orbiting tourist should know. Comins is the author of 19 books on space, including his 14th volume, *The Hazards of Space Travel: A Tourist’s Guide*.

- Early (soon after launch) onset of nausea
- Early inability to digest food
- Bone and muscle mass loss
- Radiation poisoning from a solar flare or solar mass ejection
- Rapid degrading of medicines in space
- Interpersonal issues among space travelers, and between space travelers and people on the ground
- Hardware failures
- Impacts from particles in space
- Claustrophobia
- Dust from surfaces of the worlds you visit

An image of Mars taken at the new Emera Astronomy Center, home of the Jordan F. Planetarium and Observatory at the University of Maine



Following a passion for product development

Kathleen Crosby

Connecting the dots

GROWING UP, Kathleen Crosby always played with her food. “I just wanted to experiment,” says the fourth-year University of Maine student from Georgetown, Maine, a food science and human nutrition major. **UNDERGRADUATE RESEARCH:** In her first year at UMaine, Crosby learned about the seafood research of UMaine food scientist Denise Skonberg and joined her lab. “I grew up on the coast, and my dad’s a lobsterman, so I said, ‘I have to get in on this.’” In the lab, Crosby has been mentored by Skonberg and doctoral graduate student Brianna Hughes, who received her degree in May and is now a product development specialist with Ocean Spray. **INDUSTRY EXPERIENCE:** This past summer, Crosby interned with FMC Corporation in Rockland, Maine, a

leading seaweed-based business that produces carrageenan. Because of her undergraduate research experience, Crosby was familiar with many of the instruments and had the skills to work in quality assurance, quality control and chemical analysis. “I really liked that, working in a real lab and seeing how much your work means in the food industry,” she says. **PRODUCT DEVELOPMENT:** In this, her senior year, Crosby is on a capstone project team developing a new product called Pretzel Craves that features a cranberry dough. Her team will “go through all the steps we would in industry” — from ingredient formulations and consumer testing to market research and package development. When she graduates, Crosby hopes to work in food quality assurance or quality control — and, ultimately, product development. ■

President Abram W. Harris Awards

AS PART of its 80th anniversary celebration this fall, the University of Maine Foundation presented the President Abram W. Harris Award to one graduate from each of UMaine's colleges. The Harris Award was established in the University of Maine Foundation in 2003 by President Harris' grandson Abram "Pete" W. Harris III '50 and his friend Marion Waterman Meyer '51. This year's Harris Awardees were scholarship recipients as UMaine students. They were honored for exemplary leadership, contributions to community and service to UMaine that reflect the essence of Dr. Harris' efforts as the president of the University of Maine, 1893 to 1901. To honor their legacies as successful scholarship recipients, the University of Maine Foundation presented the University of Maine with \$1,000 scholarships in the name of each of the Harris Award recipients. The scholarships will be awarded in the next academic year. Photos courtesy of the University of Maine Foundation



CHRISTOPHER P. KEATING

Investment Management Executive
B.S. Business Administration, 1979

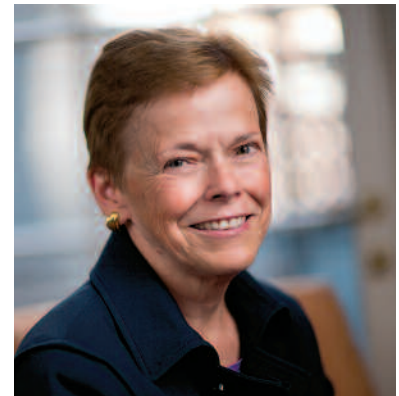
Chris Keating played for seven years in the National Football League, spending six years with the Buffalo Bills, and one with Washington. In his last three off-seasons from football, Keating worked as a registered stockbroker. Upon retirement, Keating earned his law degree from Suffolk University Law School in 1991. Combining his experience and education allowed Keating to transition into the investment management industry, where he continues to work today.



JOHN K. VERONEAU

Partner, Covington & Burling LLP
B.A. English, 1983

John Veroneau practices international trade law at Covington & Burling LLP, a Washington, D.C.-based global law firm, where he co-chairs the international trade and investment practice group. He has served in U.S. Senate-confirmed positions in Republican and Democratic administrations. Under President George W. Bush, he was deputy United States trade representative (USTR) and USTR general counsel. Under President Clinton, he served as assistant secretary of defense for legislative affairs. Veroneau was legislative director to former U.S. Sen. Bill Cohen and former U.S. Senate Majority Leader Bill Frist, and chief of staff to U.S. Sen. Susan Collins.



C. ANN MERRIFIELD

Life Sciences Executive and Board Member
B.A. Zoology, 1973
Master of Education, 1975

Ann Merrifield works with a number of small technology businesses as an independent board member, adviser or investor. From 2012–14, she was president and chief executive officer of PathoGenetix Inc., a commercial stage developer of an automated system for rapid identification and typing of pathogenic bacterial strains. Prior to joining PathoGenetix, Merrifield spent 18 years at Genzyme Corporation, a diversified global biotechnology company. Earlier in her career, Merrifield was a partner at Bain and Co., a global strategy consulting firm, and she was an investment officer at Aetna Life & Casualty.



DR. DEBRA A. GERVAIS

Division Chief of Abdominal Imaging,
Massachusetts General Hospital

Associate Professor of Radiology, Harvard
Medical School

B.S. Chemistry/Honors College, 1986

Dr. Debra Gervais attended Tufts Medical School and completed an internship year in internal medicine at Maine Medical Center in Portland, Maine. She completed her residency training in diagnostic radiology at Massachusetts General Hospital, where she served one year as chief resident in radiology. She also pursued subspecialty fellowship training in abdominal imaging and intervention. Prior to her return to Massachusetts General Hospital, Dr. Gervais was a private practice radiologist and attending radiologist at Boston Children's Hospital.



MARK "ROOKIE" A. LETENDRE

Director of Umpire Medical Services

Office of the Commissioner,
Major League Baseball

B.S. Physical Education and Health, 1978

In 2000, Mark Letendre was selected by Major League Baseball's Office of the Commissioner to develop and oversee the first comprehensive athletic health care program for the 74 umpires in the major leagues. Letendre served as a Major League Baseball head athletic trainer for 14 years with the San Francisco Giants, and eight years as a minor league and assistant athletic trainer with the New York Yankees. Letendre was honored to serve as National League athletic trainer at the 1987 and 1994 MLB All-Star Games.



CALEN B. COLBY

President, Colby Company Engineering

B.S. Civil Engineering, 1985

M.S. Civil Engineering, 1991

Calen Colby spent the first part of his career overhauling nuclear attack submarines. For 15 years, he worked for a national contractor designing and constructing power plants, and then became a project manager in the paper industry in the United States and Europe. Colby then worked in the A/E consulting engineering field. He is a registered professional engineer in 27 states and five Canadian provinces. In 2008, Colby and his wife founded Colby Company Engineering, a Portland, Maine-based firm with 26 employees.

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



umainefoundation.org

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



FOR THE FISHING INDUSTRY

LOBSTERS, FIN fish and mussels are the focus of three research projects chosen for more than \$850,000 in funding from the National Oceanic and Atmospheric Administration's Saltonstall-Kennedy (S-K) Grant Program to benefit the U.S. fishing industry.

Two of the 40 grants were recommended to be given to projects led by University of Maine researchers, and one to a collaborative effort between UMaine, the University of Maine at Machias and the Marine Biological Laboratory (MBL) in Woods Hole, Mass.

One project seeks to determine if increasing ocean temperature is a causative agent in the population decline of lobsters in southern New England. Another seeks to improve the survival of cusk and Atlantic cod bycatch from lobstering. The third will use the experimental shellfish hatcheries at UMaine's Darling Marine Center in Walpole, Maine and MBL to develop technology to cost-effectively produce mussel seed to meet the needs of the Northeastern United States mussel culture industry.

UMaine professors Heather Hamlin, an assistant professor of aquaculture, and Yong Chen, a professor of fisheries population, are the principal investigators of the two UMaine-led studies. Paul Rawson, an associate professor of marine sciences and a cooperating assistant professor of biological sciences at UMaine, will receive an S-K grant as a collaborator in a study led by Scott Lindell of MBL.

More than **61%** of Mainers — whose median age is nearly 43 years — live in areas with fewer than 2,500 people.



A SHOT IN THE ARM

THE UNIVERSITY of Maine School of Nursing has been awarded a federal grant to defray educational costs of family nurse practitioner (FNP) students who will provide primary health care for rural Mainers in medically underserved areas.

The nearly \$600,000 Advanced Education Nursing Traineeship grant from the U.S. Department of Health and Human Services will aid eligible, full-time FNP students in the School of Nursing master's degree program this year and next.

"Reducing the financial burden associated with graduate education is a tremendous benefit for the RNs enrolled in UMaine's rigorous FNP program," says Nancy Fishwick, director of UMaine's School of Nursing.

Family nurse practitioners provide comprehensive primary health care services to people, from infancy through adulthood. Since the inception of UMaine's FNP program in 1992, the majority of its graduates have lived and worked in medically underserved and rural areas in the state.

Maine is both the oldest and most rural state in the nation, according to the 2010 U.S. Census Bureau. More than 61 percent of Mainers — whose median age is nearly 43 years — live in areas with fewer than 2,500 people.

Mary Shea, UMaine assistant professor of nursing and graduate program coordinator, is directing the project.



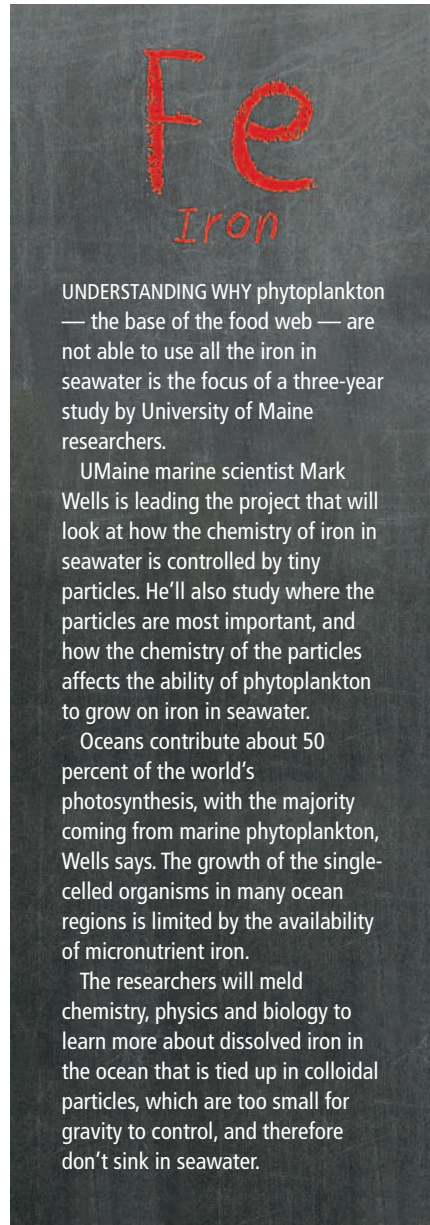
THINK BIG, GO SMALL

UNIVERSITY OF Maine researchers have been awarded \$700,000 to develop eco-friendly particleboard panels with adhesive made of cellulose nanofibrils (CNF), as well as design a commercial-scale plant to manufacture the CNF.

With one \$350,000 grant, UMaine scientists Mehdi Tajvidi, William Gramlich, Doug Bousfield, Doug Gardner and Mike Bilodeau, as well as John Hunt from the USDA Forest Service (USFS), are tasked with making strong, stiff and fully recyclable particleboard panels that can be used in countertops, door cores and furniture. The adhesive in the particleboard will be made from CNF, rather than urea-formaldehyde.

To optimize techniques and methodology, UMaine has been awarded another \$350,000 to construct a commercial-scale CNF manufacturing plant with a capacity of 2 tons per day. Bilodeau will collaborate with Zhiyong Cai of USFS on the commercial plant project.

UMaine researchers taking part in the project have a range of expertise — from forest products to chemistry and biological engineering.



UNDERSTANDING WHY phytoplankton — the base of the food web — are not able to use all the iron in seawater is the focus of a three-year study by University of Maine researchers.

UMaine marine scientist Mark Wells is leading the project that will look at how the chemistry of iron in seawater is controlled by tiny particles. He'll also study where the particles are most important, and how the chemistry of the particles affects the ability of phytoplankton to grow on iron in seawater.

Oceans contribute about 50 percent of the world's photosynthesis, with the majority coming from marine phytoplankton, Wells says. The growth of the single-celled organisms in many ocean regions is limited by the availability of micronutrient iron.

The researchers will meld chemistry, physics and biology to learn more about dissolved iron in the ocean that is tied up in colloidal particles, which are too small for gravity to control, and therefore don't sink in seawater.

Pot Versus Pills

THE POTENTIAL for medical marijuana to curb the growing incidence of opioid analgesic-associated deaths was the focus of an invited commentary in the Aug. 25 *Journal of the American Medical Association (JAMA)*, co-authored by a University of Maine psychology researcher and a physician at Eastern Maine Medical Center (EMMC).

The invited commentary, "Legalization of Medical Marijuana and Incidence of Opioid Mortality," by Marie Hayes, a UMaine professor of psychology, and Dr. Mark Brown, chief of pediatrics and director of nurseries at EMMC, references a study in the same *JAMA* issue examining the link between medical marijuana laws and unintentional overdose mortality from opioid analgesics.

This is the second time in the past two years that Hayes has been tapped for commentary by *JAMA* as a result of her research on substance-exposed newborns. And in 2013, she also was the co-author of a *JAMA* research paper.



The striking implication is that medical marijuana laws, when implemented, **may represent a promising approach** for stemming runaway rates of nonintentional opioid analgesic-related deaths." Marie Hayes and Dr. Mark Brown



SCIENCE EVOLVES

WHILE EVOLUTION often evokes thoughts about ancient origins of life, University of Maine researcher Michael Kinnison says applied evolutionary biology is about improving the future — including pressing matters of day-to-day life and issues of international policy.

A paper by lead authors from the University of Copenhagen and the University of California, Davis, as well as Kinnison, highlights ways in which food security, human health and biodiversity can benefit in the short- and long-term by using principles of evolutionary biology.

Michael Kinnison's research on fish and wildlife has shown that evolution is a surprisingly dynamic process and is extensively shaped by human activities.

The paper published online Sept. 11 at Science Express indicates when evolution is overlooked, the prevailing approaches to treat human disease, reduce agricultural pests and manage at-risk wildlife can be detrimental to achieving sustainable solutions, and exacerbate the very problems they're trying to prevent.



ACCELERATED RECOVERY

LAKES IN New England and the Adirondacks are recovering from the effects of acid rain more rapidly now than they did in the 1980s and 1990s, according to a study led by a University of Maine researcher.

Acid rain — which contains higher than normal amounts of nitric and sulfuric acid, and is harmful to lakes, streams, fish, plants and trees — occurs when sulfur dioxide and nitrogen oxide in the atmosphere mix with water and oxygen.

In the United States, about two-thirds of sulfur dioxide and one-quarter of nitrogen oxide result from burning fossil fuels, including coal, says the U.S. Environmental Protection Agency.

Sulfate concentration in rain and snow dropped 40 percent in the 2000s, and sulfate concentration in lakes in the Northeast declined at a greater rate from 2002–10 than during the 1980s or 1990s, says Kristin Strock, a former UMaine doctoral student, now an assistant professor at Dickinson College, who conducted the research in collaboration with UMaine researchers Jasmine Saros and Sarah Nelson.

Also during the 2000s, nitrate concentration in rain, snow and lakes began to decline more rapidly, Strock found. Long-term monitoring is essential to detection of these types of trends.

CHEMICAL REACTION

A UNIVERSITY of Maine study is examining how a synthetic antimicrobial common in soaps and deodorants inhibits cells that sometimes fight cancer.

The National Institutes of Health awarded Julie Gosse, associate professor of molecular and biomedical sciences, more than \$420,000 for the three-year project.

Triclosan (TCS) was once limited to use in hospitals, but in the 1990s, manufacturers began adding the chemical to antibacterial soaps, toothpaste, body washes, facial cleansers and other over-the-counter hygiene products.

TCS also is used in fabrics, plastics and clothing to slow or stop the growth of bacteria and mildew. Because of its pervasive presence in products, Gosse says TCS is also now in waterways.

When TCS inhibits the function of mast cells in skin, allergic disease may be eased. But Gosse says mast cells are involved in both pro- and anti-cancer roles, in fighting bacterial infections and in central nervous system disorders such as autism.

Gosse says the grant will allow continued exploration of the molecular mechanisms underlying the effects. She and her research team will use a variety of methods and tools — including the fluorescence photoactivation localization microscopy (FPALM) technique invented by UMaine physicist Sam Hess. The technique images individual molecules.

Hess is participating in the research, as are Lisa Weatherly and Juyoung Shim, graduate students in Gosse's lab, and students from the Hess lab.



Turning down the heat

A NEW pepper variety has been developed with a high capsinoid content to make it less pungent while maintaining all the natural health benefits of the fruit, according to U.S. Department of Agriculture and University of Maine researchers.

The scientists — Robert Jarret from the USDA/Agricultural Research Service in Griffin, Georgia, and Jason Bolton and L. Brian Perkins from the University of Maine School of Food and Agriculture — developed the new small-fruited *Capsicum annuum L.* pepper through traditional breeding methods in an effort to make the health benefits of hot peppers available to more consumers.

In hot peppers, capsaicinoids are the compounds associated both with their signature heat and health benefits, which include being a source of antioxidants. But that pungency can limit their use in foods and pharmaceuticals.

Capsinoids, closely related compounds of capsaicinoids, provide the same benefits without the pungency.



Photo courtesy of Craig Lee

Changing patterns in sea ice have significant implications for the planktonic food web, and flow of carbon and nutrients in the Arctic, including timing, magnitude and location of plankton blooms.

UNDER THE ICE

UNIVERSITY OF Maine research conducted this past summer in the Arctic's Marginal Ice Zone is expected to provide one of the first comprehensive views of the spatial distribution and abundance of phytoplankton under the ice. UMaine oceanographer Mary Jane Perry, interim director of the Darling Marine Center, received \$196,000 from the U.S. Department of Defense Office of Naval Research to sample the biogeochemistry of the Marginal Ice Zone from a Korean icebreaker and with underwater gliders. UMaine scientist Cameron Thompson participated in additional cruises from Alaska's Prudhoe Bay; Ivona Cetinić, also at the Darling Center, is involved in data analysis. Perry joined an international group of more than 40 scientists studying sea ice retreat in the Arctic. The Arctic has experienced a dramatic decline in sea ice thickness, aerial extent and age distribution. Changing patterns in sea ice have significant implications for the planktonic food web, and flow of carbon and nutrients in the Arctic, including timing, magnitude and location of plankton blooms. The Marginal Ice Zone Program, led by the University of Washington, is an Office of Naval Research initiative using autonomous robotic technologies, ships, aircraft and satellites to study the breakup and retreat of ice in the Beaufort Sea. The research is expected to contribute to our understanding of ice dynamics, including feedbacks in the ice-ocean-atmosphere system that affect rates of sea ice decline.

The pools, located mainly on private land, are a key-breeding habitat for several amphibians and serve as an important wetland resource for wildlife.



TAKING A DIVE

THIS SPRING, University of Maine associate research professor Rhian Waller in the School of Marine Sciences will be chief scientist on an expedition to explore, map and survey underwater habitats and ecosystems of Glacier Bay National Park and Preserve in Alaska.

Waller has been awarded more than \$897,000 for the collaborative project with the National Park Service, National Oceanic and Atmospheric Administration, U.S. Geological Survey, University of Connecticut, University of Hawaii and Rutgers University. She will examine deep ecosystems in some of the as-of-yet-unexplored remote fjords facing the outer Gulf of Alaska within the national park boundaries.

The park's unique fjord region has complex geological formations that provide a diverse array of marine habitats, says Waller. And what the divers and ROV learn will inform the National Park Service's marine resource management decisions.

WORTH THE TRIP

THE UNIVERSITY of Maine was named one of the 2014 Top Campuses Worth Traveling For by FlipKey.com, the vacation rental company of travel site TripAdvisor. The company used industry research and traveler feedback to compile the list of the country's 50 must-see colleges and universities known for attractions, architecture, history and beautiful campuses. UMaine was included on the list, specifically for the campus plan that was designed by landscape architect Frederick Law Olmsted, who also designed the grounds of New York City's Central Park and the U.S. Capitol in Washington, D.C. Other universities that made the list include Notre Dame, Johns Hopkins, MIT, Princeton, Duke, Dartmouth and Cornell.



Protecting pools

A RECENT article in the *Proceedings of the National Academy of Sciences* documents nearly 15 years of vernal pools research and management by University of Maine wetland ecologist Aram Calhoun, who is leading an interdisciplinary team at UMaine's Senator George J. Mitchell Center for Sustainability Solutions.

Calhoun and three coauthors — Jessica Jansujwicz, a Sustainability Solutions Initiative (SSI) postdoctoral fellow; Kathleen Bell, associate professor of economics; and Malcolm Hunter Jr., Libra Professor of Conservation Biology and professor of wildlife ecology — analyze a timeline of action and scholarship dating to 1999. In that time, close collaboration with academic colleagues, government at all levels, nongovernmental organizations, landowners, developers and citizens created an environment in which these small, significant wetlands can flourish.

Calhoun and SSI vernal pools researchers, along with other economists and biophysical scientists, have received a \$1.49 million grant from the National Science Foundation's Dynamics of Coupled Natural and Human Systems Competition Program. The four-year project began in 2013 and supports research focused on more effective strategies when it comes to vernal pools and small, natural landscape features that contribute disproportionately to larger ecosystem functions.

PERCEPTION AND REALITY

WHEN IT comes to recognizing instances of sexual harassment in the workplace, age is a fundamental factor in shaping individuals' perceptions of interactions, according to a University of Maine sociologist.

Amy Blackstone, chair of UMaine's Sociology Department, found age is important because how perceptions shift over time links to several age-related processes, such as maturity and historical context.

Participants suggested prior work experiences changed their ideas about workplace interactions and themselves as workers.

Blackstone worked with Jason Houle, a UMaine alumnus who is now an assistant professor of sociology at Dartmouth College, and Christopher Uggen, a Distinguished McKnight Professor of Sociology at the University of Minnesota, to examine how perceptions of sexual harassment at work are linked to an individual's age, experience and historical backdrop. Their findings were published in the journal *Sociological Spectrum*.

Three themes emerged among participants: As adolescents, respondents perceived some of the sexualized interactions they experienced at work as fun; while participants did not define some of their early experiences as sexual harassment at the time, they do now; and participants suggested prior work experiences changed their ideas about workplace interactions and themselves as workers.



This is about more than a market drive. **It's about socialization and community.** Timothy Waring

OPTING FOR LOCAL

MAINERS PREFER to buy local food from in-state farmers, fishermen and businesses, according to a new survey.

The findings are indicative of a sea change happening in the food industry — and Maine is on the leading edge, says University of Maine economist Timothy Waring, a member of Maine Food Strategy, the multi-institution team that prepared the report.

Of those surveyed, 80 percent said they purchase at least some produce, meat and fish from local sources. Two-thirds of respondents said they did so out of a desire to support local food providers.

"Maine is a national leader in supporting the local foods industry," said Waring, a member of UMaine's Senator George J. Mitchell Center for Sustainability Solutions.

Local food is one of Waring's areas of expertise. He recently received a five-year \$500,000 grant from the National Science Foundation to explore the role of cooperation in the local food industry.

Though local foods still make up a small percentage of total food purchased in Maine, Waring said the Maine Food Strategy report indicates the potential for a broader local shift.

"People feel more responsible and indebted to those who provide local food. They may know the farmer or the fisherman. They are willing to go out of their way to buy the food," Waring said. "It's not as depersonalized as the grocery store."

61%

of people surveyed considered "local" food to apply to the entire state of Maine



CHARTING A PATH

IMPROVING ACCESS to and the comprehension of visual material such as charts and maps for persons with visual disabilities is the focus of a three-year, \$500,000 National Science Foundation grant led by Nicholas Giudice, an associate professor in the University of Maine's School of Computing and Information Science. The research aims to develop and evaluate an intuitive, low-cost tool to aid the interpretation of graphic data for those who can't rely on vision to do so. The ability to effectively use and accurately understand graphs, figures and other visual representations of

“ If this tool is developed, deployed and broadly implemented, **it would make blind people more confident.**”

Nicholas Giudice

numeric data is critical for success in the classroom and at work, Giudice says. Spatial learning and navigating in and outside the home also frequently depend on the use of maps and other graphical aids, which can be challenging for blind people to use, he says. Providing a way for people with visual disabilities to process graphics will boost their employability, as well as confidence, independence and overall quality of life.



FIGHTING INFECTION

UNIVERSITY OF MAINE microbiologist Robert Wheeler has received a five-year, \$500,000 fellowship from the Burroughs Wellcome Fund to study how and why *Candida albicans* — the most common human fungal pathogen — transforms from an innocuous yeast in the digestive tract of a person with a healthy immune system to a potentially fatal fungus in vital organs of a person whose immune system has been compromised. Wheeler is one of 12 scientists nationwide to be named 2014 Investigators in the Pathogenesis of Infectious Disease. The goal of his research is to improve diagnosis and therapy of fungal infection through better understanding of the interactions between host and pathogen cells. His lab will explore the host-fungal dialogue at mucosal surfaces where *C. albicans* — the leading cause of hospital-acquired infection that annually kills several thousand patients in the U.S. — is normally kept in check.



VIEWS OF THE SOUTHERN OCEAN

THE SOUTHERN Ocean that encircles Antarctica lends a considerable hand in keeping Earth's temperature hospitable by soaking up half of the human-made carbon in the atmosphere and a majority of the planet's excess heat. Yet, the inner workings — and global importance — of this ocean that accounts for 30 percent of the world's ocean area remain relatively unknown to scientists, as dangerous seas have hindered observations.

Princeton University and 10 partner institutions seek to make the Southern Ocean better known scientifically and publicly through a \$21 million program that will create a biogeochemical and physical portrait of the ocean using hundreds of robotic floats deployed around Antarctica.

In addition, in a companion project, NASA awarded \$600,000 to University of Maine oceanographer Emmanuel Boss, an expert in marine optics and in the use of optical sensors to study ocean biogeochemistry. Boss will collaborate with Rutgers University and scientists from the Princeton-led project to equip the floats with bio-optical sensors to gather data about biological processes in the water column.



Celebrating **150** years

A legacy of leadership

THE MAINE College of Agriculture and the Mechanic Arts was established in 1865 under the Morrill Act that was signed by President Abraham Lincoln. Three years later, the first class — 12 students — was welcomed to campus. In 1897, the college changed its name to the University of Maine and its statewide mission as Maine's land grant institution continued, stronger than ever.

In 2015, the University of Maine will celebrate its 150-year legacy of leadership in the state. Events, activities and publications — including *UMaine Today* — will provide opportunities for members of the UMaine community and its many constituents to reflect on the history of Maine's land and sea grant university, and look to its future.

Watch for the University of Maine's 150th website (umaine.edu/150) at the start of the new year.

President A.W. Harris and faculty and staff are pictured here (not in order) on the steps of Coburn Hall in 1893: Alfred Aubert, James Bartlett, David Colby and Lucius Merrill, chemistry; Fred Briggs, natural history; Horace Estabrooke, English; Harriet Fernald, librarian; Walter Flint, mechanical engineering; Harris Gould, Weldon Munson and David Trine, horticulture; Gilbert Gowell, animal industry; Nathan Grover, civil engineering; Charles Hamlin, insolvency; James Hart, mathematics and astronomy; Francis Harvey, natural history; Mark Hersey, military science; Whitman Jordan, agriculture; Allen Rogers, history, logic and civics; Fremont Russell, veterinarian; James Stevens, physics; and Howard Webb, registrar.



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

