MAINE EPSCoR

Maine EPSCoR

FALL 2016 NEWSLETTER

High-tech buoys

Students learn sensor technology at UMaine

THE UNIVERSITY OF MAINE

From the director

WITH ITS roughly 3,500 miles of coastline as a living laboratory, Maine has a unique environment to drive aquaculture research. Aquaculture was identified as a key growth sector for the state by the Maine Innovation Economic Advisory Board in the 2010 Science and Technology Action Plan. In 2014 alone, the aquaculture industry grossed $137.6 million in economic impact for the state.

Our current NSF EPSCoR Track 1 grant, the Sustainable Ecological Aquaculture Network (SEANET), consists of four research themes: Ecological and Sociological Carrying Capacity; Aquaculture in a Changing Ecosystem; Innovations in Aquaculture; and Human Dimensions. These themes collaborate through a variety of projects to positively impact Maine's working waterfront. Our latest issue of the Newsletter includes information about some of the projects happening under SEANET.

SEANET presently consists of 37 faculty members, 93 undergraduate students and 41 graduate students who are engaged in aquaculture research at 10 institutions across the state.

During the past several months, we have been busy with many projects under the SEANET grant, and related accomplishments, include the following:

- Year 2 Annual Report approved
- Recent completion of a Project Summary Report containing 55 project summaries encompassing the entire SEANET research program
- Successful Reverse Site Visit in May with ongoing follow-up dialogue with NSF
- Follow-on grants totaling $5,995,388

The New England Sustainable Consortium (NEST) Safe Beaches & Shellfish Track 2 project successfully ended in July. Research continues on the NEST Future of Dams Track 2 project in collaboration with research teams from New Hampshire and Rhode Island. The project is being managed by UMaine's Senator George J. Mitchell Center for Sustainability Solutions under the leadership of David Hart, Sharon Klein, Bridie McGreavy, Sean Smith and Joe Zydlewski.

Finally, our Track 3 SMART (Stormwater Management Resource Team) program just completed its third year. Paige Brown, a high school student from Bangor and participant in the SMART program, won several competitions with her program work. The most prestigious award was the First Place Medal of Distinction for Global Good in the Intel Science Talent Search. SMART is waiting on confirmation of a new NSF grant to continue its momentum nationwide.

It is with great pleasure that I introduce our newly improved newsletter and invite you to read about our latest advances in research. Your interest in our research is tremendously appreciated.

SHANE MOEYKENS, PH.D.
Director of Research Administration and Maine EPSCoR

Marine ecology class from Darling Marine Center's field trip to intertidal pools at Chamberlain.

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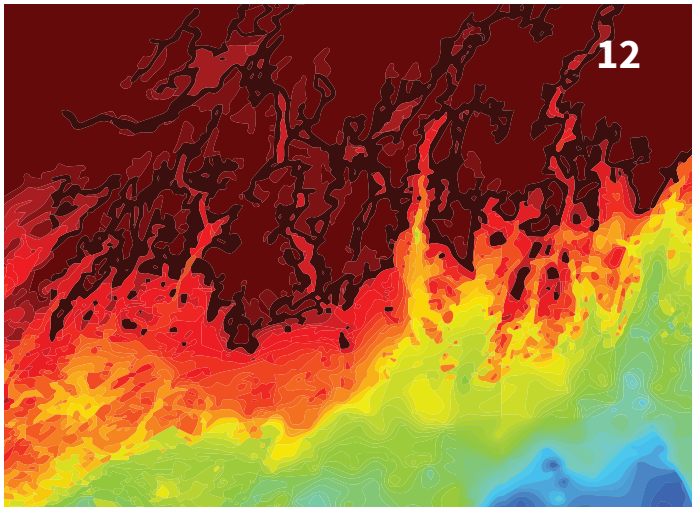
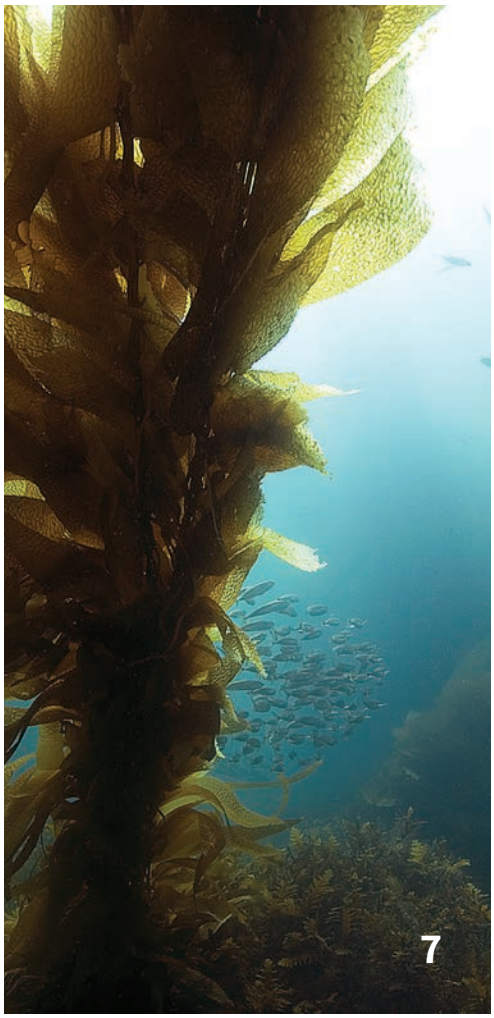


Features

ON THE COVER:
Matthew Gray, postdoctoral research associate at UMaine's Darling Marine Center, views data from an ocean-observing buoy at the mouth of the Damariscotta River to help scientists understand how different types and scales of aquaculture can fit into Maine's multiuse working waterfront. The buoy is part of the National Science Foundation's EPSCoR program, the Sustainable Ecological Aquaculture Network (SEANET), focused on creating more sustainable coastal communities and ecosystems through a deeper understanding of how these systems interact with and influence each other.



What is Maine EPSCoR?

The Experimental Program to Stimulate Competitive Research (EPSCoR) was initiated at the National Science Foundation in 1978, and now encompasses EPSCoR programs at several other federal agencies.

Maine EPSCoR at the University of Maine seeks to expand opportunities for more diverse faculty, staff and student populations. Diversity brings different perspectives and skill sets, and helps broaden our vision. We recognize that geographic and societal challenges exist that require pragmatic solutions with achievable and measurable goals. Maine EPSCoR strives to enhance diversity in all elements of EPSCoR programs while increasing participation of underrepresented minorities in science, technology, engineering and mathematics (STEM) disciplines.

Attaining aquaculture

Adequate scaling for Maine's working waterfront

GRADUATE RESEARCH assistant Libby Gorse, whose lab is in the basement of Boardman Hall at the University of Maine, is excited about research she's spearheading for a Sustainable Ecological Aquaculture Network (SEANET) project. She and Aria Amirbahman, professor of civil and environmental engineering, are studying the effects that aquaculture farms have on sediment below them.

Gorse, a civil engineering Ph.D. student, has been interested in chemistry since she was 13. Her father was an analytical chemist and Gorse followed in his footsteps by studying chemistry at Baldwin Wallace University in Berea, Ohio. She says she has been using some of the lab equipment involved in her research project since she was a youth.

The SEANET project is administered by Maine EPSCoR at UMaine. The five-year, $20 million grant from the National Science Foundation will help Maine explore how different types and scales of aquaculture fit into Maine's multiuse working waterfront.

Research involves environmental monitoring using field investigations and lab analysis along with buoy-based sensor technology to understand trophic dynamics of aquaculture within Maine's coastal ecosystem — how nutrients move from the physical environment into living organisms and then re-enter the environment.

Ph.D. candidate Libby Gorse compares sediment samples in her lab in Boardman Hall at UMaine.

SEANET has purposely split the state into three separate bioregions as a means to study each area in depth. The Maine coast serves as a living laboratory, allowing researchers to explore the feasibility of aquaculture operations. Gorse's studies will occur in all three areas and will contribute to an understanding of the carrying capacity — what density of aquaculture operations can be maintained, what kind of sites, or how many sites are appropriate — considering local conditions.

"My study will look at the different biodeposits from oysters, mussels, finfish, and all the different operations Maine supports," says Gorse. "We need to grasp how to balance aquaculture operations to keep everything healthy and know how many sites or types of sites are appropriate."

For SEANET, the studies will help determine how much aquaculture an area might be able to support. By studying the sediment below the farms, Gorse and Amirbahman hope to find out how best to advise aquaculture farmers regarding growth and placement of farms along the coast.

"It's important to know the footprint — chemical and biological — of these farms," Amirbahman says. "It's especially important for us to understand the role that these operations have on the overall nutrient budget of these systems. It will help us understand where to site — for instance how far apart from each other these operations should be. What kind of flushing rate you have, for instance — dilution via the tide or the current that can solve a lot of problems."

COLLABORATION ACROSS DEPARTMENTS

To create the equipment for her study, Gorse worked with the Advanced Manufacturing Center (AMC) at UMaine to construct flux chambers to hold her sediment samples, which she uses in conjunction with a pump system to move water through the chambers, and a chiller unit to keep the temperature of the samples at a consistent bottom water level of 45–55 degrees Fahrenheit.

John Belding, director of the AMC, says that the center regularly works with researchers to fabricate products to help move research forward. "For Libby's project, we worked from drawings and pictures of other systems that were used at other universities. We came up with a design that met their needs based on what they were doing. Libby's research is specialized, so it needed some special equipment to accomplish it," he says.

The system has taken months of testing and trial and error to work as Gorse envisioned. She hopes to have preliminary results of her testing in two to three months.

WORKING WITH STAKEHOLDERS

The next phase of the study will be to gather samples from beneath aquaculture farms and obtain comparison samples from outside the area. Amirbahman estimates that this will happen during summer 2017. Work like this has never been done in Maine, but will be of great importance in the next stage of research.

And, like collaboration between UMaine departments, it's also of utmost importance for researchers to work closely with farmers.

"We look forward to being educated and informed on the very practical aspects of this work," Amirbahman says. "These are aspects that you don't read in scientific papers or books. These are people with experience. We need to get a better understanding of the impact of these facilities, especially on the environment and being able to inform them about the carrying capacity of the region." ■

Mini-grants to bolster research

THE SUSTAINABLE Ecological Aquaculture Network (SEANET), is pleased to announce three awards through its annual, competitive research mini-grant program.

A total of $36,000 will be awarded to three projects that will augment the SEANET research portfolio by conducting studies pertinent to strategic goals and bringing in researchers from outside institutions and businesses — building the aquaculture research network in Maine.

How size-selective are oysters? Size fractionated analysis of plankton communities in support of SEANET buoy data collection and geochemical and oyster growth models.

Cynthia Heil and Nicole Poulton, Bigelow Laboratory; and Carter Newell, Pemaquid Oysters

Determining the spatial extent of remediated water quality surrounding a kelp farm in Casco Bay.

Susan Arnold, Island Institute; Nichole Price, Bigelow Laboratory; Joe Salisbury, University of New Hampshire; and Paul Dobbins, Ocean Approved

Can clam flat enhancement contribute to regional cooperation across municipal borders and economic scales of harvesters?

Theodore Willis, Passamaquoddy Tribe at Pleasant Point; Teresa Johnson, University of Maine; and Brian Beal, University of Maine Machias

"Involving Bigelow Laboratory, the Island Institute, UNH, Pemaquid Oysters, the Passamaquoddy Tribe, and Ocean Approved in the sustainable aquaculture network is invaluable to SEANET's goal of increasing statewide research opportunities, collaborations and partnerships. These annual mini-grants allow SEANET to support emerging aquaculture research and these three projects are exciting examples of the type of innovation happening at institutions along our coast," says Paul Anderson, SEANET research network director.

The next call for proposals will be in fall 2016. ■

The grievous

Emily Tarr, a sophomore marine sciences student at UMaine, collects green crabs during a recent field visit.

green crab

Repurposing coastal Maine's top invasive species

GREEN CRABS are an invasive species in Maine with no significant predators. They deplete resources by voraciously eating molluscan shellfish, destroying eel grass and marsh habitats, and causing erosion in bays and estuaries. The Sustainable Ecological Aquaculture Network (SEANET) is studying meaningful ways to use green crabs or parts of green crabs to develop value-added products.

Researchers with the SEANET project at the University of Maine are testing how to use green crabs in new and innovative ways. Although edible, the green crab has not reached a level of cuisine like other valuable crustaceans, in part because they are small and take more effort to shell than their meat is worth. The green crab has been present in the U.S. since the mid-1800s; however, their population has rapidly increased during the past 15 years. Many believe that warmer winters in New England are one reason for the population increase.

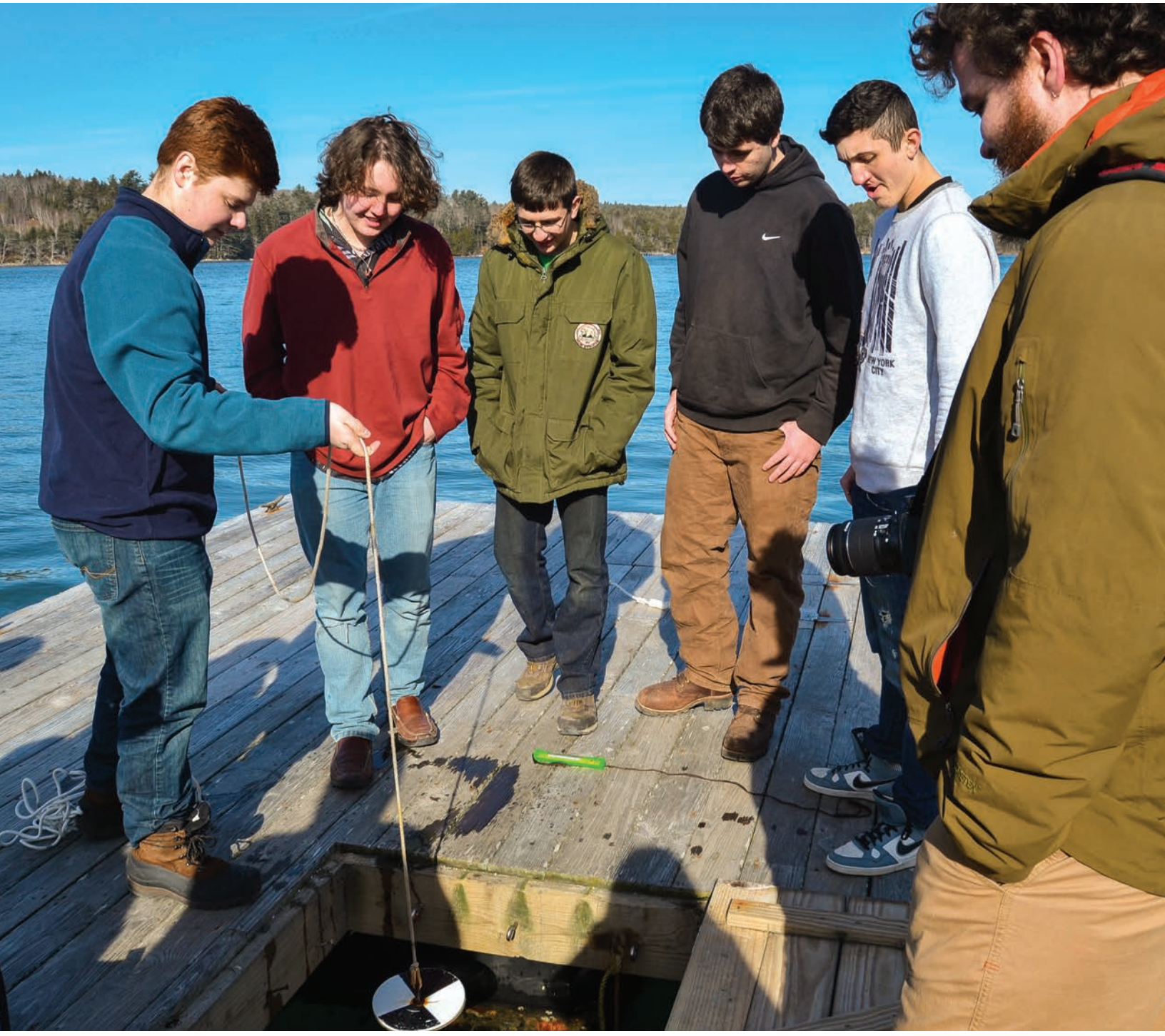
Clammers especially have a great interest in the outcome of these studies because the invasive pest affects their livelihood. The Maine Clammers Association provided hundreds of green crabs last year for research purposes.

Researchers are evaluating the characteristics of parts of the green crab, including proteins that may then be used as additives for products. Proteins have certain properties that make them valuable as food ingredients. They can emulsify, foam, hold water and be used to form gel substances. For instance, emulsifiers allow water and oils to remain mixed in mayonnaise, ice cream or sauces.

For years, proteins extracted from egg whites, or soy and whey powders, have been added to food. Potential proteins from green crabs would likely only be used in seafood products to avoid injury to those with seafood allergies. Potential uses include adding to battered products, like popcorn shrimp and fish sticks. The extra proteins in the batter can help reduce fat absorption in fried products, increasing the product's overall healthfulness.

Currently, research is concentrated on optimizing the efficiency of separating the shell from the soft tissue of the green crabs and methods to maximize yield from the product. This is the first time research of this kind has been done on crustaceans. Proteins have been isolated from finfish, but not from crabs. The next phase of the research will look at the benefits of these proteins to humans, such as improvements in certain ailments like hypertension or diabetes. The hope is to find beneficial ways to use green crab proteins as food additives that create value and lead to commercial harvesting of these invasive creatures. ■

Bouhee Kang, Ph.D. student in food science and human nutrition at the University of Maine, prepares a slurry of green crab tissue to extract proteins.



Students from Lincoln Academy lower a sensor that they built into water at the Darling Marine Center.

High-tech buoys

Students learn sensor technology at UMaine

EXPOSING STUDENTS to marine technologies like the buoy sensors used in the Sustainable Ecological Aquaculture Network (SEANET) program enables a hands-on experience with marine science and technology, and inspires them to study marine sciences and engineering.

Computer programming students in Lincoln Academy's Invent to Learn class are investigating marine technology and its application — specifically, aquaculture in the Damariscotta River estuary — thanks to funding from SEANET.

Using Sparkfun Inventor's Kits — equipment and materials to get students started with programming and hardware interaction using the Arduino programming language — the high school students are programming light and temperature sensors, push buttons, LCD screens and more. By combining these components and 3-D printing techniques, students will build sensors capable of gathering water quality data similar to that collected by SEANET buoys deployed by researchers from the University of Maine and partner institutions in the Damariscotta River.

The sensor technology program is a collaboration between Lincoln Academy (LA) and the University of Maine's Darling Marine Center (DMC) in Walpole, Maine.

Lili Pugh, DMC's K–12 education coordinator, and Maya Crosby, LA's Cable Burns Applied Technology Education Center Program director and technology coordinator, received a SEANET workforce development grant to introduce sensor technology and its application to high school students. The grant was designed to foster partnerships with organizations and institutions to boost K–20 science, technology, engineering and mathematics (STEM) outreach and education programs that are aligned with SEANET's research initiatives.

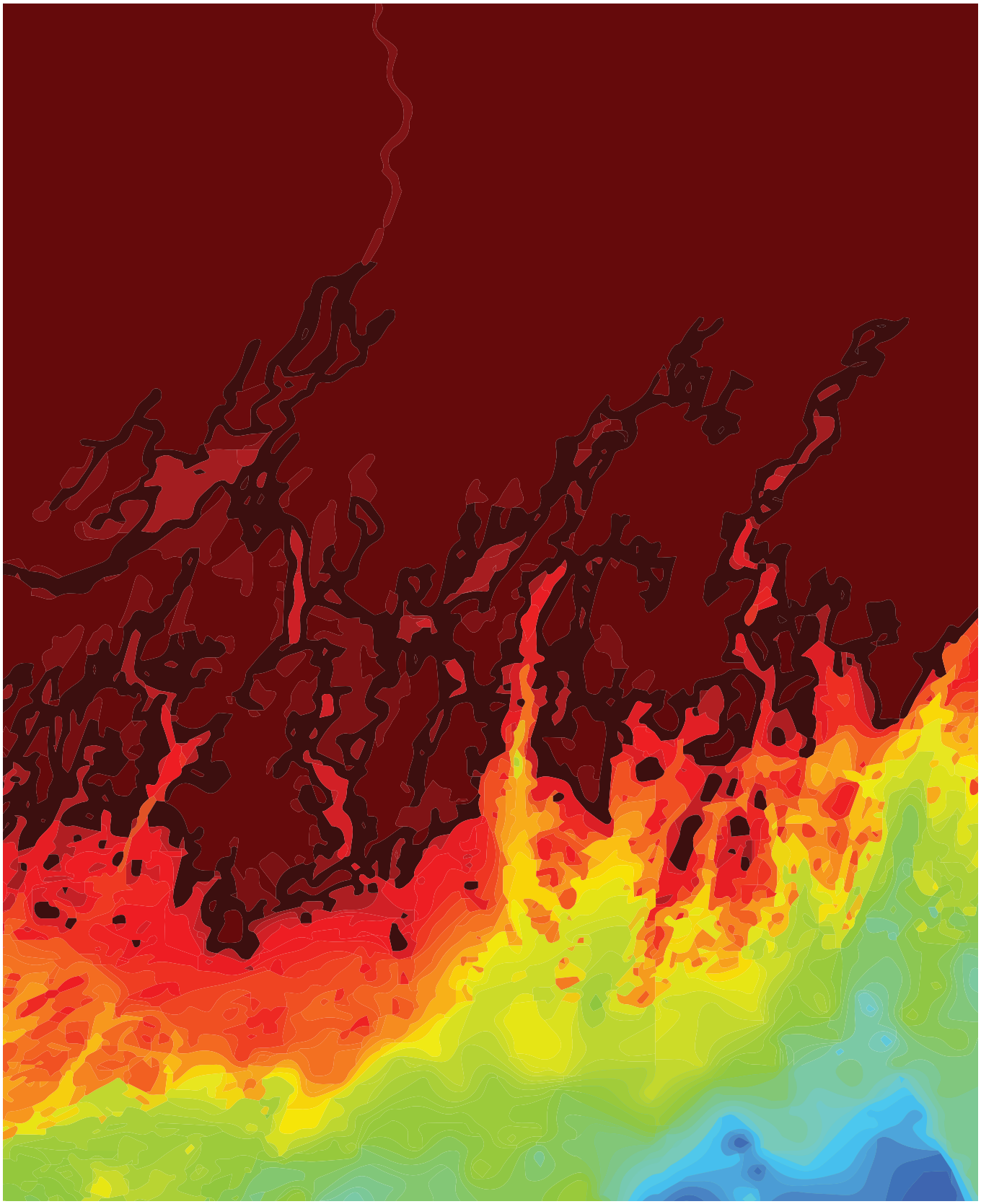
Introducing students to scientists and current research is a key part of the sensory technology program. Recently, Scott Morello, postdoctoral researcher with the Downeast Institute, spoke to students about how mussels adapt to intertidal habitats and how scientists use robomussels — temperature sensors embedded in artificial silicone mussels that mimic internal mussel conditions when out in the field — to study these adaptations.

Students from three LA classes — Invent to Learn, Marine Resources, and Oceanography — visited DMC. They toured the shellfish aquaculture facilities, learned about the Damariscotta River environment, and talked with SEANET researchers who are deploying sensors and other marine technologies to monitor oyster growth and environmental conditions.

"We hope that students will gain a greater appreciation of marine technology and how it can be applied to develop creative solutions relevant to our coastal economy," says Pugh.

This model will be used in other educational opportunities across Maine.

For more information about workforce development and education programs, contact Laurie Bragg, laurie.bragg@maine.edu; 207.581.2295. ■



Midcoast Maine bathymetry map.

Mapping estuaries for **aquaculture suitability**

The importance of knowing your site

AQUACULTURE GROWERS and the Maine Department of Marine Resources will have a new suite of tools to better site aquaculture growing areas.

The new mapping tool will help growers farm smarter. "Trial and error" aquaculture will be replaced with a system that can calculate growing potential while also minimizing environmental and social impacts on Maine estuaries.

Finding the best places to grow oysters, mussels, scallops and sea vegetables are some of the questions researchers with the Sustainable Aquaculture Research Network (SEANET) in Maine are trying to answer. Researchers are using several different mapping and sensing techniques to create a model that will advance aquaculture site prospecting for growers.

"Choosing the best site is the number one priority for growers," explains Damian Brady, assistant professor in the School of Marine Sciences at the University of Maine. "With this new tool, we can do a better job predicting where prospective aquaculture growing sites should be located."

The model uses a number of data sets, including bathymetry — high-resolution maps that characterize the bottom of the estuaries; satellite data including temperature and chlorophyll (food for many aquacultured species); and data collected from the SEANET buoys that are launched in the estuaries during the growing season and collect hourly data about salinity, turbidity (how many particles are in the water), temperature, pH and several other factors.

The SEANET buoy network is supplemented with other smaller buoys and sensors involving students, citizen monitors, fishermen and aquaculturists. These instruments provide researchers with a powerful suite of tools to better understand what makes a farm successful.

This data helps ensure that conditions are right for a specific species to grow in the best places. For instance, oysters prefer warmer waters than mussels, scallops and sea vegetables.

Growers are already accessing data from the current SEANET buoy network and the new integrated models will be disseminated to the public in later phases of the project.

Want to view SEANET data collected by the Land/Ocean Biogeochecmical Observatory (LOBO) buoy system? Visit maine.loboviz.com. ■

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RETURN SERVICE REQUESTED

Maine State EPSCoR Committee:

Maine EPSCoR is overseen by the Maine Innovation Economy Advisory Board, a statewide steering committee of individuals from Maine's education, research, and business communities and state government. The board is under the auspices of Maine's Office of Innovation.

A family interacts with the Maine EPSCoR touchtank at the Maine Science Festival at the Cross Insurance Center in Bangor.

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Maine EPSCoR
Fall 2016

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