MAINE EPSCoR AT THE UNIVERSITY OF MAINE
Experimental Program to Stimulate Competitive Research

Maine EPSCoR

FALL 2015 Newsletter

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Sustainable Ecological Aquaculture Network (SEANET) Highlight

Aquaculture Boot Camp

What's the best way to orient a group of researchers and students to an emerging discipline? Send them to Boot Camp! That's what Maine EPSCoR at the University of Maine did for their new Sustainable Ecological Aquaculture Network (SEANET) program personnel.

More than 50 faculty, staff, and students received orientation for SEANET during two sessions of this one-day Boot Camp.

Two times during the past year, groups of researchers, staff, and students spent the day at the Darling Marine Center in Walpole, Maine to learn the fundamentals of aquaculture through hands-on experience. In addition, participants heard from a number of industry professionals and fishermen regarding challenges and opportunities facing aquaculture, and the means by which the research conducted through SEANET might positively impact their industry. The discussions were followed by a boat excursion to see several aquaculture growing sites for seaweed and oysters, and even included some tasting of the products.

Researchers are employing the information gleaned during the boot camps to supplement their existing research questions, thereby ensuring alignment with industry needs. The boot camps offer a great opportunity for community collaboration among faculty, students, and growers. SEANET will continue to offer the boot camp as additional students and researchers join the team.

Sustainable Ecological Aquaculture Network (SEANET) Highlight

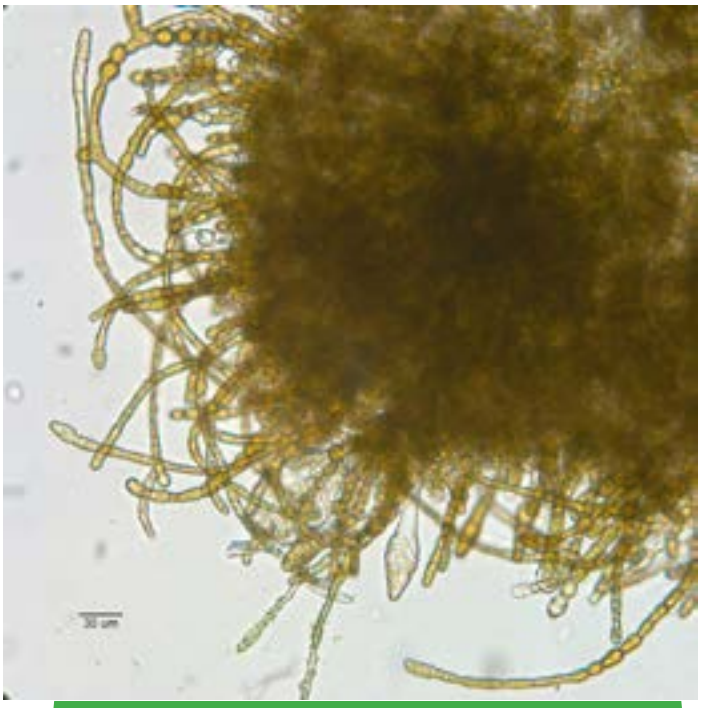
Maine Researchers Investigate Temperature Effects on Sea Vegetables

The Sustainable Ecological Aquaculture Network (SEANET) project with Maine EPSCoR at the University of Maine is investigating how it can help farmers produce higher yields of locally available species of sea vegetables. Researchers are studying Alaria esculenta (a species of kelp) from different areas of the Gulf of Maine to see how predicted warming will affect growth.

This species is at the lower edge of its biogeographical range, and this study will help us understand the tolerance of these types of seaweeds to the changing climate. Previously, the species was found in Long Island Sound, but appears to be absent now. The study is looking at two important life stages that are essential to aquaculture operations.

Preliminary research examined several locations to collect wild samples of reproductive tissue. The next phase of research will compare species from two locations with different water temperatures. The two sites selected are from around the Portland and Lubec areas.

In the lab, researchers are taking cultures of the seaweed and using these samples to compare growth and gene expression at both lower and higher temperatures. These experiments will define temperature tolerance and reveal which strains grow fastest at higher temperatures. This will support current and future sea vegetable aquaculture opportunities, while improving our understanding of the physiological mechanisms that enable temperature tolerance in macroalgae.



Male *alaria* under the microscope

Sustainable Ecological Aquaculture Network (SEANET) Highlight

SEANET Partner Spotlight - DEI

The Downeast Institute for Applied Marine Research and Education (DEI) is one of UMaine EPSCoR's Sustainable Ecological Aquaculture Network (SEANET) partner organizations. DEI began in 1987 when the clam flats in Washington county began declining. Clammers and town officials teamed up with Brian Beal, a professor of marine ecology at the University of Maine at Machias, to come up with some solutions to this problem. They created the Beals Island Regional Shellfish Hatchery (BIRSH) - a facility where wild clams were spawned, clam larvae and juveniles were reared on diets of cultured algae, and seed clams were produced for planting on the depleted municipal flats. BIRSH became DEI in 2000.

Today, DEI is engaged in several large-scale research projects looking at methods to produce Arctic surfclams and blue mussels, and examining new ways to manage shellfish resources at the local level. "We're also looking to modify what we're doing to be able to work with lobsters and other species of commercially important shellfish that we're not already working with," explains Brian Beal, director of research at DEI.

Like other parts of the SEANET program, DEI is using the Maine coast as a living laboratory for its research. To achieve its goal of becoming the easternmost lab and research center in the US, DEI is planning to build a marine lab for scientists to conduct their work. The nonprofit organization has received a large donation towards that goal and is looking to raise the matching funds to build the center. DEI is also very active in education and outreach and works with local schools doing field projects in towns with clam flats. Part of the new building will house an educational center and classroom.

Brian Beal, director of Research at DEI

A rope of mussels.

Beal is most excited about the prospect of studying the Artic surfclam, a new product that is not being cultured anywhere else in the world. "When cooked the clam turns a brilliant orange. It can be eaten raw

DEI continued next page

Sustainable Ecological Aquaculture Network (SEANET) Highlight

SEANET Partner Spotlight - DEI cont.

on the half shell, steamed and fried, and best of all, it tastes good!" Beal describes. This new species can be planted low in the intertidal waters and takes two to three years to grow to about an inch and a half to two inches in size.

There's a lot to look at when it comes to studying aquaculture in Maine. There are issues on both the political and the biological sides. Beal feels DEI can be helpful in finding answers to some of the questions raised on both sides. "With biology, we're looking at a lot of issues – problems with invasive species like green crabs, seawater temperatures that are continuing to climb which also leads to a green crab explosion," says Beal. "Politically, there are long waiting lists of people who want to try their hand at farming (especially shellfish). People can't wait forever to find out if their application is moving forward or not. We'd like to help work with municipalities to open up some of the intertidal areas for clam farming." Right now, Beal's group is working with town officials in Freeport to address this concept.

Beal sees that aquaculture can help Maine achieve a healthy bottom line, as many industries are touched across the supply chain. "Aquaculture farmers need a lot of infrastructure," Beal states, "Just look at the economy straight up and down that helps the farmer. Start with the boat and motor or raft and netting, then there are cages and rope and all sorts of needs, not to mention the people that service boats and engines. When you're out on the water, there's a whole economy in the background that is being sustained by your activities. It basically parallels the fishing industry."

Beal sees the future of Maine's aquaculture as involving a variety of species, particularly finfish – cod and haddock, and more research into land-based aquaculture. "We need to produce protein for people to eat," Beal shares. "As we move into the future, aquaculture is going to become more important."

While early attempts at growing mussels on ropes for suspension culture in Maine began in the early 1970's with Ed Myers from Abandoned Farms, successful mussel raft culture in Maine has only grown to over a million pounds in the last decade. Total U.S. production, on the east and west coasts, is less than 5 million pounds, whereas U.S. consumption is over 50 million pounds. Most mussels are imported from Canada (over 30 million pounds), and world production is led by Spain (over 500 million pounds), New Zealand (200 million pounds), and China.

Artic surfclams

Cyberinfrastructure

Advanced Computing Group Receives Awards

The Advanced Computing Group (ACG) at the University of Maine is a busy entity these days. The group works with Maine EPSCoR and SEANET to manage data and assist with high performance computer modeling, visualization, and cloud computing. The group recently received two new grants from the National Science Foundation (NSF) and national acknowledgement from the XSEDE Campus Champions Program.

"All of these new opportunities allow us to help the state in new and exciting ways," says Bruce Segee, the Henry R. and Grace V. Butler Professor of Electrical and Computer Engineering and Director of the Advanced Computing Group.

The first grant from the NSF advances UMaine's high-performance computer modeling tools to provide timely forecasts of storms and effective management of commercial fishing – essential needs in the wake of extreme weather events and unprecedented warming in the Gulf of Maine.

The project — "Major Research Instrumentation (MRI) Program Track 1: Acquisition of High Performance Computing to Model Coastal Responses to a Changing Environment" includes buying a system that nearly triples computing power at the university and acquiring an off-site backup system for project data. Damian Brady, University of Maine assistant professor in the School of Marine Sciences at the Darling Marine Center, is leading the grant and working to advance those goals.

"Maine is fortunate to have a High Performance Computation facility available to its researchers and students, and this grant will help significantly

increase the complexity of the questions that can be asked and the number of users it can support. Demand for computing resources is growing at a rapid pace, and this grant provides a great step forward to help meet the demand," Segee described.

The tools will help scientists better predict climate change and extreme weather, as well as understand ensuing ecological and physical consequences, and weigh costs and benefits of adaptation or mitigation.

Advanced Computing continued next page

Cyberinfrastructure

Advanced Computing Group Awards cont.

"The effects of climate change are not likely to be straightforward. There are species and ecosystems that will benefit and those that will not," says Brady.

"The purpose of running computer models is that they ask the really tough questions like: What will happen to the lobster industry under a 1-, 2-, or 3-degree (temperature) increase? What will the impact of increased rainfall be on shellfish along the coast? Although models will not perfectly predict the consequences of these changes, they can give us a range of potential futures," explains Brady.

Maine is uniquely positioned physically and economically to be affected by climate change, Brady says. "The state is on one of the sharpest latitudinal temperature gradients in the world and has one of the longest coastlines in the United States."

The second NSF grant is a three-year, $2 million grant designed to improve STEM (science, technology, engineering, and mathematics) education for K-12 students. The new grant is using Minecraft to teach students programming modification skills. "Students will be learning computer science techniques like programming that they wouldn't get anywhere else," Segee explains. "Through this program, we'll be able to reach any student with a laptop or tablet in school regardless of where they are in the state."

The program will tie in to subjects already in their curriculum like math, science and social studies. It will begin with four yet to be determined pilot sites in the first year and then expand to cover more of the state.

And finally, the University of Maine is now represented on the XSEDE Campus Champions Program which is supported by NSF.

The Extreme Science and Engineering Discovery Environment (XSEDE) is the most advanced, powerful, and robust collection of integrated, advanced digital resources and services in the world. It is a single virtual system that scientists can use to interactively share computing resources, data, and expertise. XSEDE accelerates scientific discovery by enhancing the productivity of researchers, engineers, and scholars by deepening and extending the use of XSEDE's ecosystem of advanced digital services, and by advancing and sustaining the XSEDE advanced digital infrastructure.

The Campus Champions program supports campus representatives as a local source of knowledge about XSEDE, as well as other digital services, opportunities and resources. There are now 253 champions at 200 institutions.

"High performance computing resources are sort of like a car engine: researchers should have access to good ones, but the vast majority should not be installing and maintaining their own systems in order to move their research forward," Segee said. "XSEDE can act as the 'mechanic' in this way. The vast majority of research that uses supercomputers isn't research about supercomputers. XSEDE helps move the domain research forward by lowering the cyberinfrastructure barriers."

The ACG is available to assist SEANET researchers with their data storage, virtual machines, and high performance computing needs. Contact Bruce Segee at segee@maine.edu or 207.581.2212 for more information.

Maine EPSCoR Outreach and Workforce Development

High School Research Internship Program Celebrates Nine Years

Now in its ninth year, the Maine EPSCoR High School Research Internship Program has served hundreds of students, providing them with amazing experiences in STEM (science, technology, engineering, and mathematics) occupations. Each summer, high school students actively work in laboratories and in the field assisting researchers with their studies.

During the last two years, the program has expanded to include participation from more area schools. Students are selected through a competitive process that considers grades, recommendations, and an interest in studying a STEM field in college. Many of this year's projects focused on the Sustainable Ecological Aquaculture Network (SEANET) and its research.

Students arrive in the lab with a wide range of skills and abilities. Their faculty and graduate student mentors help hone their skills as students participate in cutting-edge research. "One of the best parts was helping the student develop new skills and being part of that development. In addition, it helped me understand the great skills high school students can bring to a project. We truly worked collaboratively," described one mentor for the program.

"I have enjoyed working with all sorts of kids through this program and the Cooperative Extension Department. Teaching the kids and watching them as they finally understand whatever topic we're teaching them is completely worth all the work that gets put into it. This has shown me that teaching is the right path for me," explained Stephen Nelson, a junior at Orono High School. Stephen hopes to pursue a career in education focusing on science.

The experience culminates with a poster session where each student presents the findings of their work to the group, including faculty and graduate student advisors. Each student is also required to submit a research paper that presents the results of their study.

Stephen Nelson worked with Cooperative Extension-4H to develop a curriculum for children.

2015 High School Interns and Faculty and Graduate Student Mentors

Maine EPSCoR Outreach and Workforce Development

Touchtank Goes to Camp CaPella for Wild Adventures

For the last four years, Maine EPSCoR at the University of Maine has maintained a very special partnership with Camp CaPella in Dedham. The camp is dedicated to serving participants with a wide range of physical and mental disabilities.

Each year, Maine EPSCoR brings "Wild Adventures" to camp as a way for participants to experience being a scientist every day. This year, the "Wild Adventures" curriculum included a touchtank with many sea creatures for campers to meet up close. Jennifer Dunham, Maine EPSCoR student research assistant, spent every Wednesday at Camp CaPella teaching campers about the life cycle, eating habits, and other information about the animals in the touchtank. They were able to hold starfish, scallops, and clams. They watched hermit crabs and horseshoe crabs walk along the tank floor.

A camper holds a scallop.

The touchtank connects with Maine EPSCoR's SEANET grant as a way to teach the campers about aquaculture and sustainability.

Sam Bedore shows campers a starfish.

Sam Bedore was back again this summer as the Wild Adventures leader and was excited about the opportunity to work with the touchtank. "Their eyes just get so big and they're like oh my god, a scallop," says Sam, "Look what it does when it opens and closes and it's fun that they can see it, that they can see all the little eyes on the scallop. They get so excited they can touch and feel and see all these things instead of just reading about it in a book."

The program runs for seven weeks and serves more than 125 campers with disabilities each summer. Most of the campers likely would not otherwise have the opportunity to experience scientific inquiry, let alone be encouraged to explore STEM careers.

University of Maine Receives New NSF EPSCoR Track 2 Grant

The Future of Dams

A new $6 million grant from the National Science Foundation's EPSCoR program will fund a four-year study examining the future of dams in New England. This project marks an expansion in partners and scope for the New England Sustainability Consortium (NEST), adding Rhode Island to the existing partnership between Maine and New Hampshire.

NEST was launched in 2013, when Maine and New Hampshire began an innovative collaboration focused on increasing the safety of coastal beaches and shellfish beds threatened by bacterial pollution and other microbial pathogens.

NEST is designed to respond to societal challenges where economic and community development goals need to be balanced with environmental protection. Such sustainability objectives are not only of central importance in New England, but they also represent national and global imperatives.

This new tri-state collaboration will strengthen connections between scientists and decision-makers about a number of potential dam options, including maintaining existing hydropower dams, expanding hydropower capacity, and/or removing aging dams to restore fisheries or reduce safety risks. By examining economic, environmental and social tradeoffs, the project will help individuals and communities make better decisions about dams. The project is highly relevant given that hydropower is a major source of renewable energy in New England. More than 50 hydropower dams are scheduled for relicensing in the next decade, requiring states to make important decisions about their futures. The region is also home to thousands of iconic milldams that are an integral part of New England's industrial history and continue to provide recreational and water supply benefits for many communities. However, some of these milldams pose safety and liability risks due to their age and poor condition. Both hydropower dams and milldams can also have adverse effects on coastal ecosystems and economies, particularly because they often block the migrations of economically important fisheries. This project will empower stakeholders to make complex decisions about dams by taking the innovative step of combining the best available science with creative forms of community engagement.

Track 3: SMART High School Student Highlight

Paige Brown, Bangor High School

By Jennifer Isherwood

For the past year, SMART student Paige Brown has been studying pollution in six Bangor streams. Her work earned her Maine's 2015 Stockholm Junior Water Prize, an award granted to students from each state to recognize valuable work on water-related science projects.

Early on in her research, Paige used laboratory space at Bangor High School to process her samples. Once the summer of 2014 came, she found it was too difficult to coordinate with Bangor High staff to get into the school so she could work. Paige decided to move her lab to her parents' basement, using borrowed and donated equipment.

During the past year of running tests on water samples from each of the six stream locations, Paige found numerous contamination issues in the streams. Many streams were contaminated with phosphorous, which contributes to algal bloom growth. That growth blocks sunlight and prevents other aquatic plants from growing, which has an effect on other life in the stream, including fish. Every stream she studied was impaired with E. coli, exceeding EPA standards. Four of the streams had conductivity issues, a measure of water's ability to conduct electricity. High conductivity has a negative effect on fish and amphibians. Many of these problems can be tracked to a major problem faced in many urban communities: stormwater runoff.

Paige started her senior year in the fall of 2015 and expects to continue with Phase II of her project — helping to identify ways to resolve some of these pollution issues. Brad Moore, superintendent of the city's wastewater treatment plant, said city officials have met with Brown to discuss her project and are "beginning a collaborative effort" by using some of her data and sharing watershed maps and geographic information with her. Moore said he will be interested in hearing Brown's remediation recommendations and working with her on potential solutions and "measured investments."

The city is trying to determine how to effectively spend its money to remediate stormwater runoff issues and meet the conditions of its stormwater permits on a limited budget. This is a challenge facing most municipalities in the country. Cities in cold climates have an especially difficult time dealing with road salt runoff after difficult winters.

Paige Brown (middle) helping SMART students Hassan Querishi and Annalyse Nichols solder at the June stormwater institute

Paige wants to study chemical or environmental engineering either at Yale University or Massachusetts Institute of Technology, though she said she already has been offered a full scholarship to Drexel University by winning fourth place at the International Science & Engineering Fair.

She has also qualified for the National Junior Science Symposium (JSHS) as a result of her work on stormwater. Paige is currently the only SMART student with a disability; she has significant hearing loss and uses hearing aids in both ears.

5717 Corbett Hall, Room 444
Orono, ME 04469-5717

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Supported by National Science Foundation awards

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.

For more information see: **www.umaine.edu/epscor**
The Maine Science & Technology Action Plan can also be downloaded at this site.

Maine EPSCoR Office at the University of Maine:
444 Corbett Hall, University of Maine
Orono, ME 04469-5717
Phone: (207) 581-2285 Fax: (207) 581-9487
Email: maine.epscor@maine.edu
Website: www.umaine.edu/epscor

Maine EPSCoR Director:
Shane Moeykens, Ph.D.
Phone: (207) 581-3399
Email: shane.moeykens@maine.edu

Maine EPSCoR Project Administrator/ Program and Outreach Manager:
Laurie Bragg
Phone: (207) 581-2295
Email: laurie.bragg@maine.edu

Maine EPSCoR Communications and Program Coordinator:
Andrea Littlefield
Phone: (207) 581-2289
Email: andrea.littlefield@maine.edu

Maine EPSCoR Financial Administrator:
Cynthia Growe
Phone: (207)-581-3312
Email: cynthia.growe@umit.maine.edu

Maine EPSCoR Program Assistant & Diversity Specialist:
Ana Rapp
Phone: (207) 581-2285
Email: ana.rapp@maine.edu

Maine EPSCoR Project Director:
Carol Kim, Ph.D.
Phone: (207) 581-1506
E-mail: carolkim@maine.edu