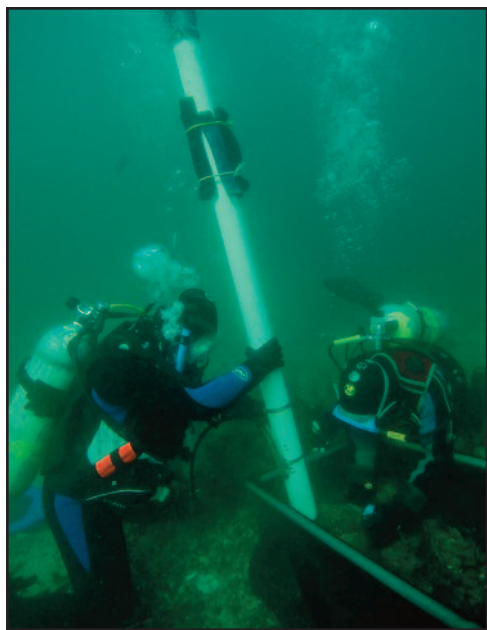


Making Waves

at the Darling Marine Center • December 2014

American Lobster Settlement Index Celebrates 25 Years



Divers using airlift suction sampling to quantify newly settled lobsters. Photo by Rick Wahle.

As larvae, American lobsters (*Homarus americanus*) are planktonic, floating in the surface waters and riding the currents as they grow. After 4-6 weeks, postlarval lobsters settle out of the water column and take up a benthic existence amongst cobble and rocks. Can that yearly pulse of baby lobsters become an early warning system for future trends in Maine's most valuable fishery? This is the question Dr. Rick Wahle has been asking for most of his career and the answers may lie in the America Lobster Settlement Index (ALSI).

In 1987, using a technique called "airlift suction sampling," Rick and a team of SCUBA divers "vacuumed" cobble habitat at several locations in coastal Maine revealing large numbers of newly settled young-of-year lobsters along with older juveniles that had to date eluded quantification. In subsequent years, Rick and collaborator Lew Incze (also now at the DMC) began monitoring eight sites on Maine's outer coast to evaluate the coupling of lobster's planktonic larval supply and settlement to the seabed. These first surveys expanded south to Rhode Island and north to Newfoundland to include over 100 sites that are now surveyed annually as part of the ALSI collaborative of marine resource agencies and fishermen contributing to this unique international monitoring effort.

Continued on page 6.

Letter from the Director

Dear Alums and Friends of the DMC,

Welcome to Making Waves; I hope you enjoy reading just a few of the highlights of 2014. The Darling Marine Center supports the University's tripartite mission of education, research, and service, and



has been very active in all three. This autumn the Semester-by-the-Sea program (SBS) celebrated its 21st year with its largest enrollment ever—23 students are enrolled in the unique experiential learning program that includes a very strong field component. This summer the dorm was also overflowing with students studying in six May term classes, working on Capstone projects, and interning with faculty. Online learning is ever expanding through the activities of "Broadening the Reach of Ocean Science," whose goal is to improve ocean literacy and broaden impacts of scientific research.

DMC research tackles problems at the heart of the local economy, including measuring juvenile lobster settlement and improving techniques for bivalve aquaculture. Discovery-based research includes topics as diverse as organism movement through mud, reproductive biology, response of macroalgae and zooplankton to ocean acidification, and analysis of phytoplankton from space. Field research and conferences continue to take faculty and students all over the globe—from tropical coral reefs to the polar ice cap.

Interaction with the local community occurs at all levels, from K-12 explorations to citizen science collaborations on estuarine water quality. As the Center moves into 2015, it plans to hire a new permanent Director and up to four new faculty. The Center will also celebrate its 50th anniversary this summer with a lecture series, an alumni reunion day, a symposium for alumni, faculty, and friends of the Darling Center, and a public open house with hands-on activities. You'll be receiving updates in the coming months and I hope that you can join us next summer.

My best wishes for the holidays and the New Year,
Mary Jane

Research Award is a Sign of Great Things to Come

Dr. Douglas Rasher received the prestigious Mercer Award from the Ecological Society of America. First awarded in 1948, the Mercer Award is given each year for the World's most outstanding ecological research paper published by a researcher under the age of 40.

Now a postdoctoral research associate at the DMC, Rasher received the 2014 Mercer Award for his eye-opening study on Fiji's coral reefs he conducted as a graduate student at the Georgia Institute of Technology. The work shows that a diverse collection of grazing fish is essential to keep coral reefs clean and free of harmful seaweeds that quickly outcompete baby corals for space on the reef. Clean reefs are healthy reefs that are better able to recover from hurricanes or other disturbances. The results provide further insight for the management and conservation of coral reefs.

Joining the ranks of such prestigious ecologists as E.O. Wilson, Jane Lubchenco, Robert MacArthur and Joseph Connell makes the award that much more meaningful to Rasher, who explains, "Over the past half century, many well known ecologists received this award for publishing what are now considered "classic" papers; these studies shaped who I am as a scientist and how I view the natural world. That makes receiving this award very personal and special to me."

In his accolades to Rasher, Dr. Bob Steneck, notes "some awards are for a lifetime of achievements—for a job well done. Others are bellwethers of great things to come. The Ecological Society of America's Mercer Award is clearly in the latter camp." Rasher's receipt of the Mercer Award is an indication of "great things to come."

The awarding-winning research paper "Consumer diversity interacts with prey defenses to drive ecosystem function," can be read at esajournals.org/doi/abs/10.1890/12-0389.1.



Dr. Doug Rasher

DMC Proud Partner in Sustainable Aquaculture Initiative

UMaine announced the launch of the SEANET program thanks to a \$20 million National Science Foundation EPSCoR (Experimental Program to Stimulate Competitive Research) grant.

The August announcement won the accolades of Senators Susan Collins and Angus King, and Representatives Mike Michaud and Chellie Pingree; all noted the benefits of this funding to our state, to our working waterfronts, and to our workforce. Through SEANET, the University expects to hire 20 graduate students, 3 faculty, and up to 3 postdoctoral fellows with some expected to be resident at the DMC.

SEANET is a multi-institutional, public-private partnership led by UMaine, in collaboration with the

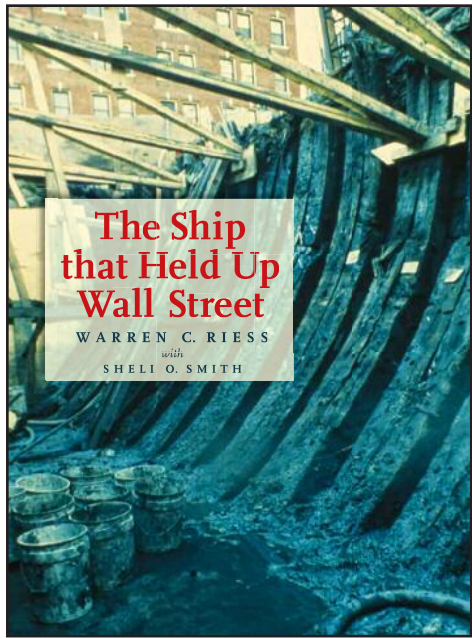
University of New England. "This project is inherently about how to make aquaculture sustainable in Maine, both socially and environmentally," says Dr. Damian Brady, Assistant Director of Research for Maine Sea Grant and a lead investigator in SEANET. "The Damariscotta [River Estuary] will be a region of focus for the project."

The Damariscotta River estuary is the home of shellfish aquaculture in Maine and "has long been a model for the rest of the state about how to integrate education, research and industry," notes Dana Morse, Extension Associate for the Maine Sea Grant College Program at the DMC.

The DMC was founded in 1965 and the National Sea Grant College Program was established in 1966.

When Dr. Herb Hidu was hired in 1970, he spearheaded research on the cultivation of blue mussels and oysters. And just around the corner from the DMC, in Clarks Cove, Ed Myers was granted the first aquaculture lease in 1974. In subsequent years, such local institutions as Dodge Cove Marine Farm, Pemaquid Oyster Company, Mook Sea Farm and Glidden Point Oyster Company, to name a few, were established by UMaine students.

"The DMC's role over time is exemplary of what could be accomplished with the SEANET program," says Morse. "The application of science to an industry, the integration of that industry with the community, and both the educational and workforce training that comes along with it—the DMC got this started in Maine."



The Ship That Held Up Wall Street

In January 1982, construction was about to begin on Howard Ronson's latest real estate development at 175 Water Street in Lower Manhattan when archaeologists at the site discovered the remains of a very old ship. Dr. Warren Riess and Sheli Smith were called in to survey the site and given one month—February—to excavate the “Ronson ship.”

In his latest book, *The Ship that Held Up Wall Street*, Riess, recounts the discovery, excavation and preservation of the Ronson ship, and the questions and curiosities that puzzled a team of

historians, archaeologists and scientists for 30 years. The ship is now believed to be the Princess Carolina; a colonial era merchant ship built in Charleston, South Carolina. As the only ship remains of its kind to be discovered, it provides us with a wealth of information about colonial America. Artifacts and the bow timbers from the Ronson ship site are at the Mariner's Museum in Newport News, Virginia.

The Ship That Held Up Wall Street can be purchased online at major booksellers and at warrenriess.com/books. Autographed copies are on sale at Maine Coast Book Shop in Damariscotta, Maine; the perfect holiday gift.

Wentworth Point History Bulletins

DMC librarian Randy Lackovic is compiling a history of Wentworth Point. To date, he has posted nine history bulletins on the University of Maine's Digital Commons, digitalcommons.library.umaine.edu/dmc_documents.

The bulletins are about the people and the place of Wentworth Point in Walpole, Maine, from the late 18th century to the inception of the University of Maine's marine laboratory in 1965. Learn about the Lowes of Lowes Cove, the Wentworths and Woodmans, and, of course, the Darling family and estate. Those familiar with the Darling property will enjoy the accompanying old photos of the farm, cleared fields and expansive water views.

Moving forward we hope to include a review of DMC marine research, past present and future. If you're a history buff and have anything to add, please let contact Randy at randy.lackovic@umit.maine.edu.

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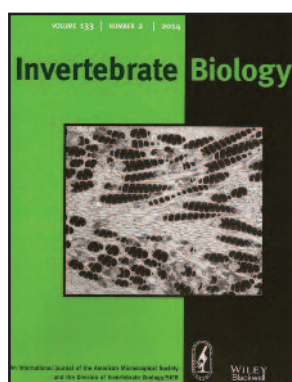
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Kevin's electron micrograph is on the cover!

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A Distinguished Maine Professor

Mary Jane Perry, Professor of Oceanography and Interim Director of the DMC, was bestowed the 2014 Distinguished Maine Professor award. Presented by the University of Maine Alumni Association, the award is recognition of outstanding achievement in the university's mission of teaching, research and public service.

Mary Jane is an internationally recognized researcher, gifted teacher and dedicated mentor to young scientists. She is known for her ability to effectively provide students with the necessary knowledge for understanding, but also to instill the skills and curiosity that motivate them to teach themselves.

A widely published researcher, Perry's papers are often at the forefront of new developments and cut across disciplines, opening doors for future investigations. She is a research pioneer in the study of ocean optics and ocean biology, and the use of autonomous underwater gliders for remote ocean measurements.

Mary Jane joined the UMaine School of Marine Sciences faculty in 1999, and was named interim director of UMaine's Darling Marine Center in 2013. Since 2000, Perry's research has brought more than \$7 million to the University of Maine in sponsored funding.

Perry was elected an Oceanography Society Fellow in 2010. She received NSF's Creativity Award in 2009 and 2003, and is one of three invited plenary speakers for the 2014 Ocean Sciences Meeting, the largest and most important gathering of aquatic scientists in the world.

Caribbean Coral Reefs Find New Balance

Dr. Bob Steneck was part of an international study recently published in the journal *Proceedings of the Royal Society B* that highlights the delicate balance that exists between bioerosion and carbonate or limestone production on coral reefs.

There is new evidence from Caribbean coral reefs that rates of erosion from excavating sea urchins and parrotfish have declined over the past several decades. As these groups decline from disease or overharvesting, the balance is tipped. Coral reefs may be persisting and growing more because of the reduction of eroding animals than due to the vigorous limestone production of reef corals.

Steneck notes that “marine ecosystems continue to surprise us both here in Maine and in the Caribbean because the cast of characters and the climate both keep changing.”

“Changing dynamics of Caribbean reef carbonate budgets: emergency of reef bioeroders as critical controls on present and future reef growth potential” is available at DOI: [10.1098/rspb.2014.2018](https://doi.org/10.1098/rspb.2014.2018).



Parrotfish feeding on a Caribbean coral reef. Photo by Bob Steneck.

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Darling Marine Center

Making Waves

is the annual newsletter of the University of Maine's Darling Marine Center.

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If you've done work at the DMC that's been published, please send the citation to our librarian randy.lackovic@umit.maine.edu.

Community Service & Outreach



DMC Day

Interim Director Mary Jane Perry called “all hands on deck” and instituted a new tradition: DMC Day. Faculty Staff and students pitched in. Some donned work gloves to pull weeds, clear trails and plant flowers, while others dipped brushes into gallons of white paint to freshen up the Plume, Cow Barn, Horse Barn and Pumphouse. The afternoon concluded with a grand potluck BBQ.



The DMC touch tank earns smiles from kids of all ages.



Armed with trash bags, Team DMC hits the beach.

Oyster & Pumpkin Festivals

Children of all ages enjoy meeting their underwater neighbors in the Gulf of Maine. Lili Pugh and undergraduate students bring touch tanks to many local festivals including the Pemaquid Oyster Festival and Pumpkinfest.

The Pemaquid Oyster Festival celebrates the oyster, sustainable working waterfronts and our local marine environment. Festival proceeds support the Edward A. Myers Marine Conservation Fund which in turn supports marine education and marine conservation. For over ten years, the fund has enabled local teachers to bring their K-12 students on field trips to the DMC.

Pumpkinfest is a week-long celebration of all things pumpkin—with a marine spin, believe it or not! Scuba divers carve pumpkins underwater while mariners compete in a giant pumpkin regatta. And so a touch tank is not so out of place along the waterfront.



Team DMC turned a giant gourd into a vintage scuba helmet at Pumpkinfest.

Coastal Cleanup

Team DMC scoured Pemaquid Beach collecting over 30 pounds of trash. The effort was spearheaded by Lisa Ouellette and took place in September, during Maine Coast Week.

Maine’s coastal cleanup campaign is the largest volunteer event in the state and coincides with the Ocean Conservancy’s International Coastal Cleanup®. In addition to collecting trash and marine debris, volunteers inventory their haul and submit their tally to the Ocean Conservancy’s Trash Index.

Since its inception in 1986, the trash index has identified hot spots of ocean trash, marked unusual trash events and raised awareness of the global marine trash problem. Annual reports of the trash index are available at oceanconservancy.org.

Team DMC has been showing up at a variety of local events. A highly spirited group, Team DMC shares their enthusiasm, creativity and knowledge of marine issues with the Pemaquid Peninsula community. **Go Team!**

Legislative Visits

A group of Maine legislators toured the DMC in June to learn more about the role of UMaine research, partnerships and education in the overall marine economy. Marine economy-related research topics included UMaine commercial fisheries, Gulf of Maine buoys monitoring and aquaculture. The legislators and UMaine marine researchers and students were joined by local business owners.

This year’s Agricultural Council of Maine (AGCoM) tour highlighted midcoast Maine and included sea-farming. During the tour, participants visited shellfish farms on the Damariscotta River and the aquaculture research facility at the DMC—home of Maine’s oyster industry. AGCoM tour participants included 33 state legislators, University of Maine System Chancellor, Jim Page, and Ed Ashworth, Dean of UMaine’s College of Natural Sciences, Forestry and Agriculture.



Legislative group boarding R/V Ira C. for a tour of an aquaculture site that hosts both kelp production and shellfish.

DMC Helps Citizen Scientists Tackle Estuarine Water Quality

Maine has a considerable history of citizen involvement in monitoring its aquatic environments. Countless volunteers contribute boats, expertise, time and devotion at a scale difficult to match via traditional scientific funding. DMC faculty, staff and alumni (such as Jon Eaton of Thomaston and Celeste Mosher of Wiscasset) are proud to work with land trusts and conservation associations to help these efforts to make a difference.



Volunteers calibrate the data sonde in the DMC's Mitchell Classroom with guidance from Dr. Larry Mayer. Photo by Peter Milholland, Friends of Casco Bay.

Last year, the Damariscotta River Association (DRA) and six other citizen groups (Medomak Valley Land Trust, Kennebec Estuaries Land Trust, Friends of Casco Bay, Sheepscot Valley Conversation Association, Georges River Tidewater Association, and Rockport Conservation Commission) decided that their impact on the region would be magnified if they got together and monitored their estuaries with the same equipment, the same techniques, and at the same time. They created the Maine Coastal Observation Alliance (MCOA) whose mission is to monitor and promote the health of Maine estuaries via sharing equipment, sampling, methods and expertise. The alliance thus starts off covering estuaries from Casco Bay to Rockport.

Sarah Gladu, DRA Director of Education and Environmental Monitoring, was key in establishing the MCOA and is president of the organization. Gladu said recently, "The partnership of the monitoring organizations and DMC staff to form MCOA and quickly work towards the development of this year's pilot monitoring project is an outstanding accomplishment. It bodes well for the long-term sentinel capacity of these coastal citizen-scientist groups to gather and analyze data, creating useful information for the region's communities."

This group quickly won some funding from the Davis Foundation, Maine Sea Grant and Maine's Department of Environmental Protection in 2014 to start a collaborative program of estuarine measurements during the summer and fall when estuaries are especially susceptible to issues such as oxygen loss or acidification due to excess nutrient loading.

DMC personnel including Ivona Cetinić, Kathy Thornton, Jeff Runge and Larry Mayer worked with MCOA's citizen scientists to establish sampling protocols and calibrate instruments, as well as help with analyses, logistics and data management.



Celeste Moser collecting water samples on the Sheepscot River. Photo by Kristin Pennock, Sheepscot Valley Conservation Association.



Kathleen Thornton at work on the Shimadzu analyzer.

New Protocol for TN

In recent years, government, academic and nonprofit groups concerned with the health of estuarine ecosystems have come to realize the benefit of monitoring sea water nutrient levels. Most are turning to total nitrogen (TN) analysis.

TN is made up of organic nitrogen in particulate and dissolved form, as well as inorganic forms of nitrogen, such as nitrate and ammonium, all of which can enter an estuary from anthropogenic sources. High TN concentrations can lead to high levels of phytoplankton growth which, in turn, may cause a harmful lack of oxygen in the water. TN measurements can aide in locating high anthropogenic inputs to an estuary, the first step towards mitigation of those sources. The downside of TN analysis was that the EPA-approved methods for the determination of TN produce large amounts of hazardous waste.

Kathleen Thornton of the Biogeochemistry Laboratory has found a better way. She developed a new protocol that utilizes a Shimadzu TOC VCHP analyzer and uses no harmful chemicals and produces no hazardous waste.

The Maine DEP Bureau of Land and Water Quality approved the new method for use in Maine estuarine monitoring on February 7, 2014. The method has been used by several estuarine monitoring groups during the summer 2014 field season (see article on MCOA, above). It is hoped that this new TN protocol will be approved for broader use as it eliminates the risk to laboratory workers of exposure to harmful chemicals and it produces no hazardous waste; protecting the environment and reducing disposal costs.

Scallops on the Half Shell

Could scallops be the next great boon to the aquaculture industry in Maine? Sea Grant Extension Agent Dana Morse hopes so and for the last 15 years (on and off) has worked to make it happen.

Sea scallops (*Placopecten magellanicus*) are a commercial fishery in Maine, but they have been an aquaculture species in Japan since the 1950s and in Atlantic Canada since the '70s. Dana was first introduced to farm-raised scallops on a trip to Japan in 1999 and since then he has partnered with fishermen, shellfish growers, CEI (a Community Development Corporations in Maine), Maine Department of Marine Resources (DMR) and colleagues overseas to bring the new industry home.

Scallop larvae (spat) are 'caught' in September, using seed collectors that resemble an onion bag filled with plastic mesh. The collectors stay out until the following May-July, at which point the young scallops are about 10mm and are put in bottom cages. If all goes well a 2.5-inch "Princess" scallop is ready for the half shell market in about 10 months—faster than any other shellfish in Maine.

Dana and the scallop growers are testing various grow-out techniques. Though bottom cages seem to be the best fit for the new industry, some growers are experimenting with a Japanese technique whereby the scallop gets a small hole drilled in its "ear," and are then threaded onto specialized lines which are hung vertically in the water column.

A mixture of fishermen and shellfish growers are involved in the project, perfecting spat collection and testing grow-out techniques. Regulatory hurdles have been resolved through the expertise and support by the Maine Dept. of Marine Resources, and marketing strategies are being carried out by the growers. Funding from the Maine Aquaculture Innovation Center (MAIC) will help with the next step, to ramp up production techniques to ensure they meet demand. With continued luck and success farm-raised scallops from Maine could be seen in fish markets and on restaurant menus in 2015!

Read more about the sea scallop, its life history, commercial fishery and current aquaculture efforts at the Sea Grant webpage seagrant.umaine.edu/resources-for-shellfish-growers/species/scallop.



Above: Dana Morse (right) and Kevin Scott of E+K Shellfish in Blue Hill examine farm-raised scallops

Left: Life-size Princess scallop on the half shell.

Photos by Dana Morse.





Dr. Nathan Briggs



Steve Auscavitch



Jenn McHenry

Graduate Degrees Conferred in 2014

Nathan Briggs successfully defended his doctoral dissertation titled *Using Temporal Variability in Optical Measurements to Quantify Phytoplankton Production, Particle Size and Aggregation during the North Atlantic Spring Bloom*. Working with Dr. Mary Jane Perry, Nathan developed novel ways to study the huge data sets gathered by bio-optical sensors on autonomous gliders and floats. Using data collected during a three-month research cruise off the southern coast of Iceland in 2008, Nathan estimated the amount of carbon transported as aggregates of phytoplankton called “marine snow” from the surface to the sea floor following the annual North Atlantic Spring Bloom.

In February Nathan begins a postdoctoral fellowship with Dr. Hervé Claustre at the Laboratoire d'Océanographie de Villefranche. Claustre operates a global fleet of “bio-optical floats.” Using the data collected by the floats and the techniques he developed for his Ph.D., Nathan will estimate carbon sequestration rates and correlate these rates to the physical, chemical and biological properties of seawater around the world. He hopes that a better understanding of the movement of carbon into the deep ocean will improve climate projections and our knowledge of deep-sea ecosystems.

Steve Auscavitch received a master's degree in Marine Biology for his research on the biogeography of deep-sea benthic communities in the Southern Ocean, the least explored marine environment on Earth.

Working with over 1,000 digital images from the Drake Passage collected in 2008 and 2011 aboard the RV Nathaniel B. Palmer by Dr. Rhian Waller, his thesis advisor, Steve found megafaunal similarities that strongly correspond to distinct Southern Ocean water masses. However, two seamounts, Sars and Interim Seamounts, had unique faunal communities. This work highlights how little is known of seamounts in remote areas of the Southern Ocean and how critical they are for understanding global deep-sea biogeography.

Steve's thesis is titled *Biogeographic Patterns Among Deep-sea Benthic Megafaunal Communities Across the Drake Passage*. He will continue to study the ecology of deep-sea corals when he enters a Ph.D. program this spring at Temple University working with Dr. Erik Cordes.

Jenn McHenry completed dual master's degrees in Marine Biology and Marine Policy working with Dr. Bob Steneck and Dr. Teresa Johnson.

Her thesis, *Abiotic proxies for benthic megafaunal assemblages in the coastal Gulf of Maine: A template for ocean planning?*, showed that abiotic factors such as depth, substrate and oceanographic processes can be used as proxies to model species structure, biomass and diversity of benthic assemblages. She believes using abiotic proxies could allow localized, rapid and inexpensive ROV surveys to be scaled up and used for ocean planning, environmental impact studies, offshore wind siting, climate change monitoring and ecosystem based fisheries management.

Jenn now works at the NOAA Northeast Fisheries Science Center in Sandy Hook, NJ, studying outer continental shelf ecosystems, offshore wind energy siting/impacts and essential fish habitat for valuable benthic species (like black sea bass) with Dr. Vince Guida and Dr. Tom Noji.



AAUS-OWUSS Intern, Katy Newcomer.

AAUS-OWUSS Intern

Katy Newcomer, a recent graduate of Williams College with a B.A. in Environmental Biology and Maritime Studies, spent four months at the DMC thanks to an internship sponsored by the American Academy of Underwater Sciences (AAUS) and the Our World Underwater Scholarship Society (OWUSS).

Working with UMaine's Diving Safety Officer Chris Rigaud and Dr. Rick Wahle, she expanded her SCUBA skill set and gained experience in fisheries ecology research. During the course of the summer Katy became an AAUS Scientific Diver and a PADI Divemaster. She also earned nitrox and drysuit specialty certifications. Working in the Wahle lab, Katy gained experience with experimental design and real field-based scientific diving while collecting specimens for various projects and conducting scallop and sea bass surveys.

Katy plans to pursue a career in benthic coastal ecology and science diving. She is currently at the New England Aquarium working as an outreach educator and aquarist.



The Lowes Cove Capstone Crew: Dr. Larry Mayer, Dr. Kevin Eckelbarger, Darron Kriegle, Madison Leary, Sabrina Pearson, Melissa Hoffman and Dr. Rhian Waller.

Extending the Lowes Cove Time Series

Over the last decade, qualitative surveys have repeatedly suggested that species diversity in Lowes Cove has declined. To see if that was indeed the case, Darron Kriegle, Madison Leary, Sabrina Pearson and Melissa Hoffman, undergraduates in the School of Marine Sciences, were enlisted to replicate a survey of the benthic macrofauna in Lowes Cove that had previously been conducted in 1979 and 1996. The project will satisfy their Capstone requirement, and their summer internships were supported through the generosity of the John H. and Bethel B. Dearborn Trust.

Lowes Cove is the intertidal mudflat that bounds the Darling property to the south. The first survey of the cove was conducted as part of a clam flat dynamics study funded by Sea Grant to Dr. Les Watling, Dr. Larry Mayer, and Dr. Franz Anderson of UNH. The second survey was conducted 18 years later, when then graduate student Martin Thiel repeated the survey to determine if the mats of green algae overgrowing Lowes Cove at that time were affecting the macrofauna. The results of his work can be read at bedim.cl/publications/hydrobiol375.pdf.

With Larry, Kevin and Rhian as their Capstone advisors, Madison, Melissa, and Sabrina collected sediment cores at 56 stations along 10 transects that crisscross the cove in June and August. The cores were sieved and specimens were preserved for sorting. Upon returning from a semester in Australia, Darron jumped in to help sort samples and identify the animals. While in residence during the fall SBS program the four undergrads analysed organic matter and sediment grain size in the biogeochem lab, data necessary to compare Lowes Cove with other estuarine mudflats. Results are expected by the spring of 2015.

Dr. Peter Jumars

Dr. Peter Jumars has been in residence at the DMC since he joined the University of Maine School of Marine Sciences (SMS) in 1999. His research interests range from polychaetes to bioturbation, biomechanics and small-scale fluid dynamics. In addition to research and teaching, Pete's professional career has included stints as an Office of Naval Research Program Officer, Editor-in-Chief of *Limnology and Oceanography*, and president of the Association for the Sciences of Limnology and Oceanography. This year he received the Outstanding Research Award from UMaine's College of Natural Sciences, Forestry and Agriculture.

Pete credits his 10th grade biology teacher and 11th grade English teacher with forging his scientific career. One taught him to think like a biologist, the other how to enjoy writing. At the University of Delaware he ventured into mosquito research, but changed tack to focus on marine science after helping to culture thecosome pteropods—sea butterflies—in a laboratory one summer. During graduate school at Scripps Institution of Oceanography Pete first focused on zooplankton ecology, but settled on a Ph.D. project studying the small-scale spatial structure of benthic deep-sea species diversity. Pete studied polychaete taxonomy under Olga Hartman and Kristian Fauchald and gained an enduring appreciation of statistics from Bill Fager.

Beginning in 1975 and for almost 25 years, Pete held a faculty position at the University of Washington (UW). During that tenure he developed a modus operandi to research that continues to serve him well: “Identify an important problem, review past work on it, and ask why progress has not been faster. He usually finds one or more missing ingredients: lack of theory for prediction, lack of field observations, or lack of laboratory or field tests. “Addressing these shortcomings often yields rapid progress.”

Pete's research at UW focused on deposit feeding as a pervasive process affecting the environment on all scales, including the global. General themes were the effects of organisms on sediment transport and vice versa. The work with sediment transport gave him an appreciation for small-scale fluid physics and an acute interest in biological-physical interactions. Pete



Dr. Pete Jumars

found that physics provided the needed equations, i.e., quantitative constraints, to understanding organism form and function.

The connection that eventually brought Pete and his wife, Mary Jane Perry, to the DMC gelled at a 1985 workshop on the ecology of marine deposit feeders, when he had the opportunity to interact intensively with Larry Mayer. Within a few years the two were Co-PIs seeking chemical kinetic constraints on the process of deposit feeding. They learned that digestive fluids of deposit feeders are much like modern laundry detergents, including both surfactants that strip hydrophobic materials from sediments and enzymes that cleave the large molecules, with the hydrolysis products being concentrated proteins. This discovery shed light on how hydrophobic pollutants and metals enter marine animal food webs.

Studies on the diel migration of mysids and the interaction of phytoplankton cell shape and fluid dynamics have all been rewarding, but it is the research conducted with Ph.D. student Kelly Dorgan on the mechanics of animal burrowing that Pete describes

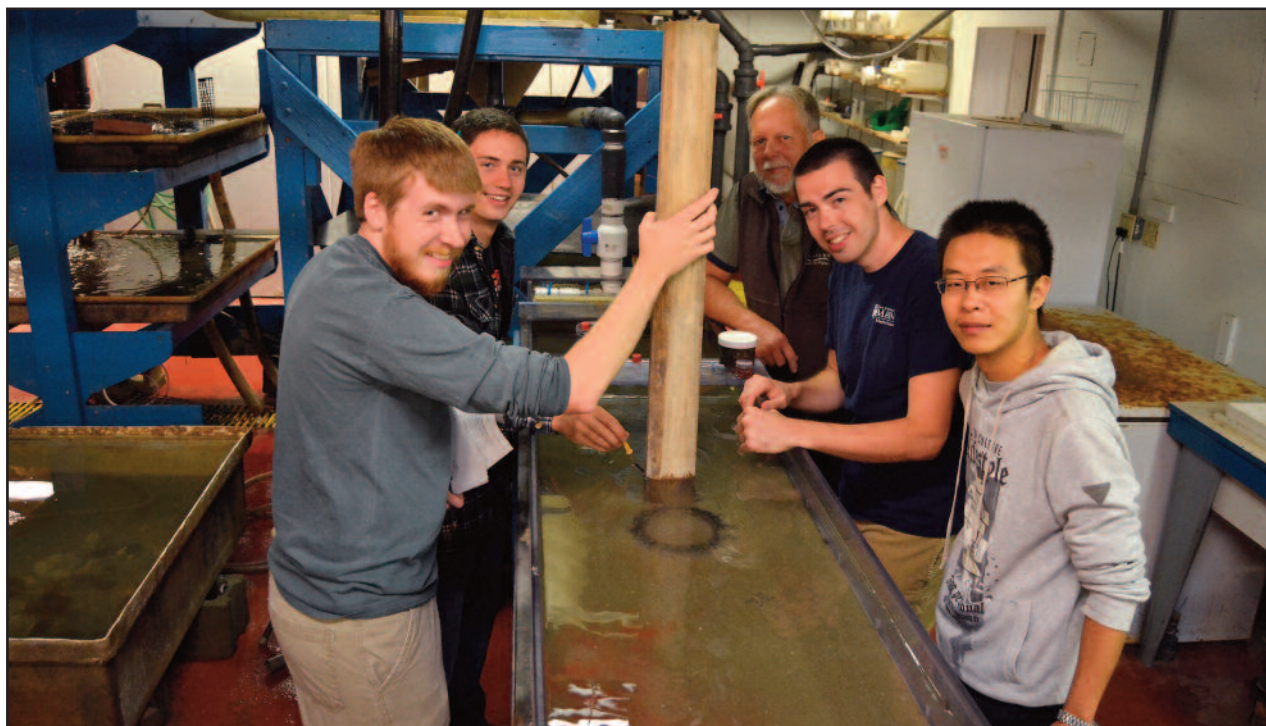
as “the most satisfying” since arriving at the DMC. His research MO held true. Previous studies of burrowing did not incorporate the physical properties of sediments. By analogy Pete points out, “Nobody would dream of analyzing swimming without the constraints imposed by water density and dynamic viscosity.” Colleagues Bernie Boudreau and Bruce Johnson, Dalhousie University, had just described how bubbles rise or “burrow” through sediments by crack propagation. The finding led Pete and Kelly to the idea that worms, with bilateral symmetry, may also rely on crack propagation to burrow through marine sediments. The work is also a rich source of puns on “ground-breaking” or “earth-shattering” results and “wise cracks” made by worms.

After 15 years at the DMC Pete is still involved in multiple projects with students and colleagues at UMaine and across the country. Pete revisited a project from his postdoc days with Kristian Fauchald that culminated in a complete review of polychaete feeding biology. With co-PI Sara Lindsay, UMaine's SMS, and Kelly Dorgan, now at the University of South Alabama's Dauphin Island Sea Lab, he revised the treatise again. The work will appear in the journal *Annual Review of Marine Sciences* in 2015 and is available online now at [doi: 10.1146/annurev-marine-010814-020007](https://doi.org/10.1146/annurev-marine-010814-020007). The online appendix swelled to 350 pages and will be posted at Annual Reviews by the end of the year (currently available at umaine.edu/marine/people/sites/pjumars/preprints/DietReduxA.pdf). Two other projects focus on fluid mechanics. One examines the inhalant siphon flows created by benthic animals with Ph.D. student Kevin du Clos at the DMC and John Crimaldi at the University of Colorado, Boulder (see *Making Waves* 2013, online at dmc.umaine.edu). The other study aims to observe, analyze and describe the vertical transport of phytoplankton in and around dissipative vortices, a project that builds on research recently completed with Lee Karp-Boss, UMaine SMS, and Lisa Fauci of Tulane University. The current project is a collaboration with Evan Variano at UC Berkeley.

Teaching has also been rewarding for Pete. His favorite course is Design of Marine Organisms. His goal for the undergraduate students in this class is to have them involuntarily think about fluid dynamics every day as they observe phenomena such as the flutter of leaves and scour marks around trees in the snow. Pete also teaches a professional skills class to incoming graduate students covering the ethics of science, scientific writing, graphics standards, society membership, and designing a career path. His pet focus in the course is the creative side of science, which he argues can be taught and learned as effectively as creative writing.

Pete offers a wealth of information on his website; reprints, preprints, class materials and philosophy of science all available at umaine.edu/marine/people/sites/pjumars.

He's posted individual essays on choosing a graduate school, the process of doing science and common pitfalls. Students considering or pursuing an advanced degree in the sciences will find the essays a rich source of insight, which Pete emphasizes is not to be taken as the authoritative way to “do science,” but rather encouragement to develop one's own philosophy.



Dr. Pete Jumars (center) and the Design of Marine Organisms class at the flume in the Flowing Seawater Lab.

ALSI *continued from page 1.*

As the ALSI time series grew in each region, its value as a forecasting tool for recruitment to the lobster fishery began to emerge. But to actually forecast the number of harvestable lobsters depends a lot on what happens during the five to eight years it takes a lobster to grow to market size, and that differs from region to region. This question spawned spin-off projects that focus on the environmental drivers of the fate of a lobster year-classes from hatch to catch, and evaluate the predictive power of regional settlement indices.

ALSI Update 2013 gained much attention in the media as it marked a widespread and deep downturn of lobster settlement throughout the Gulf of Maine that “may forebode declines in the catches of some of today's most productive areas.” Whether ALSI becomes our window to the future of the lobster fishery remains to be seen, but it gives us the unusual chances to assess the strength of incoming year classes several years before they impact landings, and that could help buy the time industry and managers need to adapt to change.

The ALSI program boasts some 30 peer reviewed publications and technical reports; it also produces a brief annual update distributed to the industry, media and fishery managers. All can be found at umaine.edu/marine/people/sites/rwahle/ALSIPage.htm.



Passive postlarval collectors deployed with commercial trap hauling gear were developed in 2005 to expand the range and depth of the annual surveys to locations unsuitable for diving.



Dr. Mary Jane Perry and Dr. Byoung Woong AN, Finnish Meteorological Institute on polar ice with the R/V Araon in the background. Photo by Dr. Eurico D'SA, Louisiana State University.

Phytoplankton Under Arctic Ice

Dr. Mary Jane Perry spent the month of August with an international team of 40 scientists, 1,100 kilometers above the Arctic Circle. They were aboard a Korean icebreaker, the R/V *Araon*, to study the biogeochemistry and primary production of the Marginal Ice Zone (MIZ.)

As a result of the warming climate, the Arctic has experienced notable changes in recent years. The sea ice is thinner and its aerial distribution much less. Though this may eventually lead to new shipping routes across the Arctic Ocean, it is already altering the timing, magnitude and location of plankton blooms that support the entire polar food webs.

With funding from the U.S. Office of Naval Research, Mary Jane and colleagues from the University of Washington used autonomous and robotic technologies to study the retreat of sea ice in the Beaufort Sea. Small submersible gliders equipped with multiple sensors deployed at the MIZ yielded a comprehensive look at the distribution and abundance of phytoplankton under thin and melting ice.

By understanding the dynamics of what's actually happening at the ice edge and scaling up those processes to match the seasonal changes of that ice as seen from above, the scientists hope to fully access how the changing ice patterns will affect the primary productivity in the changing Arctic.

Read more at the Marginal Ice Zone Program website: apl.washington.edu/project/project.php?id=miz.



The SABOR science team aboard the R/V Endeavor.

The SABOR Experiment

By measuring the optical qualities of seawater, the transmission and reflectance of light, scientists can quantify the distribution, abundance and seasonality of phytoplankton in the ocean. Satellites collect optical measurements of the ocean, but particles in the atmosphere muddle the signal. To get a more precise view of the ocean from space, scientists need to develop new ways to subtract the atmospheric effect inherent in satellite data and to see deeper into the ocean. To address this hurdle, NASA brought together marine and atmospheric scientists in the Ship-Aircraft-Bio-Optical Research (SABOR) experiment.

Dr. Ivona Cetinić had a key role in the SABOR experiment. As Chief Scientist aboard the R/V *Endeavor* this July, Ivona led a marine team that analyzed water samples for carbon and studied how particles interacted with light. Other scientists aboard the *Endeavor* measured phytoplankton biomass and photosynthesis, optical properties including polarization and scattering with LIDAR.

Simultaneously, scientists from NASA's Langley Research Center, flying in an aircraft at 30,000 feet, collected data on the size, shape and composition of particles in the atmosphere. Correlating ship and aircraft data with signals recorded by the CALIPSO, MODIS Terra and Aqua satellites at the same time, the SABOR scientists will develop mathematical algorithms to quantify the biomass of phytoplankton from the optical signal. During the cruise, the project was prominently featured on NASA's homepage.

The SABOR team is working together to develop next-generation tools that, Ivona predicts, "will change forever how we study the oceans." The ability to measure phytoplankton from space will revolutionize our understanding of how phytoplankton absorb carbon dioxide and support the marine food web at the global scale.

Read more about SABOR at espo.nasa.gov/home/sabor and earthobservatory.nasa.gov/blogs/fromthefield/category/ship-aircraft-bio-optical-research-sabor.

Ocean Optics XXII

Mary Jane Perry and Ivona Cetinić reported on MIZ and SABOR projects at the biennial ocean optics conference in Portland, Maine, in October 2014. The meeting drew over 400 people from 38 countries. UMaine professors Emmanuel Boss and Fei Chai, and graduate students Nathan Briggs and Alison Chase were also among the conference presenters. Mary Jane Perry was the co-chair of the conference and Ivona Cetinić was on the organizing committee.

Spectacular Deep-Sea Corals in the Gulf of Maine

Cold-water corals have been known to exist in the deep submarine canyons and seamounts of the North Atlantic since the 1800s, having occasionally made their way to the surface in fishing nets. Scientists have studied the biology and ecology of these creatures in the Gulf of Maine for over 40 years, but this summer researchers found them on the Schoodic Ridges in greater numbers and in greater diversity than ever before.

DMC personnel, past and present, were part of a team that discovered the spectacular deep-sea coral. Dave Packer, who received his master's degree at the DMC in 1988 and is currently a marine ecologist at the Northeast Fisheries Science in Sandy Hook, NJ, was co-chief scientist for the two-week cruise aboard the Research Vessel Connecticut. Dr. Peter Auster, their colleague at the University of Connecticut, was the other chief scientist at sea and Steve Auscavitch, who completed his master's in June of this year, was also on board. DMC Associate Research Professor Dr. Rhian Waller was involved in the expedition from shore.

Using Kracken2, a remotely operated vehicle (ROV) equipped with video and still cameras and robotic arms, the team explored multiple sites in the Gulf. On Schoodic Ridges, at depths near 650 feet, they found steep vertical walls up to 40 feet tall covered with sea fans, *Primnoa* (Red Tree) corals, and harboring countless other species of invertebrates and fish. Some of the specimens were over 6 feet tall, and may be hundreds, or even thousands, of years old!

The magnitude of their importance to the overall Gulf of Maine ecosystem is still poorly understood, but we do know from other systems that deep-sea coral habitats are host to diverse communities of marine flora and fauna.



Primnoa corals and Acadian redfish on the Schoodic Ridge. Photo by Gulf of Maine Deep Coral Science Team 2014/NURTEC-UConn/NOAA Fisheries/UMaine.

"Deep Sea corals can harbor many thousands of associated species," says Rhian. "They use these corals as areas to hide from predators, laying eggs or protecting their young, and sometimes even eating the corals themselves. These coral areas are hotspots of biodiversity, creating deep-sea ecosystems that contribute to the whole health of the ocean."

Since 2013 the team has worked together on the Gulf of Maine coral surveys. The project, which is part of a much larger deep-sea coral research program, was funded by a grant from the National Oceanic and Atmospheric Administration's (NOAA) Deep-Sea Coral Research and Technology Program, awarded to Waller and Auster.



50th Anniversary Celebration

The Darling Marine Center marks its 50th anniversary in 2015 and plans are under way for a summer-long celebration. Weekly seminars will be held in June and July for the general public with topics ranging from the history of marine labs in general and the history of the DMC in particular, to Damariscotta's oysters, Maine's lobsters, maritime history, coral reefs and deep-sea research. These seminars will lead up to a gala 3-day celebration August 6, 7 & 8.

Save the Dates!

Thursday, August 6th will be a reunion day for DMC "alums" including grads, undergrads, SBSers, interns, faculty and staff.

Friday, August 7th will be another day for DMC alums featuring a science symposium highlighting where we are now, and how we got here.

Saturday, August 8th will be a full-day open house at the DMC to which the public is invited.

Giving

Ira C. Darling donated his beloved farm to the University of Maine in 1965 establishing the Ira C. Darling Marine Center. He also created the largest Trust in UMaine history and established two chartered professorships. George Willett, the Kresge Foundation and Professor John Dearborn and his wife Bethel also made significant contributions that generously support the DMC and its programs. These and other gifts have made valuable additions to the DMC's mission. With your help we can ensure Ira's legacy for the next 50 years.

If you would like to make a donation, you can do so by sending a check made payable to the University of Maine and designate "Darling Marine Center" on the memo line. Please mail the check to:

Elizabeth Erickson
 Office of University Development
 101 College Avenue
 Orono, ME 04473

Online donations can be made using the University's Development Office secure giving site umaine.edu/development/give-now. Click on College of Natural Sciences Forestry and Agriculture and scroll down to Darling Marine Center.

If you would like to discuss giving options with our development officer, please call Liz Erickson at 207.581.1151.

Thank You!

dmc.umaine.edu

The DMC has a new website and a new URL! Be sure to visit the new site and add it to your list of favorite bookmarks—check back often for details about our 50th anniversary!

We're on Facebook, too!

[facebook.com/DarlingMarineCenterUMaine](https://www.facebook.com/DarlingMarineCenterUMaine)

Director Search

The University of Maine is seeking applications for the position of Director of the Ira C. Darling Marine Center. The link for the job can be found at: umaine.hiretouch.com (keyword Darling.) The Interim Director and Chair of the Search Committee, Dr. Mary Jane Perry, is available to provide additional details about the Center. Please contact her via email: perrymj@umaine.edu.

The recent National Academy of Sciences report, "Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21st Century" (July 2014), does an excellent job in laying out the challenges and opportunities for marine labs. The report and ancillary materials can be downloaded from: <http://dels.nas.edu/Report/Enhancing-Value-Sustainability/18806>



The Estuarine Oceanography class aboard the R/V Ira C.

2015 UMaine Accredited Courses at the DMC

Undergraduate and graduate opportunities abound at the DMC. Intensive May term and summer courses, and the residential Semester By the Sea (SBS) program engage students in courses that use the Gulf of Maine and the Damariscotta River Estuary as the primary classroom. All courses are open to students from other University of Maine System campuses and outside institutions.

May-term & Summer Courses

Full course descriptions and registration information are available at dmc.umaine.edu/education/may-term-summer-classes.

- ◆ **MATLAB for Marine Science**
Dr. Damian Brady • May 13-29
- ◆ **Science Communication Product Development**
Annette deCharon • May 13-26.
- ◆ **Introduction to Research Diving**
Christopher Rigaud • June 8 - July 29
- ◆ **Techniques in Shellfish Aquaculture**
Dr. Chris Davis • June 8-12
- ◆ **Techniques in Marine Mammal Ecology**
Dr. Kristina Cammen • June 8-19

Summer Workshops

dmc.umaine.edu/education/summer-workshops

- ◆ **Calibration and Validation for Ocean Color Remote Sensing** • July 6-31
Dr. Emmanuel Boss and Dr. Mary Jane Perry
- ◆ **Particle Flow Interaction Workshop**
Dr. Lee Karp-Boss • June 22-26
- ◆ **Natural Science Illustration Workshop**
David Wheeler • June 15-19



SBSer's Melissa Hoffman and Makaila Kowalsky in the Marine Fisheries Ecology class.

Semester by the Sea 2015

Lectures, labs and field trips revolve around the tides during the fall semester. Motivated students keenly interested in the marine realm will find SBS an invaluable experience. dmc.umaine.edu/education/semester-by-the-sea.

- ◆ **SMS 350 - Marine Ecology**
Dr. Bob Steneck
- ◆ **SMS 352 - SBS Undergraduate Seminar**
Dr. Rhian Waller & Dr. Kevin Eckelbarger
- ◆ **SMS 480 - Biology of Marine Invertebrates**
Dr. Kevin Eckelbarger
- ◆ **SMS 482 - Human Impacts on the Ocean**
Dr. Larry Mayer
- ◆ **SMS 491 - Marine Fisheries Ecology**
Dr. Rick Wahle
- ◆ **SMS 491 - Zooplankton & Ichthyoplankton**
Dr. Jeff Runge
- ◆ **SMS 491 - Introduction to Research Diving**
Chris Rigaud
- ◆ **HTY 316 - Archaeology of Shipwreck Sites**
Dr. Warren Riess
- ◆ **Capstone/Independent Research**