THE UNIVERSITY OF MAINE 1865

Making Waves

at the Darling Marine Center

2013 December

Dr. Kevin Eckelbarger

Dr. Mary Jane Perry

Introducing our Interim

Dr. Mary Jane Perry assumed the position of interim director of the DMC on 1 September. Mary Jane joined the faculty of the School of Marine Sciences at the DMC in 1999, having left the University of Washington, where she was a Professor of Oceanography. She has since served on almost every committee in the School, working hard to enhance the School's undergraduate and graduate student curriculum. Over her career, Mary Jane has organized and run major field research operations, been a member of many national and international committees, and served as a National Science Foundation (NSF) program officer. Her most recent activities include working in the sub-polar North Atlantic, using a fleet of autonomous floats and gliders to study one of the major events on the planet – the beginning of the phytoplankton spring bloom.

Feeling it was her turn to give back to the Center, Mary Jane agreed to serve as interim director, she hopes for only 18 months, while a new permanent director is recruited. In the months preceding Kevin's transition, she and other faculty proposed and received funding from the NSF for strategic planning. The grant will support an intensive and comprehensive review of the DMC's research, education and outreach activities, and chart a 10-year course for the Center. It will culminate in a written document combining long-term visionary goals and a short-term implementation plan that will prove useful for the next director. She'd welcome ideas and suggestions from DMC's friends and alums.

The Big Transition

On September 1st Dr. Kevin Eckelbarger stepped down as Director of the Daring Marine Center, a position he held for 23 years. Kevin has not retired! He wants to make that perfectly clear. He has "simply" relinquished his role as director and is now full-time faculty in the School of Marine Sciences.

As Kevin readily acknowledges, "I don't like being bored." In the weeks since his transition he started teaching two courses in the fall Semester By the Sea program, as well as gearing up for a new May-term course, advising students and collaborating on new research projects.

The Darling Marine Center was established in 1965 when Ira C. Darling donated his saltwater farm to the University of Maine to be developed as a marine laboratory. To maintain and improve the property he established the largest trust in the University's history, and to promote education he endowed two chaired professorships. Kevin became Director of the Center in 1991 and put Ira's vision and Ira's endowment to work; greatly improving and developing new facilities and programs.

Kevin secured numerous grants from the NSF's Marine Laboratory and Field Station program to upgrade, expand and construct two flowing seawater classrooms, a dive building, a vessel operations building, a dormitory/dining hall, coastal research vessels, research microscopes, a scanning electron microscope, and a marine library. He was also instrumental in the design and construction of a 20,000 sq. ft. marine culture laboratory and a 42 ft. offshore research vessel. Working with resident faculty, he renewed the tradition of undergraduate teaching and research at the DMC, establishing the Semester By the Sea program in 1993, and a NSF REU internship program in 2000.

Kevin's legacy is an internationally known and widely respected, state-of-the-art marine laboratory that welcomes over 2,200 students, researchers, and course and conference participants annually. Mr. Darling, too, would be proud of this legacy. Today, the Walpole property encompasses 170 acres and has 25 buildings valued at over $25 million, and over 40 faculty, staff and students of the University of Maine work at the DMC year round.

Celebrating 20 Years of Salty Science

The year is 1993. Six undergraduates arrive at the DMC for the fall semester and move into the "Horse Barn" dormitory. Prior to their arrival, two outbuildings, the incinerator and the garage, were converted to a kitchen and a dining hall. The faculty scramble to prepare courses that are more hands-on and field-oriented than they've ever taught before. Such were the early days of Semester By the Sea (SBS).

SBS renewed a tradition of undergraduate teaching at the DMC. Five courses were offered the first year: Coastal Oceanography, Ecology of Rocky Shores, Field Marine Geology, Invertebrates of the Maine Coast, and Maritime History & Archaeology. They were taught in the landlocked Kresge classroom and a space on the first floor of the Flowing Seawater Laboratory; one course per day, with field trip, lab and lecture times dictated by the tides. Sampling cruises were on the *R/V Lee*, a fiberglass hulled boat that groaned under the weight of a dredge. The School of Marine Sciences had yet to be formed, so the first cohort of undergrads came from the Biology and Zoology Departments. By the end of the semester the students' mantra "We survived Semester By the Sea 1993" was declared on T-shirts.

The more things change the more they stay the same. This fall 14 students moved into Brooke Hall, the waterfront dormitory/dining facility. The faculty still fuss over last-minute changes to their syllabi, but "hands-on and field-oriented" are old hat. The courses are still taught one per day, but in the well-equipped McAlice classroom, and aboard the solid and stable *R/V Ira C.* Invertebrates of the Maine Coast and Marine Ecology are offered annually. Human Impacts on the Ocean, Zooplankton and Ichthyoplankton in Marine Ecosystems and Introduction to Research Diving rounded out the 2013 program.

Over the years students have enrolled in SBS for the same reasons. They want a fun, off-campus experience, but with graduation quickly approaching, they need a hands-on learning experience that will be instrumental in defining their future. Program alums repeatedly acknowledge their SBS experience as one of the most challenging aspects of their UMaine career and as one that makes their resume unique.

Randy Lackovic, DMC librarian

An Outstanding Employee - Congratulations Randy!

Randy Lackovic received the 2013 University of Maine's Outstanding Classified Employee Award. He was nominated for the award by his supervisor, Jim Bird, the Department Head of Fogler Library's Science and Engineering Center, who is duly impressed with Randy's service and initiative as the Darling Marine Center's Librarian. In his nomination letter, Jim put into words what those of at the DMC have always known: Randy is a great librarian!

As the DMC Librarian since 2007, Randy not only manages the day-to-day tasks of running the entire DMC library single-handedly, but makes it an inviting and comfortable space to study and do research. Additionally, he has delved into DMC history, collecting archival photos, reports, and correspondence from a variety of sources. The result is a historical archive of the Darling Marine Center and reprint collection of resident and visiting researchers.

Best of all Randy takes a personal interest in library patrons', regularly checking-in to learn their current focus, and keeping his eyes open for related publication and reference material to forward along. DMC faculty Dr. Kevin Eckelbager is writing a book on the history of marine laboratories. He regularly comments, "It's just amazing what that guy can find."

Sea Grant Extension agents Dana Morse and Sara Redmond on a kelp raft.

A New Lease for Aquaculture

The DMC has a new aquaculture lease thanks to Dana Morse, the DMC's resident Sea Grant Extension Agent. Roughly three times the size of our previous lease, which has since expired, it is categorized by the Maine Department of Marine Resources as an Experimental Lease. An experimental lease is for holding and culturing organisms in research and education projects, not for commercial aquaculture purposes. The lease rounds out the aquaculture facilities available to the faculty, staff and students at the DMC as well as our visiting researchers.

The new lease covers 1.7 acres spread over three tracts in Lowes Cove and the Damariscotta River easily accessible from the DMC waterfront and permits a broad list of species (primarily bivalve shellfish and marine algae) to be cultured using a variety suspended and bottom culture techniques. The flexibility built into the lease agreement facilitates future research, innovation and education, thereby continuing three decades of aquaculture at the DMC.

The lease currently supports Dr. Paul Rawson's oyster brood stock project and Dr. Rick Wahle's research on scallop reproduction. It is also the overwintering site for our local oyster gardeners some of whom are third graders from the Great Salt Bay School. In the near future, sugar kelp and razor clams will also be growing on the site. Anyone who may have a use or need for the lease is encouraged to get in touch with either Tim Miller or Dana.

Recent Publications

Auster, P.J., M. Kilgour, D. Packer, **R.G. Waller**, **S. Auscavitch** & **L. Watling**. 2013. Octocoral gardens in the Gulf of Maine. Biodiversity. doi: 10.1080/14888386.2013.850446.

Brady, D.C. & T.E. Targett. 2013. Movement of juvenile weakfish (*Cynoscion regalis*) and spot (*Leiostomus xanthurus*) in relation to diel-cycling hypoxia in an estuarine tributary: Assessment using acoustic telemetry. Marine Ecology Progress Series 491:199-219. doi:10.3354/meps10466.

Brady, D.C., J.M. Testa, D.M. Di Toro, W.R. Boynton & W.M. Kemp. 2013. Sediment Flux Modeling: Application and Validation for Coastal Systems. Estuarine, Coastal, and Shelf Science 117:107-124. doi: 10.1016/j.ecss.2013.06.014.

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Keil, R.G. and **L.M. Mayer**. 2013. Mineral matrices and organic matter. IN: Treatise on Organic Geochemistry, Elsevier.

Liu, Z., D. Breecker, **L.M. Mayer**, J. Zhong. 2013. Composition of size-fractionated sedimentary organic matter in coastal environments affected by different physical forcing effects, Organic Geochemistry 60: 20-32..

Margolin, A.R., L.F. Robinson, A. Burke, **R.G. Waller**, K.M. Scanlon, M.L. Roberts, M.E. Auro & T. van de Flierdt. 2013. Deep-sea coral paleobiogeography in the Drake Passage over the last 35,000 years. doi: 10.1016/j.dsr2.2013.06.008

McMahan, M.D., **D.C. Brady**, D.F. Cowan, J.H. Grabowski & G.D. Sherwood. 2013. Using acoustic telemetry to observe the effects of a groundfish predator (Atlantic cod, *Gadus morhua*) on movement of the American lobster (*Homarus americanus*). Canadian Journal of Fisheries and Aquatic Sciences 70(11): 1625-1634. doi: 10.1139/cjfas-2013-0065.

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Watling, L., S. Rowley, J. Guinotte. 2013. The world's largest gorgonian? Zootaxa 3630: 198-199.

Zhang, Q., **D.C. Brady**, & W.P. Ball. 2013. Long-term seasonal trends of nitrogen, phosphorus, and suspended sediment load from the non-tidal Susquhanna River Basin to Chesapeake Bay. Science of the Total Environment, 452-453: 208-221. doi: 10.1139/cjfas-2013-006.

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

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Darling Marine Center

Making Waves

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Mysterious Mysids

Small creatures intrigue Dr. Rachel Lasley-Rasher. She studies zooplankton, copepods and mysids, and their strategies for feeding, mating and survival amid an ocean full of predators. Rachel's current research focuses on the effects of anadromous fish on the distribution and behavior of mysid shrimp over seasonal cycles to better understand this critical link in coastal foodwebs. The focal mysid species is *Neomysis americana,* which is distributed along the eastern U.S. coast from New Brunswick to Florida.

From April to November, Rachel joined a crew of NOAA researchers lead by Justin Stevens aboard the F/V Odd Ball, captained by Isleboro fisherman Josh Conover, to sample the estuarine waters of the Penobscot River. They quantified fish. She quantified the zooplankton. Rachel learned that mysids in the Penobscot hang out in cloudy waters. In the estuarine environment, where fresh water pushes into the sea, water and sediments mix. The water is turbulent, turbid and full of mysids.

Though the data still needs to be thoroughly examined, anecdotal shipboard evidence suggests that when and where there are mysids, there are fish. But what is the connection? Are the fish there to feed on the mysids? Are the mysids there because the fish are feeding on something else? The answers may be found in fish guts collected during the survey. These samples are being analyzed in Dr. Karen Wilson's lab at the University of Southern Maine and will yield insight into the importance of mysids in the diet of anadromous fish.

To get a better picture of *Neomysis americana's* distribution at larger temporal and spatial scales Rachel and Dr. Damian Brady, also at the DMC, have been looking at fish gut content data collected during Northeast Fisheries Science Multispecies Trawl Surveys. These trawls have been conducted since 1963 and quantify fish abundance as well as gut content of many fish species. Rachel and Damian are using these fish guts as 'biosamplers' to look for seasonal patterns in mysid distribution over the last 49 years.

Dr. Rachel Lasley-Rasher is a postdoctoral researcher at the Darling Marine Center working in Dr. Pete Jumars' laboratory. The mysid project builds on previous research conducted in Pete's lab that focused on diel movement and habitat use by mysids in the Damariscotta estuary. Rachel's research is funded by the National Science Foundation's Broadening Participation in Ocean Sciences program. The NOAA researchers hope to document population growth of anadromous species such as shad, alewife and salmon as the fish are able to return to their historic breeding grounds in the wake of recent dam removals in the lower Penobscot River.

Dr. Rachel Lasley-Rasher and summer interns Kate Cart and Laura MacDonald. Kate and Laura split their time working for Rachel on the mysid project and for Dr. Damina Brady on the VolturnUS monitoring.

Permitting Wind Power

At 12:40 p.m., on June 13, 2013 the blades of VolturnUS were allowed to spin, and for the first time in the Americas, offshore wind energy flowed into the power grid. VolturnUS is the first floating wind turbine. It is a one-eighth scale model of the turbines UMaine plans to place in the Gulf of Maine in 2016. VolturnUS was designed by University of Maine personnel, constructed in Brewer, launched into the Penobscot River, and escorted by tugboat to the waters off Castine, ME.

Dr. Damian Brady, Assistant Research Professor, in the School of Marine Sciences and based at the Darling Marine Center, was the Environmental Monitoring and Permitting Task Manager for the VolturnUS project. His primary responsibility was coordinating between UMaine research teams and resource agencies on the state and federal level to complete an environmental assessment of the site and implement a fish and wildlife monitoring plan.

DMC summer interns Kate Cart (University of New Hampshire) and Laura MacDonald (Vassar College) were and continue to be instrumental in monitoring the VolturnUS wind turbine for potential impacts on birds, bats, and marine mammals using a remotely operated surveillance system, or webcam.

The good news is: no reported bird strikes! Footage of birds interacting with wind turbines is rare, but Kate and Laura captured a cormorant perching on the wind turbine platform over many weeks. The holy grail of bird turbine interactions is the ability to describe the behavior of birds as they approach a wind turbine and they have it!

Dr. Damian Brady at the launching of VolturnUS.

Global Carbon

Ben Segee arrived two weeks late for the fall SBS program, but he had a good excuse. He was out to sea aboard the *R/V Atlantic Explorer* participating on a global carbon study. He was one of three undergraduate students on the vessel, the only one from UMaine, who helped collect and process CDT data, as well as water samples for chlorophyll and pigment analysis along a cruise track that started in Boothbay Harbor, ME, crossed the Gulf of Maine to the Labrador Sea and down to Bermuda. Additionally, Ben was in charge of collecting measurements of ocean color for comparison to the ones daily acquired by the NASA's MODIS satellite.

Data sets collected from this oceanographic cruise and future cruises to equatorial and polar waters will be compared to large satellite data sets to take advantage of technological advances in satellite and in-situ sensors and develop algorithms that will allow scientists to detect and map POC from space.

Ben Segee, Dr. Nicole Poulton, Dr. Ivona Cetinić and Dr. Wayne Homer Slade aboard the R/V Atlantic Explorer.

Dr. Ivona Cetinić, a research associate in the School of Marine Sciences (SMS) based at the DMC, is the Principle Investigator of the three-year, NASA funded project. Co-PI's include Dr. Mary Jane Perry, SMS based at the DMC; Dr. Nicole Poulton, Bigelow Laboratory for Ocean Sciences, East Boothbay, ME; and Dr. Wayne Homer Slade, UMaine Ph.D. 2011 and now at Sequoia Scientific, Inc. WA.

Ivona's team was one of several from U.S. and European institutions, aboard the *R/V Atlantic Explorer* in August. The cruise was led by Dr. Mike Lomas, Bigelow Laboratory for Ocean Sciences, and Dr. Adam Martiny, University of California, Irvine.

Dr. Bob Steneck

The Resilience of Caribbean Corals

In early October, Dr. Bob Steneck set sail from Christmas Cove, Maine, bound for the Caribbean Sea on his 34' Pacific Seacraft *Alaria*. With funding from the National Geographic Society, he and colleagues from the University of Newcastle, UK; University of Queensland, Australia; Universidad Nacional de Colombia; and The Nature Conservancy will survey the coral reefs on a dozen islands along the archipelago. The big question: can effective fisheries management substantially improve conditions of coral reefs despite ongoing climate and atmospheric stresses.

Caribbean coral reefs have been in decline for some time, but some have fared better than others suggesting a latent resilience and ability to recover from storms and other stresses. The reefs that have not fared well are no longer dominated by corals, but rather seaweeds, which out-compete corals for space on the reef. Studies have shown that grazing by herbivorous fish can "mow" down the seaweed, giving corals a competitive edge against the algae.

The coral reefs along the eastern shore of the archipelago, from Anguilla to Grenada, have similar oceanographic, climate and atmospheric conditions, but human population densities and fishing pressure vary from island to island. By surveying the coral reef community (corals, algae, fish, etc.) and comparing the data to local fisheries management, they hope to determine if reef health and resilience can be strengthened by effective fisheries management.

Though Steneck may be best known locally for his expertise on the ecology and fisheries of the Gulf of Maine, he is also a highly regarded coral reef ecologist. In the 1990s he helped develop an acclaimed rapid-assessment protocol to quantify species composition of the reefs accounting for corals, algae, herbivorous and carnivorous fish. His first research trip to the area was in 1973, when he surveyed some of the same reefs, giving him a unique 40-year perspective and ability to quantify the long-term changes in these ecosystems.

Track the voyage at **share.delorme.com/RobertSteneck**
Follow the science at **bobsteneck.blogspot.com**

Welcome to the Explorer's Club

Dr. Rhian Waller is a Fellow in the elite National Geographic Explorers Club. With her acceptance into the club, she joins the likes of Robert Peary, Roald Amundsen, Sir Edmond Hillary, Dr. Sally Ride and Dr. Sylvia Earl.

Dr. Rhian Waller

Rhian's field expeditions include trips to polar and sub-polar regions to study deep sea corals. To collect samples of these unique creatures, Rhian has been to the bottom of the Atlantic and Pacific Oceans in the submersible Alvin and scuba dives in the icey fjords of Alaska and Chile.

According to the Club's website, the organization was "founded in 1904 by a group of the world's leading explorers. The Explorers Club is a multi-disciplinary not-for-profit professional society dedicated to the advancement of field research, scientific exploration and the ideal that it is vital to preserve the instinct to explore." The Club extended membership to women in 1981.

Upon being nominated for membership by Capt. Diann Lynn, whom she met at a Women Divers Hall of Fame meeting, and Dr. Michael Manyak, Rhian submitted an application based on their sponsorship. Rhian was happy to hear of her nomination and positively thrilled to hear of her acceptance commenting, "It's quite an honor to have been voted into the fold!"

More information about the Explorers Club can be found at **explorers.org**.

Graduate Student Receives Awards

Nathan Briggs is a Ph.D. student in the Oceanography program of the School of Marine Sciences. Based at the DMC and working with Dr. Mary Jane Perry, his primary research interest is the use of in situ optics to study phytoplankton.

Nathan Briggs

Nathan received two awards from the University of Maine for outstanding research in 2013, a Graduate Research Excellence Award and a Doctoral Research Fellowship. Both awards recognize what Mary Jane calls "his ability to think about data in creative ways."

Optical oceanographers quantify phytoplankton populations as a means of studying the global carbon cycle. They use sensors to measure the optical properties of seawater, including chlorophyll fluorescence and backscatter of light, which are proxies for phytoplankton. The sensors provide extremely large data sets for analysis.

Of interest to Nathan are the high-frequency fluctuations in these optical measurements, which he used to derive an estimate of mean particle and mean phytoplankton size. The typical approach is to filter the data and remove these fluctuations. Nathan took an approach that allowed him to extract information from what others rejected as noise.

"Nathan's research has the potential to be quite influential in the burgeoning field of autonomous ocean observations," says Perry.

Exploring the Cayman Rise Hydrothermal Vents

During the 2013 field season, the *E/V Nautilus* cruised the Gulf of Mexico and the Caribbean Sea with a rotating team of over 150 scientists, engineers, students and educators. Steve Auscavitch was part of the crew for a 12-day leg in late August focusing on exploring the hydrothermal vent communities of the Cayman Rise. Using two remotely operated vehicles (ROVs) the scientists observed and sampled the biological and geological features of the Von Damm vent field on Mount Dent at 2300m depth. Steve worked with scientists onboard logging data collected during science operations and providing commentary over a live ROV web stream at Nautilus Live, **nautiluslive.org**.

Steve is a Master's student in the School of Marine Sciences, based at the DMC. He completed his undergraduate degree at the University of Connecticut, Avery Point. He then worked on a Caribbean coral reef project; an experience that opened his eyes to the relatively open area of deep sea coral research. He is currently working with Dr. Rhian Waller on the biogeography of deep-sea corals, and is on schedule to complete the degree in 2014. Though the Cayman Rise cruise was not specifically part of his thesis research, he was able to participate and provide assistance with identifying deep-sea animals and collecting and processing biological samples.

The chief scientist, Dr. Cindy Van Dover, Duke University, was interested in studying shrimp communities around the vent when they came across an abundance of deep-sea corals growing a short distance from active venting. This was incredibly useful for Steve because, as he notes, "There are not many field guides to the deep-ocean animals, so the ability to familiarize myself with animal morphologies I've never seen before will definitely help me with my research in the future."

The *E/V Nautilus* is owned and operated by Ocean Exploration Trust, a non-profit organization founded by Dr. Robert Ballard in 2008. More information about the Trust and the opportunities it provides to undergraduate and graduate students is available at **oceanexplorationtrust.org**.

Steve Auscavitch aboard the E/V Nautilus.
Photo courtesy Ocean Exploration Trust

Tara Expedition

Dr. Ivona Cetinić joined Tara Expeditions on it's Polar Circle 2013 cruise this autumn. The expedition is an international effort to study the Arctic ecosystem. On board, Ivona will collect particulate organic carbon data for her global carbon cycle research, see Global Carbon, page 3.
oceans.taraexpeditions.org

The Enemy Within

Graduate student Skylar Bayer is featured on the Colbert Report. Last fall, a cooler of scallop gonads was put in the wrong car. Though the matter was quickly resolved, the Colbert Report's news team picked up the story which aired March 4, 2013.
colbertnation.com/the-colbert-report-videos/424346/march-04-2013

Lobster Cannibals

Graduate student Noah Oppenheim caught lobsters eating lobsters on video. His research made a splash at scientific meetings and was featured by local and national news orgainzations. "Attack of the Cannibal Lobsters" is a Climate Desk production.
climatedesk.org/2013/07/consider-the-cannibal-lobster

Copepod Love

Dr. Rachel Lasley-Rasher speaks with Ari Daniel Shapiro about copepod mating strategies for his "Small Matters" radio segments. "Copepod Love" was featured on Public Radio International's Living On Earth program, October 18, 2013. To listen to the podcast at www.loe.org/podcast.rss.

Ocean Acidification in the Aleutian Archipelago

The National Science Foundation has awarded UMaine researchers $574,617 to study the effects of ocean acidification on the marine ecosystem of the Aleutian archipelago in Alaska.

Clathromorphum nereostratum lives in the subarctic, North Pacific Ocean. It is a long-lived, slow growing coralline alga that accretes massive "bioherms" during its 2000 year lifetime. Bioherms are mound-like reef structures that form the foundation, or substrate, of the archipelago benthos upon which the kelp forests grow. Preliminary research suggests the calcium carbonate skeleton of the coralline alga is weakening due to increased ocean acidification. With the recent ecological extinction of the sea otters, sea urchin numbers have increased. In places, the urchins have intensely grazed the kelp forest leaving behind barren ancient coralline reefs.

During past cycles of sea otter/urchin/kelp booms and busts, when ocean acidity held steady, *C. nereostratum* fared much better. Now in a weakened state, C. nereostratum is falling prey to the urchins, literally crumbling away through a process called bioerosion.

UMaine professor Dr. Bob Steneck and postdoctoral research associate Dr. Doug Rasher, both based at the Darling Marine Center in Walpole, will work with Dr. Jim Estes (University of California, Santa Cruz) to determine if *C. nereostratum* is threatened with extinction due to the combined effects of ocean acidification and food web alterations.

The three-year study will include a summer-long research expedition in 2014 to the western portion of the Aleutians, from Adak to Attu, to survey kelp forests and urchin barrens, measure ocean acidity, and collect samples of the ancient coralline bioherms. Subsequent laboratory–based research will include urchin feeding experiments at past and present levels of ocean temperature and acidity to confirm processes driving the patterns observed in the field. Additional studies will focus on the bands of calcium carbonate (similar to tree rings) in the coralline samples. The results will describe how ocean acidification affects the physiology and ecology of long-lived, carbonate producing organisms in the subarctic North Pacific. It will also be one of the first studies to document whether ocean acidification, ocean warming, and food web changes are reshaping species interactions in nature.

Dr. Doug Rasher

bioprocessalgae
Valuing Carbon

BPA Receives DOE Grant

BioProcess Algae, LLC (BPA) is a Rhode Island-based company that designs and engineers large-scale microalgae cultivation systems. BPA is working with partner Green Plains Renewable Energy (GPRE), a corn ethanol producer, at one of their locations in Shenandoah, Iowa, to commercialize the technology. GPRE supplies waste CO2 from their ethanol production process, which BPA then uses in their algae growing process.

BPA's Maine-based operations, the Biology group, is headed by Chris Maloney and occupies an Aquaculture Business Incubator overseen by the Maine Aquaculture Innovation Center at the DMC. The Biology group focuses on the research and development of algal strains and growing techniques.

BPA was recently awarded a $6.4 million grant from the U.S. Department of Energy (DOE) to use non-food biomass feed stocks, waste-based materials and algae to produce biofuels that meet military specifications for jet fuel and diesel. The funds will allow BPA to develop and scale up technologies to this end at their Shenandoah operation. In addition, it will allow BPA to expand existing research and development capabilities here at the DMC, specifically with regard to new scientific equipment and additional personnel.

Consequently, negotiations are underway to form a partnership between UMaine and BPA. Chris is optimistic about the collaboration and is "grateful to have continued access to the great resources and community in general here at the DMC."

Half a World Away for Semester By the Sea

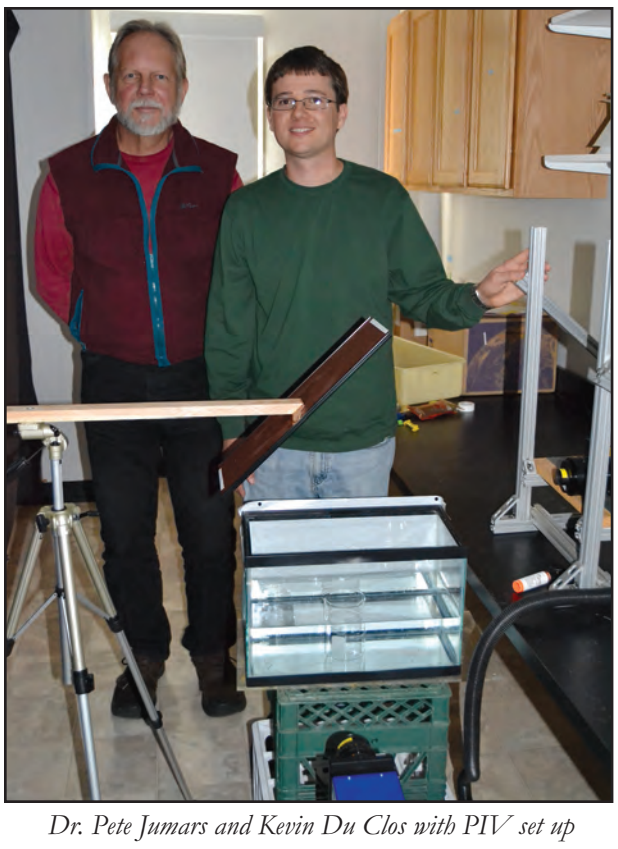
Berry Shi and Yovela Wang, both from Xiamen University in Xiamen, China, are the first Chinese exchange students to participate in Semester By the Sea (SBS). They were persuaded to attend by Dr. Fei Chai, Director of UMaine's School of Marine Sciences (SMS), who is passionate about promoting UMaine and the SMS academic programs. Fei hales from China and has colleagues at Xiamen University. When he last visited Xiamen, Fei spoke to undergrads about the SBS and encouraged students to attend.

Yovela Wang and Berry Shi

It is the first trip to the U.S.A. for both Berry and Yovela, though each has traveled internationally around Asia. The experience is most novel for Yovela. She comes from Fuzhou, China, a city of over 4 million people with a subtropical climate. She has seen snow once, but is really looking forward to her first snowfall. Berry is used to changing seasons and colder weather. She is from Shenyang, the largest city in northeast China with a population of over 8 million people.

The language barrier has been low. Both students take "international classes" at Xiamen University, meaning that all their classes are taught in English. The greatest hurdle is scientific terminology; catching the spelling, pronunciation and definitions of words that may have no direct translation to Chinese. They are quick to note the differences in the marine programs. At Xiamen University, students focus on one discipline of marine science, biology, chemistry, geology or physics, and class time is spent primarily in lecture halls. The SMS program is interdisciplinary and the SBS program is extremely hands-on.

So far they love midcoast Maine – everyone is so friendly here. Pangs of homesickness are seldom felt in Walpole, but a recent sojourn to Boston left them longing for Chinese cuisine and vibrancy of a multicultural city. All in all, they say, "It's been a great experience."



Dr. Pete Jumars and Kevin Du Clos with PIV set up

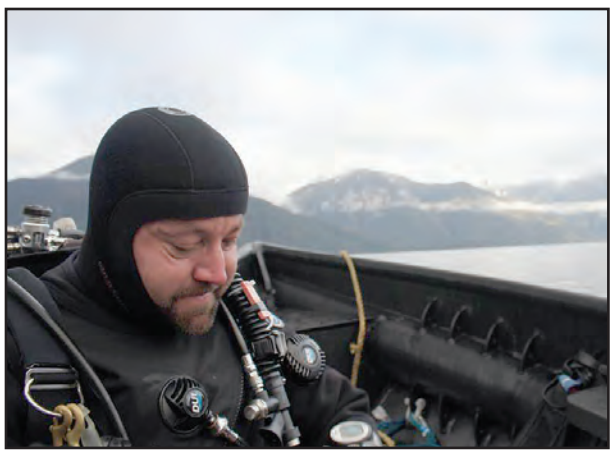
Turbulent Mathematics

Through the processes of suspension feeding and respiration via inhalant and exhalant siphons, benthic invertebrates alter the chemical properties of their surroundings and create flow fields that determine their feeding success while causing challenges for their planktonic prey. Quantifying the flow in and out of invertebrate siphons is necessary to understand the biogeochemical processes at the seafloor. Whereas there are many studies of exhalant siphon flows, there are very few studies of inhalant flows.

Dr. Pete Jumars loves a mathematical problem. He's also keenly interested in small-scale fluid dynamics. When he set out to model how non-turbulent flow enters a siphon he turned to existing engineering models of flow entering a pipe. But their basic assumption, that water flow across the opening of the pipe is uniform, made no physical sense to Pete. He recently published a numerical model that he thinks is much more accurate: **lofe.dukejournals.org/content/3/21.full.pdf+html.**

Pete and Dr. John Crimaldi, University of Colorado, received funding or $585,000 over three years from the National Science Foundation to further develop and test this new model. While the basics of the new model will be verified in John's lab, Pete and Ph.D. student Kevin Du Clos will contextually expand the mathematical model to include real-world conditions such as ambient water flow and interactions between siphons. Using particle image velocimetry (PIV) Kevin will also will measure the feeding currents of *Mya arenaria* and *Ciona intestinalis*. These two organisms are morphologically quite different and produce different flows. He'll compare the results to those generated by the computer model to see how well it predicts reality and how well Dr. Crimaldi's simplified mechanical models of the animals match animal-produced flows.

The results of the study could be far reaching. The secrets of invertebrate pumping will be uncovered yielding a better understanding of their food sources, the locations from which they can receive chemosensory cues and their energy budgets. And if all flows as planned, introductory hydraulic engineering textbooks will need a new section on the pipe entry problem.



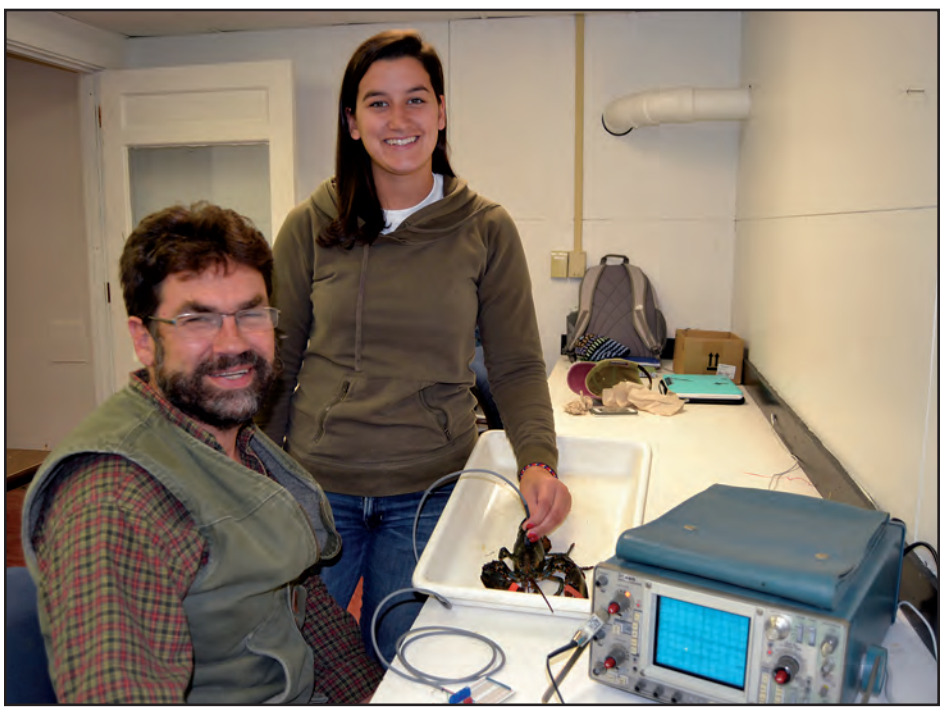
Chris Rigaud

Diver Tapped for U.S. Antarctic Program

Christopher Rigaud has been appointed to the Diving Control Board of the National Science Foundation United States Antarctic Program (USAP). The USAP Diving Control Board consists of experienced scientific divers and diving safety officers selected for their expertise and standing in the scientific diving community. The board approves and oversees all USAP diving operations to ensure they are conducted safely.

Chris has been the University of Maine Diving Safety Officer since 2003. Based at the DMC, he oversees the UMaine Scientific Diving Program and teaches both Basic Scuba and Introduction to Research Diving for the School of Marine Sciences. He is also a member of the Board of Directors of the American Academy of Underwater Sciences. Chris's diving exploits have taken him around the U.S. from New York to Maine, California, and Texas, and around the world from the Caribbean to Iceland, Australia, and Chile.

Information about the Scientific Diving Program can be found at **umaine.edu/scientificdiving**



Dr. Rick Wahle and Jaqueline Rosa

Taking the Pulse of Lobsters

As the waters in the Gulf of Maine get warmer, how will the famed Maine lobster fare? That is a question being asked on many levels by Dr. Rick Wahle and his students and his colleagues. Jacqueline Rosa, an undergraduate student in the School of Marine Studies, is working with Rick to learn how lobsters physiologically respond to heat. Her Capstone project is part of a collaborative project to develop and test an optical stethoscope that can easily be attached to the carapace of a lobster.

This summer, using a GoPro camera, a glass aquarium, and an aquarium heater Jacque monitored gill ventilation rates of lobsters as water temperature increased. She found that lobsters acclimated to cooler temperatures (10ºC vs 20ºC) have more dramatic responses to temperature increases and that all lobsters struggle to ventilate in water warmer that 22ºC.

Meanwhile, undergraduate Jordan Millington toiled away in the engineering department developing an optical stethoscope and accompanying Lab View software for his Capstone project. The device could become a practical, non–invasive health assessment tool for marine crustaceans.

Using the new stethoscope, Jacque will conduct a second round of physiological experiments. Her hypotheses being that lobsters' heart rate will increase with water temperature, and that lobsters acclimated to warmer water will have a higher failure threshold than cold-acclimated lobsters.

Jacque's experiments are a good test of the new stethoscope and shed light on how a warming Gulf of Maine will affect our famous fishery.

Emily Dernbach and Dr. Aaren Freeman, Adelphi University

Waves & Whelks

Emily Dernbach's Master's thesis explores how wave exposure and predator cues affect the foraging behaviors and preferences of the intertidal dog whelk, Nucella lapillus, in the Gulf of Maine. It expands on her undergraduate work in the laboratory of Dr. Aaren Freeman at Adelphi University, where she studied inducible behavioral responses of Nucella to native and invasive crabs. Having completed a B.S. in Biology with minors in chemistry and mathematics, she forged ahead into a M.S. degree, also with Aaren at Adelphi, conducting much of her thesis research at the DMC over the past two summers.

Since Nucella is one of the primary predators of barnacles and mussels within the intertidal, their feeding behavior alters the abundance of these recruiting species. To study theses interactions in the flowing seawater lab, Emily devised a novel wave machine using only a bucket, a brick and a bungee cord. The set-up let her study how Nucella alter their feeding behavior based on wave exposure as well as quantifying the resulting differences in community structure. To compare these lab studies to field observations, Emily used clod cards, small bricks of plaster of Paris, to monitor the erosional energy of waves in protected and exposed coastal sites, and in her wave tank.

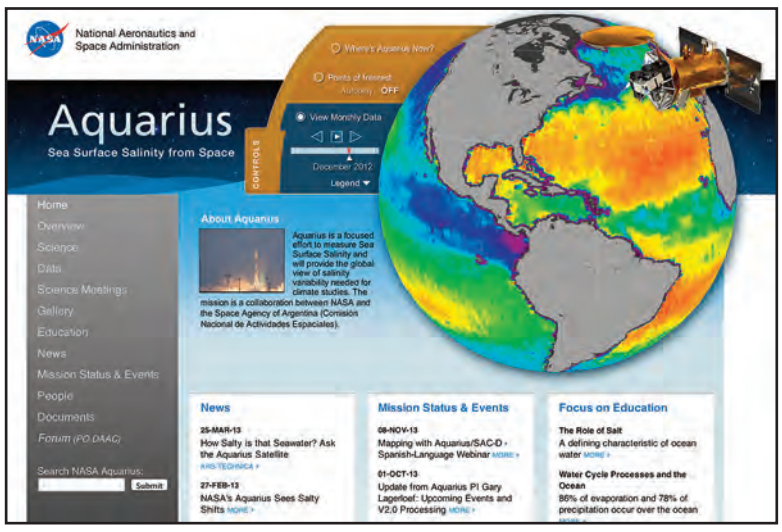
Emily was one of three recipients of the DMC's Visiting Graduate Student Awards in 2013. The awards provide facility support to graduate students needing ready access to marine environments or flowing seawater laboratories. Additional 2013 awardees include Katie Vasquez, University of Pennsylvania, and Joshua Lord, University of Connecticut.

Increasing Ocean Science Literacy

The COSEE-OS group, led by Annette deCharon and based at the DMC, continues to provide outstanding web-based resources for improving science literacy at **cosee.umaine.edu**. Partnering with various organizations, COSEE-OS develops and delivers workshops, webinars and websites to broaden our understanding of the oceans. The COSEE-OS team includes Carla Companion and Ryan Cope, based and the DMC, and Lisa Taylor, based in Orono.

The Ocean Observatories Initiative (OOI, **oceanobservatories.org**) is an National Science Foundation program that focuses the science, technology, education and outreach of a network of science-driven ocean observing systems. It provides educators with unprecedented access to near real-time and archived ocean data. Annette and Carla are part of the OOI Education and Public Engagement (EPE) team developing educational tools and translation of OOI science into pedagogical resources such as concept maps and online lessons. They are creating a concept mapping tool for OOI that builds upon existing CLIMB software (**cosee.umaine.edu/climb**) which uses concept mapping to illustrate how research results are tied to key classroom concepts and allows for the exploration of new terms through ontologies. The beta software is scheduled to be piloted with groups of community college educators this spring, and will continue to undergo refinements before being debuted to the public as part of the EPE software suite.

COSEE-OS is proud to announce the release of a completely new website for the Aquarius/SAC-D Satellite, **aquarius.umaine.edu**. Built by NASA, Aquarius is the primary instrument aboard the international Aquarius/Satélite de Aplicaciones Científicas (SAC)-D observatory. It measures sea surface salinity, a critical driver of ocean processes and climate variability. Webmaster Lisa Taylor, Annette, Carla and new team member Ryan Cope joined in the remake of the Aquarius website.



The new site provides access to a collection of resources, images, data maps, lessons, activities and mission documents relating to ocean salinity, circulation, the water cycle and climate. The homepage features an interface that helps visitors explore Aquarius' salinity data and learn about points of interest around the globe, and newly created "theme" pages can help STEM educators to access the most relevant information for their students.

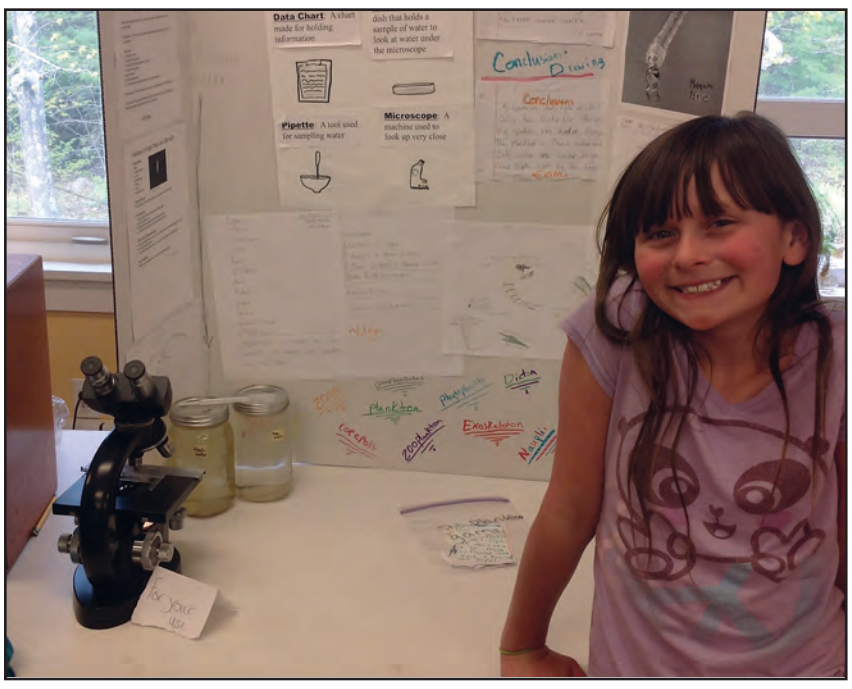
To date, the team has hosted 13 scientist-lead concept mapping webinars on NASA missions, including two Spanish-language seminars and two 3-part series featuring scientists from the salinity-related Salinity Processes in the Upper Ocean Regional Study (SPURS) oceanographic mission. Webinars are archived online at **aquarius.umaine.edu/cgi/sci_webinars**.

Ocean Optics Live and On the Web

With funding from NASA and the UMaine, the next generation of oceanographers convened at the DMC for a four-week course taught by seven of the county's top optical oceanographers, including Dr. Mary Jane Perry and Dr. Emmanuel Boss of the UMaine's School of Marine Sciences.

"Ocean Optics: Calibration and Validation for Ocean Color Remote Sensing" is a graduate-level course that attracts students with interests ranging from sensor technology to ocean ecology. The course has been offered every two to three years for almost three decades.

In the classroom, laboratory and field, students learned how to accurately measure light in and above the water, interpret satellite data, and apply the information in the study of biogeochemical and ecological processes in the ocean. The optical properties of ocean water – how sunlight is absorbed and scattered – reveal much about the phytoplankton community that sustains much of the marine food web.



Damariscotta Montessori School student with her DEEP project and South Bristol School students with a collection of marine debris.

Mary Jane and Emmanuel impress upon the students that good science goes beyond collecting good data. Collaboration and data sharing is increasingly important in today's scientific community. NASA, NOAA and NSF distribute taxpayer dollars to fund scientific pursuits so there's a civic responsibility for researchers to collect high-quality data and to make that data available for use by others.

Over 65 applicants vied for the 20 spaces in this year's class. The final complement included 20 participants from the US, Brazil, Canada, Germany, Saudi Arabia and Spain. Master's candidate Thomas Leeuw represented UMaine.

Due to the high demand for the class, funding for this year's course also included financial support for an Ocean Optics Web Book. The book was written by the course instructors as a resource for the education and reference needs of the optical oceanography and ocean color remote sensing communities. It is available for free under the Creative Commons License at **oceanopticsbook.info.**

The other instructors were Curtis Mobley, vice president for Science at Sequoia Scientific, Inc., in Washington; Collin Roesler, chair of the Earth and Oceanographic Science Department at Bowdoin College; Ken Voss, professor of physics at the University of Miami; Jeremy Werdell, research oceanographer at the NASA Goddard Space Flight Center; and Ron Zaneveld, director of research at WET Labs in Oregon. Alison Chase, a UMaine graduate student in oceanography, was the course's teaching assistant.

Estuary Explorations & Ocean Trash

Getting middle school kids engaged in science through inquiry- based and hands-on learning has been a goal of Lili Pugh, the DMC's K-12 Education Coordinator.

This year she teamed up with Sarah Gladu of the Damariscotta River Association to create the Damariscotta Estuary Education Program (DEEP). The DEEP introduced 4th-8th grade students from three area schools (Damariscotta Montessori School, Bristol Consolidated School and Great Salt Bay School) to their local estuary and the scientific method. Each student posed a question that could be answered during a day-long research trip to the DMC where they explored the intertidal, went on a research cruise, and studied in the laboratory classroom. The culminating project was a science fair event at each school for classmates and parents. "This type of activity is an excellent way for students to see science out of the classroom context," commented Tim Burch, 6th grade science teacher for Great Salt Bay School.

Seventh graders from the South Bristol School have been weekly visitors to the DMC during the fall and spring for many years. Each spring the class undertakes a research project of their choosing. This year they studied marine debris - manmade items that are now trash floating in the water, collecting on the ocean floor, or adrift on the shore. The class collected and categorized 275 pieces of shore debris from three sites in South Bristol. They learned about ocean circulation, density and buoyancy, as well as just how much trash there is out there! The students sent their data to the Rozalia Project (**rozaliaproject.org**), an organization researching and collecting information about marine debris in the Gulf of Maine and beyond.

Visitors Welcome!

Located on the shore of the Damariscotta River Estuary, in midcoast Maine, the DMC is a user-friendly marine lab.

Visiting Graduate Student Awards
The DMC grants facility awards to graduate students from outside institutions who want to collect samples or conduct experiments at our world-class marine laboratory. Each award provides up to $3,400 annually for 1-4 years of facility use: housing, laboratory space, aquaria, SCUBA support and boat rentals. Eligible students must be currently enrolled in a recognized graduate program.
dmc.maine.edu/visgrads.

1865 THE UNIVERSITY OF MAINE
Darling Marine Center
193 Clarks Cove Road
Walpole, ME 04573

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Visiting Investigators Program
Competitive rates and easy access to diverse intertidal habitats and the Gulf of Maine draw researchers from across the country and around the world to the DMC for the summer field season. Our professional support staff can provide assistance with specimen collection, equipment use, laboratory setup, and housing. **dmc.maine.edu/visinvest.html**.

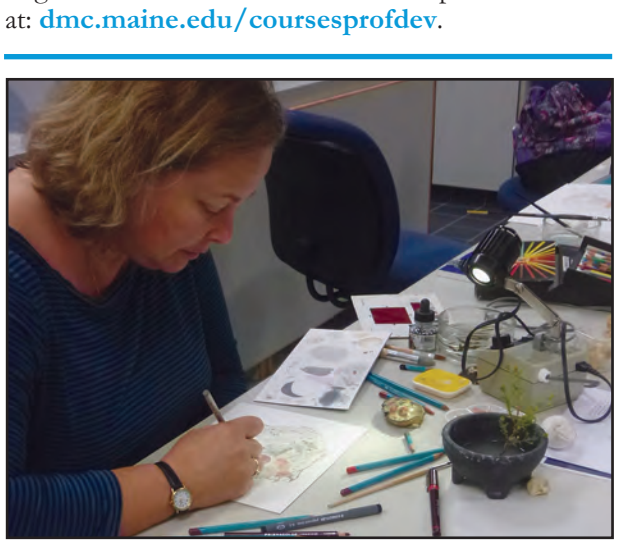
Visiting Scholars Program
Senior-level faculty and researchers who can collaborate with DMC faculty and students in a mutually beneficial way are invited to spend a semester in residence as a visiting scholar. The DMC is a great venue for manuscript writing and sabbatical research Recipients receive free furnished housing and office space. **dmc.maine.edu/visscholars**.

Visiting College Field Trip Program
A typical field trip to the DMC includes: half-day sampling cruise aboard the *R/V Ira C.*, intertidal collecting trips, access to flowing seawater classroom, lodging and meals. The cost for a weekend visit is under $2,500 for 15 students and one professor. Custom field trips can be arranged to accommodate extended stays or specific syllabus goals. **dmc.maine.edu/viscolleges**.

Similar field trips can be arranged for middle and high school classes, too. Instruction is arranged through our K-12 coordinator, **dmc.maine.edu/k12**.

DBTW 2014

The Developmental Biology Teaching Workshop will be offered June 17-21. The workshop helps college professors expand their laboratory curriculum with new techniques and lesson plans. Instructors Dr. Leland Johnson and Dr. Eric Cole will be joined by guest lecturer Dr. Jennifer Wolff, Carleton College, who will bring her expertise in *C. elegans* growth and development to the workshop. Guest lecturers to the DBTW are made possible with financial support from the Society for Developmental Biology. Registration materials for the workshop are available at: **dmc.maine.edu/coursesprofdev**.



Natural Science Illustration

Let your creative juices flow July 28-August 1! Instructor David Wheeler encourages participants to experiment with new styles and mediums as they hone their observational skills and artistic talents. During this 5-day workshop, invertebrates, freshly sampled from the intertidal zone, as well as skulls, shells, and artifacts from David's personal collection serve as the primary subjects. No art experience is required. Prior participants have included high school students, teachers and professional illustrators. Registration materials are available at: **dmc.maine.edu/coursesprofdev**.

UMaine Accredited Courses @ the DMC in 2014

"Study nature, not books" is a well-known phrase coined by the famous naturalist Louis Agassiz. At many schools it's possible to complete a four-year degree in marine science without ever seeing the ocean, touching a starfish, or going out on a research cruise, but what fun is that? At UMaine's Darling Marine Center, undergraduate and graduate opportunities abound. Intensive May term and summer courses, and the residential Semester By the Sea program engage students in courses that use the Gulf of Maine and the Damariscotta River Estuary as the primary classroom. Reading is, of course, required.

May-term & Summer Courses

Short, sweet and intense! These courses are the epitome of the DMC experience.

- **SMS491 - Estuarine Oceanography**
  May 14 - 23
- **SMS514 - Ecology of Marine Sediments**
  May 14 - 30
- **SMS491 - Larval Biology**
  May 27 - June 6
- **SMS 491 - Engineering Literacy for the 21st Century** May 27 - June 6
- **SMS491 - Matlab for Marine Sciences**
  May 27 - June 13
- **SMS309 - Techniques in Shellfish Aquaculture**
  June 23 - 27th

Room and board are available at the DMC for all May-term and summer courses. Full course descriptions and registration information is available at **dmc.maine.edu/coursesUM**.

Semester by the Sea

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. Choose from nine course to create your own academic exeprience.

- **SMS 350 - Marine Ecology**
- **SMS 480 - Biology of Marine Invertebrates**
- **SMS 481 - Marine Biomechanics**
- **SMS 482 - Human Impacts on the Ocean**
- **SMS 491 - Marine Fisheries Ecology**
- **SMS 491 - Zooplankton & Ichthyoplankton**
- **SMS 491 - Introduction to Research Diving**
- **HTY - Archaeology of Shipwreck Sites**
- **Capstone/Independent Research**

More information about the SBS program can be found at **dmc.maine.edu/sbs**.