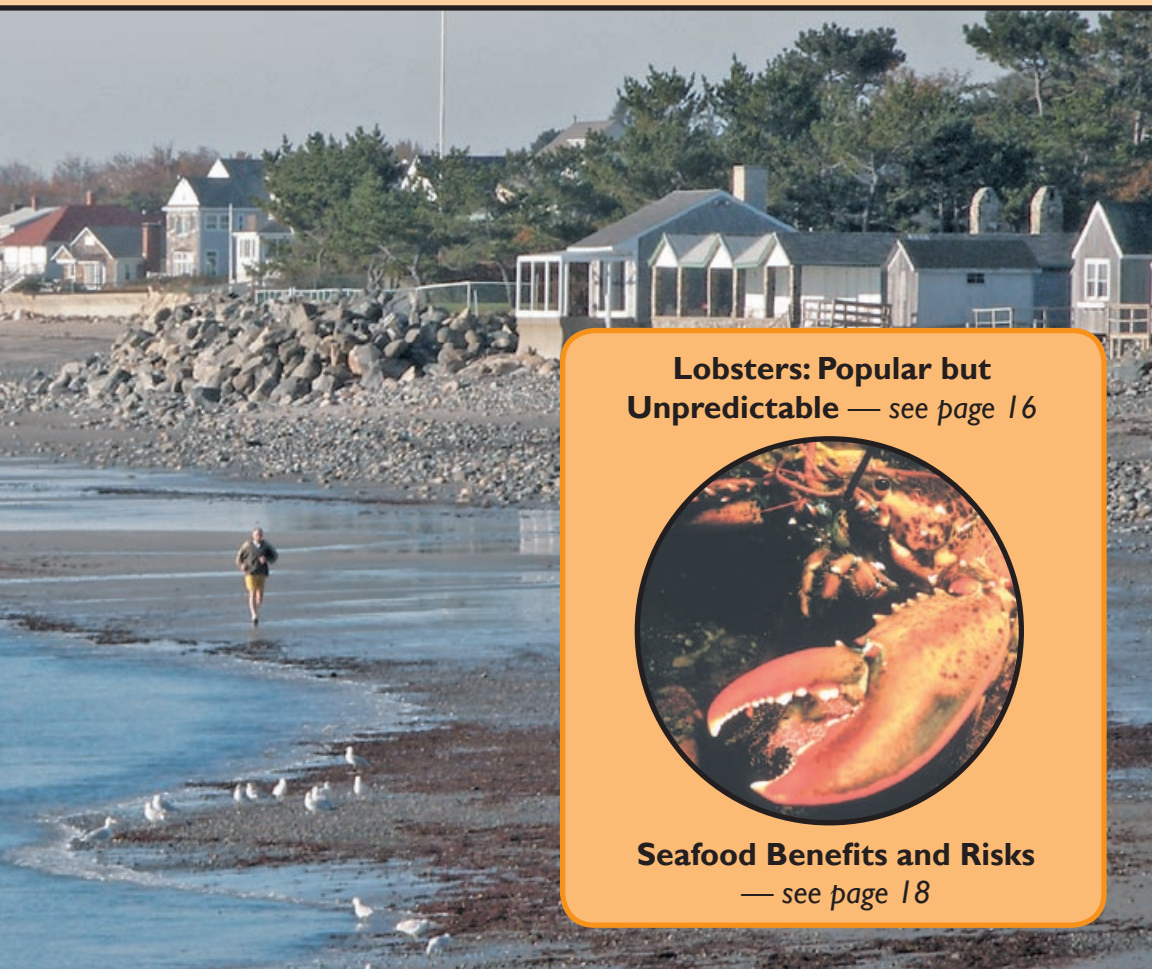




NH Sea Grant Program Guide

2008 — 2009



**Lobsters: Popular but
Unpredictable** — see *page 16*



Seafood Benefits and Risks
— see *page 18*

The NH Sea Grant College Program provides support, leadership and expertise for university-based marine research, extension and education.

A component of NOAA's National Sea Grant College Program and based at the University of New Hampshire, it is one of 30 programs throughout the nation promoting the understanding, wise use and stewardship of our coastal resources.



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UNIVERSITY of NEW HAMPSHIRE



A Message from the Director

Thank you for your interest in the New Hampshire Sea Grant College Program. In this program guide you will be introduced to some of the diverse projects and activities that we have undertaken recently as well as those that we will be supporting in 2008-09 to address the Sea Grant mission — to promote the understanding, wise use and stewardship of our coastal resources. These activities are led by a talented staff, leading researchers and educators around the state, a dedicated external Policy Advisory Committee (PAC), and numerous volunteers from our Marine Docent and Great Bay Coast Watch programs; the accomplishments of the program arise from their dedicated and inspired efforts. As evidence of these accomplishments, NH Sea Grant was recognized with a perfect score in its most recent Performance Assessment Team (PAT) review by a team of renowned external experts in the fall of 2006, one of only two programs in the Sea Grant Network to receive such a rating!

During the past biennial funding cycle, NH Sea Grant developed a new strategic plan that focuses our program on several critical issues in the coastal environment, including: (1) Conservation & Sustainable Utilization of Fisheries Resources, (2) Sustainable Aquaculture, (3) Coastal Ecosystem & Public Health, (4) Coastal Communities & Economics, and (5) Marine & Aquatic Science Literacy. We have addressed these priorities with vigor.

During 2006-07, NH Sea Grant supported five multi-year research projects and provided a number of development grants totaling over \$900,000 in finfish aquaculture, coastal and ocean regional governance, the ecology of invasive species, and finfish and lobster fisheries. During the upcoming 2008-09 biennial funding cycle, we will continue to address these critical research priorities through six multi-year research projects totaling over \$1,000,000 as well as a number of development grants. These endeavors will develop new knowledge and tools in areas including



lobster reproduction, advanced fisheries stock assessment tools, pathogenic oyster diseases, hydrocarbon sources and fates in coastal watersheds, mercury bioaccumulation in local riverine and estuarine sediments, and the remediation of contaminated sediments. At the same time, our Sea Grant extension educators and communicators will be developing exciting new programs and products to stimulate the protection and economic development of our fisheries, coastal communities and valuable coastal ecosystems.

I encourage you to contact me, members of our staff or members of the PAC if you have suggestions for ways in which we can improve NH Sea Grant or assist you in addressing priority research, extension and education needs consistent with our strategic goals.

I and the rest of the NH Sea Grant staff look forward to working with you!

Jonathan Pennock
Director



2008-2009 Research Projects

Polycyclic Aromatic Hydrocarbons Released from Sealcoated Pavements — An Evaluation of the Source and Fate of PAHs in Stormwater Runoff

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Alison Watts, UNH Environmental Research Group

Recent studies suggest that coal tar-based parking lot sealcoat is contributing significant amounts of polycyclic aromatic hydrocarbons (PAHs) into nearby waterways through stormwater runoff. PAHs are considered by the US EPA to have adverse impacts on aquatic life and human health and therefore cities around the nation are reconsidering the use of these sealcoats in their local municipalities. The researchers are assessing the mass of PAHs this runoff may be adding to New Hampshire's coastal waters. Sections of the UNH Stormwater Center parking lots will be coated with coal tar- and asphalt-based sealcoat. The runoff and vapor emissions will be compared to that of an unsealed control lot to determine which sealant contributes the highest PAH concentrations during stormwater events. The mass of PAHs released into the local environment over the course of two years will be determined by developing a mass balance. In addition, this research will allow for an evaluation of current stormwater treatment technologies to determine how effective they are at removing PAHs from parking lot runoff. Upon completion of the research, recommendations regarding the use of sealcoats will be made to the appropriate planners and regulators.

Does Sperm Limitation Take Place in Certain Areas of the American Lobster Fishery and, if so, Why?

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The egg-per-recruit fishery model is used to estimate annual recruitment of the American lobster by calculating the number of eggs a female will produce in the near future. However, this model may overestimate the total fecundity of females if there is a limitation in sperm. Through a combination of field and laboratory studies, Watson will be examining various factors that could potentially contribute to this limitation. Field sampling will occur in six widely separated



sites of the northeastern U.S. lobster fishery to quantify male:female sex ratios and size differences. These parameters will be compared to the size of non-berried and berried females in various size classes carrying sperm, the percentage of berried females in each region carrying fertilized eggs, and the percentage of eggs in a clutch that are fertilized. Laboratory research will help Watson determine if small male lobsters are capable of mating with larger females and compare the amount of time female lobsters carry eggs based on whether or not they are fertilized. The results of this study will enable researchers and managers to more fully understand the population dynamics of the American lobster and will help refine predictive stock models.

Mercury Dynamics in Estuarine Sediments: Biogeochemical Controls on Bioavailability and Bioaccumulation Along a Chemical Gradient

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Tidal estuaries and their sediments are ideal locations for the accumulation of mercury (Hg) and production of methylmercury (MeHg). These neurotoxins are considered global contaminants capable of bioaccumulation and biomagnification in both terrestrial and marine food webs. Researchers will be studying the method of Hg and MeHg transformation and mobilization in porewaters at sites around New Hampshire's Great Bay. They will be examining the process of Hg methylation and detoxification by using molecular analyses. The characterization of sulfate-reducing bacteria, which influences the cycling and bioavailability of Hg and MeHg in sediment porewaters, will be conducted using quantitative PCR techniques and DNA fingerprinting. Lastly, researchers will sample two primary consumers (*Mytilus edulis* and *Littorina littorea*) and two benthic omnivores (*Carcinus maenus* and *Fundulus heteroclitus*) to characterize the link between Hg methylation and mobilization in sediments to marine organisms. The results of this study will be used to help local and regional resource management organizations and private institutions make informed policy recommendations regarding Hg fate in the environment.



Impacts of *in situ* Treatment of Contaminated Sediments on the Benthic Communities of the Cocheco River, New Hampshire

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Many estuarine sediments throughout the U.S., including those in tributaries of Great Bay, contain elevated levels of toxic contaminants, including polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) that can persist in the environment for extended periods of time. Remediation techniques have included dredging of the contaminated sediments and *in situ* capping, both of which have met with limited success. This research will focus on improving the *in situ* capping method by using thin (25 mm) geotextile mats containing reactive compounds such as apatite and activated carbon to sequester the metals and PAHs from the sediments. Mats will be deployed in the intertidal zone of the Cocheco River and will remain in place for approximately two years. Reactive mats, control mats without reactive compounds, and unmanipulated sediment control plots will be monitored to determine physical, chemical and benthic community changes during this time frame. Specifically, the research will focus on any changes that take place to the underlying sediments and the resident benthic community. The upper surface of the reactive mats will be examined to determine the rate of sediment deposition and biological colonization. The researchers will also determine the relationship between remediation and any changes that occur. The results of this project will be on display at Henry Law Park in Dover next to the test site and at the Seacoast Science Center to help inform the public about sediment contamination and remediation issues.

Microbial Interactions Influencing the Emergence of Pathogenic Vibrios in Oysters

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Consumption of raw or undercooked bivalve shellfish has caused an increasing number of gastroenteritis outbreaks throughout the world in recent years. These outbreaks have often been associated with pathogenic strains of *Vibrio vulnificus* and *V. parahaemolyticus*, both of which are present in the Great Bay Estuary. This research will determine how changing physical conditions in the estuarine environment and interspecies interactions of oyster polymicrobial communities



influence the abundance and population structure of pathogenic *Vibrio* strains. To achieve this goal, the researchers will use multi-locus sequence typing to map the population genetic structure and virulence potential of these *Vibrio* strains and determine if recombination between the strains is occurring. In addition, they will characterize the environmental and microbiological conditions that impact the presence and persistence of both *Vibrio* strains. By identifying the causes that influence these interactions, public health officials and shellfish program managers will be better able to address shellfish-borne *Vibrio* illnesses and develop mitigation strategies.

Development of Multi-Beam Sonar as a Fisheries Tool for Stock Assessment and the Identification of Essential Habitat of Atlantic Cod

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Atlantic cod have experienced a decline in populations throughout New England primarily due to overfishing. For populations to rebound, management strategies must be based on quality estimates of relative abundance and spatial distribution. Much of this information has been collected using traditional split-beam echosounder technology; however, the use of multi-beam sonar may provide more accurate data by overcoming some limitations of the traditional surveys. Howell will be testing multi-beam sonar using Atlantic cod stocked in a submersible cage at various water depths and fish densities. By using this technology, he will be able to estimate cod abundance, determine the optimal sonar and cage configurations for cod detection, and characterize relationships between fish size and acoustic indices of abundance. Multi-beam sonar will also help researchers understand the diel and depth effects on acoustic indices of abundance and help determine how the presence of other fish species might impact the detection and abundance estimates of cod. Lastly, Howell will examine the error and uncertainty of abundance estimates from multi-beam sonar and will compare his research results with those using split-beam sonar.



Highlights from the 2007 Annual Progress Report

Each year, NH Sea Grant prepares a report on its recent research and extension activities and submits the report to the National Sea Grant Office. The following excerpts are taken from our 2007 report and briefly describe progress we have made in several areas.

Seafood Production (Commercial Fisheries)

Female lobsters carrying eggs are known to engage in seasonal migrations that range from <1 km to >100 km. Scientists speculate that these movements serve to enhance the growth and development of the eggs they are carrying by exposing them to the warmest water possible during any given time of the year (water is warmer offshore in the winter and inshore in the summer). In addition, these movements may serve to enhance the survival of the larvae when they hatch from the eggs in the spring and early summer. The overall goal of a project by Win Watson (UNH) is to quantify seasonal changes in the daily activity patterns and habitat preferences of berried female lobsters and determine if these movements influence the quality and quantity of the new recruits they produce.

Watson is also investigating the influence of temperature on egg development. Berried female lobsters were exposed to a range of temperature regimes and each month 15-20 eggs are removed from each lobster for study. So far, this procedure has worked well and more comprehensive results are expected in the second year of the project.

A Fishery Management Plan (FMP) was adopted in 2000 to protect the **overfished spiny dogfish** in the Northwest Atlantic. Accurate and updated information on life history traits such as age and size relationships, and age at sexual maturity is critical to any FMP. By developing a new method of age determination, fisheries biologists and fishermen will benefit from updated and accurate information on the biology of the spiny dogfish, because this information adds credence to future assessments of population dynamics and stock structure for this species.

Paul Tsang (UNH), James Sulikowski (Univ. of Florida) and David Koester (Univ. of New England) are attempting to compare the dorsal fin spine method to the vertebral centrum method of aging spiny dogfish to determine which produces the most accurate and reliable correlation between age and total length. A second objective is to examine age at sexual maturity, which will be assessed by examinations of male and female reproductive tracts. This will enable the PIs to determine if age at sexual maturity has decreased along with the documented reduction in size at sexual maturity.

Understanding **fishing gear selectivity** and designing gear that reduces bycatch and discards have remained a primary focus of NHSG Extension staff during the past year. A project to test new designs of low vertical profile gillnets in reducing cod catch in groundfish gillnets was completed, and a paper was published in *Fisheries Research*. A new project has begun to further test the low vertical profile nets in three states.

Two new projects to **modify shrimp trawl designs** to further reduce the catch of fish and small shrimp were funded by the Northeast Consortium and the National Marine Fisheries Service's Cooperative Research Partners Program. Sea trials have been com-



Kornbluth Awarded Knauss Fellowship

UNH graduate student Aaron Kornbluth has been awarded a Dean John A. Knauss Marine Policy Fellowship for 2008. Sponsored by the National Sea Grant College Program, the year-long paid fellowship program matches recent graduate students with hosts in the legislative and executive branches of government.

Beginning in February, Kornbluth will spend one year in Washington, DC, serving on NOAA's Ecosystem Research Program Management Team to help coordinate ecosystem research. "I have diverse interests, and my experiences in DC will no doubt help hone my skills and direction and assist me in building important connections in this field," he says.

Kornbluth, who is from Hamil-



ton, NY, received his undergraduate degree in biology and communication in the life sciences from Cornell University. His interest in environmental policy began when he studied abroad in New Zealand as part

of the UNH EcoQuest Program, a 16-credit course where topics on ecology are taught in the classroom and outdoors. Kornbluth notes that this experience continues to drive his career interests.

Kornbluth is pursuing his master's degree at UNH with his adviser Mimi Larsen Becker, chair of the Department of Natural Resources. His research will help determine how best management practices are employed in the restoration of Cains Brook watershed in Seabrook, NH.

pleted. The newly designed grid system reduced shrimp count (increased average shrimp size) by 15 to 20 count per pound. The topless shrimp trawl design reduced herring bycatch by 90% without loss of shrimp. Outreach effort for the projects is continuing with information workshops and commercial use of the devices.

Two projects testing new concepts of **haddock trawls** have started. A rope separator haddock trawl has been completed. The trawl reduced cod catch by 61% with a 16% loss of haddock. The trawl eliminated almost all other species including flounder, lobster,



International Gathering Focuses on Haddock Conservation, Harvesting and Management

Researchers and fishermen from both sides of the Atlantic met in New Hampshire to discuss ways to ensure that rebounding haddock populations are here to stay.

A two-day symposium titled “Haddock 2007: An International Symposium on Haddock Conservation, Harvesting and Management” took place in Portsmouth on October 25-26 and was hosted by UNH. Scientists from countries including Canada, Norway and Scotland attended the symposium, as well as local fishermen and researchers. Regardless of what country each attendee was from, the goal was the same — to discuss how to best balance healthy haddock populations with suitable harvesting limits.

Oral and poster presentations covered a broad range of haddock-related topics, including biology,

management and gear technologies for harvest. Clem Wardle, one of the two keynote speakers, is a world-renowned scientist from Scotland who helped pioneer the idea of using fish behavior to help design more selective gear. His presentation focused on his research conducted over the past half century. The second keynote speaker was Bob O’Boyle, associate director of Canada’s Department of Fisheries and Ocean’s Maritime Branch in Nova Scotia, who specializes in marine fisheries stock assessment. He spoke about haddock in contemporary and historical times.

Overfishing has been a common problem for New England fish populations, particularly for groundfish species such as cod, haddock and flounder. However, since the new millennium, New England has experienced a rebound in the popula-

skates and dogfish. Preliminary sea trials have showed promising results. Sea trials for a raised footrope haddock trawl will be continuing this spring.

Codend mesh sizes are strictly regulated in the multispecies fisheries in the northeastern United States. Effective mesh regulation requires good understanding of codend mesh size selectivity for different species. A project to study codend selectivity funded by the National Marine Fisheries Services was completed. A presentation on “Selectivity and Catch Efficiency of Commercial and Survey Gear” was made at the American Fisheries Society annual meeting in Anchorage, AK. The first paper in a series on codend mesh selectivity has been published in *Fisheries Research*.

Sea Grant Extension’s goals are to assist fishing industry participants in New Hampshire in particular and New England in general in upgrading their knowledge of fishing gear



NH Sea Grant commercial fishing specialists Pingguo He (left) and Ken LaValley (right) talk haddock with Clem Wardle, a scientist who helped pioneer the idea of using fish behavior to help design more selective fishing gear.

tions of haddock, with total landings valued at more than \$100 million since 2001.

Because haddock occupy the same habitat as other overfished species, including cod and flounder, regional scientists have been designing different fishing gear to separate haddock from these other species to decrease bycatch. New gear technology was the focus of the second day of the symposium, and a presentation by Capt. Bill Lee of the F/V Ocean Reporter out of Rockport, MA, demonstrated

gear use from underwater video clips. Panel discussions throughout both days allowed the audience to ask questions.

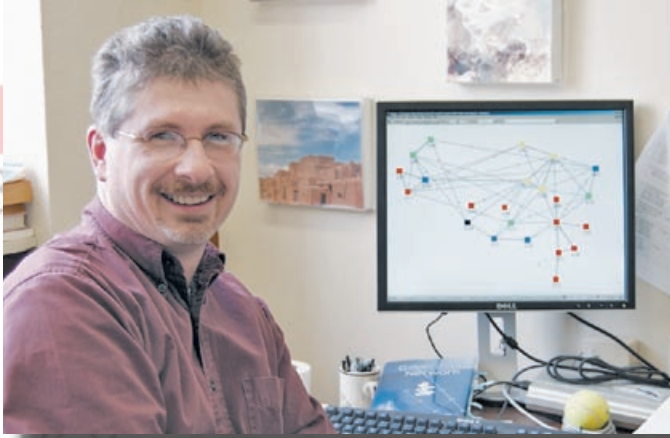
Sponsors for this symposium included NH Sea Grant, Rhode Island Sea Grant, the Northeast Consortium, the Gulf of Maine Research Institute, the Massachusetts Division of Marine Fisheries and the NOAA/NMFS Northeast Cooperative Research Partners Program.

operation, responsible fisheries and **conservation engineering**. Following successful workshops at Memorial University's (Newfoundland) tow tank facility in December 2001, 2002, 2004 and 2005, a fifth workshop was held in May 2006 with fishermen attending from Maine, New Hampshire, Massachusetts and Rhode Island, as well as representatives from NMFS. The next workshop in this series is being planned for 2008.

In parallel with improving fishermen's knowledge of conservation and responsible fishing practice, two workshops **to increase fishing gear knowledge of non-industry personnel** were conducted in the summers of 2005 and 2007. These workshops are unique because fishermen were the principal instructors for the workshop, both on-the-dock and at-sea. The participants were from NMFS scientific and management offices, congressional staffs, the NH Department of Fish and Game, the U.S. Coast Guard, NH Sea Grant and the UNH Marine Docent Program.



Mapping the Flow of Communication



Hartley shows a computer-generated “map” of communication networks for coastal and ocean management organizations. The communication can include complex directives from project coordinators or simple discussions around the workplace water cooler.

Troy Hartley could be considered a cartographer of human communication.

Hartley, a UNH assistant research professor in the Department of Resource Economics and Development, is researching communication networks. Funded in part by NH Sea Grant, his project was motivated by the U.S. Commission on Ocean Policy report that indicated effective coastal and ocean management is inhibited by a lack of communication, coordination and a sense of partnership, and thus enhanced integration in regional government is needed. He is assessing the communication patterns in projects undertaken by the Atlantic States

Marine Fisheries Commission, the New England Fisheries Management Council, the Gulf of Maine Council and the NH Coastal Program.

Hartley used interviews and surveys to measure communication patterns among individuals within these entities. The frequency and directional flow of communication within and between the organizations’ key individuals, such as project coordinators, scientists and decision-makers, were then “mapped” using the computer program Inflow. The outcome depicted a spider web effect of points connected by lines in a network. The points represent the individuals and the lines represent informa-

In a development project completed this year, Paul Tsang (UNH) and his colleagues outlined a histological method that can be used on **difficult-to-age elasmobranchs such as smooth skates**. The researchers found that the gross sectioning method did not elucidate band pairs as clearly as the histological method. In fact, they found that the gross sectioning method leads to underestimation of the true ages of smooth skates, while band clarity was much improved in the histological method. Further, the benefits



tion flow on daily, weekly or monthly time scales.

“Communication network maps make sense to people,” Hartley explains. “They create a visual of something that is conceptually difficult to wrap your arms around. Patterns of communication and information flow through a network contribute to the influence individuals and organizations have in decision-making and ultimately, to the building of trust, mutual understanding and social capital.”

He adds, “Social scientists have studied regional government in other contexts, such as public transportation, water and wastewater management, but it has shown mixed success. We have not learned how people can work together, communicate and coordinate effectively on a regional scale. We need to get better at that for regional integrated ocean management to become a reality.”

Results from his research will be fully analyzed in the upcoming year. Preliminary analysis has generated in-depth discussions with managers about how to improve communication within and among organizations to achieve the end goal: implementing effective integrated management actions.

of “accurate” age determination in smooth skates outweigh the additional cost and time needed for the histological method.

Seafood Production (Aquaculture)

A project by David Berlinsky (UNH) is attempting to develop physiological predictors that can be used to spawn **summer flounder and Atlantic cod** when egg quality is optimal. Specifically, biochemical, molecular and morphological characteristics of developing oocytes that can be used as markers of high quality eggs will be identified. The researcher will also correlate the presence of these markers in oocytes obtained from ovarian biopsies with egg quality (fertilization and hatching success) in fish pharmacologically induced to ovulate. Results from these studies will lead to the development of simple assays that culturists can use to gauge the optimal time for ovulation induction in marine finfish species. Finally, he will develop methods to effectively manually spawn cod and determine their inter-ovulatory interval.

Sea Grant Extension continues to be a partner in the UNH/NOAA Atlantic Marine Aquaculture Center (AMAC), which has been developing the technology to grow finfish and shellfish in deep water environments. With guidance from Sea Grant and AMAC staff, two fishermen have deployed 10 **submerged blue mussel longlines** using this new technology. There are now about 30-50,000 pounds of mussels ready for harvesting and processing.

Sea urchin fisheries are a valuable commercial resource in the U.S. with processed gonads sold in Japanese and American markets and maximum U.S. sales of \$150M in 1996. Wild populations of sea urchins on all coasts of the U.S. have been dramatically overfished. Aquaculture of sea urchins in land-based facilities can help restore commercial populations and preserve this ecologically important herbivore. In a development



project, Charles Walker (UNH) used invariant summer photoperiod to prevent gametogenesis in the North American green sea urchin (*Strongylocentrotus droebachiensis*) maintained in a land-based aquaculture system and provided a commercially available formulated feed that promotes maximum growth of intragonadal somatic nutrient storage cells called nutritive phagocytes. Results were compared with individuals fed the same formulated feed under ambient photoperiod in cages in the ocean.

Invariant photoperiod yields gonads in both sexes of *S. droebachiensis* that do not initiate fall gametogenesis but attain large size as their nutritive phagocytes grow substantially in size. A Canadian study of wild-collected *S. droebachiensis* indicated that gonads taste best when they contain predominantly nutritive phagocytes and not copious gametes; however, gonad taste in this study was unsatisfactory suggesting that the only commercially available sea urchin diet requires modification to support commercial development of land-based aquaculture.

Coastal Ecosystem Health and Safety

Sea Grant Extension staff are an integral part of **New Hampshire's Natural Resource Outreach Coalition (NROC)**. This group includes representatives from 10 agencies and organizations that have been working with NH coastal communities since the late 1990s to promote better land use decisions. NROC provides education, technical assistance and facilitation to community groups thus helping them to better protect their key natural resources while accommodating growth. Over the past year, communities have accomplished the following with Sea Grant extension assistance:

- The town of Wakefield contracted services for a synthesis of their existing water quality data and hosted a public forum for community members to inform them about the status of their waters.



Left to right, Discovery Cruise participants record water quality information in Great Bay, examine the contents of a sediment core from the bottom of Great Bay, meet some native organisms at the Shoals Marine Lab touch tank, board the *R/V Gulf Challenger* and collect water samples.



Discovery Cruising

Each year, adventurers of all ages become scientists for a day on UNH Discovery Cruises aboard the University's research vessel *Gulf Challenger*. Guided by Marine Docents, the participants explore the area's coastal environments and join in activities such as catching plankton and testing water clarity.

While all of the cruises leave from Portsmouth, there are two destinations. Great Bay Discovery Cruises travel up the Piscataqua River into

Little Bay/Great Bay Estuary, with a stop at Adams Point for a tour of the Jackson Estuarine Laboratory. Isles of Shoals Discovery Cruises stop at Appledore Island, with a tour of the Shoals Marine Lab.

Sponsored by the UNH/NOAA Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET) and UNH Cooperative Extension in addition to NH Sea Grant, the cruises receive great reviews year after year. One recent participant summed it up as "a great family event."



- Community members in the town of Rollinsford initiated a volunteer water quality monitoring program for their rivers and hosted a stream clean up.
- Community members in the town of Fremont reached out to 35 large parcel land owners to inform them about land conservation.
- Community members in the town of Milton organized a steering committee to start their community-based natural resource protection program.

(continued on page 18)



Popular but Unpredictable, Lobsters Rule in the Gulf

Whoever first thought to eat a lobster probably didn't anticipate that such a peculiar creature would someday become an international culinary delight. Yet every day, lobsters caught in



A Gulf of Maine lobsterman for over 50 years, Mike Flanigan started his career in Portsmouth's Sagamore Creek with five traps and a rowboat.

the Gulf of Maine are shipped as far away as Hawaii and Japan to supply their markets with lobster meat.

Changes in the marketing of lobster, along with improved methods of storage and distribution, has led to a large-scale change in the demand for lobsters. These changes and recent supply shortages have played a role in the cost of the product. Today, lobsters are considered the largest fishery in the Gulf of Maine based on monetary value.

Mike Flanigan, a long-time lobsterman based out of Rye, NH, recalls a time when \$0.50/lb. was considered big money. His two sons own Seaview Lobster Company, a wholesale business that opened in Kittery, Maine, in the mid-1990s. The air freight business, along with processors freezing lobsters, helped to revolutionize the distribution of lobsters, Flanigan says, which in turn led to significant increases in the price.

Financial hardships due to population fluctuations is an unfortunate reality of this line of work. A lot of changes have been taking place over the past couple years with the lobster populations, and some of those changes have lobsterman concerned about their future.

Flanigan explains that local lobster catches have been low for the past few years and have continued to decrease in some areas but increase in places far to the east off the coast of Maine. According to the Maine Department of Marine Resources, yearly landings in Maine are around 72 million with an estimated value of \$300 million. The low local catch rates, along with



the increasing cost of fuel to run the boats, have caused a financial burden for many lobstermen in the region.

“The high daily operating costs often make it prohibitive to leave the dock,” Flanigan adds.

Rollie Barnaby, extension educator for NH Sea Grant, says the cost of bait has been increasing as well, which has been cutting into the already small profits for many lobstermen.

“Lobstermen are really concerned about the availability of bait,” Barnaby explains. “They need herring or redfish, so if those fish stocks get knocked down and they’re not readily available, the lobstermen will be in big trouble. As it is, they are already paying a lot of money for bait.”

Win Watson, UNH professor of zoology, suggests a few reasons for these recent changes, including heavy rains in the spring of 2006 and low spring and early summer water temperatures in subsequent years. These environmental factors may have resulted in lobsters moving to different locations and affecting the catch and growth rates. However, more long-term data is necessary to determine the full impacts on the local lobster populations.

Alternatively, Flanigan wonders if local sewage treatment facilities may

be impacting the water quality of the region and influencing the lobsters’ movements. The lack of current data makes it difficult to determine if this is a cause.



Whatever the cause of these fluctuations, it is clear that demand for this culinary dish has not waned over the years. Watson adds that in addition to the public’s gastronomic obsession

with lobsters, people are genuinely interested in the species itself.

“It’s a compelling species, almost outer-space alien looking, but people are fascinated by them,” says Watson.

He remembers a time when he gave a presentation on lobsters to a group in which he only made it through five of his 30 slides because the audience had so many questions. Watson said he didn’t care about not finishing his talk because he was so encouraged by the interest in his subject.

Flanigan believes the Discovery Channel show, “Deadliest Catch,” has generated a lot of interest in commercial fishing, which he says has a positive effect on the public’s perception of their work.

“People seem fascinated by what we lobstermen do,” he adds.



In 2006, **Great Bay Coast Watch** (GBCW) volunteers monitored 20 sites in Great Bay Estuary for water quality parameters, seven of which have been monitored since 1990. Currently, the GBCW is New Hampshire's most wide-ranging program for direct citizen involvement in monitoring estuarine and coastal waters. It is a component of our Sea Grant Extension Program. Information gathered about estuarine water quality supports efforts to protect and preserve estuarine waters as well as wetland habitats, which is a top priority of statewide conservation efforts. Monitoring also engages volunteers in water quality issues that affect their own communities.

Overall bacteria levels increased this year, though not to previous highs. This year, 24% of GBCW fecal coliform samples were >40 counts/100ml, compared to 20% in

UNH Conference Focuses on Benefits and Risks of Eating Seafood

Keywords such as farm-raised, wild-caught, omega-3 fatty acids, mercury and PCBs conjure up mixed emotions for consumers who simply want to eat healthy seafood. But a conference sponsored by NH Sea Grant and UNH Cooperative Extension allowed dietitians, healthcare professionals, and the general public to better understand what seafood they should eat and what they should avoid.

The conference, titled "Seafood — Exploring Benefits and Risks," was held at The Courtyard by Marriott and Grappone Conference Center in Concord, NH, in November 2007. It addressed the health issues surrounding seafood consumption, including nutritional benefits and risks, microbial contaminants, risk communication, farm-raised vs. wild harvest, the global need for seafood and media influence on consumer choices. The overarching theme

remained consistent throughout the day: the benefits of eating seafood far outweigh the risks.

Speakers included renowned scientists in the fields of food safety, nutrition and risk analysis from institutions including Harvard School of Public Health, Tufts-New England Medical Center and the University of Rhode Island. Keynote speaker Charles Santerre, a professor of foods and nutrition from Purdue University, discussed balancing the risks and benefits of fish consumption by sensitive populations.

Santerre and other speakers discussed the impacts certain toxins, including PCBs and mercury, can have on pregnant women and children and what fish species are particularly prone to carrying high levels of these toxins. However, presenters stressed that the positive health benefits of omega-3 fatty acids for brain development, vision and heart health would far exceed the drawbacks of consuming seafood.



2005. In 2006, GBCW data showed that there were 13 instances of fecal coliform geometric mean results above the 40 counts/100 ml limit, compared to two in 2005.

GBCW volunteers also monitor five coastal sites for harmful algal blooms (HABs) weekly from April through October. The goal of the phytoplankton monitoring program is to act as an early warning system for HABs, commonly known as red tides, by identifying the presence of potentially toxic phytoplankton species in coastal waters.

NH Sea Grant is part of a two-year NOAA/NOSG regional effort to provide educational programming to address **aquatic nuisance species** (ANS) in the Gulf of Maine. The UNH portion of the effort centers around the development of a training program

Santerre said that eating eight ounces of Atlantic salmon per week would supply approximately 500% of the recommended levels of omega-3 fatty acids while containing very low levels of toxins.

The conference concluded with a panel discussion in which audience members were able to ask questions regarding healthy seafood choices.

“It seems like everywhere I go, as soon as people find out I work in the fisheries field the first thing they want to know is what seafood is safe to eat,” says Rollie Barnaby, NH Sea Grant extension educator. “There’s just so much confusion about it.” Part of this confusion may occur because consumers receive their health information from many sources other than



health care providers, he explains.

A comprehensive report on the conference is in press. Watch the NHSG web site (www.seagrant.unh.edu) for more information on this publication.



for recreational divers that educates them on the issue, trains them to identify 10 of the species of greatest concern, and provides them with information about reporting their sightings to the New England ANS database.



Using Old Oyster Shells as Substrate for Juveniles, UNH Oyster Restoration Efforts Come Full Circle

Ray Grizzle wades slowly in the shallow waters at the mouth of the Bellamy River, inspecting the river bottom and finding some shells. “2006 was a good year, maybe the best ever,” he says thoughtfully, in much the same manner a wine connoisseur would talk about a fine vintage red. Instead, Grizzle is speaking about the 2006 “spat,” or young oysters, around the Great Bay Estuary, one that added numerous juvenile oysters to the depleted population.

Grizzle, UNH research professor of zoology, and research technician

Krystin Ward have spent the morning loading a boat with bins containing oyster shells dotted with 1 million oyster spat, each no larger than a grain of sand. After a short trip out to the Bellamy at low tide, Grizzle stops the boat and they begin gently tossing the shells into the water near tall PVC pipes marking the location of their continued oyster reef restoration efforts.

“People ask, why oysters? What’s the big deal?” Grizzle says. “Well, some consider them to be a keystone species: they filter the water column



Marine Education and Human Resources

The UNH Marine Docent Program is the primary vehicle for delivering marine science education programs to the pre-K-12 school audience and adults in New Hampshire and

Left, lab supervisor Jenn Greene holds an oyster shell that is being used as the substrate for tiny oyster “spat” to grow on for the oyster shell recycling program and oyster reef restoration efforts in Great Bay. Right, research professor Ray Grizzle and research technician Krystin Ward spread oyster shells at the mouth of the Bellamy River.



for their food, they provide habitat and food for other species, including humans, and in northern estuaries, they are a unique species, one that’s important ecologically.”

Since the oyster reef restoration program began in Great Bay in 1999, researchers have determined that additional hard substrate is necessary for juvenile oysters to grow on. Old oyster shells can provide the perfect substrate for them to grow, but there has been a lack of shells available.

“Oysters are harvested from the bay, eaten and the shells are thrown into the landfill,” Grizzle explains. “That’s not the natural cycle. We wanted to complete the cycle that this species should be going through naturally by putting shells back into the estuary.” So with the help of Jenn Greene, Grizzle’s laboratory supervisor, the UNH Oyster Shell Recycling Program was developed in 2006.

The Bellamy River restoration site that Grizzle and Ward are working on is the completion of that cycle thanks to this recycling program. All the shells they are placing in the Bellamy are from Great Bay and have been donated by the public, including recreational oyster harvesters. A trailer located near Jackson Estuarine Laboratory allows locals to drop off their used shells into separate large plastic bins for use in the recycling and restoration efforts.

Although the oyster reef restoration efforts have resulted in both successes and failures over the years, the shell recycling program has added a positive component to the overall project goals. “I believe we’re beginning to see a change in something that will become important ecologically and societally,” Grizzle says. “I see some glimmer of hope for the oysters coming back in the estuary.”



Sorting out Seaweeds: UNH Researchers are Determining Which Species of Red Seaweeds are Native, Which are Not

Sherlock Holmes would have had a difficult time distinguishing between the various species of red seaweed (genus *Porphyra*) found in New England. Although this puzzle is far from “elementary,” using DNA from the plants has helped researchers like Art Mathieson and Chris Neefus determine which plant is which.

Mathieson and Neefus, both UNH research professors of plant biology, along with several UNH graduate students, have welcomed playing the role of scientific sleuths for part of a NH Sea Grant-funded project investigating this topic. There has been recent concern among researchers over whether or not many of the *Porphyra* species found in New England are originally from the region or if they are instead Japanese cultivars, plant varieties propagated for specific

traits. This concern stems from the potential of non-native species to utilize the habitat and resources necessary for the survival of native plants.


When researchers realized that distinguishing among the various species was too difficult to do by sight, they turned to more powerful genetic analysis tools to help out.

“There has been difficulty knowing what is the native *Porphyra* and what is introduced, so we had to apply molecular techniques,” Mathieson explains. “A lot of *Porphyra* plants look alike but are extremely diverse genetically.”



DNA sequencing of the species requires being able to compare present-day samples collected throughout the coastal regions of New England with species collected from the past. This enables researchers to determine

New England. The program addresses the needs and intended outcomes of the strategic plan for marine science education of UNH Cooperative Extension and NH Sea Grant and the ocean literacy goals of NOAA. Over the past year, the Marine Docent Program:

- Trained 20 new docents in basic marine science and formal and informal education practices. These new docents joined existing program teams to provide educational programming to schools or began volunteering at other informal marine education venues, including the Seacoast Science Center, the Sandy Point Discovery Center, the Great Bay Coast Watch and the Gundalow Program.
- Conducted 50 SeaTrek marine education programs for approximately 3,500 students in 35 schools.
- Trained 100 students from five schools in boat-based marine science activities through the docent-led Floating Lab Program. The students learned about the marine envi-



UNH scientists are using molecular analysis to separate Japanese *Porphyra* species found along the New England coast (bottom photos) from those native to New England (top photo).



if new species have begun colonizing the region or if samples from the past were simply misidentified.

This research requires going back to historical collections of seaweeds held in herbariums where samples are kept from 200 years ago in some cases, rehydrating the samples, and then doing genetic analyses on a small piece of the old seaweed.

“It’s fascinating to be able to use samples from herbarium collections that are really old and make them have meaning,” Mathieson adds.

Once analyses are conducted on both the old and new samples, the genetics can be compared to see if a Japanese cultivar has been introduced recently and is spreading or if it has been here for many years without scientists knowing it.

“It’s a can of worms in terms of finding out the right names of the species and when they were introduced to a region, and then determining the potential effects they could have on native species,” Mathieson says. “There’s a lot of detective work that goes on.”

ment by participating in hands-on activities in water quality measurement, plankton collection and observation, current measurement, benthic sampling and navigation.

- Educated 100 students and eight teachers about the Great Bay estuarine environment through the boat- and shore-based Great Bay Living Lab.
- Increased the knowledge and awareness of 225 adults and 125 children from the general public about the Gulf of Maine, the Isles of Shoals and the Shoals Marine Lab through one-day Shoals Discovery Cruises to Appledore Island.
- Supported the Nor’easter Bowl, the northern New England regional component of the National Ocean Science Bowl (NOSB) by staffing two judging teams for the competition held at the University of Maine. NOSB is an annual national academic quiz competition for high school teams in marine science. A NH high school team won the first prize and eventually won the national competition.



Partnerships

During 2007, NH Sea Grant collaborated with a wide range of institutions, organizations and businesses.

Federal

Coastal Response Research Center (NOAA)
 Environmental Protection Agency
 National Marine Fisheries Services (NOAA)
 National Weather Service (NOAA)
 Office of Naval Research
 Stellwagen Bank National Marine Sanctuary (NOAA)
 U.S. Department of Agriculture
 U.S. Forestry Service
 U.S. Coast Guard
 U.S. Geological Survey

Regional

Atlantic States Marine Fisheries Commission
 Gulf of Maine Council on the Marine Environment
 Gulf of Maine Marine Education Association
 Gulf of Maine Research Initiative
 NE Fisheries Management Council
 NE Regional USDA Water Quality Team
 Northeast Consortium
 Regional Assoc. for Research on the Gulf of Maine

Rockingham Regional Planning Commission
 Strafford Regional Planning Commission
 UNH/NOAA Cooperative Institute for Estuarine and Environmental Technology

Local and State

Great Bay Estuary Commission
 Great Bay Nat. Estuarine Research Reserve
 Hodgson Brook Restoration Committee
 MA Dept. of Marine Fisheries
 ME Dept. of Marine Fisheries
 NH Coastal Program
 NH Estuaries Project
 NH Dept. of Fish & Game
 NH Dept. of Environmental Services
 NH Dept. of Resources & Economic Development
 NH Port Authority

NGOs

American Fisheries Society
 Bigelow Lab for Ocean Sciences
 Blue Ocean Society
 Census for Marine Life
 Coastal Conservation Association
 Chewonki Foundation
 Consortium for Oceanographic Research and Education
 Estuarine Research Federation
 Great Bay Resource Protection Partnership

- Conducted “Day of the Coast” programs in Newmarket, Somersworth and Canaan, NH, that involved more than 600 students and teachers.
- Provided marine science awareness to hundreds of New Hampshire citizens at exhibits at “Discover Wild New Hampshire Day,” the Rochester Fair, Rockingham County Cooperative Extension Day and UNH’s “University Day.”
- Conducted 10 monthly docent training meetings, each of which was attended by more than 80 docents.

The Bigelow Laboratory, the University of Maine and UNH are grant-funded partners responsible for developing the first theme-based **Center of Ocean Science Education Excellence (COSEE)** in the national system. The role of this COSEE is to develop ocean science curriculum and instructional resources and support that can be used successfully by all schools, including those inland. The role of UNH in the partnership is to develop and implement teacher professional development components. NH Sea Grant provides program evaluation support to the UNH component and to the entire COSEE effort.



Great Bay Stewards
 Gundalow Project
 NH Environmental Educators Assoc.
 NH Marine Coalition
 Northwest Atlantic Marine Alliance
 Ocean Conservancy
 Salem Sound Coastwatch
 Seacoast Science Center
 The Nature Conservancy

International

Canadian Dept. of Fisheries & Oceans
 International Council for the
 Exploration of the Sea
 Memorial University
 University of New Brunswick
 U.S./Japan Joint Panel on Nat. Resources

Industry/Business

AE Fisheries
 Altus Engineering
 Aquaculture Industry
Commercial Fisheries News
 Commercial Fishing Industry
 Eastman's Fishing Fleet
 Granite State Whale Watch
 Great Bay Aquafarms
 Marine Institute
 Mc Millan Offshore Survival Training
 NE Marine & Industrial

Northeast Safety Training Center
 Portsmouth Yacht Club
 Smuttynose Brewing
 Welder Training Services
 West Marine
 Yankee Fisherman's Cooperative

Academic Institutions

Dartmouth College
 Johns Hopkins University
 Massachusetts Institute of Technology
 Memorial University (Newfoundland)
 Plymouth State University
 University of Southern Maine
 University of Connecticut
 University of Florida
 University of Maine
 University of New Brunswick
 University of New England
 University of Rhode Island
 University of Vermont

Sea Grant Programs

Connecticut
 Massachusetts Institute of Technology
 Maine
 New York
 Rhode Island
 Vermont
 Woods Hole Oceanographic Institution

Formal Education

The Sea Grant-supported **Undergraduate Ocean Research Program** provides students with a year-long, hands-on experience in the solution of marine problems. The course's purpose is to provide an educational vehicle for students to study, organize and solve a marine-related problem under the direction of a faculty advisor. The interdisciplinary student teams are required to define a real-world need, devise a solution, build the necessary equipment and/or conduct the necessary studies, and prove that it provides a feasible solution by testing it under field operating conditions or carrying out the experiments necessary to test a particular hypothesis.

Five projects were completed in May 2007 and another four got under way in the fall. Of the completed projects, one involved designing and testing a device to record and analyze acoustic vocalizations of dolphins and another examined the feasibility of open ocean kelp aquaculture. Of the current projects, two of them are focused on extracting and storing energy from tides and waves. As in past years, a number of the projects are collaborations with companies and individuals in the commercial world outside of the University.



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Policy Advisory Committee

The NH Sea Grant Policy Advisory Committee (PAC) provides advice and oversight for all aspects pertaining to the management and operation of the program. Appointed by the UNH president, PAC members play a critical role in strategic planning, including determining program priorities in research, extension, education and communications. The members are selected to ensure that NH Sea Grant is listening to people with diverse interests and expertise, including university administrators, academic researchers, entrepreneurs, clientele and concerned citizens, as well as federal, state and local agency staff.

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Peter Whelan

Recreational/Charter Fishing Industry
Portsmouth, NH



NH Sea Grant Publications

This section contains information on some of the recent publications produced by researchers, students, extension staff and others associated with NH Sea Grant. All of these publications are available for purchase from NHSG or from the National Sea Grant Library on loan or as PDF downloads. For more on the library, see the box on page 31.

Research Publications

A comparison of human chorionic gonadotropin and luteinizing hormone releasing hormone analogue for ovulation induction in black sea bass *Centropristis striata* (Linnaeus, 1758) (UNHMP-JR-SG-07-12) M. Denson, W. Jenkins, D. Berlinsky and T. Smith. Reprinted from *Aquaculture Research* 38(9):918-925, 2007. \$2.

BatTri: A two-dimensional bathymetry-based unstructured triangular grid generator for finite element circulation modeling (UNHMP-JR-SG-06-47) A. Bilgili, K. Smith and D. Lynch. Reprinted from *Computers & Geosciences* 32:632-642, 2006. \$2.

Distribution, morphology and genetic affinities of dwarf embedded *Fucus* populations from the Northwest Atlantic Ocean (UNHMP-JR-SG-06-41) A. Mathieson, C. Dawes, A. Wallace and A. Klein. Reprinted from *Botanica Marina* 49(4):283-303, 2006. \$3.

Economic valuation of beach erosion control (UNHMP-JR-SG-07-08) J. Huang, P. Poor and M. Zhao. Reprinted from *Marine Resource Economics* 22(3):221-238, 2007. \$3.

Effect of the headline height of gillnets on species selectivity in the Gulf of Maine (UNHMP-JR-SG-06-44) P. He. Reprinted from *Fisheries Research* 78:252-256, 2006. \$2.

Gillnets: Gear Design, Fishing Performance and Conservation Challenges (UNHMP-JR-SG-06-43) P. He. Reprinted from the *Marine Technology Society Journal* 40(3):12-19. \$2.

Identification of a functional corpus luteum in the Atlantic Hagfish, *Myxine glutinosa* (UNHMP-JR-SG-06-21) M. Powell, S. Kavanaugh and S. Sower. Reprinted from *General and Comparative Endocrinology* 148:95-101, 2006. \$2.

Induced sex change in Black Sea Bass (UNHMP-JR-SG-06-02) C. Benton and D. Berlinsky. Reprinted from the *Journal of Fish Biology* 69:1491-1503, 2006. \$3.

Morphological and molecular variability of *Porphyra purpurea* (Roth) C. Agardh (Rhodophyta, Bangiales) from the Northwest Atlantic (UNHMP-JR-SG-06-18) T. Bray, C. Neefus and A. Mathieson. Reprinted from *Nova Hedwigia* 82(1-2):1-22, February 2006. \$4.

Opening Pandora's Box: Tradition, Competition and Technology on the Scotian Shelf, 1852-1860 (UNHMP-PR-SG-06-16) W. Leavenworth. Reprinted from *Studia*



Plan a “visit” to the National Sea Grant Library

NH Sea Grant and the other programs in the national Sea Grant network submit copies of all of their publications and other communications products to the National Sea Grant Library, which makes all of those items available as PDFs and/or on loan. The library is available online at: <http://nsgl.gso.uri.edu/>

If you're interested in NHSG publications in particular, go to: <http://www.seagrant.unh.edu/publications.html> From there, you can initiate a search of the library's holdings of NHSG publications or of all Sea Grant publications.

Atlantica: Proceedings of the 7th Conference of the North Atlantic Fisheries History Association, 2006. \$3.

Selectivity of large mesh trawl codends in the Gulf of Maine: Comparison of square and diamond mesh (UNHMP-JR-SG-07-05) P. He. Reprinted from *Fisheries Research* 83:44-59, 2007. \$3.

Suspension of annual gametogenesis in North American Green Sea Urchins (*Strongylocentrotus droebachiensis*) experiencing invariant photoperiod — Applications for land-based aquaculture (UNHMP-JR-SG-00-51) S. Bottger, M. Devin and C. Walker. Reprinted from *Aquaculture* 261(4):1422-1431, 2006. \$2.

Extension Publications

Cooperative Research gives new Insights into Yellowtail Flounder (UNHMP-IS-SG-06-36) no charge.

The Great Bay Coast Watch 2006 Annual Report (UNHMP-AR-SG-07-04) \$14.

The Great Bay Coast Watch Guide to Common Gulf of Maine Phytoplankton (UNHMP-M-SG-06-35) \$7.

Growing Seafood in the Open Ocean — Offshore Aquaculture in the United States (UNHMP-TR-SG-06-23) no charge.

Innovative Technologies may provide Alternatives for Whale Entanglement Mitigation (UNHMP-IS-SG-06-37) no charge.

Is there Something Fishy with this Fish? (UNHMP-IS-SG-07-15) no charge.

Onboard Handling Techniques Key to Higher Quality and Price (UNHMP-IS-SG-06-31) no charge.



Recent Advances in Haddock Separation Technology: 2007 Haddock Workshop (UNHMP-R-SG-07-16) no charge.

Setting Goals, Redefining Boundaries: How New Hampshire's Coastal Watershed Communities are Addressing Growth (UNHMP-AR-SG-06-39) no charge.

Science and Industry Collaborate to Reduce Small Shrimp Catch (UNHMP-IS-SG-07-03) no charge.

Western Gulf of Maine Closure Area: 2007 Symposium (UNHMP-R-SG-07-06) no charge.

What is the Optimum Mesh Size to Harvest Groundfish on Georges Bank? (UNHMP-TR-SG-06-22) no charge.

2006-2007 Tech 797 Ocean Project Reports

Acoustics Measurement Buoy (UNHMP-TR-SG-06-29) L. Gaudet, K. Jerram and A. Risso. \$7.

The Behavior and Holding Strength of Darts used to Attach Pop-up Satellite Tags (UNHMP-TR-SG-06-30) S. Kloek, K. Hartman and C. Kirkland. \$7.

The Designing and Testing of a Sonar Apparatus to Record and Analyze Acoustic Vocalizations of La Plata Dolphins (UNHMP-TR-SG-07-20) P. Gamache, C. Anason and S. Lightner. \$9.

Kelp Open Ocean Aquaculture (UNHMP-TR-SG-07-18) T. Pickett, J. Buckless, R. Despins, M. Payeur and J. Sullivan. \$10.

Laboratory Culture of *Didemnum* sp., an Invasive Colonial Tunicate (UNHMP-TR-SG-07-19) B. Ho, B. Kelley, K. Trull, W. Roda and L. Bordonaro. \$5.

UNH Aquacats: A Student-Built Racing Hydroplane (UNHMP-TR-SG-07-21) N. Jenkins, T. Morgenthau, B. Chase, M. Ohanian, R. Shackett, A. Giroux and N. Dargie. \$14.

UNH Hovercats Racing: Design and Fabrication of a Racing Hovercraft (UNHMP-TR-SG-07-17) J. Marston, K. Kelso, A. Evangelou, P. Gagnon and J. Farrell. \$8.

UNH Hovercats: Formula 2 Rated Hovercraft Hull System (UNHMP-TR-SG-06-28) M. Borrelli, J. Brode, C. Greenlaw and B. Whalen. \$7.

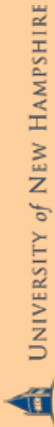
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