Constant flux

Developing muscles

Religion and violence

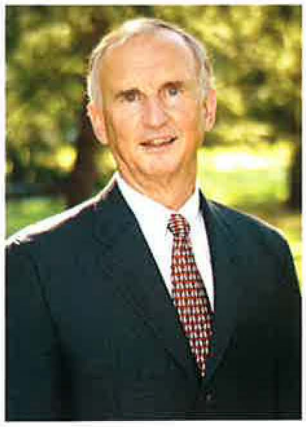
Better view of the molecule

UMaine Today

CREATIVITY AND ACHIEVEMENT AT THE UNIVERSITY OF MAINE JULY/AUGUST 2007

Can biomechanics preclude catastrophe?

President's Message



AS THE UNIVERSITY OF MAINE'S research enterprise approaches the annual $100 million mark, a goal we set for ourselves just a couple of years ago, we are seeing the momentum and critical mass that signify real institutional strength. This issue of *UMaine Today* features an array of stories that, considered together, demonstrate the strong foundation on which this growing enterprise is built.

Clarissa Henry's zebrafish research and the microscopy discovery by Sam Hess and Michael Mason represent basic research — that fundamental work that advances human knowledge and upon which all practical discoveries depend. Mick Peterson is helping to move an entire industry, horse racing, in a new direction with his biomechanics research. The scholarly achievements of artist Owen Smith and philosopher Doug Allen offer us perspective and insight, and a better understanding of the world in which we live.

All of this work occurs in a comprehensive liberal arts and science-based community, where creativity is encouraged and carefully nurtured. When undergraduate and graduate students are involved and collaborations are fostered, as we see in this *UMaine Today* issue, our faculty achievements reverberate throughout the community in important ways.

The initiative, innovation and inspiration of our faculty and students make UMaine's goals possible and our foundation that much stronger.

Robert A. Kennedy
President

ON THE COVER: Horses have been racing on tracks of dirt, turf and other natural materials for centuries. But while track grooming and maintenance standards evolved through the years, no systematic testing existed to measure the effects of these racing surface changes on horses. That's why University of Maine Professor of Mechanical Engineering Michael Peterson invented a testing device that provides in situ measurement of track performance characteristics based on the biomechanics of the gait of a galloping horse. Testing data can be used to compare tracks based on the response the horse would experience when racing or training. See related story on page 2.

Photo by Michael Peterson; cover photo by AP/Wide World Photos

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University of Maine profile

Located in Orono, Maine, the University of Maine is the state's land-grant and sea-grant institution. UMaine serves its home state through its explicit statewide teaching, research, and public service outreach mission. Offering 88 bachelor's, 64 master's and 25 doctoral degree programs, UMaine provides the most varied and advanced selection of programs available in Maine. The Carnegie Foundation for the Advancement of Teaching classifies UMaine as a Doctoral Research Extensive University, the highest classification.

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1865 THE UNIVERSITY OF MAINE
A Member of the University of Maine System

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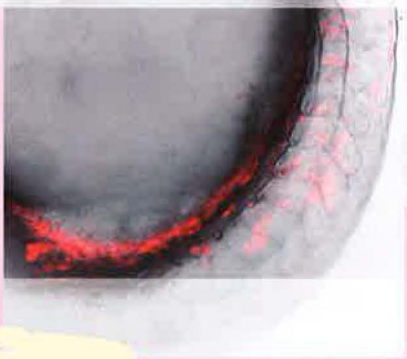

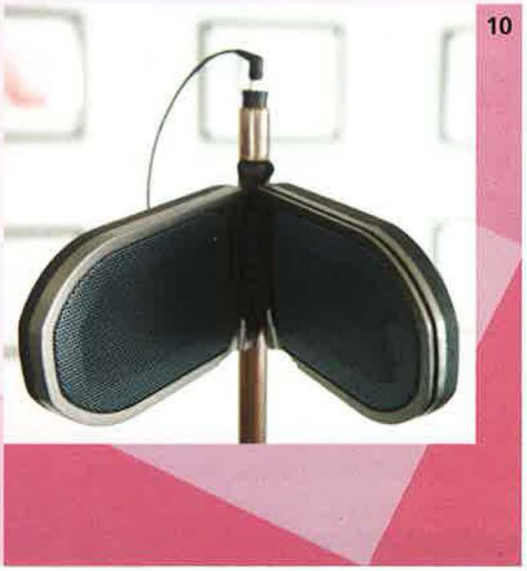

features

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Biomechanics research to improve racetracks could help prevent injuries to horses and jockeys

By Margaret Nagle

University of Maine Professor of Mechanical Engineering Michael Peterson invented a biomechanical hoof device for testing racetracks. Designed to duplicate the force produced by a running horse, the mechanism measures the impact and horizontal movement of the hoof hitting the surface. With it, Peterson can test the response of the track to the impact of a horse hoof during a race and measure the forces placed on a horse's leg. Data generated by the robotic device can help horse owners and trainers, jockeys and track managers make more informed decisions about racing on certain surfaces and in particular conditions. In addition, it could lead to standardization of tracks, ensuring uniformity between racing surfaces.

Photo courtesy of Michael Peterson

JUST OVER A YEAR ago, the sight of Barbaro shattering his right hind leg at the start of the 131st running of the Preakness sent up a collective gasp heard coast to coast. The national vigil during the colt's eight-month struggle to recover from his catastrophic injury drew millions of fans, including many who knew little about horse racing, but were captivated by his story.

However, for those who know horses and racing, the now unforgettable image of Barbaro's catastrophic injury that ultimately ended his life this past January was eerily familiar.

Those in the racing industry remember Ruffian, the equally promising 3-year-old filly who similarly captured the hearts and minds of Americans in 1975, only to break down at Belmont Park and be euthanized. In the 1990 Breeder's Cup, another 3-year-old, Go for the Wand, broke her front right foreleg and was put down.

High stakes

Through the years, other catastrophic injuries only ended the racing careers — not the lives — of high-profile horses, as in the case of Charismatic, who recovered in 1999 after breaking his left foreleg.

Then there are the untold numbers of local racers like Miss Pretty Promises, a 2-year-old quarter horse who crossed the finish line in seventh place at Retama Park, Texas, in April 2006, only to crumple to the ground with both front legs broken, as detailed by the *San Antonio Express-News*.

No nationwide statistics are kept on the number of racehorses each year that sustain catastrophic injuries, but most industry officials and veterinarians agree that the rate is low. The number often cited: fewer than two fatal injuries in 1,000 race starts.

But all agree that's two horses too many.

"Since World War II, there's been a consistent decline in the number of starts per horse and the lengths of race horses' careers," says biomechanics expert Michael Peterson, who uses engineering principles to understand the dynamics of animal motion. "The horses are facing multifactorial risk — from genetics and training protocols to an emphasis on racing younger and the priorities of the racing business. Tracks have improved, but not enough. But if we can take tracks out of the equation, we can then focus on other concerns. The goal is to keep horses and jockeys safe."

IN 1994, AN INDUSTRY panel called for a quantitative evaluation of racetracks. The panel, which included noted horse trainer Richard Mandela, and track superintendents Dennis Moore of Hollywood Park and Steve Wood of Del Mar and Santa Anita parks in California, turned for answers to veterinarian and equine orthopedic surgeon C. Wayne McIlwraith, who directs the Orthopedic Research Center at Colorado State University, and Peterson, a researcher at Colorado State before joining the University of Maine mechanical engineering faculty in 1999.

Peterson and Colorado State graduate students conducted preliminary investigations of the effects of track surfaces on joint loading or stress in racehorses. As a horse runs, the pressure on the legs depends on how fast the hoof stops, how hard the landing is and how much resistance is present as the animal pushes off.

Traditionally, it's believed that a track that is too soft causes bowed tendons, while an extremely hard track results in broken legs. Today, Peterson and others are saying disease and injury risks are more complicated.

"When the leg on a horse breaks, it is not usually just because of a bad step but because of accumulated damage to joints and bone," he says. "That suggests that any solution to joint disease has to start from the beginning of the horse's life."

Peterson began focusing on a track's shear strength — the pressure of the surface

FOR THE PAST three years, University of Maine mechanical engineer Michael Peterson has shipped his 7-foot-tall, 700-pound impact testing system to racetracks in California and elsewhere in the country in order to conduct on-site research into how to make surfaces safer.

Now part of his research focuses on improving the design of the robotic hoof, and that includes reducing its heft to make it more transportable and easier to use on tracks nationwide.

For assistance in the device's upgrade, Peterson turned to mechanical engineer Ryan Beaumont, who received his graduate degree in engineering from UMaine in May and who owns his own engineering consulting business; and Jim Alexander, owner of Alexander's Mechanical Solutions in Greenfield, Maine, which offers custom machining and manufacturing for clients across the country.

In the past 13 years he's been in business, Alexander has built a reputation on prototyping and inventing innovations for Maine's paper and seafood industries, as well as individuals. Beaumont provided some of the computer-aided design for Alexander's patented KoreChuck, used in the paper converting process in mills.

Now Alexander and Beaumont's collaboration continues as they design and develop a more portable, lightweight frame for the racetrack testing mechanism.

The improved impact testing system for racetracks will have a similar appearance, but its weight (aluminum instead of steel) and size will be reduced. Most important, its strength and stiffness — mirroring the impact of a running racehorse — will remain the same.

The result of their efforts will be a more compact and marketable device for use in the racing industry.

Building a better hoof

Jim Alexander, left, and Ryan Beaumont

on the front and back of the hoof as the horse stops and pushes off. If the shear strength is low on a "cuppy" track, the hoof slips as the horse propels itself forward, risking tendon and soft tissue injury. If the shear force is high, the pressure on the hoof causes increased horizontal stress on the bones in the hind legs producing the huge forces needed to propel the racehorse at a gallop.

Both the hardness and shear strength of the track directly affect the forces exerted on the horse as it runs, says Peterson. Understanding these forces and keeping them in an acceptable range are essential to injury prevention.

The more Peterson talked to veterinarians and track superintendents, the more he recognized the need for a device to measure variations between tracks, including deviations beneath the well-groomed surfaces. Peterson was particularly concerned about deep compaction — hard spots related to that "proverbial bad step."

PETERSON INVENTED a biomechanical hoof device for impact testing on racetracks. Designed to duplicate the force produced by a running horse, the mechanism measures the vertical and horizontal accelerations, and vertical force on the hoof hitting the soil. With it, Peterson can test the response of the track to the impact of a horse hoof during a race and measure the forces placed on a horse's leg.

With data generated by the robotic device, horse owners and trainers, jockeys and track managers can make more informed decisions about racing on certain surfaces and in particular conditions.

In 2004 at tracks in California, Peterson used the device to find inconsistencies among surfaces at different tracks, as well as something no one expected — deviations in individual tracks. Along one backstretch, the vertical stiffness of the track "dropped off the map."

"It was so much softer," Peterson says. "It would be like the

Jockey Jose Badilla Jr., hits the ground after Hes My Dasher breaks his front legs in the MBNA American New Mexico Challenge Championship at Sunland Park Racetrack and Casino, New Mexico, April 7, 2002. Kenneth Hart, right, atop Kendall Jackson, broke the world record in the 440-yard race with a time of 20.73 seconds. Badilla survived the breakdown; Hes My Dasher did not. Even though there are no nationwide statistics on the number of racehorses each year that sustain catastrophic injuries, most industry officials and veterinarians agree that the rate is low. The number often cited: fewer than two fatal injuries in 1,000 race starts. But all agree that's two horses too many.

AP/Wide World Photos

"When you ship a horse to a new racing venue, there's always a risk of soft tissue injury or fracture because the horse has trained and adapted to one type of surface and suddenly needs to adjust its gait to a different track. That's why we wanted to establish a quantitative baseline."

Michael Peterson

difference between running on grass and then on a street. In no way can that be good for a horse."

Soil samples confirmed uniform surface composition, but ground-penetrating radar revealed that 8 inches down, an underground stream or poor drainage had caused a washout. After the track bed was reconstructed, the backstretch was retested and found consistent.

"What I like about that is we found the problem before trainers and veterinarians found bowed tendons in the horses. That's the goal. We don't want to be waiting to have a backlog of injuries for the track veterinarian before determining if it's a track-related problem," says Peterson, who has had inquires about his testing system from as far away as Australia, where there is interest in standardizing tracks.

Last October, Peterson was among the national experts and prominent members of the thoroughbred breeding and racing industry who gathered in Lexington, Ky., for a Welfare and Safety of the Racehorse Summit, sponsored by Grayson-Jockey Club Research Foundation and the Jockey Club. The goal was to identify critical issues affecting horse health and longevity of racing careers, and to develop a strategic plan to address those problems.

Participants focused on issues related to the decline in the racing careers of thoroughbreds in the last 50 years in terms of fewer years raced and annual starts. Two of the resulting six recommendations from the summit deal with injury monitoring, including development of a national injury reporting and surveillance system. Another recommendation calls for safer racing surfaces throughout the country, gathering data to ultimately implement a certification and standardization process for racing surfaces.

Implementation of the recommendations by industry stakeholders or regulatory agencies is purely voluntary.

THE WELFARE AND SAFETY of the Racehorse Summit was held at Keeneland, a horse racing complex that was among the first in North America to install a Polytrack surface made of silica sand, fibers, recycled rubber and wax. Keeneland's fall race meet last October was the first conducted on the new track.

This past March, Del Mar Park in California also announced the debut of its new Polytrack racing surface for this season, making it the fourth horse racing facility in the country to replace dirt or turf with engineered material. The California Horse Racing Board has mandated that all major tracks in that state have synthetic tracks installed by the end of this year.

Installation of the new surfaces, costing upward of $10 million per track, has led to improvements in base layers, reducing variations around a track from 24 percent to 7 percent, Peterson says. And at least initially, that has translated into fewer catastrophic injuries.

Nevertheless, Peterson worries about the "synthetic movement," which has its roots in Europe and England. In particular, he is concerned how this surface is going to hold up under different environmental conditions and uses. Like traditional dirt horse tracks used for generations yet largely untested, the new synthetic surfaces leave engineers like Peterson with more questions than answers.

"In England, these tracks are used for racing only," Peterson says. "But you take Del Mar, where between 5 and 10 a.m., there can be as many as 2,000 horses that have worked out down the straightaway."

In addition, says Peterson, the synthetic track movement has divided the horse racing industry into the "haves and have nots."

"I'm worried about those facilities that can't afford $10 million tracks to keep horses sound," he says. "That's a huge challenge for fairgrounds and other smaller tracks without the big stakes appeal."

Research on how to test and maintain the synthetic tracks in the United States for the optimum safety of horses and jockeys could be the next set of questions Peterson tackles. He also is now looking for a dirt horse track where he can spend a season collecting data.

"I'd like to see standard maintenance protocols according to the compositions of the tracks," he says, "including responses to changes in temperature and moisture content." ▮

Developing muscles

Basic biological research on zebrafish may lead to better treatment of human diseases and injuries

By David Munson

With the help of the tiny zebrafish, Clarissa Henry's early work uncovered a phenomenal amount of data regarding muscle cell development, laying the groundwork for further research related to tendon attachment and other processes.

Staring into the crystal-clear plastic boxes inside the University of Maine's zebrafish research facility, it can be difficult to focus on the movements of an individual fish. Both its stripes and its size make it hard to distinguish from its brethren in a population that is now more than 40,000 strong. The fish, on the other hand, seem to be very good at tracking the movements of an individual human, darting away in a flurry of fins and sinew at the slightest agitation.

At first glance, it seems as if the frightened fish simply bullet through the water, like tiny torpedoes propelled by some hidden, turbocharged motor. But closer observation reveals the true power behind their movements: a fluttering undulation of the body and tail, dependent, of course, on muscle.

With every flip of its fins, tiny bundles of skeletal muscle extend and contract in precisely coordinated synchrony, leveraging their movements against the fish's miniature frame.

UMaine researcher Clarissa Henry has always been fascinated by the dynamic processes that shape the complex machinery of movement, and has pioneered a unique new system for studying how muscles and tendons develop inside the zebrafish. With a $1.28 million grant from the National Institutes of Health's National Institute of Child Health and Human Development, Henry is shining a microscope-mounted light into the darkest corners of developmental biology, revealing new truths about embryonic processes that may lead to better treatment methods for conditions ranging from muscular dystrophy to tendinitis.

Henry's current research, aimed at developing a better understanding of tendon formation and attachment in the embryo, is the next step in her pioneering efforts to describe the complexities of early development in vertebrates using zebrafish. Her previous research, funded by the Muscular Dystrophy Association,

Developing muscles

With a $1.28 million grant from NIH's National Institute of Child Health and Human Development, Clarissa Henry is conducting research in developmental biology that may lead to better treatment for conditions ranging from muscular dystrophy to tendinitis.

looked at how embryonic muscle cells transform from relatively stubby globs of cytoplasm into the long, multinucleated fibers of skeletal muscle in fully developed fry.

Skeletal muscles — from the orbicularis oculi to the gluteus maximus — are primarily responsible for movement in vertebrates, and abnormalities that arise during their formation can have dire consequences. For example, muscular dystrophy, one of the most common genetic diseases in humans, is characterized by a loss in muscular function that can manifest in many ways.

"One of the critical questions related to the treatment of muscular dystrophy is: How do humans make muscle during embryonic development?" says Henry. "We were able to make a significant step forward in this area because we were able to use an in vivo model. Prior to our work, no one was able to look into a live vertebrate embryo to see how muscle cells form at high resolution. We were able to do that with the zebrafish, thanks to the MDA."

The strength of the preliminary data was one of the reasons NIH reviewers expressed such strong support for Henry's latest project, pointing to her well-established methodology and the work's potential benefits in the treatment of human disease. In addition to her obvious enthusiasm for the research, Henry has a technological advantage as well, utilizing cutting-edge equipment like a Zeiss ApoTome fluorescence microscope to peer inside the living embryo.

Like their plastic tanks, the developing eggs of the zebrafish are largely transparent, allowing researchers to observe and record changes in the cells as they happen, which is difficult or impossible in other vertebrate research models, such as mice or chickens. The zebrafish model has advantages over cell culture techniques as well, revealing important nuances in growth and development that can only be seen when cells form under the influence and constraints of a living organism.

With the help of the tiny zebrafish, Henry's early work uncovered "a phenomenal amount of data" regarding muscle cell development, laying the foundation for further research related to tendon attachment and other processes. The new research path has already led Henry and her team to some important discoveries.

"Tendons are incredibly important structures, but exceedingly little is known about tendon development. It is very understudied, but it has implications in the treatment of a variety of tendon afflictions, from tendinitis to disorders caused by antibiotics or cancer treatments," Henry says. "Traditionally, tendons have been thought

of as uniform, with the same protein structure throughout. We have found that that is decidedly not the case. Tendon structure is spatially and temporally dynamic. We're very excited about looking further at how the type and location of tendon proteins change over time."

Henry and her UMaine colleagues continue to show that the zebrafish model has significant advantages over other research systems. Perhaps best of all, recent studies have shown that many of the processes that occur during zebrafish development are very similar to the developmental changes that occur in mammals, including humans.

"There's a lot of basic science in this area that we just don't understand," says Henry. "We don't know how these structures grow, how they increase in mass or how the attachment between the tendon and the skeleton is maintained. There's a real opportunity here to do pioneering work."

While zebrafish development will remain the primary focus of her research, an opportunity to interact with some of the country's leading stem cell researchers will soon have Henry working with a slightly larger fish: the dogfish shark. Henry is the recipient of one of a handful of New Investigator Awards from Mount Desert Island Biological Laboratory (MDIBL). The honor will allow Henry to work with MDIBL scientists for several weeks, examining muscle growth and development in the dogfish.

Dogfish developed their unique physiology long before bony fish like the zebrafish evolved. Henry hopes that comparisons between dogfish and zebrafish embryonic development offer insights into the evolution of muscle development and function.

"This award allows my lab to delve into questions that we would be unable to ask without the valuable intellectual and practical resources at MDIBL," Henry says.

Hoping to make the most effective use of her discoveries, Henry is currently working with UMaine's administration to develop new opportunities for collaboration with specialists in human genetics and other fields.

"Having a system like this, where we can see the fine details of cell behavior as it forms structures like muscle, facilitates a much more complete understanding of the processes at work. If we're going to talk about developing treatments for diseases, we need a very thorough understanding of what's going on," says Henry.

"Part of what is so exciting about this work is that we are not just using the zebrafish model to recapitulate what has been done in other systems, we're using the zebrafish to ask questions that aren't easily answered in other systems to complement what's known." ▮

Image courtesy of Clarissa Henry

Three-dimensional images of muscle cells in a zebrafish embryo allow researchers to compare fast muscle cells (in red) with slow muscle cells (in blue) to determine the number and the amount of specific proteins required to repair defective muscle.

Researching the role of fibronectin

MOLECULAR BIOLOGY and biochemistry major Chelsi Snow wanted to pursue a career in the natural sciences because it was the most expedient and obvious way to contribute to society.

"Everyone has, directly or indirectly, been touched by congenital disease," says Snow, who will be starting her fourth year as an undergraduate researcher in the lab of Assistant Professor of Biological Sciences Clarissa Henry. "Cancer and cardiovascular and neuromuscular diseases affect the patients, as well as their families and friends. This is why I am particularly interested in scientific laboratory research with direct and clear applications to human disease."

Snow coauthored a recent paper, submitted for publication to the journal *Developmental Biology*, investigating the role of the protein fibronectin in the growth of muscle cells. Her role in that project helped her earn a Barry Goldwater Scholarship for undergraduate research. Snow is one of only 300 students nationwide to receive the scholarship, which will fund the next phase of her project.

"Muscle cells normally have a certain limit or boundary that they grow to, but we observed cells that went beyond those boundaries in the absence of the fibronectin protein," says Snow. "I want to see what might be going on in the extracellular matrix that influences cell invasive behavior and how this protein plays a role in growth."

Snow will use the zebrafish research techniques pioneered by Henry to develop a new line of zebrafish that break down fibronectin at an increased rate, offering new insights into the role the protein plays in cell growth.

This summer, Snow also will work with scientists at the Mount Desert Island Biological Research Laboratory in Bar Harbor, just as UMaine's other Goldwater award recipient this year, Benjamin Burpee, did in 2006. Both Snow and Burpee are participants in the Maine IDeA Network of Biomedical Research Excellence, an organization affiliated with the National Institutes of Health. The goal of the network is to strengthen Maine's capacity to conduct competitive biomedical research.

Constant F

By David Munson

SOMETIME IN the late-1950s, Fluxus began to appear on the landscape. Decidedly contagious and surprisingly robust, it bounced from city to city in tattered knapsacks and the trunks of Buicks, establishing itself whenever and wherever it found a compatible host. It crept down back alleys and lingered in the flickering light of subway tunnels. It drifted into living rooms, offices and public parks. From elegant high-rise apartments to cramped fourth-floor walk-ups, it seemed Fluxus was everywhere.

Fluxus was, and continues to be, a pivotal movement in the development of contemporary art, music and performance. An attempt to reposition art back into people's everyday lives, Fluxus was nothing short of a creative revolution, and, like all good revolutions, it questioned the norm, bucked the system, and placed the power of change firmly in the lap of the people.

University of Maine artist and professor Owen Smith could easily be described as one of the high priests of Fluxus. The author of the book *Fluxus: The History of an Attitude*, and numerous articles about the Fluxus phenomenon, Smith is a highly respected historian on the genre. He also is an accomplished artist. And, as Smith readily admits, the marriage of the two professions can be a bit complicated.

"Even though I'm a Fluxus historian, I don't call myself a Fluxus

flux

Owen Smith explores how art affects our thinking, culture and values

Fluxus is an attitude that Owen Smith's work embraces. At the heart of any Fluxus work — and at the heart of Smith's work — is the all-important seminal concept: the seed idea or question that forms the foundation for the artistic expression.

artist," says Smith, whose expressions of art range from performance pieces and installations to paintings and video. "There are a lot of similarities between my work and Fluxus: in how I engage in thinking about art, where art exists and what it looks like. My work is in the Fluxus vein, but I am not a Fluxus artist."

In truth, the matter of who is and who isn't a Fluxus artist is a point of contention among historians and artists. Many artists' works are influenced to varying degrees by the Fluxus legacy, but Smith sees the time and place in which an artist became involved in the movement as critical. Smith references himself as a case in point.

"For me, Fluxus is a movement aimed at reconnecting people to art, but it is also an historical movement during which established Fluxus artists lived and worked, and that is a period that I am separate from."

According to Smith, the Fluxus movement began in the 1950s. From Nam June Paik's *One for Violin Solo* (where the performer slowly raises the violin over his or her head and then smashes the instrument) to George Maciunas' *Burglary Fluxkit* (a small box of numerous found

Old Dead White Men Products, 1991–2006
Artist's multiples, various materials and dimensions

Constant Flux

"My connection with Fluxus lies in the idea that a work starts with a concept or an idea, not with a particular medium."

Owen Smith

What Lies Hidden (the only good red ...), 2004
Ultrachrome ink on archival paper

In the classroom or around the world, the exploration of ideas and the challenges they pose are the moving forces behind Owen Smith and his art.

keys), Fluxus had a strong antiart and anticommercial focus, sought to make art part of people's lives, encouraged participation of the audience in the creative work, and valued simplicity over complexity.

ALTHOUGH NOT universally defined, Fluxus was an international group of artists, writers, musicians and performers who explored new forms of art, making and creating what is now often referred to as intermedia (intersections of differing media) that stressed a commonness and simplicity of materials for maximal effect, similar to haiku poetry. In addition to its existence as a historical group, Fluxus also is a philosophy and a way of thinking that is deeply engaged in the importance of play as a creative process and mechanism, an approach Smith has referred to as "being serious about not being serious."

Perhaps most important, Fluxus is an attitude that Smith's work embraces. At the heart of any Fluxus work — and at the heart of Smith's work — is the all-important seminal concept: the seed idea or question that forms the foundation for the artistic expression.

"My connection with Fluxus lies in the idea that a work starts with a concept or an idea, not with a particular medium," says Smith, whose Fluxus tendencies were seen most recently at the Center for Maine Contemporary Art in Rockport, Video Space in Raleigh, N.C., and the Artists' Book Archive at the Museum of Modern Art in New York City.

A Semblance of Resemblance: Art and the Nature of the Image, an exhibition by Smith, Alan Stubbs and Andy Hurtt, is on display through Aug. 3 in Lord Hall on campus.

"Once you have identified the concept, you find whatever media or material that seems most appropriate for the work. Fluxus

Learning Curve, 1996
Mixed media sculpture

tends to include a lot of humor and play, which is often part of my work, as well. The core of my work is in using art to investigate art itself, to get at how art affects our thinking, our culture and our values."

A PROFESSIONAL ARTIST since the mid-1980s and a UMaine faculty member since 1991, Smith has built an extensive and strikingly diverse body of work that examines political, social and personal issues with challenging insights and a uniquely descriptive aesthetic.

His work has been included in more than 60 national and international exhibitions.

"Whatever medium I choose to work in, the art itself is about the idea. What ideas are worth exploring? What questions are worth asking? I want people to think about what I explore or present in my work. I don't offer answers. I don't want to. I want people to think."

Smith's desire to "get people to think" is a common theme that links his varied pursuits as artist, teacher and UMaine New Media Department chair. It is, perhaps, the source of his energy and enthusiasm, as well.

After wrapping up a spring show at the Center for Maine Contemporary Art, Smith headed across the Atlantic this past May, playing yet another role in Copenhagen as the co-organizer of an international conference on Events and Event Structures at the Royal Danish Academy of Art.

In the classroom or around the world, the exploration of ideas and the challenges they pose are the moving forces behind Smith and his art.

"Art ultimately is not about me gluing two things together, it's about me asking a question," says Smith. "The viewer then thinks about an answer, and it is in that exchange where the art resides." ▮

Evolution of the New

Owen Smith

MULTIPLICITY APPEARS to be a mantra for University of Maine Professor of Art Owen Smith, both in his approach to artistic creativity and in his professional career. In addition to creating new expressions of art and serving as both teacher and mentor to his students, he also is director of the New Media Department in the College of Liberal Arts and Sciences.

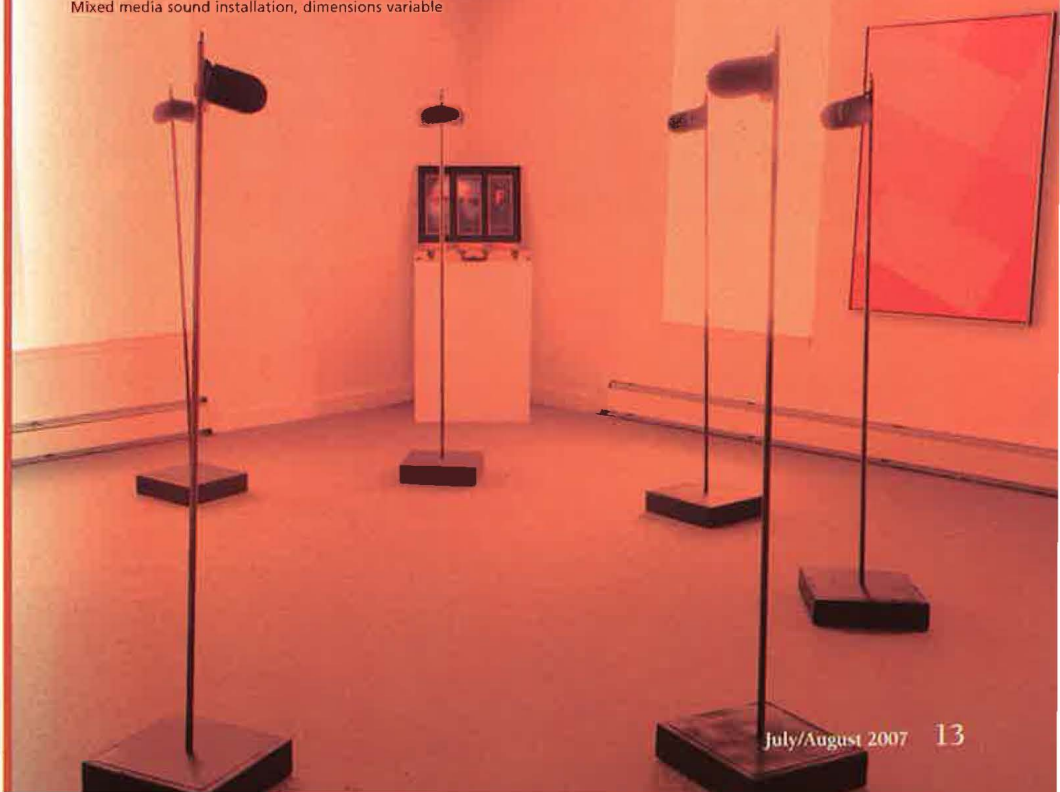
Ever evolving, new media at UMaine began in 1993 under the multimedia moniker as an interdisciplinary, faculty-driven initiative organized by Smith and others. Like-minded professors from across the UMaine community came together with the goal of developing a program that could keep up with the pace of technological change and its far-reaching influence on art, thought and culture. Since then, the program's interdisciplinary core has become more focused, providing a shared approach to thinking and creating in an ever-changing world.

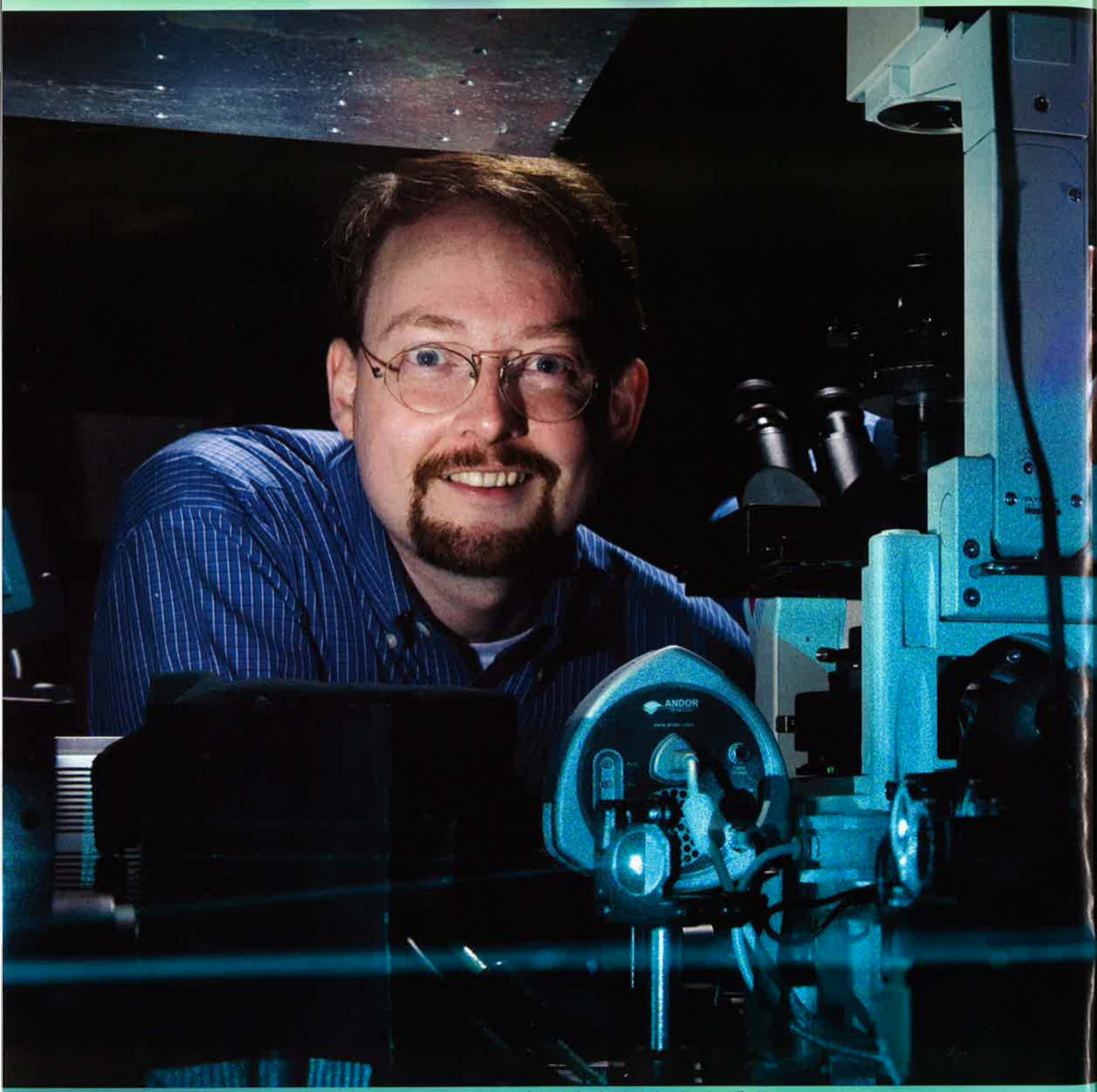
Now a full-fledged department, new media offers a variety of areas of study to its diverse and enthusiastic degree students. Majors have the opportunity to develop their own educational path based on one or more of the program's five primary sequences. The increasing demand for new media professionals has caused the program to expand considerably in recent years; it now includes more than 200 majors.

"New media isn't just about the newest technology or the latest gizmo, it's about understanding the value of newness," says Smith. "It's about exploring the multiplicities of an idea: How we come up with it, how we evaluate it, where we go with it. At its core, the program is about thinking creatively, and applying that creative thinking using digital tools and technologies."

More information about the department is on the Web (newmedia.umaine.edu).

Speaking in Tongues, 2006/7
Mixed media sound installation, dimensions variable





Assistant Professor of Physics and Astronomy Sam Hess, left, and Assistant Professor of Chemical and Biological Engineering Mike Mason

New method of microscopy using fluorescence photoactivation could help

A better view of the molecule

address biological questions

By David Munson

SCIENCE HAS LIMITS. Defined by theories, laws and formulaic equations, these limits define the boundaries within which scientific discoveries are made.

In most cases, having boundaries that are clearly defined by justifiable rules is a good thing. In science, however, the existing limits often interfere with the overall quest: the search for a cure, the advancement of technology, the depth of our understanding of ourselves and our universe. For scientists, the goal is often to break through those limits to reveal the discoveries on the other side.

For University of Maine Assistant Professor of Physics and Astronomy Sam Hess, a breakthrough idea that would redefine the limits of scientific microscopy arrived late at night, accompanied by a heavy backbeat and a lot of yelling.

A raucous party at his neighbors' apartment had made it impossible for Hess to sleep. Instead of simply pulling a pillow over his head and contemplating moving, Hess considered the limits of physics. In particular, he mulled over the refraction barrier, which has long set the magnification limit of light microscopy as the size of the wavelength of visible light — roughly 400–700 nanometers.

"It was 2 in the morning. I was tossing and turning, thinking about this idea, and at the time it seemed like it could work," says Hess, laughing about the circumstances that surrounded his discovery. "The party continued, and I continued to think about the idea and I just couldn't prove it wrong, so I decided to go downstairs and write it down. I figured I would have a good laugh when I read it in the morning."

As it turned out, Hess couldn't find any problems with his approach in the morning either, and neither could his colleagues. With a nod of encouragement from some of his most trusted peers, he decided to take the next step, enlisting the help of fellow UMaine professor and friend Mike Mason.

"We had talked about different ways to approach this problem a number of times. I had done some work on a similar technique as a postdoc, and Sam knew

a lot about photoactive dyes," says Mason, assistant professor of chemical and biological engineering. "When he came to me with the idea, we knew we had to get working on it."

AFTER A REVIEW of the literature yielded no mention of the new approach by other researchers, Hess and Mason discussed the new technique at length, outlining the steps necessary to build and test a prototype. The new microscope system, dubbed FPALM (Fluorescence Photoactivation Localization Microscopy), combines existing technologies to build an image based on the florescence of individual molecules. The device's magnification capabilities exceed those of the most powerful confocal light microscopes available.

"A normal microscope looks at all of the molecules at once, which can make the individual molecules difficult to see, like drops in a stream of water," says Hess. "The separation between individual objects needs to be larger than the microscope's resolution, otherwise the light coming back through the microscope is blurred and the objects are indistinct. This new technique allows us to find out where the molecules are and separate them as individual entities. The key is in the use of photoactive dyes."

The device uses lasers to excite dye molecules on the surface of the subject being observed. The laser causes a portion of the molecules to fluoresce, and the light given off creates an image that is captured digitally. The process is repeated as new sets of molecules are excited, and the individual images, each reminiscent of a starry sky at night, are layered with the help of a computer to create a composite image. The resolution of the new image is at least eight times better than any traditional light microscope available today.

Mason, whose research utilizes single molecule imagery to probe local processes in biology and materials science, brought in a highly sensitive camera to aid in detection of the faint single molecules. The prototype yielded its first preliminary data in October 2005.

THE FIRST FEW tests had barely ended before disaster struck the project. A steam pipe in Hess' lab burst, ruining some of the highly sensitive equipment and setting the project back several months. To make matters worse, Hess learned that another research team was close to publishing its findings on a similar microscopy technique.

"The pipe was repaired, the lab was cleaned up, we got another camera and we began taking more measurements," says Hess. "We heard that another group had submitted its paper already, so we really had to push. It was stressful, but it was also very motivating. We spent a lot of late nights, but we were able to get our paper published in *Biophysical Journal* within a few days of when the other group's work was published."

"This is the type of discovery in which the general technique can be applied in a lot of different systems. It's a beautiful thing when science works this way: You talk through an idea, you run through the numbers, you set it up in the lab and it works."

Mike Mason

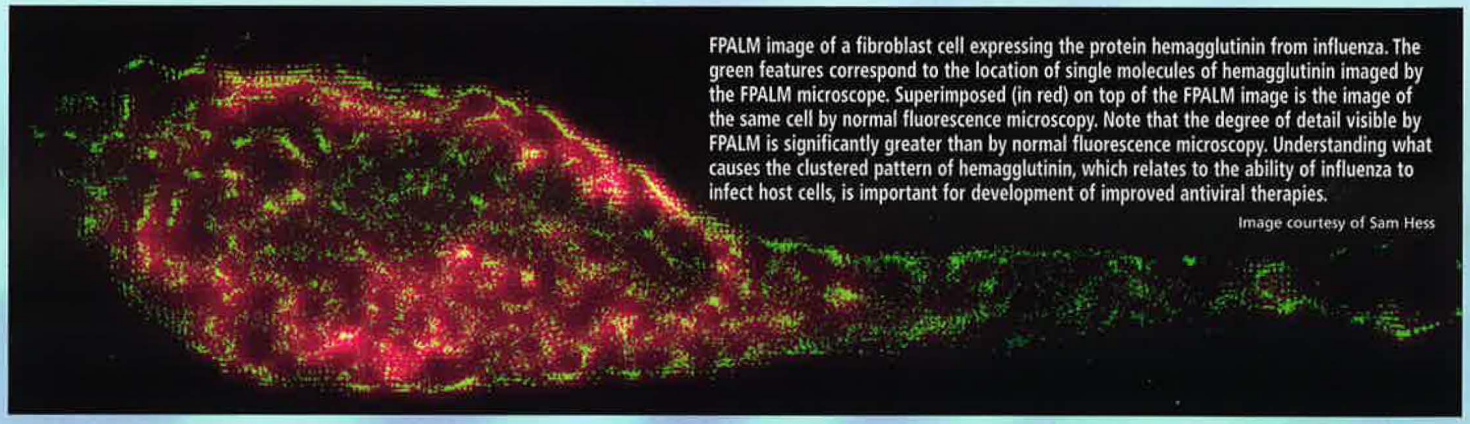
In the final stages of the peer review process, Hess and Mason were asked to calibrate their device to show that the new microscope did, indeed, break the refraction barrier. They collaborated with a team of researchers at UMaine's Laboratory for Surface Science and Technology — George Bernhardt, Scott Collins and Patrick Spinney — who were able to make a calibration sample and image it by atomic force microscopy in just three days.

"The difficulty in calibrating our microscope was in finding an accurate standard to measure against. If you have a microscope that can look at things that are smaller than any other microscope can see, how do you verify what is being seen?" says Hess.

Their published paper earned important recognition on *Science* magazine's Top Ten Discoveries of 2006 list.

"I can really see this being used in a lot of labs. The entire device costs about one-fifth of the cost of a confocal microscope, and its resolution is 10 times better. Theoretically, the technique could eventually yield images that have resolutions that are 100 times better or more," says Hess.

"There's a lot more to do in this area, and I'm so motivated to keep it going, I can't sit still." ▮



FPALM image of a fibroblast cell expressing the protein hemagglutinin from influenza. The green features correspond to the location of single molecules of hemagglutinin imaged by the FPALM microscope. Superimposed (in red) on top of the FPALM image is the image of the same cell by normal fluorescence microscopy. Note that the degree of detail visible by FPALM is significantly greater than by normal fluorescence microscopy. Understanding what causes the clustered pattern of hemagglutinin, which relates to the ability of influenza to infect host cells, is important for development of improved antiviral therapies.

Image courtesy of Sam Hess

Healthy beaches

Photo by Michael Mardosa

Esperanza Stancioff

Title: Statewide Associate Marine Extension Professor, Maine Healthy Beaches Coordinator, University of Maine Cooperative Extension and Maine Sea Grant

Research focus: Water quality, invasive species and climate change

Years at UMaine: 20

Milestones: Providing a leadership role in the development and implementation of coastal citizen environmental monitoring in Maine, supplying data used by local, state and federal data managers; and facilitating opportunities for volunteers (both youth and adult) to gain real-life science experience that is meaningful for their communities.

Question: What do you consider the biggest threat to the overall health of Maine's beaches?

Answer: With the population growth primarily in the coastal and southern regions of the state, we face development pressures affecting the beach areas. Typically accompanying these development pressures are nonpoint source pollution, and human practices that affect water quality and health. However, beyond immediate human development pressures, the biggest threat to Maine's beaches is the effect of climate change through sea level rise, storms and other coastal hazards.

Question: Why are clean beaches so important?

Answer: Clean beaches are important for the abundance and distribution of beach system organisms and the health of this fragile ecosystem. Tourism is Maine's largest industry, with 60 percent of visitors coming explicitly to explore the beach and ocean. Beaches are vital to our economic well-being.

Question: What role do beaches play in the ecological health of coastal areas?

Answer: Sandy beaches provide habitat for important small organisms, such as decomposer bacteria and fungi, algae and invertebrates, as well as shore birds. Sandy beaches also provide ecological linkages to adjacent ecosystems, such as sand dunes, the surf zone, estuaries and coastal lagoons supporting a myriad of life.

Question: What can people do to protect Maine's beaches and coastal areas?

Answer: Some of the most basic steps that can be taken include maintenance of septic systems and healthy habits at the beach. The latter includes a long list of practices, such as the use of swim diapers, picking up your litter, leaving pets at home or cleaning up after them, not feeding the wildlife, etc. The more involved and critical things that can be done include the following: ensure that communities maintain and monitor waste systems, including sewage treatment systems and individual septic systems; require that boaters have holding tanks and use pump-out facilities; avoid construction in critically sensitive areas, such as wetlands or beaches. Finally, we all have to do our part to reduce carbon emissions through whatever ways possible, such as replacing incandescent lights with fluorescent in our homes, driving fuel-efficient vehicles, and selecting green power as our source of electricity.

UMAINE PHILOSOPHER REFLECTS ON THE DICHOTOMY BETWEEN RELIGION AND VIOLENCE

By Dick Broom

RELIGION ENCOMPASSES both the tenets of a faith and the ways those beliefs are interpreted and acted on by people at any given time and place. It can respond positively to many of the world's troubles, and all too often can be the cause of violence and suffering, says a University of Maine philosopher whose extensive research includes the area of philosophy called the phenomology of religion — the nature of religious experience, symbolism and myth, and how to interpret religious meaning.

All major religions, East and West, have essential teachings that sound like the Golden Rule, says Douglas Allen, a professor of philosophy and one of the world's foremost scholars of Gandhian philosophy. They all talk in some way about peace, love and compassion, and are critical of hatred, violence and humanly caused suffering. Yet throughout history, violence and intolerance have stemmed from religion, and most wars have been given religious justification.

In our post-9/11 world, violence in the name of someone's god is particularly pervasive. The question, Allen says, is why in our contemporary world does the dark side of religion seem to be dominant?

In a modern world full of ambiguity and doubt, where contradictions can be found even in a traditional touchstone like religion, militancy and fundamentalism increasingly fill a void, he says. It's easy to understand the attraction — and the danger.

Militant religious groups offer followers a clear identity and a sense of community with like-minded believers, says Allen. They also define the enemies — them, the "others," those unlike us, the nonbelievers — who stand in their way of attaining a "higher good."

"If you regard the others as evil, then the options are to tolerate or to eradicate evil, and the model we're increasingly seeing is adversarial," says Allen. "The result is violence and hatred that is threatening to destroy humankind."

"MURDER, TORTURE AND OTHER FORMS OF PHYSICAL VIOLENCE ARE ONLY PART OF IT. VIOLENCE ALSO CAN BE ECONOMIC, PSYCHOLOGICAL, CULTURAL, RELIGIOUS, LINGUISTIC. WE HAVE SEEN OVER AND OVER HOW VIOLENT LANGUAGE CAN INFLAME HATRED AND INTOLERANCE."

Douglas Allen

IN 2003, as president of the Society for Asian and Comparative Philosophy, Allen took the lead in organizing an international conference, "Comparative Philosophy in Times of Terror." There, he and colleagues from around the globe explored what philosophy can contribute to our understanding of the terror, terrorism, violence and insecurity that increasingly dominate our discourse and our lives psychologically, economically, politically, militarily, culturally and religiously.

The goal was to determine if philosophical analysis of the relations between religion and violence could suggest alternatives to conflict, leading to greater nonviolence, peace and justice.

That conference inspired a book, edited by Allen, *Comparative Philosophy and Religion in Times of Terror*, published last September. Each chapter, written by a different philosopher or religious scholar, offers insights from the teachings of great thinkers — from Aristotle to Zen Buddhists.

To understand the complex relationship between religion and violence, Allen says, one has to look beyond the abstract spiritual and ethical ideals of a given faith to how it actually functions and is expressed in a society. While religions might claim to be inspired by an infallible higher power, imperfect human beings practice them, he says.

"If you look at the world today, religion is mainly a negative and destructive force when it comes to compassion, peace and goodwill. Some of the dominant forms of religion, from radical Islamic fundamentalism to radical Christian fundamentalism, hold a similar view: We are good. Everyone else is sinful

and evil. God is on our side and not on the side of the evil others."

Such intolerant views justify the use of righteous violence because "you don't make peace with forces you consider evil," Allen says. "You must defend yourself against them and even use violence to destroy them. The evil is like a cancer that you must destroy before it destroys you."

But along with traditions of intolerance and hatred, in most religions there are strong traditions of love and acceptance of and respect for people of other faiths, Allen says. The trouble in today's world is that peacemakers and those who seek to follow these positive aspects of their religions are increasingly marginalized and silent, drowned out by the more vocal, aggressive and often well-funded militants.

Particularly disconcerting are the negative voices that shape policy and support war, says Allen, a longtime peace and justice activist.

IN A MODERN WORLD FULL OF AMBIGUITY AND DOUBT, WHERE CONTRADICTIONS CAN BE FOUND EVEN IN A TRADITIONAL TOUCHSTONE LIKE RELIGION, MILITANCY AND FUNDAMENTALISM INCREASINGLY FILL A VOID. IT'S EASY TO UNDERSTAND THE ATTRACTION — AND THE DANGER.

SINCE THE TERRORIST ATTACKS of Sept. 11, 2001, Allen has lectured extensively on Mohandas Gandhi's views of violence and terrorism. In addition, he has had numerous publications on Gandhi's philosophy, including a Gandhi chapter in his book on philosophy and religion in times of terror. His newest book, *The Philosophy of Mahatma Gandhi for the Twenty-First Century*, will be published this November.

"Gandhi strongly refutes the terrorist position," Allen says. "He would speak unequivocally on how terrorism such as we saw on 9/11 is unjustified and must be opposed. But he would maintain that, to prevent such acts, we must try to understand and deal with the underlying causes of terrorism."

What comes out of an analysis of Gandhi and other philosophers is the need to see the common denominator — humans — in all the world's religions. "We must show that we care about the well-being of other people, appreciating what's good and, through dialogue, appreciating what all of us are saying," Allen says.

Through constructive dialogue and mutual understanding comes greater compassion and nonviolent conflict resolution. And that must involve having empathy for how those different from us have been socialized in this world.

Allen believes that one of Gandhi's greatest contributions was his attempt to broaden the world's understanding of the nature of violence.

"Murder, torture and other forms of physical violence are only part of it," Allen says. "Violence also can be economic, psychological, cultural, religious, linguistic. We have seen over and over how violent language can inflame hatred and intolerance."

Gandhi also spoke of economic violence in terms of humanly caused poverty, exploitation and oppression as examples of "the structural violence of the status quo." He maintained that anyone who is aware of such conditions and profits from them or does nothing about them is complicit in the violence.

ANOTHER REALITY IS that opposing sides in religious wars are not always people who pray to different gods. Sunni Muslims and Shia Muslims kill each other in Iraq in the name of Allah. Not long ago, Northern Ireland was a battlefield on which followers of Christ — Protestant and Catholic — spilled each other's blood. The Middle East is full of endless escalating violence by those on warring sides who trace their religious origins to the same biblical God.

Gandhi, India's icon of tolerance and nonviolence, was assassinated by a fellow Hindu because of Gandhi's commitment to interreligious dialogue, Hindu-Muslim mutual understanding and harmony, and advocacy of justice for Muslims and all other Indians.

Throughout history, Allen says, religion has been used theologically and ideologically to perpetuate the status quo and to justify nearly every form of violence. Religion also has been a powerful force for peace, and he believes it can be today.

"If you are a religious person, you have resources within your religion to be a peacemaker because all religions have ideals of nonviolence, tolerance and love."

Following that path means understanding the distinction between religious pride, in the sense of treasuring what is truly moral and spiritual in one's own religion, and religious arrogance, Allen says.

"You should be proud of all that is good in your religious tradition," he says. "But be humble. Realize that you are an imperfect, fallible human being, and you don't have an exclusive understanding of the Truth with a capital T. Realize that there may be other worthy paths to God or the Truth. Recognize that others, both religious and nonreligious, have incomplete but valuable truths. Through constructive dialogue, you can learn from others, and this can help you to develop your own ethical and religious understanding.

"If you really identify with a religion, it is your obligation to try to purify your own religion, as Gandhi would say, so that it is free of hatred, bigotry, violence and intolerance." ▮

Indoor urchins

It's morning in Franklin, Maine, and the young ones are already out for a swim. The temperature is perfect; the water is clear, and just down the hall, refreshments are already percolating away. This is the life — especially if you're a green sea urchin.

TUCKED AWAY in a quiet, temperature-controlled room at the University of Maine's Center for Cooperative Aquaculture Research (CCAR) in Franklin, dozens of bristly, thumbnail-size urchins vie for position on the walls of specialized tanks, waiting to be released among the rocky crags and crevasses of the Atlantic. Unlike their wild counterparts, the verdant invertebrates lead a life of leisure, their every need addressed by UMaine graduate student Nicole Kirchhoff.

Coddling baby urchins is part of Kirchhoff's multifaceted investigation into green urchin aquaculture. Working with CCAR Manager Nick Brown, she hopes to develop efficient and reliable techniques for raising juvenile urchins. Hatchery-raised urchins could one day be used to reseed the Maine coast, where overharvesting in the late '80s and early '90s led to the collapse of the urchin fishery.

"No one had ever done this type of research before," says Kirchhoff as she harvested eggs from one of the large urchins serving as brood stock for the program. "We have looked at everything: brood stock management, how to grow juveniles economically. There is still a lot we don't know."

The first stage of Kirchhoff's work focused on urchins' reproductive biology. By manipulating the length of day and the temperature in the lab, she was able to change urchins' seasonal spawning cycle, causing them to produce viable eggs and sperm year-round. Lab tests are under way to determine if the eggs and sperm produced out of season are fully developed.

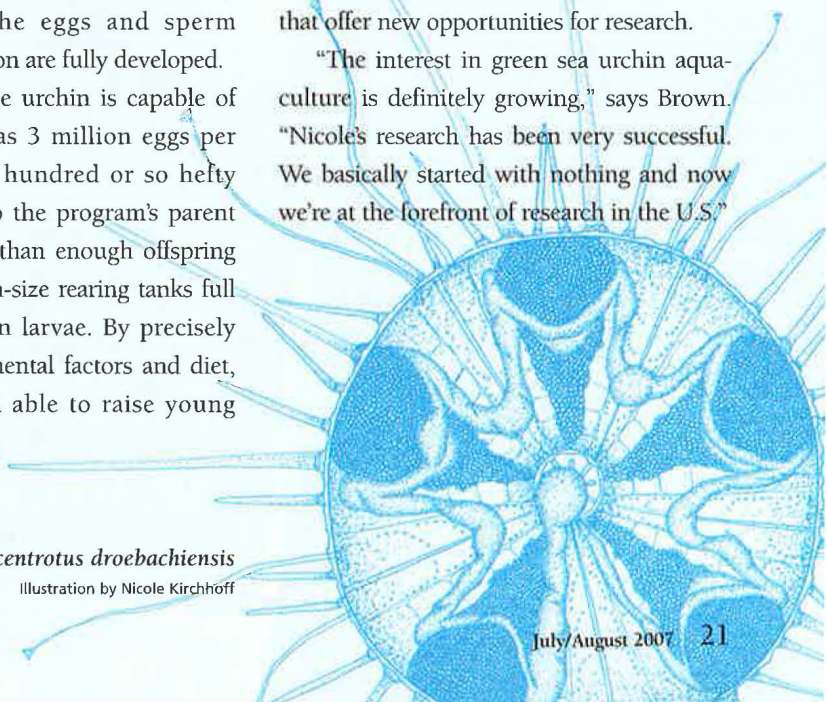
Since each female urchin is capable of releasing as many as 3 million eggs per spawning, the few hundred or so hefty adults that make up the program's parent stock provide more than enough offspring to keep the trash can-size rearing tanks full of planktonic urchin larvae. By precisely controlling environmental factors and diet, Kirchhoff has been able to raise young urchins no larger than the period at the end of this sentence to a respectable 10 millimeters or larger — a critical size in the life of a young urchin.

"Once they get past 15 millimeters or so, they become much less susceptible to predators," says Kirchhoff. "At that size, they could be used to restock areas where the urchin population is low."

Another part of Kirchhoff's master's work looked at urchins' rate of growth under varied environmental conditions. Captured and caged in mesh tubes beneath the waves of Penobscot Bay, a population of more than 5,000 fingernail-size urchins was carefully measured and monitored for six months. Data collected on the juveniles will help to determine optimal bottom type, currents, temperatures and other factors that could influence the success of green urchin aquaculture and reseeding programs.

Kirchhoff is now applying what she learned from her initial research to develop a better understanding of urchins' breeding biology and to determine the optimal conditions for successful rearing of juveniles. With every discovery, new questions arise that offer new opportunities for research.

"The interest in green sea urchin aquaculture is definitely growing," says Brown. "Nicole's research has been very successful. We basically started with nothing and now we're at the forefront of research in the U.S."



Detail of an internal aboral view of the green sea urchin, *Strongylocentrotus droebachiensis*

Illustration by Nicole Kirchhoff

It's political

COLLEGE STUDENTS involved in emotionally charged movements like campus-based antirape campaigns often describe their activism as nonpolitical, but avoiding politics can limit the potential to bring about social change, according to a University of Maine sociologist.

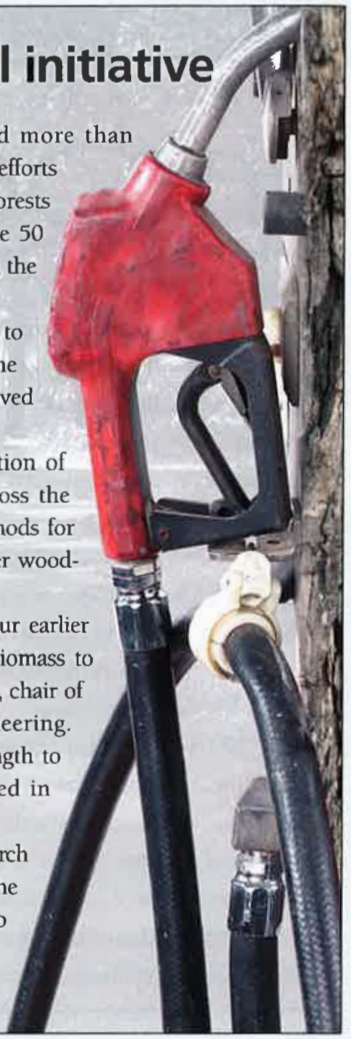
Even actions that appear at first glance to be apolitical have political consequences for movements and their participants, according to Amy Blackstone, assistant professor of sociology, writing in the journal *Sociological Spectrum*.

Politics has to do with power — who has it, who wants it and how it is negotiated, given or taken away. While very personal, sexual violence also is an important social problem linked to broader relations of power and inequity in society. Volunteers' self-effacing characterizations of their efforts as above or below politics can limit the transformative potential, says Blackstone.

Helping people is arguably the most important aspect of the antirape movement. Activists and volunteers Blackstone interviewed and observed emphasized that their work is done, in part, to be with other like-minded people and, especially in informal settings, to have enjoyment and camaraderie. At the other end of the spectrum, volunteers see activities such as Take Back the Night marches and vigils as solemn, almost sacred. In both cases, they perceive the emphasis on emotion superseding the focus on social change.

Whatever participants' reasons for wanting to avoid a political label, their involvement contributes to changing some aspect of our social structure, and in so doing, they have found politics, Blackstone says.

DOE backs UMaine's biofuel initiative



THE DEPARTMENT OF ENERGY (DOE) has awarded more than $1.5 million to the University of Maine to advance ongoing efforts to develop methods for converting biomass from Maine's forests into fuels and valuable chemicals. The state will contribute 50 percent in matching funds to the multifaceted project through the Maine Economic Improvement Fund.

The funding through the DOE's Experimental Programs to Stimulate Competitive Research (EPSCoR) will be added to the $6.9 million the Forest Bioproducts Research Initiative received in a 2006 National Science Foundation EPSCoR award.

The UMaine initiative is a multidisciplinary collaboration of scientists from educational institutions and businesses across the state who are working to develop effective and efficient methods for transforming waste products from paper processing and other wood-based enterprises into fuels, plastics and other materials.

"This project adds the thermal conversion pathway to our earlier biochemical conversion focus for the utilization of woody biomass to produce biofuels and other coproducts," says Hemant Pendse, chair of UMaine's Department of Chemical and Biological Engineering. "Together, these projects put UMaine in the position of strength to deal with the entire spectrum of technical issues involved in biomass conversion."

Supporting 12 researchers across the state, the new research cluster will allow UMaine to expand its efforts to overcome the technological barriers faced by Maine companies working to develop techniques for producing wood-based fuels and chemicals within the wood products industry's infrastructure.

Fresh water in the gulf

"While we can't say that conditions in the 1990s were caused by global warming, our work suggests a new way that global warming could impact marine ecosystems."

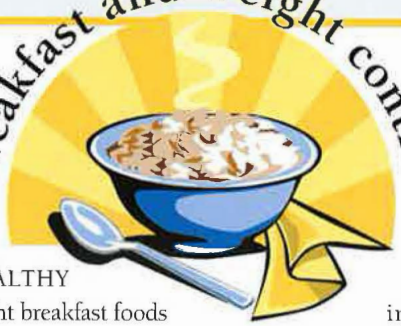
Andrew Pershing

SIGNIFICANT SHIFTS in the marine ecosystems of the northwest Atlantic in the past decade, including changes in the abundance and seasonal cycles of phytoplankton, zooplankton and fish, were the result of a dramatic increase in meltwater entering the ocean due to climate change, according to two marine researchers.

In a paper published in a recent issue of the journal *Science*, Andrew Pershing of the University of Maine School of Marine Sciences and the Gulf of Maine Research Institute, and Charles Greene of Cornell University's Ocean Resources and Ecosystems Program suggest that the increase in low-salinity water entering the Atlantic from the Arctic altered circulation and stratification patterns, resulting in an ecosystem regime shift — a large, relatively rapid alteration in the ecosystem at multiple levels.

Dramatic changes in the abundance of herring, shrimp and other species in the 1990s were reversed when saltier conditions returned around 2001.

Breakfast and weight control



MAINTAINING A HEALTHY weight starts with the right breakfast foods that can increase satiety or a sense of fullness, often reducing hunger throughout the morning and at lunchtime, according to two University of Maine food scientists.

Delayed satiety contributes to overeating, which is why it's never a good idea to skip breakfast, according to Professor Mary Ellen Camire and dietetic intern Megan Blackmore, writing in the journal *Food Technology*. The key to selecting good breakfast foods for the greatest satiety involves knowing the effects of food volume, proteins, lipids, carbohydrates and dietary fiber on appetite.

In their review of the literature, Camire and Blackmore explored the options for increasing satiety through breakfast foods. Those most satiating: oatmeal, followed by whole-grain bread, high-bran cereal and eggs. Among the other points highlighted:

Expanding food volume without more calories by whipping foods or adding water can increase the feeling of fullness.

High-protein meals delay stomach emptying and create longer-lasting satiety.

Fat-free breakfast foods may backfire because satiety may be reduced.

An Australian study found a high-bran breakfast reduced hunger and increased fullness and alertness most, compared to meals of croissants, eggs and bacon, and cornflakes.

A green Economy

FROM SOLID WASTE management companies to nontraditional energy start-ups, environmental and energy technology businesses and organizations in Maine generated $574 million in sales, supported 5,269 jobs and provided $222.8 million in employee earnings in 2006, according to a survey by University of Maine School of Economics researchers.

The survey by resource economists Todd Gabe and Caroline Noblet is the first comprehensive report on the economic significance of Maine's environmental and energy technology sector. Based on statistics from government and industry sources, the report outlines a growing sector with nearly 700 Maine business and organizations. More than half employ one or two workers.

Although these businesses can be found throughout Maine, Cumberland and York counties are home to a combined 45 percent of environmental and energy technology industries.

Funded through a cluster enhancement award from the Maine Technology Institute and conducted in cooperation with the Environmental and Energy Technology (E2Tech) Council of Maine, the study provides a definition of the sector and a way to track growth.

Gabe and Noblet also expect to provide data regarding operating conditions for businesses in the sector in Maine.

Too much of a good thing

How does your garden grow?

Hopefully a good summer growing season is yielding a bountiful crop of fresh vegetables. It's about this time of year when the fresh veggie harvest is continuous, bordering on overwhelming. The sustainable agriculture students of the Black Bear Food Guild know all about growing the freshest vegetables for their community-supported agriculture (CSA) shareholders. They also have creative suggestions for coping with copious amounts of produce that come on all at once, including profuse zucchini. As in past years, this season's guild members — Hayley Williams, Britta Jinson and Elonnai Hickok — offer CSA subscribers recipes for using bumper crops of fresh produce. They also have general tips:

Freeze those fresh veggies to enjoy summer produce year-round.

Try out different recipes on family and friends. Ever had zucchini or beet chocolate cake?

Have a creative vegetable cook-off with friends to come up with fun, innovative dishes.

Try juicing your favorite veggies in nutritious, delicious drinks or dry produce to use in soups and other dishes.

Can fresh produce to preserve the taste of summer for home use or gift giving.

insights

Mercury in Acadia

A SEVEN-YEAR STUDY of mercury contamination in Maine's Acadia National Park has documented that fish, amphibians and even tree swallows have high concentrations of the metal in their systems.

In a series of papers published in a special issue of the journal *Environmental Monitoring and Assessment,* researchers from the University of Maine, Plymouth State University, the U.S. Geological Survey, National Park Service and Harvard University demonstrated why concentrations of mercury in the environment are higher in some places than in others.

Ten lead scientists traced mercury as it moved from the sky to the mountains of Acadia, down through the forest canopy, and into streams and lakes, where it built up in zooplankton, insects, fish and fish-eating wildlife.

The researchers found evergreen forests of spruce, fir and pine act as air filters, raking mercury from the air. As a result, the amount of mercury that falls through the forest canopy is much higher than that detected in rain alone. The mercury is washed to the ground with rain, snow, and falling needles and twigs, where it collects in the soil, and eventually moves into streams and lakes.

Walpole and the White Sea

RESEARCHER ALEXANDER TZETLIN, a professor of biology at Moscow State University and director of the White Sea Biological Station (WSBS), visited the University of Maine's Darling Marine Center in Walpole, Maine recently to discuss possible collaborations and to learn more about marine laboratory administration from center director Kevin Eckelbarger.

Located on the Arctic Circle along the shores of the White Sea, WSBS is one of the most remote marine laboratories in the world. Accessible only by boat or snowmobile, the facility is one of five marine stations in Russia. The fauna of the White Sea is very similar to that of the Gulf of Maine.

Tzetlin hopes to increase the international visibility and research use of WSBS, and sees the Darling Center as a model. He spoke at length with Eckelbarger regarding operations, affiliations, funding and marketing. The meeting also helped lay the foundation for possible collaborations between UMaine marine scientists and Moscow State University researchers. Moscow State has the largest marine science program in Russia.

UMaine aquaculture nutritionist Linda Kling with cod raised at the Center for Cooperative Aquaculture Research, Franklin, Maine, in 2004.
Photo by Fred Field

Optimizing Atlantic cod

AN ADVANTAGE OF land-based aquaculture is the ability to manipulate water temperature, an important factor affecting growth, survival and feed efficiency of fish. That's particularly pertinent when raising Atlantic cod and trying to reduce time to market as cost-effectively as possible.

The key is in finding a balance between maximizing feed efficiency achieved at lower temperatures and growth rate in warmer waters, according to University of Maine aquaculture researchers, writing in a recent issue of the journal *Aquaculture.*

UMaine aquaculture nutritionist Linda Kling, and graduate students Adrian Jordaan and Jennifer Muscato Hansen conducted two, four-week growth trials on juvenile Atlantic cod to determine optimal temperature for best growth and feed efficiency. Among their latest findings: Juvenile cod have good growth rates and minimal loss of feed efficiency when raised in water temperatures up to 14 degrees C.

In documenting the relationship between growth, feed efficiency, temperature and survival for juvenile cod, the researchers found fish gained weight best in waters 14 and 16 degrees C, but fed less efficiently than if the water was 10 degrees C. In addition, cannibalism was generally higher in the warmer water.

A pellet twice the size of the 1 millimeter used in the first experiment was fed in the second. A 2-millimeter pellet is considered large for other fish species of this size, but appears to greatly reduce the cannibalism that usually plagues cod hatcheries.

last impression

THE MAINE SEA GRANT College Program at the University of Maine has been rated in the top tier of Sea Grant programs across the country for its contributions to science, technology and society in the state and region.

National Sea Grant evaluates all its university-based programs on a five-year rotating basis. UMaine's program was rated in Category 1, making it among the highest performing of the 32 Sea Grant programs in the country.

"The value of Maine Sea Grant is its ability to reach constituents and have an impact on their lives. This ability benefits from the numerous partnerships that Maine Sea Grant has developed to enhance its reach in serving Maine's citizens," National Sea Grant noted in its final evaluation.

The assessment also cited the value of Maine Sea Grant's collaboration with University of Maine Cooperative Extension, and the program's investment in research that addresses challenging problems.

The high national rating puts the program and its constituents in a position to benefit from future funding increases from such agencies as the National Oceanic and Atmospheric Administration (NOAA), says Paul Anderson, director of Maine Sea Grant.

Established in 1980, the Maine Sea Grant Program takes a leadership role in marine science and education for the sustainable development, management and stewardship of marine and coastal resources.

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Maine spirit

The Maine Spirit Fund was established at the **University of Maine Foundation** in 2007 to provide stable, long-term financial support for student groups at the University of Maine. As the university's goodwill ambassadors, student organizations such as the UMaine cheerleaders and the University Singers bring entertainment and spirit to events. Groups like the team of students who won first place in the national Institute of Food Technologists (IFT) Student Association's 2006 Product Development Competition bring positive attention to the university through state, regional, national and even international events. Income from this fund will support student groups and organizations in such endeavors.

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