12-31-2005

# Maine Economic Improvement Fund Annual Report, FY2005

University of Maine System

**Return on Investment** – $12.7 million of state money matched by $41.9 million in federal and private funds produced $54.6 million for targeted research • **Jobs** – funding 743 jobs • **Success** – new products, new technologies • **Strategic Impact:** $54.6 million invested in MEIF's seven targeted R&D areas

UNIVERSITY OF MAINE SYSTEM

# MAINE'S MOST VALUABLE PUBLIC ASSET

*The catalyst for Maine's future*

Maine's Public Universities
UNIVERSITY OF MAINE SYSTEM

## MAINE ECONOMIC IMPROVEMENT FUND ANNUAL REPORT

*A successful partnership between the University of Maine System, government, and the private sector.*

December 2005

Maine's Public Universities

UNIVERSITY OF MAINE SYSTEM

# STATE FUNDED RESEARCH ANNUAL REPORT

**DECEMBER 2005**

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* The narratives provided demonstrate the breadth and diversity of research conducted at UMaine and USM in FY05. Far from all-inclusive, these stories highlight the significant ways that R&D activity spurs innovation, job creation, and economic development in Maine.

Maine's Public Universities
UNIVERSITY OF MAINE SYSTEM

# STATE-FUNDED RESEARCH ANNUAL REPORT

**December 2005**

In the mid-1990s, a group of University of Maine faculty members began a statewide awareness-raising campaign. Their objective: to promote the idea that university-based research could become a major economic catalyst for Maine.

Working with university leaders and state policymakers, their awareness campaign succeeded. In 1997, in response to public interest in the concept, the Maine Legislature established the Maine Economic Improvement Fund (MEIF) to help increase federal and private investment in university-based research. Shortly thereafter, the Maine voters began a series of investments in university-based research and development.

The investments have paid off. Maine has realized a clear, documented cause-and-effect relationship between university research activity and economic growth. Less than ten years after policymakers initiated MEIF, university-based research has created new jobs, new technologies, new industries, new products—and new tax revenues to support state and local needs.

MEIF represents a vibrant and effective partnership between the state and its University System. That successful partnership produced additional results in 2005.

## How It Works

MEIF was created to focus on seven key areas of strategic importance and potential to Maine:

- **Aquaculture and Marine Sciences**
- **Biotechnology**
- **Composites and Advanced Materials Technologies**
- **Environmental Technologies**
- **Information Technologies**
- **Advanced Technologies for Forestry and Agriculture**
- **Precision Manufacturing**

Under Maine law, the state appropriates MEIF funds directly to the University of Maine System. In turn, the System allocates the funds to the University of Maine (UMaine) and the University of Southern Maine (USM). Those two universities have specific institutional responsibility for basic and applied research in all or some of the seven research areas.

At both universities, MEIF funds are used for similar purposes: to support faculty and staff involved in the research enterprise; to support needed infrastructure; to purchase research equipment; to provide the required matching funds necessary to leverage grants and contracts; and to acquire and maintain the physical space in which research will be conducted.

However, the use of those funds differs according to the role, history and current needs of the two universities.

- **For UMaine,** MEIF funding is intended to help extend and expand the university's well-established, historic role as the State's primary and most diverse research institution. With UMaine's formal responsibility as a research institution dating back to its founding in 1865, it already has a significant amount of infrastructure in place and therefore can use a large portion of its MEIF funds to target specific research and grant opportunities.

- **For USM**, MEIF funding is intended to serve a different, equally important purpose: to help the university build and develop the necessary infrastructure to compete as a graduate-level university for research funding in a narrower range of fields of scientific and economic relevance to the institution and its region. Though its program of externally funded research is much younger than UMaine's, USM has, in recent years, made significant progress in building both its research potential and its ability to attract research grants. For USM, some MEIF funding is used to develop the infrastructure necessary to expand the university's research capacity and promise. Once that infrastructure is in place, USM will be positioned to attract external research grants and contracts.

In addition to the research work supported by MEIF and conducted by UMaine and USM (the University System's two schools with graduate programs), much more is happening at Maine's public universities. Faculty, students and staff at all seven universities of the University of Maine System are actively engaged in an enormous range of scholarly work that contributes to the economy and society. Those works are in a variety of academic disciplines—the arts and humanities; business and law; healthcare and public policy; education and human development; social and behavioral sciences; and physical sciences and engineering. The work of those scholars provides essential and valuable contributions to the educational, creative, investigative and public service roles of Maine's public universities. More important, each of them provides—directly and indirectly—countless educational, cultural, environmental and economic benefits to Maine people and the state's quality of life.

## MEIF and 2005

Through utilization of the state research appropriations, the University of Maine System is contributing dramatically to the state's economic development. During the fiscal year ending June 30, 2005 (FY05), UMaine and USM used MEIF funds to attract $41.9 million in external grants and contracts, primarily from the federal government. Those funds support hundreds of jobs, purchase millions of dollars in goods and services, and lead to the creation of new technologies and industries that will fuel Maine's economy.

**Consider the following highlights from FY05:**

**— SUCCESS:** Using MEIF funds as leverage, UMaine and USM attracted an additional **$41.9 million** in external grants and contracts for research related specifically to the MEIF initiative's seven targeted areas of economic growth and potential.

**— RETURN ON INVESTMENT:** As Maine's designated research institution, UMaine used **$10.4 million** in state funds to generate a total of **$40 million** in federal and private-sector grants and contracts for total funds of $50 million—**a 5-for-1 return** on investment for every MEIF dollar it received. USM, which is building and developing its research capacity, used **$2.3 million** in state funds to leverage another **$1.9 million** in federal and private-sector research grants and contracts related to MEIF.

**— STRATEGIC IMPACT:** Overall, a total of **$54.6 million** ($41.9 million in external grants and contracts, plus $12.7 million of MEIF investment) was invested in university-based research and development in MEIF's seven targeted areas (Table 1).

**— CREATING JOBS: 743** full-time equivalent (FTE) positions were created and/or supported as a result of MEIF funds and external grants and contracts.

**TABLE 1**

| | UM Funds | USM Funds | Total Funds |
|---|---|---|---|
| MEIF Funds | $10,438,369 | $2,253,955 | $12,692,324 |
| Grants & Contracts Generated | 39,998,389 | 1,865,356 | 41,863,745 |
| Total Funds | $50,436,758 | $4,119,311 | $54,556,069 |

# UNIVERSITY OF MAINE *HIGHLIGHTS*

## GRANTS AND CONTRACTS: **The Return on Investment in University-based Research**

Total new dollars available for R&D expenditures were $65 million in FY05. Of that amount, MEIF funds accounted for $50 million. UMaine used $8 million of its $10 million in MEIF funds to leverage $39.9 million in external grants in the seven targeted sectors. The remaining $2 million in MEIF funds were used for building infrastructure capacity.

The increase in R&D infrastructure and activity has enhanced UMaine's capacity to spur industrial growth, as evidenced by a 23.5 percent increase in industry contracts from FY04 to FY05, when the total reached $3.7 million.

UMaine submitted a total of 593 proposals during FY05, involving 353 faculty and professional staff from 61 departments or units as principal investigators or co-investigators. A total of $141.3 million was requested from external sponsors. In addition, UMaine faculty and staff produced more than 2,200 publications in FY05, including papers, books, book chapters and technical reports.

The University of Maine had significant grant and contract activity in all seven of Maine's targeted sectors. UMaine used $8 million in MEIF funds to leverage $39.9 million in external grants in the seven targeted sectors, a leverage of 5 to 1.

**Table 2**
**Maine Targeted Technology Sector**

| | External Grants |
|---|---|
| Adv. Technologies for Forestry & Agriculture | $5,399,744 |
| Aquaculture & Marine Science | 6,763,593 |
| Biotechnologies | 4,591,530 |
| Composites | 4,909,175 |
| Environmental | 8,780,048 |
| Information Technologies | 8,241,199 |
| Precision Manufacturing | 1,313,100 |
| **Total All Sectors** | **$39,998,389** |

## POSITIONS LEVERAGED

- In FY05, 624 job positions at UMaine were created and/or supported as a result of MEIF funds and external grants and contracts. This includes positions directly supported by MEIF funds, and people paid through R&D grants and contracts leveraged from the MEIF funds.

## FACILITIES AND EQUIPMENT

UMAINE continues to expand and develop state-of-the-art research facilities to support the targeted technologies.

- In FY05, construction was completed on the new 51,000-square-foot Engineering and Science Research Building. Scientists and students from the Laboratory for Surface Science and Technology (LASST) and the Department of Electrical and Computer Engineering moved in during fall 2004. The building includes a 3,500 square-foot "Class 1000" clean room for research and development in the areas of nanotechnology, microfabrication, sensors and biotechnology. The Maine Technology Institute recognized the importance of the facility by granting a Cluster Enhancement Award of $497,200 to equip the clean room specifically to nurture Maine's nanotechnology companies.

- The Advanced Manufacturing Center was completed in fall 2004 with a grand opening in spring 2005. The 30,000-square-foot facility dedicates 20,000 square feet to machining and materials testing.

- The Advanced Engineered Wood Composites Center completed Phase II of its lab/office expansion funded by the June 2003 Jobs for Economic Growth Bond. The 7,500-square-foot addition increases the world-class lab's size to 48,000 square feet, and will help the center prepare for the $6.2 million in Army funding awarded in the end of FY05 for development of an Army Center of Excellence in Composite Structures. This project focuses on ballistic-resistant structural components, and includes work with Maine companies such as TexTech Industries in Monmouth and Applied Thermal Sciences in Orono and Sanford.

- At the Center for Cooperative Aquaculture in Franklin, construction was completed on a new 24,000-square-foot marine finfish hatchery building. This building was primarily funded by the Economic Development Administration and Maine incubator funding. In addition, construction was completed on some of the initial

infrastructure at the USDA Agriculture Research Service (ARS) aquaculture center. The ARS facilities are also located at Franklin. The center includes nearly $3 million in shared infrastructure, including a new state-of-the-art seawater pumping, filtering and sterilization building; new seawater and freshwater reservoirs; and complete back-up power generation.

- Design work was completed and a groundbreaking ceremony took place on the Student Innovation Center, a more than 5,000-square-foot building on campus that will support the creation of innovative businesses by students involved in R&D and the creative economy. In addition, credit and noncredit courses are being developed to encourage entrepreneurship and increase opportunities for graduates to use their education in Maine. Several of the companies started at the Target Technology Incubator have been created by graduate students commercializing their research.

- More than $3.5 million in new equipment was procured to support UMaine R&D activity. Major purchases (greater than $50,000) through various FY05 grants included 37 pieces of scientific equipment. This equipment outfits labs throughout the university.

UMaine graduate student Leigh Stearn uses "flubber" to teach school children how to study glacier movement.

## INCREASED STUDENT INVOLVEMENT IN RESEARCH

Graduate and undergraduate students continue to play a major role in research at UMaine. Nearly $4 million from grants and contracts was used to support students in all technology sectors. Graduate students receive stipends and tuition, while undergraduates are paid hourly to work in labs and on projects.

Two National Science Foundation GK-12 programs support graduate science and engineering students who go into K-12 classrooms and work with students and teachers to better understand their research and science. Students also worked with blueberry farmers and food science researchers who were looking at the health benefits of blueberries, while others worked with sensor researchers on the development of new sensors.

## TECHNOLOGY TRANSFER AND COMMERCIALIZATION

UMAINE continues its vibrant technology transfer and commercialization program. The university's total patent portfolio now contains more than 50 patents, patent applications and international patents.

In FY05, UMaine filed nine new patent applications. Three new U.S. Patents were issued and were published by the U.S. Patent and Trademark Office:

1. U.S. 6,782,342 "Spectroscopy instrument using broadband modulation and statistical estimation techniques to account for component artifacts" **Information Technologies**

2. U.S. 6,781,120 "Fabrication of chopper for particle beam instrument" **Precision Manufacturing**

3. U.S. 6,808,788 "Method for strengthening wood products and modified unsaturated polyester resins therefore" **Composites and Advanced Materials Technologies**

Three new licenses were executed to Tate & Lyle of Decatur (IL), Cerealus of Waterville and Intelligent Spatial Technologies of Orono.

UMaine helped start or spin-off two new companies: Maine Specialty Materials, LLC, which received Maine Technology Institute start-up funding, and Maine Secure Composites, LLC, which was started on a $1 million Department of Homeland Security grant. Both companies are affiliated with the Target Technology Incubator.

UMaine's Target Technology Incubator, one of seven such incubators among the statewide Advanced Technology Development Centers, provides both physical space and business counseling services to technology companies. Even though the center had only been open for three years at the end of FY05, it had already graduated one company that is located in East Blue Hill, Maine. Three other spin-off companies from UMaine—Stillwater Scientific, Intelligent Spatial Technologies and Milcord, ME—were tenants during FY05. Student start-ups Knife-Edge Productions and Version Zero continue to reside at Target; legal software developer Finasys moved to Target from Massachusetts.

The incubator also works with UMaine students interested in starting businesses. In FY05, nine student companies received support from the incubator in the form of business counseling services, access to experts and resources and, in some cases, space in the incubator to operate their businesses. In addition to these nine companies, many more students attended Lunch

# UNIVERSITY OF MAINE *HIGHLIGHTS*

Nathan Hankla and Sheridan Kelley started Knife Edge Productions, one of six student-led businesses UMaine helped start or spin off in the past two years.

and Learn seminars held at the Target Technology Incubator and met with Target staff to discuss their business ideas.

UMaine interns, working at the Target Incubator, formed UMaine's first Student Entrepreneurship Club in FY05. This club will offer further opportunities for students interested in exploring entrepreneurship.

Target also has an affiliate program that serves companies that want to take advantage of the programs and services of the incubator, but do not need physical space. There were 12 affiliate companies in FY05. In addition, more than 200 other individuals received referrals or counseling from the incubator.

More than 200 people from all parts of the state have participated in the program's award-winning Lunch and Learn series of seminars. The seminars cover topics such as patent basics, market research, commercialization, business development and human resource issues.

The Target Technology Center also hosts a patent attorney from the Maine Patent Program, part of the University of Maine School of Law. Students, faculty and area companies can receive assistance without traveling to Portland. The Patent Program also held five inventors' forums in FY05.

UMaine also partners with the Maine Aquaculture Innovation Center to manage an aquaculture incubator, another of the Advanced Technology Development Centers. The incubator has locations in Franklin, at the Center for Cooperative Aquaculture Research (CCAR) and in Walpole, at the Darling Marine Center. The CCAR incubator has two tenants: Seabait of Maine, LLC and Maine Halibut Farms. The Darling Center incubator has one tenant: Microtechnologies. All of these companies are moving toward full-scale commercialization and have received Maine Technology Institute grants to further their development.

The Composites Technology Center is also managed by a partnership that includes the Sanford Industrial Development Corporation, the Town of Greenville, Eastern Maine Development Corporation and the University of Maine. The Target Technology Incubator provides management assistance, while the Advanced Engineered Wood Composites Center provides sources of new technology and technical assistance. The facility in Sanford is fully occupied and a new building in Greenville, which opened in March 2005, is now 60 percent occupied.

The University of Maine led a team of organizations, including the Applied Technology Development Centers, Maine Manufacturing Extension Partnership, Maine Technology Institute, Maine Patent Program, Maine Procurement Technical Assistance Center and the University of Southern Maine, to host MaineTech 2005. MaineTech is a showcase of the state's companies that are commercializing new technologies. The show featured more than 100 exhibitors and included workshops on obtaining Small Business Innovation Research (SBIR) and Maine Technology Institute grants. A highlight of this year's show was the elevator pitch contest in which companies had 10 minutes to present their company and their plans for growth to a panel of seasoned investors and entrepreneurs. Seabait of Maine, LLC was the winner of the contest.

UMaine worked with Gov. Baldacci's office, Maine's Congressional delegation, the U.S. Navy, the U.S. Fish & Wildlife Service, and Acadia Capital Corporation to move toward the transfer of the former Corea Naval Base to the University of Maine System. The UMS Board of Trustees has approved the transfer of the property, which was immediately transferred to Acadia Capital Corporation, an economic development corporation, with the intent to create an aquaculture and marine business park.

UMaine works with several economic development organizations and municipalities to package real estate, programs and services necessary to support incubator graduate companies and spin-off companies that do not need incubator space. Specific projects are in the planning stages with the Bangor Regional Development Alliance, the Coastal Acadia Development Corporation, the Piscataquis Economic Development Corporation, the Millinocket Area Growth and Investment Council, the Town of Franklin, the City of Brewer, the Town of Greenville, and the City of Bangor. These projects also support business development, attraction and recruitment.

# THE UNIVERSITY OF MAINE FY05 HIGHLIGHTS

UMaine R&D activity marked record-setting milestones in FY05:

- Total R&D expenditures reached $65 million. Of that amount, MEIF funds accounted for $50 million. A large portion of the $10.4 million from the State of Maine was leveraged to bring in an additional $39.9 million in external grants.
- 593 proposals were submitted involving 353 researchers and 61 departments, with $141.3 million requested from external sponsors.
- More than 2,200 publications were produced by faculty and staff.
- UMaine leveraged $39.9 million in external grants and contracts, specifically for the seven technology sectors.
- 624 job positions were created and/or supported through MEIF funds and external grants and contracts.
- Nearly $4 million from grants and contracts was used to support students' tuition and salaries to work in all technology sectors.
- Construction was completed on several state-of-the-art research facilities.
- Over $3.5 million in major equipment was secured to outfit labs throughout the university.
- Nine new patent applications were filed, and three new U.S. Patents were issued.
- UMaine helped start or spin-off two new companies based on UMaine-developed technologies.
- The Target Technology Incubator housed six tenants, supported 12 affiliate companies, and provided referrals or counseling to more than 200 walk-in companies and individuals.
- UMaine-affiliated aquaculture incubators in Franklin and Walpole supported three tenants moving toward full-scale commercialization.

# UNIVERSITY OF SOUTHERN MAINE *HIGHLIGHTS*

## GRANTS AND CONTRACTS: **The Return on Investment in University-based Research**

THE UNIVERSITY OF SOUTHERN MAINE, which is building and developing its research capacity, used $2.3 million in state funds to leverage another $1.9 million in federal and private-sector research grants and contracts related to MEIF.

With MEIF support, University of Southern Maine continues to make significant progress in its efforts to build and develop the necessary infrastructure to compete for research funding in fields of scientific and economic relevance to the institution and its region, demonstrating steady growth in grant activity during FY05. While the number of proposals during FY05 remained consistent with FY04 figures, combined total funding dollars requested in FY05 (by more than 150 USM faculty and staff members) increased dramatically, from $77.6 million in FY04 to $85.4 million in FY05. This sizeable increase places FY05 among USM's highest proposal dollar value years, ranking second only to a record $113.7 million in FY03.

Throughout FY05, USM's R&D efforts have remained focused on building the necessary infrastructure needed to compete for research funding through investments in faculty, staff, students, equipment and facilities. This commitment to R&D has allowed programs like USM's Bioscience Research Institute of Southern Maine (BRISM) to increase activity levels ($8.6 million in proposals submitted this past year). Overall, R&D proposal activity increased dramatically in FY05 to $23.3 million, up from $15.7 million in FY04.

However, the story of USM's continued grant activity success cannot always be told with numbers and dollars alone. Faculty and staff efforts continue to support increasing levels of research, public service and scholarly activity that have an impact both on life in Maine and the future of our students and our state.

## POSITIONS LEVERAGED

In FY05, 118 job positions at USM were created and/or supported because of MEIF funds. This includes 27 positions (faculty, staff and students) directly supported by MEIF funds, and an additional 91 positions paid in part or whole through R&D grants and contracts leveraged from MEIF funds.

The growth of bioscience research at USM also has resulted in the creation of two new positions. In 2005, a third senior postdoctoral student joined the staff of the Maine Center for Toxicology and Environmental Health (MCTEH). As part of its biosciences initiative, USM also added support for one doctoral student, bringing the number of Ph.D. students at USM from five to six.

Visitors to the new USM Aquatic Systems Offices at the Gulf of Maine Aquarium in Portland.

## FACILITIES & EQUIPMENT

USM continues to expand and develop state-of-the-art research facilities to support the targeted technologies.

- In December 2004, USM's School of Applied Science, Engineering, and Technology (ASET) opened the doors to its new Advanced Technology Wing of the John Mitchell Center, on USM's Gorham campus. The $8 million, 23,000-square-foot expansion and renovations to the existing center was funded through $4 million in state monies, $2 million in federal funds, and $2 million contributed from local industry. The USM expansion gives students and Maine businesses greater access to the educational resources, technology and services they need to grow the manufacturing and advanced technology industries in our region. The newly upgraded facility now houses new laboratories for industrial control and robotics, digital arts and technology, mechanical engineering, environmental safety and health instruction, and more classrooms to accommodate increasing numbers of students, including those who are taking advantage of transfer agreements with the Maine Community College System. The expanded facility also provides new laboratory space for computer engineering, and electromechanical technology; expanded laboratory space for digital arts and technology; equipment and instrumentation to support

engineering and technology labs; classrooms and seminar rooms; and environmental and safety upgrades. USM's materials and products testing capabilities have expanded because of the renovations, and with the help of a new 10,000-pound bridge crane suspended over a 70,000-pound testing platform. The added space also allows USM's technology- and engineering-related departments to double enrollments from about 50 graduates to 100 graduates in five years. This is particularly important for ASET's continuing efforts to help address the region's growing demand for skilled professionals and services for the advanced technology sector.

- In FY05, USM completed a three-floor 27,000-square-foot addition to the Biosciences Research Wing of its Science Building, located on USM's Portland campus. Funded through the state's R&D initiative, the facility expansion enables USM researchers to attract external grants and generate the teaching and research initiatives necessary to improve the regional economy through expanded biomedical research resources. The Bioscience Research Wing first opened in June 2003 and included development of basement facilities, as well as two additional floors. The expansion provided much needed space to house laboratory suites, equipment rooms, an animal facility and a technology infrastructure that included data back-up and storage systems, as well as wireless networking. The three newly added upper floors, completed in FY05, will house additional laboratories and bioscience research facilities over time.

- In May 2005, USM's Aquatic Systems Group completed the relocation of its laboratories and offices into the newly constructed Gulf of Maine Research Institute (GMRI) facility. USM is leasing research and laboratory space at GMRI's newly constructed home on Portland's waterfront, occupying approximately 6,000 square feet on the first and third floors in four labs (including two wet labs), wet storage for sea-going equipment, offices, shared computer labs, and common areas for students and visitors. USM is one of several marine research institutions housed in the GMRI facility. This partnership with GMRI and its partnering organizations is expected to greatly enhance USM's ability to leverage new opportunities for collaboration with marine scientists and interdisciplinary researchers from other institutions and organizations, as well as members of the fishing community. The group supports three graduate students and several part-time undergraduate students, each of whom benefitted from gaining time at sea or other field work and experience in a working marine lab.

- Major equipment purchases (greater than $50,000) in FY05 included the purchase of an automated high-throughput comet assay analysis system. This equipment serves USM toxicologists in their studies of DNA damage from chromium, as well as analysis of marine mammal tissues.

Undergraduate student participation in research is on the rise at USM. "Thinking Matters," a two-day celebration of student achievement, showcased more than 170 presentations of original research and student-faculty collaborations.

## INCREASED STUDENT INVOLVEMENT IN RESEARCH

Undergraduate research at USM continues its rapid expansion and increased visibility. The number of students participating as presenters or coauthors in the annual student research conference *Thinking Matters* nearly doubled from 135 in 2004 to 266 in 2005. During the April two-day event, students presented 171 projects in poster and oral sessions, highlighting original research conducted by student-faculty teams.

Funding for faculty research projects from state MEIF appropriations, as well as from the National Science Foundation, NASA and the National Institutes of Health (NIH), provides invaluable opportunities for USM students to learn scientific skills and interact with researchers from other institutions across the United States. For example, during summer 2005, two USM biology students sailed onboard the research vessel R/V Savannah of Skidaway Institute of Oceanography (Georgia), collecting water samples for phytoplankton analysis. Additionally, three USM students spent their summer at NASA field centers learning new research techniques in atmospheric and space sciences. Also, during the summer months, USM supported eight undergraduate research fellows (SURFs) to conduct independent projects with faculty mentors. With the establishment of an Undergraduate Research Committee planned for 2005-06, USM is moving toward institutionalization of undergraduate research, which plays a critical role in the integration of the university's research and teaching missions.

In June 2005, USM's School of Applied Science, Engineering, and Technology (ASET) hosted its first ASET Camp for 15

seventh and eighth graders in the newly renovated John Mitchell Center and Advanced Technology Wing on the Gorham campus. Taught by USM professors from ASET and teachers from local area high schools, this resident camp provided the young participants opportunities for exploration in the areas of science, engineering and technology through hands-on experience in the areas of environmental science, design/CAD, engineering and automation/robotics.

## TECHNOLOGY TRANSFER AND COMMERCIALIZATION

The Center for Law & Innovation at USM offers the only statewide resource for education, research, and service on intellectual property for the public and private R&D community. It is also rapidly becoming a centralized resource for technology transfer counseling and legal services for the state's universities and nonprofit laboratories. Founded in 1999, the center, which is part of the University of Maine School of Law, offers courses, public seminars and other educational outreach activities to teach Maine's academic and business communities about the role of intellectual property in economic growth. Through the Maine Patent Program, the center provides patent, trademark and copyright counseling services to Maine's entrepreneurs, small businesses, research scientists and independent inventors.

With offices in Portland and Orono, the center employs two full-time attorneys with expertise in intellectual property law and technology transfer, one part-time patent attorney, a part-time patent agent, a full-time administrative manager and two part-time administrative assistants. The center recently received a grant to hire a life sciences technology transfer expert to serve the state's university and nonprofit research communities during FY06. Additionally, the center and program work with up to three law students at any given time and offer internship opportunities for students in other departments within the University System. By fall 2006, the Law School will host an official transactional clinic to supplement and enhance the program's innovation law services.

In FY05, the center hosted and participated in several conferences on intellectual property law, science and innovation. The program also offered several workshops around the state on the basics of patents, trademarks and product commercialization; delivered over 130 videotaped presentations of the program's basic patent seminar; and hosted the Maine Inventors Forum in both Portland and Orono (120 attendees). In all, the center served 1,360 individuals through educational outreach on intellectual property in FY05, and the Maine Patent Program continues to grow in popularity as Maine inventors and entrepreneurs increasingly seek our services. March 2005 was a record-setting month, with 28 new applications for intellectual property counseling. While patent matters are by far the most common, more clients are seeking trademark, copyright and licensing counseling as well.

| **Programs in FY04** | **Approx. # of Attendees** |
|---|---|
| Patent Basics Seminars | 160 |
| Special Workshops | 330 |
| Maine Inventors Forum | 120 |
| Conferences & Forums | 620 |
| Number of videotapes mailed | 130 |

In FY05, the Maine Patent Program provided patent, trademark, copyright or licensing counseling to approximately 160 clients, an increase of nearly 20 percent over the previous fiscal year (135 clients served in FY04). Through FY05, 513 Maine clients have been served since the Maine Patent Program's inception.

| | |
|---|---|
| Clients served in FY04: | 135 |
| Clients served in FY05: | 159 |
| **Total Maine clients served from program's inception until June 30, 2005:** | **513** |

The center has the capacity to serve the state's growing demand for increased technology transfer services in the biomedical, medical devices and marine technology sectors.

- In April 2005, the center received a cluster enhancement award from the Maine Technology Institute for the Bio-Technology Transfer Capacity Project. With this award, the center also hosted the first Knowledge Transfer Workshop in June 2005, inviting research scientists and high-level administrators to a three-day event at the Schoodic Research and Education Center to learn about technology transfer in Maine. The MTI Cluster Enhancement Award underwrote the event. Among the participants were Bigelow Laboratory, Foundation for Blood Research, Gulf of Maine Research Institute, Jackson Laboratory, Maine Medical Center Research Institute, Mt. Desert Island Biological Laboratory, University of Maine, University of New England and University of Southern Maine.

- The center brought on board life sciences technology transfer consultant Todd Keiller to work closely with the state's universities and nonprofit laboratories in the coming year. In July 2005, Keiller began a yearlong collaboration with the center, working with intellectual property lawyers from the center to assist participating organizations with technology transfer education and with developing a process for innovation disclosure, patenting and licensing, as well as compliance with federal regulations. Over the course of the year, the team is evaluating the extent to which these organizations need and want ongoing technology transfer support, and will develop a business plan to meet that need.

- Building on this momentum, the center has hired Leonard Agneta as its new Maine Patent Program director. Agneta, a medical technologist and patent attorney by training, is the former chief of intellectual property and technology transfer for the University of Nebraska Medical Center.

## THE UNIVERSITY OF SOUTHERN MAINE FY05 HIGHLIGHTS

USM R&D activity marked significant milestones in FY05:

- USM generated $41.4 million in external funding.
- Total grant and contract expenditures at USM reached $42.3 million in FY05.
- 274 proposals were submitted, with more than $85.4 million requested from external sponsors.
- $2.3 million in MEIF funds were leveraged to bring in an additional $1.9 million in external grants.
- 118 job positions were created and/or supported through MEIF funds and external grants and contracts.
- Through FY05, 513 Maine entrepreneurs have been served by the Maine Patent Program, which provides patent, trademark, copyright and licensing counseling.
- In FY05, USM completed a three-floor, 27,000-square-foot addition to the Bioscience Research Wing on the Portland campus.
- In summer 2005, USM's Maine Center for Toxicology and Environmental Health held the nation's first conference to explore research on chromium and its effects on humans. Maine suffers a high frequency of lung cancer, in many cases caused by high levels of chromium in the air.
- USM expanded its biomedical research seminars in FY05 to include sessions on topics ranging from arsenic in groundwater to childhood asthma. These sessions linked USM scientists with researchers from the Maine Medical Center Research Institute, the Maine Bureau of Health, the University of Maine, Yale University School of Medicine, Cornell University and the National Institutes of Health.

# AQUACULTURE AND MARINE SCIENCES

## Phytoplankton Monitoring Program

Some of the smallest organisms in the sea are true giant killers. Take tiny phytoplankton—microscopic algae with bizarre but beautiful shapes. While most varieties are harmless and indispensable to healthy marine life, some can generate toxins deadly enough to kill whales.

In the Northeast and elsewhere, these insidious invaders also have contaminated shellfish and sickened people, leading government agencies and citizen volunteers to maintain vigilance.

When such toxic species do show up in Maine, a network of more than 60 volunteers monitor their activity as part of the Maine Phytoplankton Monitoring Program coordinated by The University of Maine Cooperative Extension. Motivated by their curiosity and love of the sea, citizen teams monitor coastal waters spring, summer and fall, and thus serve as an early warning system for the coast.

Volunteers monitor coastal waters at about 40 locations along the Maine coast. In addition to Extension, supporting organizations include Maine Sea Grant, the Bigelow Laboratory for Ocean Sciences and the Maine Department of Marine Resources.

## Harvesting Irish Moss

The decline of the sea urchin population along the Maine coast has led to the increased abundance of a dark purple, edible seaweed known as Irish moss, or Chondrus crispus.

With a $10,000 Maine Technology Institute seed grant, FMC BioPolymer in Rockland is working with University of Maine scientists to determine just how much Irish moss has expanded and how it can be sustainably harvested. The research may lead to new harvesting methods and new jobs.

## Decreasing Diversity

For most of the past 4,500 years, cod was king in the Gulf of Maine's coastal waters. Today, the groundfish have given way to the Jonah crab, with potential long-term consequences for coastal fisheries, according to a recent University of Maine research report published in the journal *Ecosystems.*

The authors of the report, Robert Steneck, professor of marine sciences at UMaine's Darling Marine Center, and former UMaine graduate students John Vavrinec and Amanda Leland, analyzed fishing records and previous studies to gather evidence for the changes brought on by fishing pressure in marine ecosystems.

For example, ancient coastal middens have revealed evidence suggesting that Native American fishing activities were beginning to affect near-shore ecosystems several thousand years ago. Analysis of colonial and modern fish landing records shows that such changes accelerated with the adoption of new fishing technologies.

It is an overturning of the established order brought on by fishing pressure that leads to major changes in the coastal marine ecosystem, according to the article, "Accelerating Trophic-level Dysfunction in Kelp Forest Ecosystems of the Western North Atlantic." In the Gulf of Maine, the revolution was brought on by the drastic reduction in the number of cod and other top predators in the past century.

## Sustaining the Shellfish Industry

After more than a century of harvesting, commercial shellfish production has rapidly expanded within the food sector, making it one of the fastest growing industries in global aquaculture. The need to address health issues affecting oysters and mussels has proven to be a priority in sustaining the shellfish production industry and trade within Maine. Previous research has mainly focused on the diagnostics and causation of such diseases, while the need to apply research toward the commercial realm is now being stressed. An array of factors has contributed to the increased mortality rates of shellfish used for aquacultural purposes.

Scott Haskell, UMaine Extension veterinarian, leads research that will address shellfish health management for both farmed and wild populations, the development of a shellfish health program that deals with recognition and management, practical diagnostic techniques, and up-to-date information for existing and emerging diseases. We will increase the understanding of the effects of shellfish aquaculture on the environment and how environmental conditions can affect the growth, distribution and survival of shellfish.

## Hatchery-raised Cod Placed in Aquaculture Pens

UMAINE researchers are working with regional scientists to investigate the potential of other species of fish as a viable alternative to Atlantic salmon for Maine aquaculture.

In Eastport, scientists monitor live footage captured by an underwater camera that watches thousands of Atlantic cod (Gadus morhua) from the bottom of a 50-foot-wide circular pen. These hatchery-raised cod are among the first to be

placed in aquaculture pens, following in the wake of similar efforts in New Brunswick and New Hampshire. They are the progeny of wild fish caught a few miles away in 2000. Those wild fish are the broodstock of an emerging cod aquaculture industry.

University of Maine scientists are working with the aquaculture industry to determine the feasibility of raising cod from egg to market in Maine. UMaine researchers working on this project include Nick Brown, manager of UMaine's Center for Cooperative Aquaculture Research in Franklin, Maine; UMaine food scientist Denise Skonberg; marine bioresources graduate student Bill Palmer and animal nutritionist Linda Kling, along with Austin Dinsmore, manager for International Aqua Food USA's Eastport operations.

Supported by a $358,000 federal Department of Commerce grant, the cod-rearing project is one of many research efforts around the world aimed at developing alternative species for fish farms. Spurred on by declining wild fish stocks, aquaculture is already meeting a significant share of the nation's seafood demand.

The Center for Cooperative Aquaculture Research (CCAR) in Franklin, Maine, is a commercial-scale facility with both seawater and freshwater aquaculture systems. Some of the objectives of CCAR are to develop integrated aquaculture techniques, to serve as a business incubator, to produce finfish juveniles for commercial grow-out, to develop sustainable aquaculture techniques, and to train staff and students in aquaculture techniques. The center houses a salmonid egg incubation facility, pilot-scale recirculation systems for marine finfish, a marine finfish nursery, a marine broodstock facility and several large grow-out systems. The systems currently hold halibut, cod, seaworms, sea urchins and the red alga porphyra.

# ENVIRONMENTAL TECHNOLOGIES

Aaron Putnam of Chapman, Maine, spent two months as part of a four-person expedition studying the stability of the West Antarctic Ice Sheet. With the master's student on the expedition, supported by a National Science Foundation grant, were Robert Ackert and Sujoy Mukhopadhyay of Harvard University, and mountaineer Peter Braddock.

## Solar Power

A team led by University of Maine scientists has reported finding a potential link between changes in solar activity and the Earth's climate.

In a paper for the *Annals of Glaciology,* Paul Mayewski, director of UMaine's Climate Change Institute, and 11 colleagues from China, Australia and Maine describe evidence from ice cores pointing to an association between the waxing and waning of zonal wind strength around Antarctica and a chemical signal of changes in the sun's output.

The researchers' goal is to understand what drives the Earth's climate system without taking increases in greenhouse gases into account. Understanding how the system operates in the absence of human impacts is important for responding to climate changes that might occur in the future.

The ice core data show, the authors write, that when solar radiation increases, more calcium is deposited. The additional calcium may reflect an increase in wind strength in mid-latitude regions around Antarctica, especially over the Indian and Pacific Oceans. Calcium in West Antarctic ice cores is thought to derive mainly from dust in Australia, Africa and South America, and from sea salt in the southern ocean.

That finding, they note, is consistent with other research suggesting that the sun may affect the strength of those mid-latitude winds through changes in stratospheric ozone over Antarctica.

## Recycling Lobster Traplines

UNIVERSITY OF MAINE engineers will work with Saltwater Marketing, LLC, an affiliate of the Lobster Institute at UMaine, to develop recycling options for used lobster traplines. The project comes at a time when Maine lobstermen are considering replacing the commonly used ground lines that string traps together in an effort to protect endangered right whales.

The lines are designed to float and thus reduce the chances of snagging on rocks and other obstacles on the sea floor. However, as they hover over the ocean bottom, such lines can present a threat to right whales. Lobstermen are now looking at the possibility of using heavier rope that stays on the sea floor and, therefore, has a lower chance of entangling the whales.

The National Marine Fisheries Service estimates that 5 million pounds of float rope is currently used in Maine as ground line in the lobster industry.

Saltwater Marketing received a $20,000 grant from the National Fish and Wildlife Foundation's National Whale Conservation Fund to support its Lobster Ground Line Buyback and Recycling (ME) Project. The Lobster Institute, UMaine's Advanced Engineered Wood Composites Center (AEWC) and the National Marine Fisheries Service, Protected Resource Division, will assist.

Saltwater Marketing has contracted with AEWC to develop processing techniques for reusing the rope. Researchers will explore techniques to clean and process the rope into a usable form, and will determine the workability of the material in conventional plastic processing equipment.

## Sampling 143 lakes

UNIVERSITY OF MAINE ecology and environmental sciences graduate student Catherine Rosfjord, a scientist in the Senator George J. Mitchell Center for Environmental and Watershed Research, visited 143 lakes in seven northeastern states last summer as part of her study of long-term water quality trends. The lakes were sampled by the U.S. Environmental Protection Agency in 1984 as part of the Eastern Lake Survey (ELS). With funding from the Northeastern States Research Cooperative, Rosfjord's resampling will allow scientists to assess changes in water quality in the last 20 years.

In less than eight weeks, Rosfjord and crew sampled 143 lakes in Maine, New Hampshire, Massachusetts, Rhode Island, Vermont, New York and Pennsylvania.

Data collected will help Rosfjord and other scientists detect changes in water quality. Since the first ELS in 1984, the Clean Air Act was amended to reduce emissions of sulfate, a precursor to acid rain. By measuring water chemistry, scientists can gauge the effectiveness of Clean Air policies.

As part of her study of long-term water quality trends, UMaine ecology and environmental sciences graduate student Catherine Rosfjord spent almost eight weeks sampling 143 lakes in seven northeastern states. With the help of students and staff of the Senator George J. Mitchell Center for Environmental and Watershed Research, Rosfjord, a Mitchell Center scientist, accomplished what it took dozens of EPA employees with a helicopter to do 20 years ago.

### EPA Fellowships

**Two University of Maine graduate students—one researching a new method for analyzing mercury in sediments, another studying the cultivation and use of the seaweed Porphyra—have received fellowships from the U.S. Environmental Protection Agency to support their research.**

**Karen Merritt, a Ph.D. candidate in civil and environmental engineering, will receive $105,000 over three years; Nicolas Blouin, a master's candidate in marine biology, receives $70,000 over two years.**

**Merritt works with engineer Aria Amirbahman on a mercury analysis system using a thin membrane made of chitosan, a material that comes from lobster and crab shells. Merritt's goals are to determine the best way to adsorb or hold mercury-bearing compounds. If successful for mercury detection, the chitosan system could improve the accuracy of mercury monitoring.**

**Blouin is working with marine biologist Susan Brawley to understand the reproductive mechanisms and potential uses of the common seaweed porphyra, also known as nori and laver. At Schoodic Point, Blouin collects porphyra samples and studies its distribution and abundance. At UMaine's Center for Cooperative Aquaculture Research in Franklin, Blouin is studying techniques for growing porphyra in tanks, as well as its potential to grow alongside finfish aquaculture pens. The commercial aspects of his works are also funded by the Maine Technology Institute and Maine Sea Grant for commercial demonstration trials.**

# INFORMATION TECHNOLOGIES

Stillwater Scientific Instruments is a spin-off business that combines advanced signal processing software with time-of-flight techniques that bring several benefits to mass spectrometers and electron energy analyzers. The technology was developed and patented at UMaine with the help of National Science Foundation funding. As a start-up, Stillwater Scientific Instruments was headquartered at Target Technology Center. It was the first company funded by the Maine Technology Institute's accelerated growth fund. Working with some of the world's largest instrument manufacturers, the company is developing simpler, smaller, more efficient mass spectrometers, and is now producing its first products for sale.

## UMaine Spectrometer to be Distributed Worldwide

Stillwater Scientific Instruments, Inc., a University of Maine spin-out company and the developer and manufacturer of advanced analytical instrumentation, and LK Technologies, a scientific instrument manufacturer, announced that the two companies recently entered into a six-year, multimillion-dollar exclusive distribution agreement. LK Technologies will resell Stillwater's Time-Of-Flight High-Resolution Electron Energy Loss Spectrometer (TOF-HREELS) into the worldwide scientific instruments market. Stillwater manufactures its devices in Orono.

Stillwater's first product, the TOF-HREELS v1.0, is an electron energy measurement instrument that measures the speed, or energy, of individual electrons at high resolution with dramatic improvements in efficiency. The University of Maine and Stillwater developed a new statistical analysis method for time of flight (TOF) spectrometry, in which multiple pulses of electrons are admitted to the flight tube in a pseudo-random sequence. Scientists and researchers can use the TOF-HREELS Instrument to make extremely sensitive, high-resolution, high-throughput measurements.

The University of Maine holds two U.S. patents issued in August 2004 on the technology.

## New Satellite Groundstation

With the installation of a new satellite tracking groundstation, UMaine becomes a source of data on the oceans, forests and other natural resources for New England. A crew from the Cote Crane Company of Auburn lifted the 800-pound dome containing the 2.4-meter receiving dish onto the roof of UMaine's Aubert Hall in May 2005.

Funded by a $330,000 National Science Foundation grant, the new facility will enable researchers to download information from new NASA satellites that deliver higher spatial and spectral resolution, and a correspondingly larger data volume, according to Professor of Oceanography Andrew Thomas. UMaine is home to a NASA Center of Excellence in Remote Sensing, comprised of researchers in the School of Marine Sciences, Department of Electrical and Computer Engineering, Department of Spatial Information Science and Engineering, and the Department of Forest Management.

In the Northeast, the closest existing groundstation for receiving the data is at Rutgers University in New Jersey.

## BIOTECHNOLOGIES

***THE UNIVERSITY OF MAINE***

### Advanced Microscope Arriving Soon

Imagine having a microscope so powerful, it can reveal the three-dimensional nanostructure of genetic material within a cell. Now scientists in Maine have such an instrument—the 4Pi Confocal Laser Scanning Microscope.

The most advanced optical microscope in the world is the first such instrument in the United States. It was made possible by a $732,624 National Science Foundation grant to a Maine interdisciplinary biophysical research program, the Institute for Molecular Biophysics (IMB).

The institute brings together expertise in biophysics and engineering at the University of Maine; molecular and cell biology at Maine Medical Center Research Institute, Scarborough; and genetics and genomics at Jackson Laboratory, Bar Harbor. IMB's goal: to explore the structure and function of genes and chromosomes in cells to understand precisely how genes control both normal development and disease.

Installed at Jackson Lab, the 4Pi microscope will enable researchers to examine specific structures in a cell—such as a single gene on a chromosome—at a resolution four to seven times greater than previously possible.

As IMB co-director Barbara Knowles of Jackson Lab and UMaine describes it, astronomers have space telescopes to understand the universe, and physicists have giant particle accelerators to isolate elements of energy and matter. Now geneticists and biologists have an advanced tool to examine the very structure of mouse, human and other genomes.

### New Functional Genomics Ph. D. Program

In Maine, three research institutions—UMaine, the Maine Medical Center Research Institute and Jackson Laboratory—have combined efforts to offer a new Functional Genomics Ph.D. Program. The National Science Foundation jump-started the program with a $2.6 million IGERT (Integrative Graduate Education and Research Traineeship) grant.

As an example of a functional genomics project at UMaine, scientists are studying gene function in a variety of organisms, including zebrafish, fruit flies, microorganisms and plants. They have confirmed that zebrafish have a gene for producing interferon, a critical part of the animal immune system. They also have identified genes that affect heart rate, muscle function and biochemical processes in microbes.

The new program will offer many new research opportunities in Maine.

### Sensing Pathogens

A new microwave acoustics patent may lead to a sensor for detecting pathogens in liquids. The patent focuses on crystal orientations that enhance sensor sensitivity in a liquid environment.

A biosensor that detects the presence of proteins and other biomolecules such as DNA could have applications in medicine and public safety, says Mauricio Pereira da Cunha, UMaine assistant professor of electrical and computer engineering. Pereira da Cunha and Paul Millard, assistant professor of chemical engineering, lead research teams working together on biosensors. Key to the new sensor technology is the langasite family of crystals that are more sensitive in liquids and are more stable at high temperatures than other sensing platforms, like quartz crystals.

**New Facility:**

**Throughout history, new imaging capabilities—from the first 17th-century light microscopes to the latest MRIs and electron microscopes—have opened new worlds in biomedical research. But today, with such breakthroughs as the sequencing of human and mouse genomes, researchers need nanoscale imaging technologies to explore the structure and function of genes and chromosomes.**

**This past May, the Institute for Molecular Biophysics (IMB) opened a new 3,400-square-foot research facility at Jackson Laboratory. The IMB was created to develop and deploy the biological imaging technologies of the future. The interdisciplinary program brings together expertise in biophysics and engineering at the University of Maine, cell biology at the Maine Medical Center Research Institute in Scarborough, Maine, and genetics and genomics at Jackson Laboratory, Bar Harbor, Maine.**

**IMB's initial funding was provided by the National Science Foundation's EPSCoR program.**

# COMPOSITES/ADVANCED MATERIALS

## Wood Composites Improve Highway Bridges

Highway bridge girders take a daily punishing as cars and trucks repeatedly bend them. Over time, the resulting fatigue can lead to failure. Engineers in the Advanced Engineered Wood Composites Center at UMaine have demonstrated that glue-laminated beams properly designed with a fiber-reinforced polymer layer can withstand the punishment of bridge traffic. Publishing in the *Forest Products Journal,* Associate Professor Bill Davids and former graduate students Matthew Richie and Christopher Gamache describe their tests of nine Douglas fir laminated girders with FRP reinforcing. They show that girders with full-length or properly confined partial reinforcing have sufficient fatigue resistance under laboratory conditions. Davids is continuing to study fatigue in girders exposed to moisture and other environmental stresses.

The UMaine Advanced Engineered Wood Composite (AEWC) Center recently received the 2004–05 Timber Bridge Award for its design and engineering of the Millbridge Pier. The award highlights the elegance, strength, economy and historical role of timber bridges. It is presented annually by the American Institute of Timber Construction, APA—the Engineered Wood Association, and the USDA National Forest Service Wood in Transportation program. The Millbridge Pier, the first engineered wood commercial pier in the world, features a system of panels designed and fabricated in AEWC labs. The panel system delivers strength equal to concrete, but weighs 66 percent less, allowing for more efficient and economical construction. AEWC Director Habib Dagher and Melanie Bragdon, a civil and environmental engineering graduate student, were the principal designers and engineers on the award-winning project.

## Wood Composite Seawall

Maine Maritime Academy (MMA) has teamed up with the Advanced Engineered Wood Composites (AEWC) Center at the University of Maine, Correct Building Products in Biddeford and the Cianbro Corporation in Pittsfield to build a wood composite seawall at MMA's campus in Castine. The wall was completed November 2004 and is the first such structure using Correct Building Products' wood/plastic composite structural members. The 153-foot-long, 6-foot high structure replaces a conventional wooden seawall that had deteriorated, allowing soil to erode from a paved boat storage area, according to Jim Soucie, executive director of planning, compliance and facilities operations at MMA. Olivia Sanchez, a UMaine graduate and AEWC research engineer, designed the wall and provided project coordination, managing a team of undergraduate engineering students and working with representatives of Cianbro, MMA, and Correct Building Products. A $40,000 grant from the U.S. Department of Agriculture and contributions from Cianbro and Correct Building Products supported the project.

## AEWC awarded new $6.2 Million U.S. Army R&D Program

UMAINE recently announced a new $6.2 million U.S. Army research program awarded to the Advanced Engineered Wood Composites (AEWC) Center.

The research focus will be on studies of high-strength structures for military applications, including advanced materials, tent protective structures, high-performance airbeams, rigidified inflatable structures, rapidly deployable bridges and ballistic modular building components. AEWC engineers will work with the U.S. Army Natick Soldier Center and the U.S. Army Corps of Engineers.

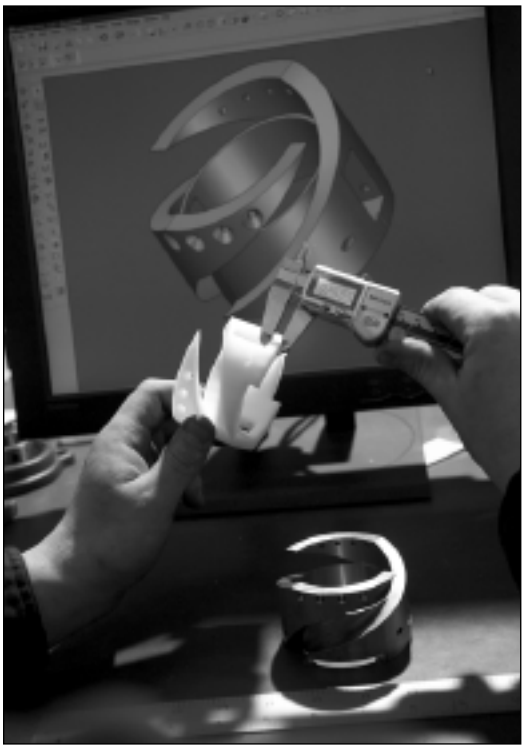
The $4.5 million, 15,000-square-foot laboratory expansion was a key part of UMaine's ability to meet the Army's research needs, noted Habib Dagher, AEWC director. The facilities include equipment and space to develop thick composites technologies, resin infusion processes and polymer extrusion. The space accommodates an anticipated 35 additional research personnel, including engineers, scientists and support staff, who will be funded through the new research program.

Researchers in the UMaine composites laboratory develop and investigate the properties of synthetic and natural fiber-based composites at scales from molecules to large structures.

With eight different labs occupying 48,000 square feet, AEWC provides the only university-based research facility in the U.S., where new composites products can be taken from initial concept to prototype design and full-scale production and testing under one roof.

## PRECISION MANUFACTURING

***THE UNIVERSITY OF MAINE***



In addition to prototyping, AMC engineers use their "design-build" approach to solve manufacturing problems and support research programs in the state.

### UMaine Opens $6.2 Million Facility to Support Maine Manufacturers

UMAINE'S College of Engineering and private manufacturing meld at the Advanced Manufacturing Center (AMC), a 30,000-square-foot, $6.2 million engineering building that opened in December 2004 at the University of Maine.

UMaine established the AMC to provide research and technical support for Maine manufacturers, noted Scott Dunning, the AMC's executive director. These companies—including start-up businesses—face myriad challenges in designing, developing, and marketing new products. The AMC assists these firms in precision manufacturing support; research and development; technical education; and economic development outreach.

Often working with basic ideas, the center's staff will design and build the prototype or help at any other stage of product development, according to Thomas Christensen, AMC's director of operations. On the other hand, sometimes a manufacturer needs only a machine part tooled to keep equipment operating; with many metal shops often backlogged for weeks or months, the AMC staff can quickly manufacture that part and shorten a client's down time.

UMaine engineering students play key roles at AMC by designing prototypes, writing computer code and operating the machining equipment. The students also work with various metals and milling machinery.

In the future, the AMC's educational aspect will extend to privately employed engineers, welders, computer programmers, machinists and other specialists who form Maine's manufacturing infrastructure.

### UMaine Awarded $3.16 Million NSF Grant for Graduate Sensors Program

Building on existing research strength and state-of-the-art infrastructure, the University of Maine will use a new five-year, $3.16 million research award to establish an interdisciplinary graduate education program in Sensor Science, Engineering, and Informatics.

Funding comes from the National Science Foundation's (NSF) Integrative Graduate Education and Research Traineeship (IGERT) program, which exists to train Ph.D. scientists through interdisciplinary programs that address pressing global needs. UMaine

**New Facility:**

**A new $16 million Engineering and Science Research Building on campus is the home of The University of Maine Department of Electrical and Computer Engineering, and the Laboratory for Surface Science and Technology (LASST). A highlight of the facility is a 3,500-square-foot clean room for research and development in the areas of nanotechnology, microfabrication, sensors and biotechnology. It is the only such facility in northern New England and one of approximately 25 university-based clean rooms of its kind in the U.S. Opened in fall 2004, the new clean room is equipped with state-of-the-art nanofabrication equipment. Some equipment was donated by companies such as Fairchild Semiconductor and Abbott Laboratories, while a recent Cluster Enhancement Award ($497,000) from the Maine Technology Institute will purchase equipment specifically important to Maine's nanotechnology businesses. The facility will increase the Lab's commercialization efforts, building on the six existing spin-off companies from LASST.**

# PRECISION MANUFACTURING

is also home to a second IGERT program in functional genomics.

The IGERT program will benefit from the resources and reputations of two of UMaine's most productive and best known research centers, the Laboratory for Surface Science and Technology and the National Center for Geographic Information and Analysis.

Five Ph.D. students, to be known as IGERT fellows, began studies earlier this year. Over the course of five years, the program will train 20 IGERT fellows, each of whom will be mentored by an interdisciplinary group of faculty members. The program's academic focus will be on sensor systems, including the creation of new materials and new methods for the interpretation of sensor data.

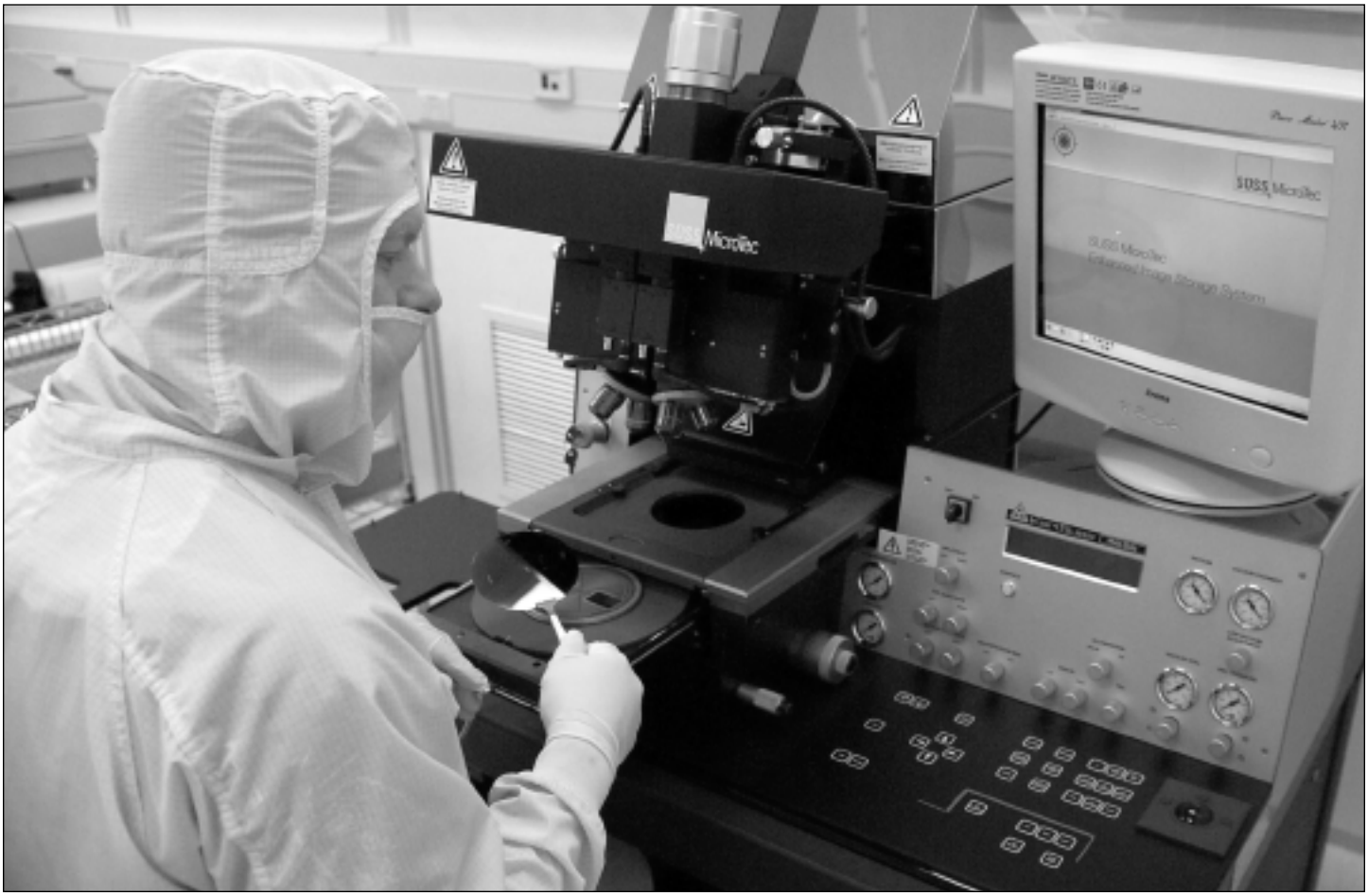
## Nanomechanics

Three University of Maine scientists are now fabricating a nanopore with tiny electrodes and built-in circuits that will be used in high-speed DNA sequencing experiments that could pave the way for medical treatments tailored to an individual's genetic make-up. Biochemist Scott Collins and bioengineers Rosemary Smith and David Kotecki will attempt to measure differences in the electron tunneling of individual nucleotides in DNA molecules.

Such measurements are important because each nucleotide can be identified by the way it affects an electric current. Electron tunneling is a process that allows an electric current to pass through a material that is normally resistant.

Their research is funded by a two-year, $850,000 grant from the National Human Genome Research Institute of the National Institutes of Health.

With passage of a jobs bond last November, the University of Maine Laboratory for Surface Science and Technology (LASST) will receive $2 million to enhance its nano-technology research and development capabilities. The latest LASST funding is expected to allow UMaine to continue to attract multimillion-dollar R&D grants from federal agencies, hire and train a skilled workforce in Maine, and provide resources for businesses.



# ADVANCED TECHNOLOGIES FOR FORESTRY AND AGRICULTURE

## Pulp to Polymers

With a three-year, $1 million grant from the U.S. Department of Energy and a contract with International Paper, UMaine Professor Adriaan van Heiningen is focusing on a portion of pulp known as hemicelluloses. In a pulp mill, most of the hemicelluloses end up in the spent pulping liquor and are burned. However, hemicelluloses contain a considerable amount of oxygen and do not generate much heat when burned in industry boilers. Van Heiningen wants to increase the value of hemicelluloses for the paper industry by using them for new value-added products, ranging from ethanol to car fenders and tabletops.

Van Heiningen works with professors Douglas Gardner and Joseph Genco, research engineer Haixuan Zou, and graduate students on new uses of hemicelluloses extracted from wood chips prior to pulping. Hemicellulose-based polymers will be used in the Advanced Engineered Wood Composite Center to make new products.

## Supporting Organic Milk Production

New England sales of organic milk were up 60 percent last year. Maine supermarket representatives have confirmed that demand outpaces supply. Organic milk's premium price is enabling many dairy farmers to stay in business.

To support farmers wishing to convert to organic production, the University of Maine, the University of New Hampshire, Maine Organic Milk Producers, and the U.S. Department of Agriculture's Agricultural Research Service/New England Plant, Soil and Water Lab have formed the Organic Livestock Research & Education Consortium (OLREC), led by UMaine Extension Professor Rick Kersbergen. The consortium has obtained $829,000 in USDA funding to research alternative cropping systems to feed organic herds.

Kersbergen has also been working with the Maine Organic Farmers and Gardeners' Association, and Maine Organic Milk Producers on organic dairy needs assessment and development. He is also a coprincipal investigator with UMaine Associate Professor of Resource Economics and Policy Tim Dalton and the University of Vermont on an organic cost-of-production study, funded by the U.S. Department of Agriculture's Cooperative State Research, Education, and Extension Service.

## Biodiesel Production

UMAINE Extension Crops Specialist Peter Sexton is working with growers in Aroostook County to pilot the production of biodiesel fuel from canola oil. Three farmers have each grown 10 acres of canola or another oil seed crop such as mustard. Oil is being extracted from the seed and locally processed. The biodiesel will then be used by the growers or marketed through a local fuel company. This field-to-fuel-tank trial is designed to bring hidden costs or benefits to light. The project includes an economic feasibility study of the establishment of a biodiesel production facility in northern Maine by the Houlton Band of Maliseet Indians.

### UMaine Student Wins Crop Science Award

**Megan Gardner has received the 2005 Gerald O. Mott Meritorious Graduate Student Award in Crop Science, presented by the Crop Science Society of America to one graduate student in each crop science graduate program in the U.S. Gardner is working with Marianne Sarrantonio, an associate professor in the Department of Plant, Soil, and Environmental Sciences and director of UMaine's Sustainable Agriculture Program. Gardner's research focuses on the benefits of cover crop root systems to nutrient cycling. She is working with three organic farming rotations and examining the use of red clover and winter rye within the rotations. Her goals are to quantify root distributions through the soil profile and to understand how this material decomposes.**

# ADVANCED TECHNOLOGIES FOR FORESTRY AND AGRICULTURE

## UV Light Pasteurizes Cider

Increasing concern about food safety following contamination of unpasteurized apple cider with Escherichia coli reinforces the need for using the best technologies in apple cider production to reduce risk to consumers. Pasteurization with ultraviolet irradiation (UV) is a low-cost alternative to heat pasteurization for small juice processing operations, according to a report by UMaine researchers in the *Journal of Food Processing and Preservation.*

Authors are Darrell Donahue, a professor in the Department of Chemical and Biological Engineering; Nazife Canitez, former master's student in the Department of Bio-Resource Engineering; and Alfred Bushway, professor in the Department of Food Science and Human Nutrition.

When raw unpasteurized apple cider was exposed to UV light in a commercially available UV light machine, researchers found that multiple passes reduced bacteria concentrations in inoculated apple cider to levels below those required by federal Food and Drug Administration standards. Taste testing trials yielded no significant differences between the UV-treated and control apple ciders. The UV-treated apple cider has a significantly longer shelf life through inhibition of yeast and mold growth.

## Antioxidants Extend Wood Life

Antioxidants play a role in a healthy diet by preventing cell damage. Wood scientists have now found evidence that they can also help to protect wood from degradation by fungi. A team of researchers, including Barry Goodell, leader of UMaine's Wood Science and Technology Program, and scientists at Mississippi State, has found that a mixture of the antioxidant BHT, a common food additive, combined with the biocide chlorothalonil, was two to three times more effective in retarding wood degradation by fungi than the biocide alone. The researchers conclude that antioxidants may be an economical and effective option in organic wood treatment systems. Their report was published in the January 2005 issue of the journal *Wood and Fiber Science.*

# AQUACULTURE AND MARINE SCIENCES

Undergraduate student participation in research is on the rise at USM. "Thinking Matters," a two-day celebration of student achievement, showcased more than 170 presentations of original research and student-faculty collaborations.

## Improving Management of the Gulf of Maine

As part of an emerging focus on aquatic research at USM, the university created the Aquatic Systems Group (ASG), led by Director and Bioscience Research Institute Senior Research Scientist Lewis Incze. This group's mission is to build interdisciplinary expertise in aquatic systems, and to help broaden the state's capacity to research, educate and better manage human interactions with the environment. With support from MEIF, USM, and grant funds, Incze and his team conduct ongoing research in the Gulf of Maine through collaboration and large-scale scientific projects. One such project is the Census of Marine Life Gulf of Maine Area Program.

One of seven initial field projects of the Census of Marine Life (CoML) program, a global network of researchers in more than 70 nations, the Gulf of Maine Area Program seeks to assess and explain the diversity, distribution and abundance of marine life in the oceans, and how this changes over time. Additionally, the program, which targets waters north to Halifax, Nova Scotia, and out to the continental slope and New England Seamounts, seeks to help develop the scientific information and theories needed to implement ecosystem-based management.

In April 2005, the Gulf of Maine Area Program launched The Dynamic Atlas of the Gulf of Maine, an online portal bringing together decades of rich marine data, much available publicly for the first time, about the complex marine ecosystem off New England and Canada's southeast coast. With the collaboration of the Gulf of Maine Ocean Observing System, the first-in-the-nation marine buoy system that reports ocean conditions in real time, and the Gulf of Maine Ocean Data Partnership, the alliance of 20 agencies and organizations providing marine data, the new portal (http://gmbis.iris.usm.maine.edu) offers up decades of work by agencies and scientists dedicated to understanding the Gulf of Maine ecosystem and its species.

This new tool will enhance scientific understanding of biodiversity, biological patterns and the relationships of life in the Gulf of Maine to the surrounding environs, enabling resource managers and scientific researchers to analyze information in unprecedented ways, creating new insights into the Gulf of Maine's ecology. Such knowledge is fundamental to ecosystem-based management.

## Counting on the Gulf of Maine

In July 2005, members of USM's Aquatic Systems Group and other researchers logged sea time aboard a 48-foot lobster-type research vessel, taking trips to Platts Bank and Three Dory Ridge off the coast of Cape Elizabeth to determine the use of the Gulf of Maine's offshore banks and ledges by seabirds, marine mammals and large fish. This project's goal was to establish a baseline record of offshore habitat by pelagic

seabirds, mammals and large fish, and the underlying conditions that exist when these predators are present and absent. Developing a better understanding of how natural changes in this environment affect marine life usage patterns will help future management of the Gulf of Maine and its resources.

## Effects of Contaminants on Right Whales

The North Atlantic right whale is one of the most endangered marine mammals, with only a few hundred animals left in their population. While the underlying causes for the inability of these animals to recover in population size are uncertain, one possible factor contributing to the reduced population is the effect of environmental chemicals on the reproductive tissues of right whales.

Unfortunately, studying right whale reproductive systems is complicated by the absence of any right whale tissues. Except for a few skin biopsies, right whale tissues are unavailable and no right whale cell lines exist. Thus, it is not possible to directly study right whale tissues and investigators are limited to relying on those skin biopsies, fecal samples, and data from other species.

With the help of a $497,000 federal grant from the National Oceanic and Atmospheric Administration (NOAA), John Wise, associate professor of biosciences and applied medical sciences, and principal investigator for USM's Wise Environmental & Genetic Toxicology Laboratory, is hoping to address this issue. His team is investigating the genetic effects of environmental contaminants on North Atlantic right whales by using their closest living relative, the bowhead whale, as a surrogate model.

Through August 2006, Wise and members of the Wise Lab are investigating the genetic effects of five classes of environmental contaminants (polycyclic aromatic hydrocarbons, metals, anti-fouling agents, anticorrosives and radionuclides) that pose a specific concern for right whales. Whale tissues samples are being collected from right whales in Lubec, Maine, and bowhead whales in Barrow, Alaska, and sent to the Wise Lab for cell line development and study. Bowhead whale samples will come from native Alaskans who have federal authorization to continue limited subsistence whale hunting.

A humpback and calf surface off the coast of Argentina. USM researchers are developing the nation's most extensive Marine Cell Line Library that will assist researchers worldwide to investigate the effects of environmental contaminants on marine mammals.

This study is expected to greatly enhance scientific knowledge of the physiology and toxicology of the right whale. This work also enhances another major university research initiative to continue development of a National Marine Mammal Cell Line Library at USM. The samples can be used to create tools, or cell lines, housed in the Cell Line Library that can serve as right whale-specific models. The living cell repository would allow other scientists around the world to do research on endangered marine mammals without harming or interfering with living animals. In the case of the right whale, the cell lines can be used by other investigators to better understand additional aspects of right whale genetics, physiology, immunology and biochemistry, as well as investigations into the effects of other contaminants and infectious agents. This information is critical if scientists are to discover the cause of major die-offs and strandings among whales and other species, including seals, sea lions, dolphins and other marine creatures that are federally protected and too large to bring into a landlocked laboratory. This information also may lead to comparative studies between marine mammals and humans.

The national Marine Cell Line Library is supported, in part, by grants from the National Oceanic and Atmospheric Administration and the National Institutes of Health. USM scientists receive their tissue samples from a network of collaborators, including Connecticut's Mystic Aquarium and the Marine Mammal Center in Sausalito, Calif.

## Chromium and Its Effects on Humans

At a time when Maine suffers from substantial public health issues related to exposure to environmental contaminants, more than 50 scientists from around the country gathered at USM in late August to discuss the latest research on chromium and its effects on humans.

Sponsored by USM's Maine Center for Toxicology and Environmental Health (MCTEH), the "Workshop on Chromium and Human Health" was the first of its kind focusing on this hard metal often found in stainless steel, other alloys, and dyes or paints.

Maine suffers a high frequency of lung cancer, in many cases caused by significantly high levels of chromium in the air, says John Wise, USM associate professor of biosciences and applied medical sciences, and principal investigator for the Wise Environmental and Genetic Toxicology Laboratory. The goal of this event was to convene all of the major investigators of chromium as a cause of disease or treatment to discuss major findings, next steps and broad collaborations.

MCTEH contributes to national and statewide efforts to study environmental contaminants and reduce their effects by promoting interactions among scientists, regulators and commercial enterprise working on environmental problems that may affect human health. Wise and his team of researchers focus on toxicology of metals and particulates, marine toxicology, and molecular epidemiology, using state-of-the-art molecular and toxicological techniques to investigate the impact of metals and particulates on humans. The center has three core facilities that provide state-of-the-art technology to center members to support major research initiatives. These core facilities include: Biostatistics, Bioinformatics and Computational Analysis; Cellular and Molecular Imaging; and Chemical Exposure and Assessment.

### Biomedical Research Seminar Series Expanded

**USM expanded its biomedical research seminar series in FY05. Twenty-five seminars were held on topics ranging from arsenic in groundwater to the fate of the North Atlantic right whale, and childhood asthma. Focused on topics of toxicology and human health, these sessions linked the interdisciplinary expertise of USM scientists with researchers from Maine Medical Center Research Institute, Maine Bureau of Health, University of Maine, Yale University School of Medicine, Cornell University, and the National Institutes of Health.**

# ENVIRONMENTAL TECHNOLOGIES

## Hands On in Hawaii

For many, a trip to Hawaii may be the ideal spot for a weeklong island getaway from Maine's wintry weather. But for USM biology students Tammy Sweetsir and Emily Pighetti, the tropical island in January 2005 provided the ideal living classroom to gain some hands-on experience conducting a field study.

Sweetsir and Pighetti joined USM Assistant Professor of Biological Sciences Lisa Moore to participate in a 10-day study of one of Hawaii's more unique natural features, the anchialine pond. The trio joined 20 other students and faculty from Tufts University and MIT to conduct field research of the anchialine ponds located within the boundaries of Kaloko-Honokohau National Historic Park (NHP) on the island of Hawaii. The effort was part of a project run out of MIT's Traveling Research Environmental Experiences (TREX) program, designed to provide MIT undergraduate students opportunities to study environmental issues through hands-on research.

Anchialine ponds are landlocked coastal ponds, typically found on volcanic islands such as the Hawaiian Islands. The brackish ponds, many as small as a small pothole, are influenced by tides as fresh water contained within the pond mixes with seawater that enters from underground fissures and tunnels. Although many ponds are located very close together, it remains uncertain whether direct connections exist between ponds. However, researchers have learned that the ponds are quickly becoming endangered ecosystems.

As many as 90 percent of anchialine ponds have disappeared primarily due to human impact, such as housing development, land use and the introduction of organisms, like tropical fish and other substances that can disrupt the whole ecosystem. While anchialine ponds within the Kaloko-Honokohau NHP remain, for the most part, unaffected by nearby development, Moore says one of the TREX team goals was to develop baseline chemistry and microbiological information about the Hawaiian ponds to enable future study.

While many of the tests the students conducted could be done in the field, including testing pH, salinity, oxygen levels and temperature at different hours of the day, nutrient tests were conducted using a makeshift lab at the NHP station. The teams also collected water samples that were frozen and transported back to USM for further analysis. Once back on campus, the USM team analyzed the samples for microbial growth and to determine their biodiversity.

## Historical Ecological Archaeology of Fragile Coastal Environments

Sandy beaches and the dunes that back them are important locations for studying maritime adaptations in many areas of the North Atlantic because zooarchaeological and spatial archaeological evidence is often well preserved in their deposits. Coastal sands are also vulnerable to periodic, catastrophic destabilization, resulting in the mass transport of sand via the wind onto human settlements.

With funding from the National Science Foundation, Gerry Bigelow, an adjunct professor of anthropology in USM's College of Arts and Sciences, has embarked on the exploratory phase of a new international, interdisciplinary research project to investigate the interaction of climactic and cultural changes in coastal sand environments of the Shetland Islands, the northernmost region of Scotland.

Over the long-term implementation of the Shetland Islands Climate and Settlement Project, Bigelow hopes to reconstruct the sequence of aeolian sand deposition at several coastal locations that were settlement foci over the past 2,500 years; investigate possible associations between phases of sand blows, the occurrence of extreme weather events or phases of storminess, and particular types of climate change; and define contemporary cultural changes that may have been adaptive responses to transformations in local ecology related to global change. During the exploratory phase of the project, Bigelow surveyed the area's geology, ran test excavations of an archaeological site, collected sediment samples for dating, and surveyed the Shetland Archives for historical documentation of past, extreme weather, and changes in the landscape and human culture during the historic period.

Bigelow and his team believe the study area has high potential to support such a fine-grained analysis. This type of investigation has not been attempted in the North Atlantic region before, and many geological and archaeological forces may have altered the site and its environment sufficiently to disqualify them as targets of research. Over the summer of 2005, Bigelow sought to collect the background information required for submitting a large-scale proposal with full investigation of the site and its contents as the centerpiece, or rule it out. Participating personnel included students and faculty researchers from the United States, United Kingdom and Australia, most of whom are experienced in Shetland archaeology.

## Mapping the Maine Coastline

Students aren't likely to catch Mark Swanson and Matthew Bampton on campus during the month of July. The USM professors of geosciences and geography and anthropology, respectively, accompanied by a team of students participating in the Research Experience for Undergraduates (REU) program, spend most of the month paddling Maine's Muscongus Bay region in sea kayaks filled with digital surveying gear, radio transmitters and GPS satellite receivers. The effort is all part of a project of the USM Geographical Information Systems (GIS) lab on USM's Gorham campus to study a collision between North America and Africa that happened 300-400 million years ago. In July 2004, the team hit pay dirt, discovering new evidence of an inactive fault zone off Harbor Island in eastern Muscongus Bay.

The GIS lab project began in 2002 and was funded by a two-year grant from the National Science Foundation (NSF) in the Research Experiences for Undergraduates Program. Swanson and Bampton also received additional funding through 2007, with a second NSF grant. The NSF grants allowed Swanson and Bampton to train undergraduates in this emerging scientific field and help provide networking opportunities for young researchers. The summer 2004 team consisted of students from all across the country, including states as far away as Texas and California.

The USM team has been mapping rocks of the coastline using the digital mapping ability of GPS and Total Stations, downloading the data in the field, and then analyzing their data back at the GIS lab. Traditionally, mapping of this nature has been done by hand, but the equipment and techniques allow the team to map very fine details more precisely and then zoom out via computer to view the Casco Bay to Muscongus Bay region on a larger scale. By teaming up with Bampton to apply GIS/GPS technology to his geological work, Swanson and his students can map in a week what used to take a whole field season.

The biggest surprise of the July 2004 data collection was finding a previously unrecorded rock material called pseudotachylite at Harbor and Black Islands. Pseudotachylite, or "false volcanic glass," is a friction melt produced as fault surfaces slide against one another during faulting. Swanson says the presence of pseudotachylite in an area is a good indicator of paleoseismic activity.

Swanson, who has been studying pseudotachylite formations in other parts of Maine for some time, says the team was completely surprised to find the formation in over 50 surfaces on Harbor Island. Perhaps what was more exciting about the find was the opportunity to name the new fault zone, now called the "Harbor Island fault zone."

## Online Directory of Watershed Funding Resources

The New England Environmental Finance Center (EFC1) at the University of Southern Maine has provided research, education and analytical services designed to address the "how to pay" issues of environmental protection in New England. As part of this effort, led by Sam Merrill, Environmental Finance Center project director and assistant research professor at USM's Muskie School of Public Service, EFC1 recently developed programming in drinking water and stormwater related topics of environmental finance. During the program development process, EFC1 staff received feedback from municipalities, land trusts, and other groups that an online directory of current funding sources for work in water resources would be most useful to them.

USM Research Associate Nicholas Wolff processes samples of plankton pulled from nets off the coast of Cape Elizabeth. The sampling was taken during a month-long census to establish a baseline record of marine life along Platts Bank and Three Dory Ridge in the Gulf of Maine.

# INFORMATION TECHNOLOGIES

## Focus on IRIS

USM'S Institute for Research in Information Science (IRIS) is comprised of four faculty members, one full-time professional staff member, and 10-12 students from various departments and disciplines. Much of the work of IRIS in FY05 continued to build USM's capacity and technology infrastructure to collaborate with and support the growing number of research and development projects, and complex instrumentation requirements in the biosciences. In addition, IRIS has continued its key role as collaborator in the ongoing efforts around Thinking Matters, USM's two-day showcase of scholarly research. Highlights of FY05 IRIS activities include:

- IRIS Web designers worked collaboratively with members of the Maine State Planning Office, Maine Coastal Program, and Aquarion Engineering to secure a grant from the Maine Outdoor Heritage Fund. The grant provided funding to upgrade and expand the State of Maine Think Blue Web site (www.thinkbluemaine.org), first designed by IRIS in FY04. The Web site serves as a clearinghouse of information, a catalyst for networking and partnering amongst local stream and river groups, and reference source of materials and training opportunities to advance stream protection efforts throughout Maine. The IRIS team was involved in all aspects of the Web site development, including esthetics and content areas, and provided statistical analysis, Web management, promotion consulting, and interactive applications development. This work was done in concert with a statewide radio and television media blitz intended to "raise the stormwater management consciousness" of the citizens of Maine.

- In January 2005, IRIS submitted an NSF proposal titled "Acquisition of Integrated Electron Microscopy, Tomography, and Computational Resources Supporting Interdisciplinary Collaboration in Research and Education at USM," led by proposal principal investigator Monroe Duboise and coprincipal investigators Glenn Wilson and Ak-Kau NG. The project proposes the acquisition of a transmission electron microscope (TEM) with advanced tomographic capability, along with a closely integrated Apple G5 Xserve high performance parallel computing cluster, to support tomographic image acquisition, three-dimensional reconstruction, data storage and systems modeling applications. The technology also provides advanced bioinformatics support for research and education projects in an interdisciplinary community of scientists working on campuses of the University of Southern Maine and at other regional institutions, including the University of New England and the Maine Medical Center Research Institute. This TEM and a scalable high-performance computing (HPC) cluster are two key pieces of the core instrumentation of a new integrated facility that has been identified as strategically important infrastructure for a growing collaborative interdisciplinary biosciences research community. The funding of this proposal provides a unique opportunity for IRIS and the Bioscience Research Institute of Southern Maine, also housed at USM, to work collaboratively to establish a model for designing, implementing and managing a "core" facility.

## Taking New Technology Ideas to the Next Level

In July 2005, policymakers, entrepreneurs, and others gathered on USM's Portland campus to share best practices on how to help convert new ideas and products into successful businesses that, in turn, can boost the state's economy. The gathering was all part of USM's annual Technology Commercialization and Incubation Summer Institute. The institute is hosted by the USM School of Business Center for Entrepreneurship and Small Business, and sponsored by the Applied Technology Development Centers, a statewide system of business incubators aimed at developing and retaining successful start-up businesses. The Maine Department of Economic and Community Development coordinates the system.

During the event, Dr. Janet Yancey-Wrona, newly appointed director of the Office of Innovation, and Maine's Science and Technology Advisor, addressed the outlook for Maine's science and technology businesses. Other speakers included Jim Finkle, manager of the Long Island High Technology Incubator, an award-winning incubator noted for community and academic partnerships that generate needed services for client companies; Joel Wiggins, director of the award-winning Austin Technology Incubator; Debbie Neuman of Target Technology Center; and John Ferland of the Center for Environmental Enterprise.

## Dummy Brings New Smarts to USM Nursing Education

Thanks to the help of a real "dummy," students in USM's College of Nursing and Health Professions are gaining valuable, hands-on training in real emergencies, right in the classroom. It's all thanks to a patient named "SimMan," a state-of-the-art, computerized, robotic mannequin at the Learning Resource Center in USM's College of Nursing and Health Professions.

USM is one of only eight universities chosen to participate in a national study on the use of simulation in nursing curricula. The purpose of the national, multi-site project, underwritten by the National League for Nursing and the mannequin manufacturer, Laerdal, is to study various parameters related to the use of simulation in basic nursing education programs and selected student outcomes.

SimMan is equipped with a software program that allows nursing faculty to program simulated healthcare situations—such as sudden cardiac arrest, choking, or asthma attack—where a nurse would have to react. Because of his robotic capabilities, nursing students can see, hear and feel his responses. Instructors can program the speech software to make SimMan speak, groan or even address a student by name. USM Associate Professor of Nursing Janis Childs, who directs the program's Learning Resource Center, says that depending on the students' actions—such as checking for a real, simulated pulse, performing a tracheotomy, suctioning, giving injections, administering oxygen—SimMan's condition either improves or deteriorates. In real time, the students receive instant feedback from their caregiving strategies by viewing the mannequin's vital statistics on nearby monitors.

The usefulness of simulation in teaching a variety of professions and trades has been well documented. The true-to-life experience is good, says Childs, because it not only creates opportunities for using all the senses during the learning process, it also encourages critical thinking and on-the-spot decisionmaking. SimMan makes learning safer for students; their anxiety is not in the way as much as it would be in a hospital setting.

The mannequin is especially useful for students enrolled in USM's accelerated, 15-month nursing degree program, because it moves them further along in their training at a quicker pace and more thoroughly.

**NEW BIOSCIENCE RESOURCE WING**

In the spring of 2005, USM completed a three-floor addition to the Biosciences Research Wing of its Science Building, located on Falmouth St., Portland. The facility, funded through the state's R&D initiative, enables researchers to attract external grants and generate the teaching and research needed to improve the regional economy by expanding biomedical research resources. The Bioscience Research Wing first opened in June of 2003. The three newly added upper floors will house additional laboratories and bioscience research facilities over time.

# LEGISLATIVE HISTORY OF STATE RESEARCH APPROPRIATION FOR OPERATIONS

The following is a summary of the actions of the 118th, 119th, 120th, and 121st Maine Legislatures with regard to appropriating research funds for operations to the University of Maine System:

## 118th LEGISLATURE

**March 26, 1997:** Governor signed into law the Economic Improvement Strategy (Chapter 24) that appropriated $0.5 million to UMS for research.

**April 1, 1998:** Governor signed into law the Economic Improvement Strategy (Chapter 643, Part LL, Section S-3) that appropriated $4 million to UMS for research. These funds were allocated from the FY98 year-end state surplus for use in FY99.

## 119th LEGISLATURE

**March 15, 1999:** Governor signed into law the Part I Current Services budget (Chapter 16) that appropriated $4 million in 1999/00 and 2000/01 to UMS on a "base budget" basis for research. This extends the one-time FY99 $4 million research appropriation that was funded from the FY98 year-end state surplus.

**June 4, 1999:** Governor signed into law the Part II Supplemental Appropriation budget (Chapter 401) that appropriated an additional $5.55 million in 1999/00 and an additional $50,000 in 2000/01 to UMS on a "base budget" basis for research.

**April 25, 2000:** Governor signed into law the Part II Supplemental Appropriation budget (Chapter 731) that appropriated $0.3 million in 2000/01 to UMS on a "base budget" basis for the Maine Patent Program.

## 120th LEGISLATURE

**June 21, 2001:** Governor signed into law the Part II Supplemental Appropriation budget (Chapter 439) that appropriated an additional $2 million in 2002/2003 to UMS on a "base budget" basis for research.

**March 25, 2002**: Governor signed into law a deappropriation (Chapter 559) that reduced the FY03 $2 million Supplemental Appropriation by $1 million.

**July 1, 2002:** Governor signed a Financial Order that curtailed the FY03 $2 million Supplemental Appropriation by an additional $1 million. This eliminated the FY03 increase of $2 million for research, bringing the FY03 research & development appropriation back to the FY02 level of $10.1 million.

**November 18, 2002:** Governor signed into law a Supplemental Appropriation budget (Chapter 714) that deappropriated the $1 million curtailment that was signed on July 1, 2002.

## 121st LEGISLATURE

**January 30, 2004**: Governor signed into law a Supplemental Appropriation budget (Chapter 513, Part P, Sec. P-2) that includes a provision to transfer to MEIF up to $2 million of any unbudgeted State revenue remaining at the close of FY04. The full amount was subsequently transferred to UMS. This same Chapter 513, Part P, Sec. P-3 made the $2 million part of the MEIF FY05 base appropriation.

### NEW APPROPRIATION

**118th LEGISLATURE**

| | FY1998 | FY1999 | Total 2-Year |
|---|---|---|---|
| UM | $400,000 | $3,200,000 | $3,600,000 |
| USM | 100,000 | 800,000 | 900,000 |
| Total | $500,000 | $4,000,000 | $4,500,000 |

**119th LEGISLATURE**

| | FY2000 | FY2001 | Total 2-Year |
|---|---|---|---|
| UM | $4,440,000 | $40,000 | $4,480,000 |
| USM | 1,110,000 | 10,000 | 1,120,000 |
| Total | $5,550,000 | $50,000 | $5,600,000 |

**120th LEGISLATURE**

| | FY2002 | FY2003 | Total 2-Year |
|---|---|---|---|
| UM | $0 | $0 | $0 |
| USM | 0 | 0 | 0 |
| Total | $0 | $0 | $0 |

**121st LEGISLATURE**

| | FY2004 | FY2005 | Total 2-Year |
|---|---|---|---|
| UM | $0 | $1,600,000 | $1,600,000 |
| USM | 0 | 400,000 | 400,000 |
| Total | $0 | $2,000,000 | $2,000,000 |

### TOTAL YEARLY RESEARCH APPROPRIATION

| | FY2005 |
|---|---|
| UM | $9,680,000 |
| USM | 2,420,000 |
| Total | $12,100,000 |

## STATE FUNDING FOR CAPITAL RESEARCH PROJECTS

**November 3, 1998:** Maine voters approved a $20 million bond issue to improve the Maine economy by supporting innovative research and development. UMS received $13.5 million from this bond issue to be used for capital improvements and equipment purchases to support research and development. The bond proceeds were distributed between UMaine ($10.8 million) and USM ($2.7 million).

**June 4, 1999:** Governor signed into law the Part II Supplemental Appropriation budget (Chapter 401) that appropriated $2.5 million in 2000/01 to UMS on a "base budget" basis to pay the debt service on a $25 million university R&D revenue bond. The University issued the revenue bond on August 15, 2000 that provides $20 million for the UMaine Engineering & Science Research Facility and $5 million for the USM Portland Science Building Lab Renovation.

**April 25, 2000:** Governor signed into law a one-time supplemental appropriation (Chapter 731) that appropriated $9 million for the renovation of teaching laboratories and classrooms in Aubert Hall at UMaine.

**June 11, 2002:** Maine voters approved a $35 million bond issue to be used in part to stimulate job growth. UMS received $9 million with the bond proceeds being distributed to UMaine ($5 million) for the Advanced Manufacturing Center and to USM ($4 million) for the Mitchell Center.

**June 10, 2003:** Maine voters approved a $60 million bond issue to be used in part to stimulate job creation and economic growth. UMaine and USM received a combined total of $15 million to support their research efforts, $3.6 million of which was matching funds for MEIF R&D projects.

**November 8, 2005:** Maine voters approved a $20 million bond issue to be used to stimulate economic growth and job creation. UMaine received $2 million for the development of the Laboratory for Surface Science Technology.

### FY2005 SUMMARY OF STATE FUNDING FOR RESEARCH CAPITAL PROJECTS

### UMAINE/USM COMBINED

| | Referendum Bond Portion | Other Funds | Total Project Budget | Expenditures to Date |
|---|---|---|---|---|
| **FY1999 State Bond Issue (approved by voters 11/3/1998)** | | | | |
| UM | $10,800,000 | $1,168,622 | $11,968,622 | $11,860,227 |
| USM | 2,700,000 | 155,100 | 2,855,100 | 2,855,100 |
| TOTAL | $13,500,000 | $1,323,722 | $14,823,722 | $14,715,327 |
| **FY2001 University R&D Revenue Bonds (Debt Service Paid by $2,500,000 State Appropriation - Issued 8/15/2000)** | | | | |
| UM | $20,000,000 | $896,315 | $20,896,315 | $20,582,837 |
| USM | 5,000,000 | 4,211,234 | 9,211,234 | 9,175,684 |
| TOTAL | $25,000,000 | $5,107,549 | $30,107,549 | $29,758,521 |
| **FY2001 One-Time State Appropriation (signed by Governor 4/25/2000)** | | | | |
| UM | $9,000,000 | $3,441,899 | $12,441,899 | $11,043,446 |
| **FY2002 State Bond Issue (approved by voters 6/11/2002)** | | | | |
| UM | $5,000,000 | $0 | $5,000,000 | $4,347,971 |
| USM | 4,000,000 | 73,500 | 4,073,500 | 4,000,000 |
| TOTAL | $9,000,000 | $73,500 | $9,073,500 | $8,347,971 |
| **FY2003 State Bond Issue (approved by voters 6/10/2003)** | | | | |
| UM | $7,000,000 | $137,257 | $7,137,257 | $4,838,193 |
| USM | 4,400,000 | 0 | 4,400,000 | 3,325,203 |
| TOTAL | $11,400,000 | $137,257 | $11,537,257 | $8,163,396 |

APPENDIX B

## UMAINE

| | Referendum Bond Portion | Other Funds | Total Project Budget | Expenditures to Date | Funds Carried Forward To FY2006 | Estimated Completion Date |
|---|---|---|---|---|---|---|
| **FY1999 State Bond Issue (approved by voters 11/3/1998)** | | | | | | |
| Hitchner Expansion & Renovation and Food Science Building | $9,400,000 | $544,220 | $9,944,220 | $9,944,220 | $0 | 6/30/05 |
| Hitchner FY2001 Revenue Bond Interest | 0 | 438,860 | 438,860 | 330,465 | 108,395 | 6/30/05 |
| Aquaculture Renovation & Expansion | 200,000 | 0 | 200,000 | 200,000 | 0 | 10/31/01 |
| CRW Lab Related Work | 250,000 | 64 | 250,064 | 250,064 | 0 | 6/15/99 |
| Boardman Hall Basement Renovation | 0 | 159,398 | 159,398 | 159,398 | 0 | 2/01/02 |
| Barrows Lab Renovation | 74,015 | 1,080 | 75,095 | 75,095 | 0 | 5/10/01 |
| Software Eng & Adv Materials Labs | 875,985 | 25,000 | 900,985 | 900,985 | 0 | 10/25/00 |
| | $10,800,000 | $1,168,622 | $11,968,622 | $11,860,227 | $108,395 | |
| **FY2001 University R&D Revenue Bonds (Debt Service Paid by $2,500,000 State Appropriation - Issued 8/15/2000)** | | | | | | |
| Engineering & Science Research Facility | $14,568,596 | $500,000 | $15,068,596 | $14,756,197 | $312,399 | 3/31/05 |
| Machine Tool Lab Addition | 200,000 | 0 | 200,000 | 198,921 | 1,079 | 6/30/05 |
| Advanced Manufacturing Center | 2,460,000 | 0 | 2,460,000 | 2,460,000 | 0 | 12/01/04 |
| Hitchner Addition | 2,000,000 | 0 | 2,000,000 | 2,000,000 | 0 | 12/31/02 |
| Boardman Hall Renovation | 500,000 | 0 | 500,000 | 500,000 | 0 | 2/01/02 |
| Underground Steam Distribution Upgrade | 271,404 | 396,315 | 667,719 | 667,719 | 0 | 10/31/03 |
| | $20,000,000 | $896,315 | $20,896,315 | $20,582,837 | $313,478 | |
| **FY2001 One-Time State Appropriation (signed by Governor 4/25/2000)** | | | | | | |
| Aubert Hall - Phase 1 | $9,000,000 | $1,441,899 | $10,441,899 | $10,441,899 | $0 | 4/30/04 |
| Aubert Hall - Phase 2 | 0 | 2,000,000 | 2,000,000 | 601,547 | 1,398,453 | 12/31/05 |
| | $9,000,000 | $3,441,899 | $12,441,899 | $11,043,446 | $1,398,453 | |
| **FY2002 State Bond Issue (approved by voters 6/11/2002)** | | | | | | |
| Advanced Manufacturing Center | $3,600,000 | $0 | $3,600,000 | $3,202,288 | $397,712 | 9/30/05 |
| CAM Tools Advanced Materials Center | 1,200,000 | 0 | 1,200,000 | 1,118,197 | 81,803 | 3/31/05 |
| Cloke Plaza | 200,000 | 0 | 200,000 | 27,486 | 172,514 | 9/30/05 |
| | $5,000,000 | $0 | $5,000,000 | $4,347,971 | $652,029 | |
| **FY2003 State Bond Issue (approved by voters 6/10/2003)** | | | | | | |
| Blueberry Hill Building | $150,000 | $0 | $150,000 | $65,374 | $84,626 | 9/30/05 |
| Blueberry Hill Office/Lab | 452,204 | 0 | 452,204 | 359,771 | 92,433 | 9/30/05 |
| Aroostook Farm Greenhouse | 129,682 | 77,905 | 207,587 | 207,587 | 0 | 12/31/04 |
| Rogers Farm Storage Barn | 49,481 | 0 | 49,481 | 49,481 | 0 | 12/31/04 |
| Littlefield Garden Electric Service | 16,021 | 0 | 16,021 | 16,021 | 0 | 12/31/04 |
| Highmoor Farm Irrigation | 60,000 | 25,000 | 85,000 | 44,064 | 40,936 | 6/30/06 |
| Rogers Farm Bathroom Renovation | 17,560 | 0 | 17,560 | 17,560 | 0 | 12/31/04 |
| Witter Center Facility Improvements | 58,651 | 0 | 58,651 | 58,651 | 0 | 12/31/04 |
| Witter Farm Bathroom Improvements | 10,026 | 0 | 10,026 | 10,026 | 0 | 12/31/04 |
| Demeritt Forest Facilities | 56,375 | 34,352 | 90,727 | 90,727 | 0 | 12/31/04 |
| Innovation Center | 1,500,000 | 0 | 1,500,000 | 84,079 | 1,415,921 | 6/30/06 |
| AEWC Expansion | 3,000,000 | 0 | 3,000,000 | 2,941,762 | 58,238 | 10/31/05 |
| Capital Equipment for AEWC Expansion | 1,500,000 | 0 | 1,500,000 | 893,090 | 606,910 | 10/31/05 |
| | $7,000,000 | $137,257 | $7,137,257 | $4,838,193 | $2,299,064 | |

## USM

| | Referendum Bond Portion | Other Funds | Total Project Budget | Expenditures to Date | Funds Carried Forward To FY2006 | Estimated Completion Date |
|---|---|---|---|---|---|---|
| **FY1999 State Bond Issue (approved by voters 11/3/1998)** | | | | | | |
| Portland Science Building Lab Renovation | $2,254,890 | $30,100 | $2,284,990 | $2,284,990 | $0 | 7/01/05 |
| Portland R&D Parking | 57,966 | 0 | 57,966 | 57,966 | 0 | 7/01/03 |
| Mitchell Center R&D Renovations | 387,144 | 125,000 | 512,144 | 512,144 | 0 | 11/30/00 |
| | $2,700,000 | $155,100 | $2,855,100 | $2,855,100 | $0 | |
| **FY2001 University R&D Revenue Bonds (Debt Service Paid by $2,500,000 State Appropriation - Issued 8/15/2000)** | | | | | | |
| Portland Science Building Lab Renovation | $5,000,000 | $4,211,234 | $9,211,234 | $9,175,684 | $35,550 | 7/01/05 |
| **FY2002 State Bond Issue (approved by voters 6/11/2002)** | | | | | | |
| Mitchell Center Expansion | $4,000,000 | $73,500 | $4,073,500 | $4,000,000 | $73,500 | 12/15/04 |
| **FY2003 State Bond Issue (approved by voters 6/10/2003)** | | | | | | |
| Portland Science Building Expansion | $4,400,000 | $0 | $4,400,000 | $3,325,203 | $1,074,797 | 7/01/05 |

## SUMMARY OF UTILIZATION OF FY2005 R&D APPROPRIATION FOR OPERATIONS

### UMAINE/USM COMBINED

| | Source of R&D Funds | | | Utilization of R&D Funds | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | FY2005 R&D Base Budget [4] | Unused R&D Funds from Prior Years | FY2005 Total R&D Funds Available | FY2005 R&D Actual Expenditures | Transferred To Match Grants & Contracts | Transferred Between R&D Accounts | Total R&D Funds Utilized | Unused Funds Carried Forward To FY2006 [1] | New Grants & Contracts Generated [2] | Total FTE Positions Supported By All R&D Funds [3] |
| | (a) | (b) | (a)+(b) | (c) | (d) | (e) | (c)+(d)+(e) | | | |
| UM | $9,680,000 | $1,411,923 | $11,091,923 | $8,704,008 | $1,636,578 | $97,783 | $10,438,369 | $653,554 | $39,998,389 | 624.1 |
| USM | 2,420,000 | 36,539 | 2,456,539 | 2,107,068 | 146,887 | 0 | 2,253,955 | 202,584 | 1,865,356 | 118.8 |
| Total | $12,100,000 | $1,448,462 | $13,548,462 | $10,811,076 | $1,783,465 | $97,783 | $12,692,324 | $856,138 | $41,863,745 | 742.9 |

### UMAINE

| | Source of R&D Funds | | | Utilization of R&D Funds | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Targeted Research Area | FY2005 R&D Base Budget [7] | Unused R&D Funds from Prior Years | FY2005 Total R&D Funds Available | FY2005 R&D Actual Expenditures | Transferred To Match Grants & Contracts | Transferred Between R&D Accounts | Total R&D Funds Utilized | Unused Funds Carried Forward To FY2006 [1] | New Grants & Contracts Generated [2] | Total FTE Positions Supported By All R&D Funds [3] |
| | (a) | (b) | (a)+(b) | (c) | (d) | (e) | (c)+(d)+(e) | | | |
| Adv. Technology Forestry & Agriculture | $1,890,000 | $723,017 | $2,613,017 | $1,496,696 | $479,981 | $535,512 | $2,512,189 | $100,828 | $5,399,744 | 150.0 |
| Aquaculture & Marine Science | 1,340,497 | 62,761 | 1,403,258 | 1,105,775 | 334,952 | (199,216) | 1,241,511 | 161,747 | 6,763,593 | 83.0 |
| Biotechnology | 900,000 | 169,916 | 1,069,916 | 1,068,485 | 659,733 | (703,387) | 1,024,831 | 45,085 | 4,591,530 | 47.0 |
| Composites | 2,100,000 | 944 | 2,100,944 | 902,289 | 0 | 1,126,390 | 2,028,679 | 72,265 | 4,909,175 | 77.1 |
| Environmental | 600,000 | 133,130 | 733,130 | 1,217,572 | 86,880 | (613,811) | 690,641 | 42,489 | 8,780,048 | 103.8 |
| Information Technology | 1,417,503 | 157,118 | 1,574,621 | 1,644,363 | 13,807 | (136,877) | 1,521,293 | 53,328 | 8,241,199 | 116.4 |
| Precision Manufacturing | 1,432,000 | 165,037 | 1,597,037 | 1,268,828 | 61,225 | 89,172 | 1,419,225 | 177,812 | 1,313,100 | 46.8 |
| Total | $9,680,000 | $1,411,923 | $11,091,923 | $8,704,008 | $1,636,578 | $97,783 | $10,438,369 | $653,554 | $39,998,389 | 624.1 |
| 2003 Jobs for Economic Growth Bond [5] - MEIF Matching Funds | $0 | $2,060,000 | $2,060,000 | $0 | $232,579 | $0 | $232,579 | $1,827,421 | $0 [6] | 0.0 |

[1] Include year-end equipment carry-over funds (equipment ordered, not received, and not paid).
[2] Dollar value of new grants & contracts that resulted from FY2005 State R&D funds.
[3] One FTE position is equivalent to one full-time employee working for an entire year on R&D projects.
[4] Includes cascade funding of $2,000,000.
[5] Original amount was $2,880,000. Job creation and economic growth bond.
[6] Included in grants & contracts generated figures shown above.
[7] Includes cascade funding of $1,600,000.

## UTILIZATION OF FY2005 OPERATING RESEARCH APPROPRIATION

### USM

| | Source of R&D Funds | | | Utilization of R&D Funds | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Project | FY2005 R&D Base Budget [4] | Total Unused R&D Funds from Prior Years | FY2005 Total R&D Funds Available | FY2005 R&D Actual Expenditures | Transferred To Match Grants & Contracts | Transferred Between R&D Accounts | Total R&D Funds Utilized | Unused Funds Carried Forward To FY2006 [1] | New Grants & Contracts Generated [2] | Total FTE Positions Supported By All R&D Funds [3] |
| | (a) | (b) | (a)+(b) | (c) | (d) | (e) | (c)+(d)+(e) | | | |
| College of Arts and Sciences R&D | $0 | $1,050 | $1,050 | $430 | $0 | $0 | $430 | $620 | $0 | 0.0 |
| Information Science Institute A | 132,724 | (12,519) | 120,205 | 120,094 | 127 | 0 | 120,221 | (16) | 0 | 11.8 |
| Research Development | 566,756 | 29,482 | 596,238 | 517,135 | 0 | 0 | 517,135 | 79,103 | 0 | 6.0 |
| Bioscience Institute | 651,109 | (17,601) | 633,508 | 562,019 | 28,148 | 0 | 590,167 | 43,341 | 1,865,356 | 84.0 |
| Operations (plant, facilities, lease) | 230,000 | 0 | 230,000 | 230,000 | 0 | 0 | 230,000 | 0 | 0 | 0.0 |
| Opportunity Programs | 33,165 | 13,439 | 46,604 | 25,996 | 7,996 | 0 | 33,992 | 12,612 | 0 | 4.0 |
| Undergraduate Research | 60,950 | 18 | 60,968 | 66,708 | 0 | 0 | 66,708 | (5,740) | 0 | 0.0 |
| Library | 95,000 | 13,455 | 108,455 | 91,305 | 0 | 0 | 91,305 | 17,150 | 0 | 0.0 |
| Animal Facility | 113,410 | (8,897) | 104,513 | 108,051 | 0 | 0 | 108,051 | (3,538) | 0 | 2.5 |
| Wise Lab Personnel | 191,278 | 6,015 | 197,293 | 181,548 | 29,916 | 0 | 211,464 | (14,171) | 0 | 5.0 |
| Information Science Institute B | 185,608 | 12,097 | 197,705 | 158,976 | 5,700 | 0 | 164,676 | 33,029 | 0 | 5.5 |
| GMRI Laboratory Fit-Out | 85,000 | 0 | 85,000 | 44,806 | 0 | 0 | 44,806 | 40,194 | 0 | 0.0 |
| Organic Chemistry Lab | 75,000 | 0 | 75,000 | 0 | 75,000 | 0 | 75,000 | 0 | 0 | 0.0 |
| Total | $2,420,000 | $36,539 | $2,456,539 | $2,107,068 | $146,887 | $0 | $2,253,955 | $202,584 | $1,865,356 | 118.8 |
| 2003 Jobs for Economic Growth Bond [5] - MEIF Matching Funds | $0 | $687,707 | $687,707 | $0 | $469,175 | $0 | $469,175 | $218,532 | $1,503,315 | 0.0 |

## UTILIZATION OF FY2005 MAINE PATENT PROGRAM APPROPRIATION

### USM

| | Source of Patent Program Funds | | | Utilization of Patent Program Funds | | | | | | Total FTE |
|---|---|---|---|---|---|---|---|---|---|---|
| Major Program Area | FY2005 Patent Program Base Budget | Total Unused Funds from Prior Years | Total Patent Program Funds Available | FY2005 Patent Program Actual Expenditures | Transferred To Match Grants & Contracts | Transferred Between Patent Program Accounts | Total Patent Program Funds Utilized | Unused Funds Carried Forward To FY2006 [1] | New Grants & Contracts Generated [2] | Positions Supported By All Patent Funds [3] |
| | (a) | (b) | (a)+(b) | (c) | (d) | (e) | (c)+(d)+(e) | | | |
| Maine Patent Program | $306,000 | $4,586 | $310,586 | $297,825 | $12,761 | $0 | $310,586 | $0 | $0 | 3.8 |

[1] Include year-end equipment carry-over funds (equipment ordered, not received, and not paid).
[2] Dollar value of new grants & contracts that resulted from FY2005 State R&D funds or Maine Patent Program funds.
[3] One FTE position is equivalent to one full-time employee working for an entire year on R&D projects or Maine Patent Program projects.
[4] Includes cascade funding of $400,000.
[5] Original amount was $720,000. Job creation and economic growth bond.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