

2002-06 Strategic Plan

UNIVERSITY OF WISCONSIN SEA GRANT COLLEGE PROGRAM



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University of Wisconsin Sea Grant College Program

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University of Wisconsin Sea Grant College Program
"Science for the Sustainable Use of Wisconsin's Great Lakes Resources"

Vision Statement

To integrate, transfer and apply scientific knowledge and new technology to strengthen U.S. leadership in Great Lakes, coastal and marine-related commerce.

This vision involves three interpenetrating themes. The University of Wisconsin Sea Grant College Program's efforts and investments will:

- Enhance the economic well-being of coastal communities;
- Enhance healthier coastal and Great Lakes ecosystems through greatly improved air and water quality; and
- Develop an informed citizenry and produce highly qualified professionals.

Introduction

The University of Wisconsin Sea Grant College Program is dedicated to the sustainable use and conservation of Great Lakes and ocean resources. In pursuit of this goal, UW Sea Grant supports a comprehensive, interdisciplinary and integrated program of research, outreach and education. Created in 1968, UW Sea Grant is one of the oldest and largest programs in a national network of 30 university-based programs created under the National Sea Grant College Program. UW Sea Grant's highly diversified research agenda has made it a national leader in the areas of toxic contaminants, water quality, fisheries management and ecosystem dynamics.

Apart from their economic and intrinsic natural values, the Great Lakes offer a unique laboratory for the study of aquatic systems and the creation of resource management models. This is especially true with regard to understanding the environmental fates and human health effects of toxic contaminants, developing ecosystem approaches to fisheries management, rehabilitating degraded coastal ecosystems, and exploring and applying biotechnology to Great Lakes and ocean problems. As a nonadvocate academic institution, UW Sea Grant is ideally positioned to build bridges and foster partnerships among all parties concerned with the protection and use of aquatic environments—elected officials at all levels, government resource management agencies, user groups, industry and the public—by providing accurate and credible scientific information for the management and protection of Great Lakes and ocean resources.

Situation Analysis

The Great Lakes hold an estimated six quadrillion gallons of fresh water—20 percent of all the drinkable water on the surface of Earth. Coupled with the region's vast forest, agricultural and mineral resources, the abundant supply of water and cheap transportation afforded by the Great Lakes were major factors in the region becoming the population and industrial heartland of both the U.S. and Canada.

With the world's potable water supplies dwindling under the pressure of continuing human population growth, the region's wealth of water is becoming increasingly valuable. At the same time, these freshwater seas have proven to be particularly sensitive to population pressures and the insults of human activities in their watersheds. Outflows from the Great Lakes are relatively small (less than 1 percent per year) in comparison with the total volume of water. Contaminants that enter the lakes—by direct discharge along the shores, via tributaries, from urban or agricultural land runoff, or as atmospheric fallout—are thus retained in the system and can become increasingly concentrated over time.

The UW Sea Grant program subscribes to the whole-ecosystem approach, which recognizes that the Great Lakes Basin is composed of numerous interactive and inseparable elements—air, water, land and living organisms, including humans. Implicit in this view, for example, is that water quality cannot be considered in isolation since it is intimately connected to large-scale interactions affecting the entire system that extend to global processes. Thus, remedial efforts directed at water quality alone would be analogous to treating a symptom without regard to the underlying problem.

Scientific research, outreach and education provide the information necessary to develop an understanding of ecosystem components and processes, human impacts and resulting deleterious effects, and to develop technology for effective remediation strategies. Responsible and informed policy-making depends on such research as well as the public understanding and support afforded by ongoing outreach and education.

A National, Regional and State Agenda

The UW Sea Grant College Program Strategic Plan 2002-06 presents a research, outreach and education agenda that carefully integrates and responds to clearly identified long-range goals and short-term priorities at the state, regional and national levels. In addition, the program's administrative agenda is a direct reflection of the strategic goals and priorities of the strategic plans promulgated by the UW-Madison, its Graduate School and the University of Wisconsin System.

First and foremost, the UW Sea Grant Strategic Plan addresses the national theme-area goals and priorities jointly established by the Sea Grant Association (SGA) and NOAA Sea Grant, which in turn support the strategic priorities of the National Oceanic & Atmospheric Administration (NOAA), U.S. Department of Commerce. These national Sea Grant goals are then addressed within the context of both regional (Great Lakes Basin) and state (Wisconsin) priorities established by such agencies as the U.S.-Canadian International Joint Commission (IJC), Great Lakes Fishery Commission, U.S. Environmental Protection Agency-Region 5 and the EPA's Great Lakes National Program Office, North Central Regional Aquaculture Center, and several state agencies, including the Wisconsin departments of Natural Resources and Agriculture, Trade & Consumer Protection, among others. UW Sea Grant priorities also take into account the feedback and continual input received from our many constituencies, both directly and via our outreach specialists in aquaculture, aquatic nuisance species (ANS), business, coastal engineering, education, fisheries, geographic information systems (GIS), habitat restoration, water quality and water safety.

UW Sea Grant goals and priorities thus take into consideration constituent-identified priorities as well as the carefully developed strategic plans of the various state, regional, federal and international organizations with jurisdiction over the Great Lakes and the nation's marine resources. The overarching goal of all UW Sea Grant research, outreach and education efforts is to contribute science-based information for better

stewardship of our nation's coastal, Great Lakes and marine resources, while enhancing the economic competitiveness of the State of Wisconsin, the Great Lakes region and the United States.

Sea Grant's National Themes

Recently, the National Sea Grant College Program adopted the concept of using a theme-area approach to enhance the program's effectiveness in addressing the nation's critical ocean, coastal and Great Lakes issues. A thematic area represents a core area of emphasis and expertise within the program's purview. The expected benefits of this approach are that it will:

- Help organize Sea Grant activities under common areas of interest;
- Serve as a method for synthesizing thematic area efforts on a national scale;
- Create opportunities and new directions for national and regional Sea Grant initiatives and strategic investments;
- Catalyze cooperative efforts among Sea Grant programs, between individual programs and NOAA Sea Grant, and between NOAA Sea Grant and NOAA;
- Provide opportunities for cooperative ventures with other agencies;
- Focus the flow of funds to high-impact areas;
- Accommodate interdisciplinary research;
- Provide a forum to organize Sea Grant research, outreach and education efforts on a national scale;
- Provide a strategically useful method for providing information to policymakers, and
- Provide a basis for strategic planning at the state, regional and national levels.

The National Sea Grant College Program has thus identified and established the 11 following thematic areas:

- **Aquaculture**
- **Aquatic Invasive Species** (*new*)
- **Biotechnology**
- **Coastal Communities & Economies**
- **Coastal Natural Hazards**
- **Digital Ocean/Great Lakes**
- **Ecosystems & Habitats**
- **Fisheries**
- **Marine & Aquatic Science Literacy**
- **Seafood Science & Technology**
- **Urban Coast**

In addition to these national themes, the Wisconsin Sea Grant program will continue to invite proposals for projects that take advantage of new technologies and opportunities to address other coastal, ocean and Great Lakes issues as part of its unique **Innovative Science and Technology** theme.

Relationship to Regional and State Priorities

The national themes promulgated by SGA, NOAA Sea Grant and NOAA is in harmony with those put forth by a number of state and federal agencies in the Great Lakes Basin. The Great Lakes research community is

perhaps one of the most focused “ecoregions” in the world, thanks in large measure to the coordinating influence of the IJC.

Moreover, the 1972 Great Lakes Water Quality Agreement (GLWQA) requires the governments of the United States and Canada to develop and orient scientific research programs in the Great Lakes Basin in accordance with IJC principles. In 1978, the IJC adopted the ecosystem approach for addressing human impacts on the Great Lakes-St. Lawrence River system. In large measure, this concept drives the Great Lakes Basin research agenda to this day and has enhanced the commitment to extensive, coordinated research programs.

In 1997, the IJC, with input from scientists and research managers from throughout the Great Lakes Basin (including UW Sea Grant staff) reaffirmed that the top priority issues confronting the lakes were:

- Identification and virtual elimination of the input of toxic substances to the lakes;
- Determining the human and ecosystem health effects of toxic contaminants;
- The rehabilitation of degraded Great Lakes habitats, and
- The control of nonindigenous ANS.

The commission’s GLWQA priorities for 2001-03 include the source-receptor relationship for atmospheric deposition of mercury to the Great Lakes, the water quality impacts of urbanization and “smart growth” programs, and the impacts and implications of climate change on Great Lakes water quality.

In its *Great Lakes Program to Ensure Environmental and Economic Prosperity*, the Great Lakes Commission (GLC) has federal legislative and appropriations priorities similar to the IJC’s:

- Cleaning up toxic hot spots;
- Shutting the door on invasive species;
- Controlling nonpoint-source pollution;
- Restoring and conserving wetlands and critical coastal habitat;
- Ensuring the sustainable use of water resources;
- Strengthening policy decision-support capability, and
- Enhancing the commercial and recreational value of the region’s waterways.

At the GLC’s 2002 semiannual meeting, the state and provincial delegates to the commission, including Wisconsin’s, identified 34 current and emerging regional priorities, many of which have relevance for Sea Grant, among them:

- **Human and Ecosystem Health**—the potential impacts of pharmaceuticals in Great Lakes water, atmospheric deposition of persistent bioaccumulative contaminants, environmental and socioeconomic implications of climate change, and maintenance of a diverse and sustainable Great Lakes ecosystem;
- **Biological Contamination**—invasive species control, particularly ballast water management and the Sanitary & Ship Canal barrier in Chicago;
- **Water Resources Management**—water supply, usage and withdrawal issues.
- **Land Use**—specifically brownfield sites in coastal areas;
- **Tourism**—particularly water-based tourism, including cruises and group tours;
- **Maritime Transportation**—harbor/channel maintenance, navigation safety and lake level monitoring;
- **Water Quality**—contaminated sediment remediation and nonpoint-source pollution controls;
- **Habitat Protection**, and
- **Environmental Monitoring**.

Similarly, in *Great Lakes Strategy 2002*, the U.S. Policy Committee—a forum of senior-level representatives of the federal, state and tribal governmental agencies responsible for environmental protection and natural resources management of the Great Lakes—identified the following four goals and priorities for advancing the restoration and protection of the Great Lakes Basin ecosystem:

- 1. Chemical Integrity: Reducing and eliminating the threat of toxic pollution and excess nutrients**, including atmospheric deposition of out-of-basin toxins (particularly persistent bioaccumulative toxic substances) and remediation of contaminated sediments
- 2. Physical Integrity: Promoting habitat protection, water quantity management and improved land use practices**, including habitat protection and restoration (particularly coastal wetlands), sustainable land use, brownfield redevelopment, conservation practices on agricultural lands and storm water discharge regulation.
- 3. Biological Integrity: Protecting Human Health and the Ecosystem's Species**, including human health studies, safe drinking water, clean and healthy beaches, healthy fisheries, and preventing and controlling invasive species, and diverse and self-sustaining populations of predominantly native fish and other aquatic life, wildlife and plants in the Great Lakes Basin.
- 4. Working Together: Effectively coordinating programs and resources to protect and restore the Great Lakes**, including implementing Lakewide Management Plans, Remedial Action Plans for cleaning up Areas of Concern, collecting and reporting environmental data and trends, and fostering binational coordination/cooperation and public involvement.

Wisconsin's Great Lakes-related priorities likewise include toxic contaminants and sediment remediation issues, beach closures due to waterborne pathogens, protecting and restoring coastal habitat, and stemming the spread of nonindigenous ANS to inland waters. Wisconsin also has some unique issues with regard to nourishing a rapidly developing freshwater aquaculture industry, managing its valuable recreational and commercial Great Lakes fisheries, and managing coastal development. State and university leaders also strongly support the development of biotechnology and other advanced bioscience industries.

The Planning Process

In 2002, the UW Sea Grant program strategic plan was restructured to mirror the new national Sea Grant themes. This process began with recasting the existing strategic goals and priorities for each research, outreach and education subprogram into the national Sea Grant themes. This draft program plan was distributed for comment in September 2002 to more than 400 individuals throughout the state and beyond, including key individuals at Wisconsin Department of Natural Resources, Wisconsin Coastal Management Program, Wisconsin Department of Transportation, Trout Unlimited-Upper Midwest, and U.S. Geological Survey (USGS), including the USGS Great Lakes Science Center, Ann Arbor, Mich.; USGS-Middleton, Wis., and USGS-Gainesville, Fla. The distribution list included the UW Sea Grant Advisory Council, the Committee on Advisory Services, current and recent UW Sea Grant project investigators, all UW-Madison department chairs, UW System chancellors and vice, associate and assistant chancellors, and the deans/associate deans and directors at all UW System campuses and nine private institutions.

In addition, the draft plan was reviewed by each of the program's Advisory Services specialists, who met with and solicited comments and input from coastal engineering firms, land information officers in 15 coastal counties, the Southeastern Wisconsin Regional Planning Commission, Fox-Green Bay remediation officials, GLC staff, NOAA's Great Lakes Environmental Research Laboratory, and the U.S. Environmental Protection Agency's Great Lakes National Program Office, among others. A copy of the draft plan and an invitation to submit comments was also placed on the UW Sea Grant Web site.

All comments received were compiled and reviewed by program management, after which the Wisconsin priorities under each national theme were revised to incorporate most of the suggested deletions, revisions and

additions. This revised list of priorities then became the program's 2004-06 Request for Proposals (RFP), reflecting UW Sea Grant Advisory Council guidance that the RFP should identify specific high-priority research areas, yet include the full range of research needs within each theme area for casting a broader net in soliciting project proposals to get the best research on a wide variety of issues. Four high-priority areas were identified in the 2004-06 RFP: (1) **aquatic invasive species**, (2) **aquaculture**, (3) **aquatic biotechnology**, and (4) **development of GIS and remote sensing technology for Great Lakes, ocean and coastal applications**. Finally, Wisconsin priorities in each national theme were selected from the RFP and further refined according to the recommendations of the preproposal and proposal technical review panels and the program's outreach and education staff. The capstone to this process was restructuring and updating the previous UW Sea Grant strategic plan's administrative functional goals to comply with UW-Madison's new strategic plan, as revised in early 2003.

This strategic plan thus represents the UW Sea Grant program's institutional and programmatic goals and priorities for the 2002-06 period. In concert with the written Decision Principles prescribed for each step in the program development process, this plan has provided the fundamental criteria by which the Wisconsin Sea Grant program screened proposals and selected the research, outreach and education projects to be supported during the 2004-06 biennium.

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Institutional Goals and Priorities

Strategic planning is an invaluable process for identifying strengths and weaknesses, pointing out critical needs, and helping determine how best to meet those needs. By basing our institutional goals and priorities on the strategic priorities of our parent institution, we create a powerful base of shared values by which to chart our course and allocate our resources during the next biennium and beyond. The priorities identified here echo traditional strengths while pointing toward critical areas of program development that will determine future success. They serve as guideposts for local action by the UW Sea Grant Institute to contribute to the continuous advancement of the UW-Madison as well as NOAA Sea Grant.

GOAL 1: Promote Research

- Maintain a high-quality Great Lakes and aquatic sciences research program.
- Enhance Great Lakes, coastal and marine research/educational experience for students.
- Maximize administrative performance by developing Web-based financial and project management systems, and supporting on-site training for staff, researchers and other users.
- Increase resources and improve infrastructure for research. Specifically:
 - Provide electronic research administration for potential principal investigators and funded researchers via online information about grant opportunities, electronic submission of proposals and reports, and an interactive project budget management system.
 - Encourage promising new investigators (especially those from underrepresented groups) to participate in the UW Sea Grant program.
 - Increase funding for Sea Grant program activities by encouraging staff and project investigators to seek supplemental grants and other funding.
 - Leverage Sea Grant funds through an emphasis on multi-institutional regional/national collaboration and partnering with public, private and nonprofit organizations.
 - Develop long-range information technology strategies regarding facilities, process and people.
- Disseminate Sea Grant project results and transfer technology to promote economic development and benefit society. Specifically:
 - Communicate the findings and results of Sea Grant projects via a variety of media.
 - Encourage and provide support for researchers and students to publish the results of Sea Grant-funded work in peer-reviewed professional journals and present their findings at professional meetings.
- Maintain and build public support for the National Sea Grant College Program at the local, state, regional and national levels.

GOAL 2: Advance Learning

- Employ students to work on Sea Grant projects and provide financial assistance to students to complete their theses after projects have ended.
- Provide post-graduate support for advanced training.

- Provide travel support to students to attend professional conferences, present papers, and acquire on-site or at-sea field experience.
- Encourage Wisconsin students to apply for national Sea Grant fellowships and provide support for those selected to receive them.
- Improve access to Great Lakes and water resources information.
- Expand educational programs to K-12 students, nontraditional students and the adult public.

GOAL 3: Accelerate Internationalization

- Provide national/international leadership in Great Lakes and aquatic sciences.
- Build knowledge with Great Lakes and aquatic sciences partners in Canada and abroad by:
 - Developing regional (Canadian) and other international research, outreach and education partnerships that address critical Great Lakes issues.
 - Cosponsoring and hosting international meetings, conferences and seminars on Great Lakes, coastal and aquatic science issues, and disseminating the results of these events to interested parties.

GOAL 4: Amplify 'The Wisconsin Idea'

- Maintain and build a highly effective statewide outreach program.
- Address Great Lakes issues through cross-disciplinary, multi-institutional and regional approaches.
- Advance Great Lakes, coastal and aquatic science education and scientific literacy statewide, regionally, nationally and internationally.
- Advance the Wisconsin and regional economy through outreach and technology transfer to Great Lakes-related businesses and emerging enterprises based on aquatic resources.
- Provide research-based expertise to state agencies, educational institutions and the private sector.
- Encourage and support university, local, state and national public service by Sea Grant staff, researchers and students.
- Encourage and support Great Lakes, coastal and aquatic science research at UW System institutions and other public and private Wisconsin colleges and universities statewide.

GOAL 5: Nurture Human Resources

- Recruit and retain outstanding staff and students.
- Establish workplace conditions that foster individual and organizational success by:
 - Informing all staff members of university and program policies and procedures, and the resources available to them in their positions.
 - Taking advantage of supervisory and managerial professional development offerings for the effective management of people and processes.
 - Actively promoting an attitude of respect and civility in the workplace.

- Maximize the potential of our human resources by:
 - Promoting the concept that every employee is a responsible partner in her/his career development.
 - Encouraging and supporting professional development and continuing education for all employees.
 - Performing timely evaluations of performance and promotions.
 - Providing clear career advancement guidelines.
 - Fostering effective communications and teamwork.

Aquaculture

Worldwide, aquaculture is the fastest growing sector of agriculture. The growth of the aquaculture industry is driven to a large extent, by three factors: (1) the expanding human population, (2) the fact that harvests of many of the world's wild fisheries have met or exceeded their maximum sustainable yield, and (3) increased per-capita seafood consumption, due largely to a general realization of the health benefits of diets high in seafood. The U.S. aquaculture industry has been growing rapidly since the 1980s. Nevertheless, the United States continues to import more than 40 percent of its seafood, making seafood second only to petroleum as the largest contributor to the national debt among natural resource products.

Wisconsin currently has a moderately sized and diverse aquaculture industry that includes the production of food fish, baitfish and fish for stocking. The industry has great growth potential, particularly in the area of food fish production, because of the availability of ample supplies of high-quality water, land, labor and markets. The most likely candidates for expansion in Wisconsin are cool-climate, freshwater fish species. One major obstacle to achieving the state's aquaculture growth potential is conditioning these species to intensive culturing, including improving growth rates, reducing stress and disease, and controlling reproduction. Practical, cost-effective production parameters are needed, along with the development of environmentally sound aquaculture systems focused on reducing water usage and waste effluents.

National Goal

Develop the scientific, technological information and expertise needed to propagate and successfully culture fish with commercial and/or recreational value to the United States and the rest of the world.

Wisconsin Priorities

- Develop sustainable and cost-effective production technology and domestication methods for high-value Great Lakes regional aquaculture species for use by Wisconsin aquaculturists. Specifically:
 - Establish biological, physical, chemical, environmentally sustainable and cost-effective aquaculture systems, particularly Recirculating Aquaculture Systems and other Intensive Aquaculture Technology for Great Lakes regional species.
 - Develop and apply selective breeding and biotechnological approaches to improve the growth and controlled reproduction of cultured fish.
 - Improve methods for cost-effective intensive production of quality fingerlings for Great Lakes regional species.
 - Develop cost-effective methodologies and sustainable technology for recovery and beneficial reuse of suspended solids and dissolved nutrients to satisfy effluent water quality standards and avoid water use conflicts.
 - Develop improved methods to identify, detect and control diseases, parasites and other pathogens to maintain fish health (e.g., spring carp viremia, largemouth bass [LMB] virus, etc.).
 - Improve fish feed effectiveness through nutritional analyses, early life-stage feeding strategies and the use of regionally based feed ingredients as alternatives to fish meal.
- Develop propagation technology for stock enhancement and Great Lakes species rehabilitation, such as genetic conservation, reproduction, nutrition and optimal rearing parameters, and a sound scientific understanding of the impacts of hatchery-produced fish.

- Investigate ways to couple freshwater aquaculture to other water-based industries to more efficiently utilize available resources for diversified and cost-effective production.
- Develop and present aquaculture training and advisory services, including outreach directed towards pre-service and in-service vocational agriculture teachers.
- Increase general awareness of the economic and healthful food supply potentials of freshwater aquaculture in Wisconsin and the Great Lakes region.
- Investigate and assess the nutritional and health benefits of Great Lakes regional aquaculture food products relative to fish and seafood products from other sources.

Aquatic Invasive Species

Aquatic invasive species (AIS) pose a major threat to coastal and Great Lakes ecosystems and create significant economic costs and human health risks. From parasitic sea lampreys in the 1940s to zebra mussels in the 1990s, the Great Lakes in particular have been severely impacted by invasions of nonindigenous aquatic species. As of 2004, there were 162 confirmed invasive species in the Great Lakes. Since 1990, the Great Lakes have been invaded at a rate of one new aquatic species a year, and some studies indicate the rate of introductions is likely to increase in the future. As indicated below, the priorities in this cross-cutting theme are also priorities in other national Sea Grant themes.

National Goals

- Understand the ecological changes effected by exotic aquatic species.
- Understand the biology of the invaders to develop effective means of prevention and control.
- Understand their impacts on aquatic systems and our economy.
- Identify safer and more effective control strategies.
- Identify more effective and less expensive strategies to prevent new introductions.

Wisconsin Priorities

- Conduct research on the effects of invasive species on the Great Lakes ecosystem, including food webs, nutrient and contaminant cycling, and socio-economic implications. Develop predictive tools for understanding effects of future invasions.
- Develop scientific approaches to guide control practices for dealing with aquatic invasive species.
- Provide training to industrial and commercial partners on how to control the spread of AIS in their harvest and stocking activities. (*Aquaculture Theme*)
- Create biotechnological tools for addressing problems and issues related to AIS. (*Biotechnology Theme*)
- Develop monitoring tools and methods—including *in situ* as well as remote sensing technology, geographical information systems and computer modeling tools—for continuously tracking and assessing the nature and extent of AIS-related biological and physical changes in and Great Lakes ecosystems. (*Digital Great Lakes Theme*)
- Conduct research, outreach and education activities for deterring, identifying, eradicating and/or controlling invasive species, nuisance algae and aquatic toxins. (*Ecosystems & Habitats Theme*)
- Evaluate the biological and economic impacts of invasive aquatic species on the Great Lakes' fisheries, and develop scientific approaches to guide control practices for dealing with them. (*Fisheries Theme*)
- Discover and develop new, novel and beneficial uses for invasive aquatic species. (*Seafood Science & Technology Theme*)
- Assess the threats to human health and aquatic life posed by the introduction of exotic parasites, bacteria and other pathogens to the Great Lakes. (*Urban Coast Theme*)

Biotechnology

The United States leads the world in marine biotechnology research expertise. Focused academic research in marine and aquatic biotechnology in concert with commercial development offers the promise of societal benefits as well as economic growth, leading to new industries and employment opportunities. It will also help upgrade and advance higher education to meet U.S. needs in an increasingly technical world. The national Sea Grant network has identified five key areas for investment in biotechnology: (1) marine natural products, (2) biomolecular processes discovery, (3) marine environmental biotechnology, (4) marine resource management, and (5) seafood safety and processing.

From a scientific standpoint and particularly in Wisconsin, the study of freshwater aquatic organisms provides an essential complement to studies of marine organisms. For the Great Lakes region—which already supports a vibrant and growing biotechnology industry—biotechnology offers new opportunities for addressing such problems as contamination of Great Lakes fish and sediments with toxins, control of nonindigenous species, and enhanced production at public game fish hatcheries and private bait and food fish farms.

National Goal

Encourage and support a wide range of freshwater and marine biotechnology research for:

- Restoring and protecting aquatic ecosystems.
- Improving risk characterization of toxicants to aquatic animal life.
- Enhancing aquaculture and seafood safety.
- Developing new pharmaceuticals, biomaterials and bioprocesses.

Wisconsin Priorities

- Develop more accurate approaches for assessing and predicting the risks to feral fish populations exposed to persistent bio-accumulative chemical contaminants. Specifically, develop gene micro-arrays in fish for identifying alterations in gene expression associated with chemical and physical stresses.
- Explore the genetics of native and invasive species as a tool for improving management of Great Lakes fisheries and ecosystems.
- Develop and apply biotechnological approaches for improving the growth and controlled reproduction of aquacultured fishes. (*Aquaculture Theme*)
- Develop biotechnological tools for addressing the problems of beach closings, harmful algal blooms and other water quality issues. (*Urban Coast Theme*)

Coastal Communities and Economies

The continuing economic growth occurring within our nation's coastal regions stimulates land use change and competing demands for the use of the shoreline. Without sound planning, it is likely that coastal degradation associated with coastal development and urbanization will continue. Sound planning can also help minimize risks to regional economies posed by such natural disasters as hurricanes, storm-driven coastal flooding and dramatic changes in sea level elevations caused by climatic variations.

Balancing economic growth and coastal resource quality are important issues for all of the nation's coastal communities—including those around the Great Lakes.

National Goals

- Strengthen coastal planning through better evaluations of coastal resources and amenities (“natural capital”) and by educating coastal planners and decision-makers.
- Stimulate integrated coastal management by constructing frameworks for sustainable development and developing decision-support systems.
- Contribute to community and economic development by building leadership; supporting the development of science-based ocean, coastal and Great Lakes policies; and revitalizing economically depressed coastal communities.

Wisconsin Priorities

- Apply GIS and/or other state-of-the-art techniques to improve coastal resources management by assisting decision makers in the wise, science-based planning and development of coastal watersheds and shorelands. Specifically:
 - Develop tools and techniques for engaging Wisconsin citizens in “Smart Growth” planning for coastal areas.
 - Demonstrate and publicize the value and usefulness of Web-based GIS for various decision-support applications by coastal planners, resource managers and policymakers.
 - Develop teaching models/modules for training users of GIS.
- Evaluate and document the value and impacts of Great Lakes-based businesses to coastal communities.
- Develop and validate new techniques for economic valuation of Great Lakes resources and their importance to thriving coastal communities and businesses.
- Initiate new policy-relevant research and outreach on Great Lakes issues, such as the valuation, ownership and stewardship of fresh water.
- Enhance public appreciation of Great Lakes and coastal historical and cultural resources by engaging public interest in the exploration of these resources.

Coastal Natural Hazards

This national theme is aimed primarily at mitigating the risks and damage posed by hurricanes and tsunamis along the nation's saltwater coasts. In the Great Lakes region, the principal coastal natural hazards are coastal flooding, storm surges and wave run-up, especially during times of above-average water levels, which can cause severe erosion and damage or destroy coastal structures. Conversely, below-average water levels reduce navigation safety in shallow channels and the entrances to ports and marinas for mariners, commercial fishers and recreational boaters alike. Storms, extreme water levels and winter ice on these freshwater seas pose significant risks to profitable and safe navigation, and to coastal infrastructure. Hazards for swimmers include coastal rip currents and bacterial contamination of beach waters. Hypothermia is an ever-present natural hazard to everyone exposed to these cold northern seas.

National Goal

Enhance preparedness to prevent or greatly reduce human deaths, injuries, property and environmental damages, and associated economic losses caused by coastal natural hazards.

Wisconsin Priorities

- Develop an understanding and communicate to user groups the causes of and effective strategies for coping with coastal slope failures, shore erosion and flooding due to storm waves, lakebed erosion, storm surges and high Great Lakes water levels.
- Evaluate impacts of extreme Great Lakes water levels on coastal infrastructure.
- Develop and apply GIS for assessing and reducing natural coastal hazard risks. Specifically:
 - Improve shoreline mapping and watershed change analysis methodologies, including the development high-resolution elevation data and topographical mapping.
 - Develop, refine and demonstrate coastal community risk and vulnerability assessment methods and standards, leading to improved cost-benefit analysis methods for use by local officials.
 - Improve understanding of the magnitude of and trends in intensified shoreland investments and the vulnerability of these investments to major precipitation events, coastal storms and extreme lake levels.
- Develop an understanding and communicate scientific, technical and public information on the impacts of climate change on Great Lakes coasts (lake water levels, water quality and supply, storm intensity, etc.).
- Increase public safety through greater awareness of Great Lakes hazards (hypothermia, rip currents, navigation hazards posed by low water levels, etc.).

Digital Ocean – Great Lakes Geospatial Technologies

Imagine placing the global ocean on a microchip. That's essentially what Sea Grant's Digital Ocean Theme aims to do by developing methods to create extensive digital representations (computer models) of ocean resources, hurricanes and other extreme events, and such phenomena as El Niño events. Such models will transform chemical, biological and physical data into tools that will enable us to better understand, monitor and manage our marine resources. One of the "critical actions" recommended by the recent U.S. Commission on Ocean Policy is the development and implementation of a Integrated Ocean Observing System (IOOS) and closely linked to it a national network for monitoring inland as well as coastal and open-ocean waters. The commission recommended development of an integrated Great Lakes Observing System (GLOS) as one of the regional nodes of the IOOS initiative.

As part of these national efforts, Wisconsin Sea Grant's priorities in this theme are to begin developing new observational technologies and interpretive geospatial technology to help foster development of the GLOS. The overarching goal of this theme is to help our nation maximize its environmental remote sensing capabilities in order to provide critical, real-time data for a broad suite of users, including resource managers, researchers, homeland security interests, the commercial shipping industry and the recreational boating community, among others.

National Goal

Develop tools to assimilate data from distributed observatories, or individual networked ocean sensors, and then connect this assimilated data with the various existing computer models of ocean processes.

Wisconsin Priorities

- Develop research and monitoring tools and methods—including *in situ* as well as remote sensing technology, geographical information systems and computer modeling tools—for continuously tracking and assessing in real time the nature and extent of chemical, biological, geological and physical changes in marine and Great Lakes waters.
- Assimilate digital spatial data from multiple distributed online sources (local, academic, state, regional, federal data custodians) through Web mapping and other Web-based applications, and enable remote access and real-time integration of these data by multiple users for specific applications, management and educational purposes.
- Integrate watershed- and land-based information from Great Lakes observing systems to improve our understanding of the physical, chemical, biological and geological coupling at the land-water interface.
- Develop visualization technologies for spatial and temporal data sets for use in such applications as coastal hazards, coastal planning & development, and ecological responses.

Ecosystems and Habitats

Coastal areas provide essential habitat for 75% of U.S. commercial landings of fish and shellfish as well as critical habitat for numerous species of recreational fishes, waterfowl, migratory birds, amphibians and mammals. The continuing rapid urbanization of our coasts has destroyed a significant amount of coastal wetlands, degraded coastal water quality and severely stressed coastal ecosystems.

Nowhere is an understanding of the linkages between terrestrial and aquatic environments more critical to resource quality, sustainability and management than in the Great Lakes region. With nearly 9,500 miles of shoreline, the Great Lakes are aquatic systems dominated by their coastal watersheds.

National Goals

- Develop a quantitative understanding of the structure and function of critical nearshore habitats and coastal ecosystems.
- Identify the processes that control the transport, transformation and fate of biogeochemically important materials in the nearshore area, the impact of riverine inflows, and the influence of watershed management on coastal and estuarine systems.

Wisconsin Priorities

- Integrate watershed- and land-based information from Great Lakes observing systems to improve our understanding of the physical, chemical, biological and geological coupling at the land-water interface. (*Digital Great Lakes/Geospatial Technologies Theme*)
- Develop technologies for better spatial and temporal characterization of nearshore environments and coastal ecosystem dynamics.
- Evaluate the significance of invertebrate species to planktonic and benthic food webs and the role of these organisms in the Great Lakes food web transfer of energy and contaminants.
- Create partnerships to improve and enhance spawning habitat and nursery grounds to optimize native species rehabilitation.
- Improve the design, function and assessment of coastal habitat rehabilitation and restoration projects.
- Develop an understanding of how shoreline and harbor structures affect nearshore habitat, aquatic species and water quality, and how aquatic species use this habitat and interact with these structures.
- Conduct research, outreach and education activities for deterring, eradicating and/or controlling invasive species, nuisance algae and aquatic toxins. (*Aquatic Invasive Species Theme*)
- Foster increased public understanding and appreciation for Great Lakes ecosystems and habitats.

Fisheries

America's fisheries are under extreme stress from many sources, and new management approaches must be found to cope with the difficult challenges. The long list of needed research includes fish population dynamics, stock assessment, habitat and ecosystem health, environmental contamination, management strategies, fish biology and behavior, effects of climate change, management institutions, socioeconomic impacts, and conflict resolution.

The fisheries of the Great Lakes have been strongly influenced by ecological changes brought about by deliberate as well as unintentional introductions of exotic species. Sea lampreys contributed to the collapse of native fish populations. Alewife and smelt replaced the native forage fishes. Thriving recreational fisheries have developed around the introduced Pacific salmon species. New invaders—such as zebra mussels, round goby, ruffe and white perch—pose different and equally significant challenges. Key research challenges include developing ways to control the spread of exotics, creative methods for reducing their adverse ecological effects, and the combination of conceptual and analytical tools required to evaluate the future of fishery restoration efforts. Recently, Wisconsin Sea Grant-supported fisheries research has focused on the lake trout fishery and food web dynamics in Lake Superior, and the decline of yellow perch and smelt fisheries in Lake Michigan.

National Goals

- Develop an ecosystem perspective in renewable resource management.
- Understand the ecological changes effected by exotic aquatic species.
- Restore habitat and ecological conditions required by native species.
- Understand ecological variability and its role in resource management practices.

Wisconsin Priorities

- Develop methods and models to improve management of Great Lakes commercial and recreational fisheries from a whole-ecosystem perspective.
- Evaluate the biological and economic impacts of invasive aquatic species on the Great Lakes' fisheries, and develop scientific approaches to guide control practices for dealing with invasive aquatic species.
- Identify factors and conditions necessary for rehabilitation of self-sustaining populations of native fish species. Specifically:
 - Elucidate the dynamics of yellow perch recruitment and identify the key factors preventing the fishery's recovery from a population collapse in the early 1990s in Lake Michigan and recently in Green Bay.
 - Identify the conditions that prevent remnant populations of native fishes from recovering and develop appropriate restoration strategies.
- Foster better understanding of the historical, cultural, ecological and economic significance of Great Lakes fisheries to Wisconsin, the region and the nation.

Marine and Aquatic Science Literacy

Virtually every serious study of national goals for the new millennium underscores the critical importance of education to national prosperity. To sustain a growing economy, we must also be stewards of the natural environment upon which all life depends. To that end, developing a highly skilled, technologically capable workforce and increasing the scientific literacy of the population are necessary for the United States to remain competitive in the world economy while, at the same time, conserving its natural resources. The recent U.S. Commission on Ocean Policy emphasized the importance of promoting lifelong ocean education, noting that “strengthening the nation’s awareness of the importance of the ocean requires a heightened focus on the marine environment through both formal and informal education efforts.”

UW Sea Grant contributes to this national Sea Grant theme by providing leadership in the development of well-prepared professionals who understand and are conversant in Great Lakes and aquatic science, by supporting teachers to advance and develop their scientific knowledge and skills and to enable them to more effectively bring marine and aquatic science to their students, and fostering lifelong learning by extending aquatic science education to local communities, museums, parks and other public venues.

National Goal

Provide national leadership in the development of well-prepared professionals who understand marine and aquatic science and research, and to be a leader in enhancing public aquatic sciences literacy from “cradle to grave.”

Wisconsin Priorities

- Support the development of ocean- and Great Lakes-related K-12 and informal education nationwide.
- Provide opportunities for graduate and undergraduate students to participate in all aspects of UW Sea Grant program activities.
- Develop and/or enhance formal and informal educational opportunities on Great Lakes, coastal and marine subjects. Specifically:
 - Create opportunities for K-12 teachers, including those of under-represented groups, to increase their marine/aquatic science literacy.
 - Attract a new generation of young adults to professions in aquatic science and related disciplines.
 - Foster better understanding among the public and key user groups of Great Lakes, oceanographic and other aquatic-related sciences through life-long learning opportunities.
 - Provide support for special on-campus symposia, workshops and lecture series on marine and aquatic sciences and Great Lakes, coastal and ocean topics.
- Encourage strategic partnerships with other state, regional and national education efforts.
- Enhance public awareness and understanding of Great Lakes issues and appreciation for Great Lakes history, culture and resources.

Seafood Science and Technology

This national theme aims to develop new ways for Americans to reap the bounty of our waters on a sustainable basis. Sea Grant-sponsored research and technology transfer in this theme helps the seafood industry by improving processing technology, products and methods for assuring seafood safety. As wild fish stocks decline, we need to find new ways to reduce waste and by-catch by improving fishing gear, developing markets for underused species, and ensuring the safety and quality of products through better storage, processing and packaging techniques.

Examples of Sea Grant-supported research and technology transfer in this area includes applying Hazard Analysis Critical Control Point methods in commercial processing to ensure seafood safety, reducing crab processing waste by improving minced meat recovery, developing super-absorbent gels from fish protein extracts, and finding ways to use omega-3 fatty acids common in fish oils as nutraceuticals—foods or food additives that confer nutritional, therapeutic or preventative medical benefits to individuals at risk for cardiovascular disease, certain forms of cancer and diabetes, hypertension and other health problems.

National Goal

Improve the safety, quality, shelf life and marketability of existing and new seafood and seafood-derived products.

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Wisconsin Priorities

- Develop new uses and research potential regional, national and international markets for seafood and Great Lakes fisheries products and by-products, including finding novel uses for by-catch, invasive exotic fishes and underutilized species for developing new fisheries.
- Develop new and beneficial products from traditional raw materials, underutilized species and waste streams.
- Develop accurate and cost-effective methods for detecting pathogens, contaminants and toxins in seafood.

Urban Coast

Economic growth since 1950 has sparked increased urbanization of coastal areas—with corresponding rises in pollution and environmental degradation. In an urban setting, a shoreline has significant appeal, as shown in the demand for recreational, business and residential developments near the water. Communities and states must balance economic and environmental values, manage the impacts of nutrient runoff and waste disposal, and consider needs for transportation, recreation and commerce—all while maintaining the integrity of coastal ecosystems that provide critical habitat and nursery areas for countless species.

Protecting the water quality of the Great Lakes is essential to the region and the nation. Millions of Americans depend on the Great Lakes for drinking water, and the lakes support multibillion-dollar fisheries, shipping and tourism/recreational industries. Population growth and development poses an increasing threat of water quality impairment by chemical contaminants and nutrient loading as well as increasing demand for and consumption of Great Lakes water. Research is needed to develop and support management programs designed to protect and enhance the quality of this vital ecosystem.

National Goals

- Resolving water quality, beach access, coastal land use and development, and similar coastal issues.
- Reducing contaminants, nutrients and other nonpoint-source pollution from urban watersheds.
- Enhancing ports, harbors and marinas to meet growing demands for service while addressing concerns about impacts on the local community and environment.
- Resolving conflicts over existing and proposed uses of coastal space and resources.

Wisconsin Priorities

- Identify the mechanisms, sources and fate of bacterial and viral contamination responsible for beach closings in the Great Lakes and other coastal areas.
- Assess the threats to human health and aquatic life posed by parasites and chemical and pathogenic contamination of the Great Lakes and other aquatic ecosystems.
- Identify and quantify the key physical, chemical and biological processes and mechanisms that control the transport, distribution and fate of chemical contaminants and nutrients in coastal waters and the Great Lakes.
- Integrate watershed- and land-based information from Great Lakes observing systems to improve our understanding of the physical, chemical, biological and geological coupling at the land-water interface. (*Digital Great Lakes/Geospatial Technologies Theme*)
- Develop technologies, methods and strategies for the prediction of lifespan, necessary repair and/or replacement of deteriorating Great Lakes harbor and marina infrastructure.
- Evaluate potential impacts of climate change and lake levels on the vulnerability of coastal urban infrastructure.
- Provide engineering guidance, education and innovative tools to assist Great Lakes harbor and marina operators with sediment management and maintenance dredging issues.
- Develop technologies, methods and strategies for remediation of harbors, bays and other areas degraded by chemical contaminants and/or nutrient overloading.

Innovative Science and Technology

Investigations of the Great Lakes and ocean environments may be sweeping or sharply focused, aimed at specific locales or at vast regions. They may examine short or long periods of time; they may explore specific technologies or generic problems. Given the breadth of research possibilities, UW Sea Grant encourages scientists and engineers to undertake innovative and original research projects that fall outside the confines of present Sea Grant themes. This includes the development of initiatives that take full advantage of special opportunities, apply state-of-the-art scientific techniques and new technologies, and tap the full spectrum of unique talents available in the Wisconsin scientific community.

Potent areas for such research include the ocean's role in climate change and the potential effects of climate change on Great Lakes hydrology and ecosystems; the application of state-of-the-art technology to marine resource utilization and ocean exploration, and a host of marine and Great Lakes-related human safety issues, particularly with regard to undersea exploration.

Goal

Provide an opportunity for university scientists and engineers to undertake original and innovative Great Lakes, coastal and ocean research, especially work that reaches beyond the established national Sea Grant research, outreach and education themes.

Wisconsin Priorities

- Improve the safety and cost-effectiveness of diving through better understanding of physical and mental responses to the underwater environment, and facilitate the transfer of research results to members of the diving community, medical professionals and other concerned groups.
- Quantify the potential effects of climate change on Great Lakes hydrology and ecosystems, including water budgets and levels, wetlands, food web structure and fisheries productivity.
- Evaluate the implications for the Great Lakes freshwater resource of possible changes in land use under foreseeable future climate scenarios, such as increasing pressure for inter- and intra-basin transfer and other changes in consumptive and non-consumptive use of Great Lakes water, and analyze the economic, legal and political effects of possible climate change on valuation of water and other aquatic resources, and the region's institutional readiness to recognize and respond to the effects of possible changes in regional and global climate.
- Identify the principal sources and the long-range atmospheric transport and deposition mechanisms by which chemical contaminants from far outside the basin accumulate in Great Lakes waters.
- Explore and develop engineering and computer-aided design solutions for problems faced by private, municipal and industrial facilities in various Great Lakes, coastal and arctic marine environments, such as dock and marina design, dredging technology and remotely operated vehicle (ROV) development.

Performance Measures

Wisconsin Sea Grant uses a number of criteria to organize and interpret societal benefits that result from the multitude of activities within the program. It is also our experience that a combination of quantitative and qualitative measures is necessary for any reasonable evaluation of impact.

Thus, while numbers are easy to verify, descriptive performance standards can be just as useful if they have three components:

- (1) a judge (like a review panel—someone who provides testimony),
- (2) facts and factors that the judge may examine, and
- (3) a verifiable description of what represents “meeting expectations.”

Moreover, we must consider a geographical component in the mix. To the extent possible, the Wisconsin Sea Grant program staff strongly subscribes to the value of “the Wisconsin Idea.” The Wisconsin Idea of the 21st Century says that the university “will share and apply advances in knowledge in collaboration with the State, its many constituents and communities, and its partners around the world for the common good.” Given this background, here are some of our metrics for measuring success in our program:

Program Administration

- The number of UW Sea Grant efforts on research, outreach and education issues identified by local, regional and national prioritization activities.
- The number of new faculty hires that are successful in obtaining Sea Grant funding.
- The number of local, state, regional and national partnerships in research, outreach and education.
- The number of professional presentations, publications, patents, articles and radio programs resulting from Sea Grant-funded research, outreach and education.
- Funding level increases for research, outreach and education.
- Development, implementation and adoption of state-of-the-art information technology hardware and software, including project management software.
- Strict compliance with and adherence to university hiring, promotion and retention policies and procedures.
- Evidence of continued UW Sea Grant staff professional development and advancement.
- Staff participation and leadership in local, state, regional or national activities and associations related to the Sea Grant or University of Wisconsin mission.
- Documented approval of operations by the University of Wisconsin System, University of Wisconsin-Madison, UW-Madison Graduate School, and NOAA Sea Grant.

National Theme Areas—Wisconsin Priorities

- The adverse effects of stress in aquacultured fish are minimized.
- Aquacultured fish supply increasing amounts of the seafood consumed in Wisconsin.
- The number of relative toxicological potency factors determined for chlorinated aromatic hydrocarbons.

- The number of research tools and methods incorporated by environmental managers in assessing the nature and extent of chemical, biological, physical and geological changes in the Great Lakes Basin.
- The number of workshops and collaborations that result in world-wide transfer of university-developed fisheries modeling tools to fisheries managers.
- Ability to quantitatively predict zebra mussel impacts on the relationship between primary producers and higher trophic level organisms in Lake Michigan.
- Deployment of *in situ* observation technology in the Great Lakes systems that can deliver real-time data.
- Identification of the sources and effects of microcontaminants in the Great Lakes.
- Identification of the factors preventing the recovery of the yellow perch fishery in Lake Michigan.
- Acceptance and incorporation of UW Sea Grant research results on the risks associated with diving into standard safety procedures for professional and recreational divers.
- The number of peer-reviewed journal articles resulting from UW Sea Grant-supported projects.
- Documented acceptance and use by peers of new methods, approaches, information and tools resulting from UW Sea Grant-supported work.
- The number of staff and principal investigator appointments and interactions with committees and advisory boards charged with guiding state, regional and national research and resource management activities.
- The number and/or amount of documented increases in revenues, or savings, in existing business or government operations resulting from the application of Sea Grant-funded work.
- The number of educators who participate in teacher training sponsored or conducted by UW Sea Grant.
- The amount of Sea Grant information requested and distributed.

Finally, the University of Wisconsin-Madison, in recognizing the importance of strategic planning, recently established an Office of Quality Improvement. We will continue to seek counsel from this office on how to improve or further refine our performance measures.



For information about currently funded UW Sea Grant research, outreach and educational activities, please visit our Web site, www.seagrants.wisc.edu, or contact Assistant Director for Research & Outreach James Hurley (hurley@aqu.wisc.edu) or Director Anders W. Andren (awandren@aqu.wisc.edu), phone (608) 262-0905.

For more information about Sea Grant's national themes, visit the Sea Grant Association's Theme Teams Web site: www.SGA.seagrants.org/ThemeTeams.